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PROCEEDING BOOK

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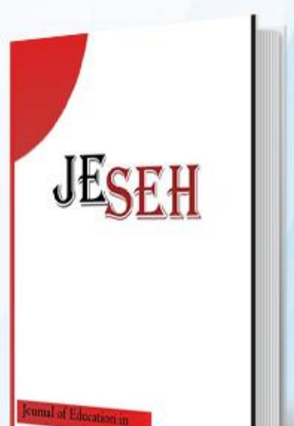

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DESIGN ENGAGING MOBILE LEARNING FOR THE GLOBAL AUDIENCE

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ABSTRACT: As technology becomes more portable and mobile learning (mLearning) is adopted more widely, the development of supporting pedagogies and instructional design for this educational delivery method is essential. To these ends, this paper presents an overview of the current state of the art and argues the case for a new and comprehensive model for designing mobile learning materials; The Location, Technology, Culture, and Satisfaction model (LTCS) that we contend overcomes problems that are inherent in earlier models, notably the lack of multi-cultural support for mLearning program designers. In doing this we hope that instructional designers can use the methods derived from this model to synthesize the work of several disciplines into a heuristic model of design that will maximize the teaching capabilities of mLearning and, perhaps trigger some discussion on this rapidly developing area of education.

Key words: Mobile Learning, Instructional Design, Learning and Design Models, cultural diversity

INTRODUCTION

Mobile learning, also known as mLearning or m-Learning, refers to anytime anywhere learning supported by a variety of technologies, including but not limited to mobile devices (Shen, Wang, Gao, Novak, & Tang, 2009; Wang & Shen, 2011). Started mainly as informal and fragmented way to learn, mobile learning has been used in formal settings and is gradually entering the mainstream education, from both K-12 to higher education (Wang, Barone, Simpson, & Leister, 2011; Xiao, Wang, & Li, 2001). Our definition for mLearning focused on the mobility of learners. Researching mLearning from the mobile learner's perspective requires studying: "…how the mobility of learners augmented by personal and public technologies can contribute to the process of gaining new knowledge, skills, and experiences" (Sharples, Sánchez, Milrad, & Vavoula, 2009, p.3). There has been a handful of research on mLearning, from pedagogies to message design, but there is still a lack of research about principles for systematic mLearning design. In particular, guidelines are needed for designing mLearning systems or software and technologies used in supporting college or university classrooms. In addition, mLearning tends to target learners around the world. There is a need to address how to better design learning materials to cater the needs of mobile learners with diverse cultural backgrounds.

By synthesizing previous research and current developments in mLearning, we have created a comprehensive model for designing mLearning materials and activities. Specific recommendations can be derived from this model, on how to design effective mobile teaching and learning, such as: 1) design for different mobile devices, 2) design for learner mobility, 3) design for interactivity, and 4) design for knowledge construction and sharing. In addition, we discuss cultural considerations in mLearning design as well. The goal of this position paper is to provide an overview of principles and processes of instructional design for mLearning, including materials, devices, and methods.

MOBILE LEARNING MODELS

Shih's Mobile Learning Model

The design model we proposed in this paper builds on Shih's Mobile Learning Model. Thus, we now describe aspects of this model that are necessary to understand our contributions. In this respect an important comment from Shih and Mills (2007) is "While implementing mLearning, it is necessary to consider ... the following aspects of new mobile technologies: a) new learning opportunities; b) potential influence on changing individual's learning styles; c) potential influence on social interaction; and d) how the mobile technology itself will be changed or enhanced" (p.1). In addition, two essential elements that instructional designers should always consider are: how individuals learn and how learning tasks take place.

Following the above criteria, Shih and Mills (2007) created a mLearning model (see Figure 1), which was a variation of Keller's ARCS (Attention, Relevance, Confidence, and Satisfaction) motivational model (Keller, 1983). This model was created to support instructional design for mLearning. It builds on social constructivism and advocates learning methods, such as peer interaction, collaborative discussion, and digital story telling.

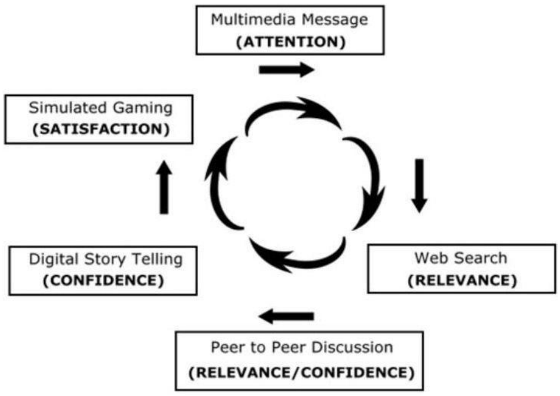

Figure 1. Shih's Mobile Learning Model

The learning cycle in Figure 1 includes activities such as: sending a multimedia message, searching on the web, peer discussion supported by mobile technologies, producing a digital story, and applying learning in a simulated environment. Digital stories have been shown to be especially useful beyond formal learning environments, such as for self-understanding of medical and lifestyle choices (Pavel 2013). Shih's Mobile Learning Model provides a useful contribution to the field of instructional design and mLearning. In particular it serves the purpose of engaging online learners and thus aims to enhance online teaching and learning experiences. This model, however, is highly contextualized and has limited applications. It was created for pre-university schools and was tested with a teacher education class in California.

Given the variety of settings that mLearning is frequently used in, a broader model that applies to teaching and learning in higher education, industry, and other organizations is needed. This broader model should also support different learning theories and situations. The model we propose in this paper (Location, Technology, Culture, and Satisfaction) is such an attempt. Most importantly, it addresses an increasingly influential factor in globalized teaching and learning - cultural differences.

CMM: LTCS Model

In this section we propose an innovative model; the “Comprehensive mLearning design Model: Location, Technology, Culture, and Satisfaction” (CMM: LTCS) that can be used to construct mLearning platforms and that can also be used to design or adapt mLearning materials/resources for global audience. This model draws components from both Keller's (1983) ARCS model and Shih's mobile learning model (Shih & Mills, 2007). Our approach is to synthesize existing models and theories of teaching and learning, augmenting this model in a way that provides support for hitherto neglected areas (e.g., formalized mLearning). We also intend to provide a model and methodology that can guide educators as they develop engaging mLearning materials. Instructional designers can use this collection of methodologies to synthesize the work of several disciplines into a heuristic model of design that will maximize the teaching capabilities of mLearning.

Of particular concern to us is learner attrition and retention, two related factors that have been key issues in eLearning programs for many years (Tyler-Smith, 2006). According to the reported literature, it is evident that the full scope of the attrition problem is unclear and, consequently, there is a need for educators to collect this information. In formal education, it is imperative to keep learners engaged in learning all the way through to the completion of their learning goals.
In our approach, we argue that educators tasked with developing engaging mLearning material should start their analysis with four learner variables that are particularly important to mLearning, namely: Location, Technology, Culture, and Satisfaction (LTCS). These variables are drawn from a variety of existing models in social sciences, and are familiar to those in the field of Educational Technology. However, mLearning requires instructional designers to understand these ideas through the lens of user-centric design. Placing users at the

centre of the design process ensures they are provided with an engaging mLearning experience that they will return to for continued education. More importantly, the variables in the LTCS present an opportunity to combat learner attrition by ensuring that learning is particularized to individuals taking mLearning programs.

High-Level Description of the CMM: LTCS Model

Figure 2 shows the structure of the LTCS Model for Designing mLearning Material, in both informal and formal educational settings. Alignment with the heavy emphasis on learner retention in many online programs, learning resources and learner satisfaction are key focuses of the model. To ensure the highest learner satisfaction, learning materials need to be designed with the consideration of Location, Technology (learning platform, device, and methods), and Culture. Designing instruction for mLearning covers three aspects: pedagogical design, technical design, and usability design. The bottom section of the Model provides an example of "Technology", which is one method that can be used to structure mLearning activities. Learning resources can originate from both live classrooms and informal learning sites, such as podcasts and user driven online video services (eg YouTube). Students will receive such learning resources via different devices and then actively participate in process (study and create). For example, in an English lesson, students will be prompted to record their pronunciation with their cell phones and then upload the recordings to a learning management system (LMS), or to social networking sites. They will then receive feedback from tutors, instructors, or peers. We now describe each element of our Location, Technology, Culture, and Satisfaction (LTCS) model in turn.

Location

Location has twofold meanings. At the macro level, learners' location can be local or global (i.e., distributed around the world). At the micro level, location refers to the specific locations where learners study. And these could include formal settings, such as classrooms, or informal settings, such as Starbucks, teahouses, subways, or airports.

This variable comes as a response to emerging trends in demography, ethnography, and geography. mLearning presents the possibility of broader access to Internet-based classrooms for people from different locations and cultural groups. This promise also requires that instructional designers understand the global distribution of their learners, and design mLearning materials to help facilitate knowledge construction and sharing. In addition to the global composition of a learner group, mLearning program designers in the developing world may need to consider the linguistic differences amongst their learners.

In considering location during an instructional analysis, instructional designers can look for ways to make the mLearning materials more authentic and relevant to the projected learners' day-to-day context. Informal settings can include low-noise places (eg home or coffee shop) and high-noise places (eg streets, airports, or subways). The environment where learners are located will determine the content design. Learning content for formal settings can be longer and more complex, compared to the one for informal settings. Learning material used in places with significant noise needs to be less than 5 minutes, needs to include captions, and needs to consider colour scheme and display lighting setting (Wang, Shen, Novak, & Pan, 2009).

Technology

In our LTCS model, technology assumes a broad definition, including not only regular IT (e.g., computers, devices, networks, and learning platforms) but also educational techniques (e.g., teaching and learning methods). The LTCS Model shows the basic framework for delivering mLearning and for conducting interactive learning. Learners receive the learning content from either formal settings (classrooms) or informal settings (eg websites or online resources). They engage in individual learning and also create materials by using a computer or mobile device. They are then encouraged to upload these materials to a learning management system or social networking sites where feedback will come from the teacher, mentor, or peers. Comments, such as difficulties in using the system, are also feedback into the usability or pedagogical components. This process is an effective way to ensure that the overall system is able to adapt to changing student needs and correct basic design deficiencies.

Mobile devices come in increasingly varied forms, and instructional designers must develop mLearning practices that make the best use of the increasing connectivity, power, and variety of mobile devices. In relation to mLearning curriculum design, new 3G and 4G technologies better enable users to manage their time via facilitating a wider range of devices with added features, such as always-on connectivity, better video displays, speech recognition attributes, and scientific calculators. Also, more applications will be available to more users, and these newer devices tend to have increased memory resources. The current trend of better interoperability and richer interactivity will continue to be an expectation of mobile learners. In support of this, mLearning application designers will need a wider array of tools, models, capacities and standards to work with in developing new education applications.

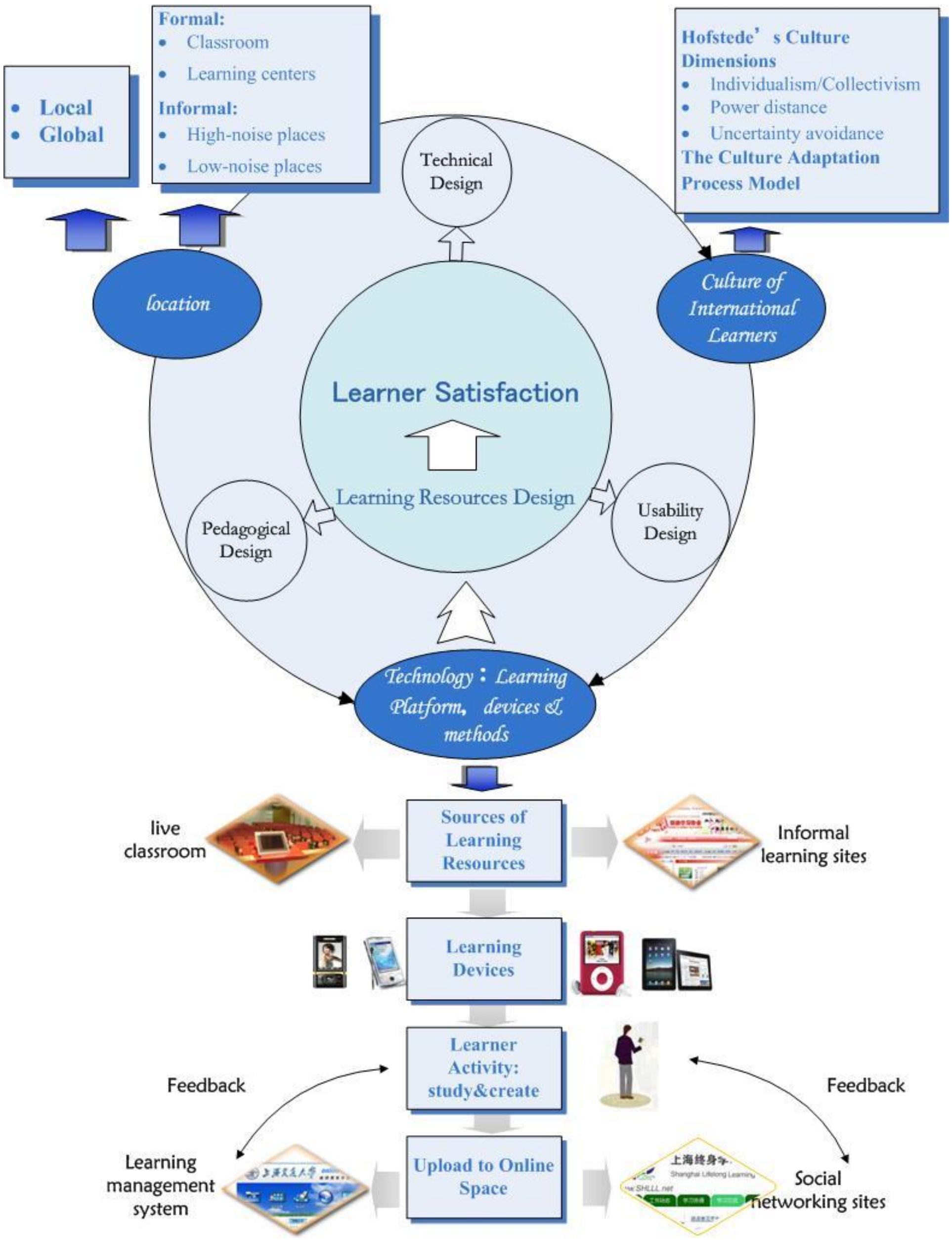

Figure 2. The Comprehensive mLearning Design Model: Location, Technology, Culture, and Satisfaction (LTCS)

Culture

Culture in our model refers to the cross-cultural dimensions of globalized eLearning and mLearning. Here we examine culture from two widely used models in teaching and training: Hofstede's (1991) cultural dimensions, and Edmundson's (2007) Cultural Adaptation Process (CAP) Model: Designing E-Learning for Another Culture.

A handful of studies (e.g., Marinetti & Dunn, 2002; Selinger, 2004; Triandis, 1995; Tylee, n.d.; Wang, 2007) on the influence of cultural attributes on learning derived their variables from Hofstede's Cultural Dimensions, which include five attributes: Power Distance Index (PDI), Individualism (IDV), Masculinity (MAS), Uncertainty Avoidance (UA), and Long-Term Orientation (LTO). Three of the five attributes are found to be most influential to learning: PDI refers to the gap between the distribution of power and wealth in a country's society; IDV indicates the degree to which a society values individual over collective achievement; and UAI focuses on a society's level of tolerance for new, unknown or surprising situations.

Table 1. Power Distance and Its Influence on Teacher/Student Perceptions

Element	Low PDI	High PDI
Knowledge perception	It is a "truth" accessible for everyone.	It is "wisdom" only transmitted by a guru.
Communication	Two-way communication, students speak spontaneously.	One-way communication, students speak only when invited by the teacher.
Confrontation and criticism	Allowed.	Not allowed.
Preferred age of teachers	Younger teachers.	Older teachers.
Roles perception	Equals. Learned- centred.	Respect. Teacher- centred.
Motivation	Education is a way to facilitate equality.	Education is a way of gaining authority and expertise.

A high uncertainty avoidance ranking indicates low acceptance of unforeseen situations and changes, while a low uncertainty avoidance ranking denotes a society's flexibility, adaptability and acceptance for variations. Table 1 is adapted from Hofstede's (1986) cultural framework and compares elements between low and high Power Distance Index. Edmundson (2007) described the Cultural Adaptation Process (CAP) Model, addressing the issue of designing eLearning for another culture. The CAP model is based on earlier work of Marinetti and Dunn (2002), who proposed guidelines for creating courses of differing degrees of complexity to serve the requirements of students from diverse cultures. The CAP model also builds on Henderson's (1996) earlier work, in which she proposed the Multiple Cultural Model (MCM) that characterized different courses. In essence the CAP model takes the form of a set of guidelines for matching existing elearning courses to the cultural profiles of targeted learners. In theory, this model can also guide the development of culturally appropriate elearning courses and materials, so as to help learners achieve equitable learning outcomes (i.e., acquisition of skills and knowledge). According to Edmundson (2007), the CAP model is supported by an empirical cultural study of eLearning, and also integrates findings from other studies on culture and cultural dimensions (e.g., Hofstede, 1991).

In this model a two dimensional matrix is formed, which characterize the issues involved in adapting an eLearning course to a given culture. The vertical axis shows a set of incremental steps associated with adapting an eLearning course to a given culture. The horizontal axis depicts the course's complexity as a set of four levels of increasingly complexity (1 is the simplest and 4 is the most complex). An interesting observation is that the attributes listed in this matrix follow a similar pattern to the cultural dimensions reported in papers by other researchers.

In our LTCS model (Figure 2), one element of the five design principles is "design for learners with diverse cultural backgrounds". Our model complements the work of the models described earlier in this paper by providing a more "process & device" centric view of the communication elements in the above models. The reason for this is that mobile phone communication is often dominated by the physical and interface characteristics of the device (e.g., screen size, colours, & captioning). In summary, this section has argued that the LTCS model provides a better fit to earlier mobile learning models, especially in respect to the support it provides for incorporating culture and location.

Sample Design Principles Derived from the LTCS Model

Design for different devices: At present, many challenges in the design of mLearning materials stem from the variety of mobile devices used in formal and informal learning. Future educational initiatives will deploy mLearning materials via devices that can be used at home, in workplace, during transportation periods, or during leisure activities. To realize these opportunities, instructional designers will need to develop a basic understanding of the information delivery capabilities of these devices, as well as the appropriateness of each type for different environments and content. For example, network-centred devices such as smart phones can be used to share materials amongst dispersed learners.

Design for learner mobility: Locations where learners will use mobile materials should be considered in instructional design. The following is a tabulation of location-design considerations.

Table 2. Location Considerations in Design

Environment	Types of Design	Example
Subway & bus	visual numerical	short article, strong pictures
Home	auditory-visual-kinesthetic combination	Music, oral material, instructional videos, sports videos
Office	written expressive	PPT, e-books
Café	auditory & visual linguistic	Music, Oral material, Instructional videos

CONCLUSIONS

In this position paper we have argued that existing models of mLearning do not capture the full richness of the mobile student's environment. In response to this we have proposed a new model, the Location, Technology, Culture & Satisfaction (LTCS) model that we have argued provides a better fit mobile learning than do earlier models, producing learning systems that are more effective for a wider range of students, particularly for those with more diverse cultural backgrounds.

Whilst we suggest this model will provide developers of mLearning systems with an effective design framework, we recognise that this model will benefit from refinement based on broader and more diverse samples of mLearning situations and participants which, we hope, publication of this model will enable. For example, going forward, researchers might explore possible solutions for some of the following pressing issues:

- How will learning theories influence the development of instructional design strategies for mobile devices, and vice versa?
- How can instructional designers leverage existing captioning standards into standards that fit the specificities of mobile devices?
- How will developments in network access, device design, and information exchange extend the experiential possibilities of mLearning?

The answers to these questions can help instructional designers form a baseline of knowledge that can guide future data collection. Equally, such answers shoul lead to design and development criteria that will improve mLearning courseware. With this greater store of knowledge, we hope educators will be able to design more satisfying mobile instructional experiences for students. Finally, as the world moves towards an era when almost everyone on the planet has a mobile phone, and our society is becoming increasingly a knowledge based, it's not difficult to see the massive opportunity of delivering mobile phone based education that meet the needs of learners. As Muyinda (2007, p. 102) commented, "In this brave new world, mLearning is well positioned to champion these innovations". Whilst the need and opportunity for such systems is obvious, how to develop and manage such systems has been less clear, and we hope this paper can make a small contribution to achieving those ends.

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POTENCIALIZE-SE: A VIRTUAL GAME OF MATHEMATICS

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Fundação de Apoio à Escola Técnica

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ABSTRACT: Currently, it is impossible to think about a modern society dissociated from innovations that have emerged in recent decades. This continuous process of development makes many new devices arise as many become obsolete. This new dynamic brings constant changes, so the school, as integral and fundamental part of this process, needs more than ever to draw its attention to the development of computer technology. Therefore, this project aims to contribute to these many changes, developing a technological tool that helps in the learning process of mathematics and that encourages the students to break with the stagnation of learning basically in the classroom. It also intends to facilitate and offer to the teachers a tool to contribute to the improvement of the classes. The project is the development of a virtual game named "Potencialize-se" which is divided into eight stages'. The contents of the game have been chosen by six students of the 2nd year of the integrated course in Computer Science under the guidance of a teacher of mathematics based on the fundamental prerequisites for a high school diploma to be granted.

Key words: Mathematics, Computing, Education.

INTRODUCTION

The millennial development of mathematics, its mechanisms, systems and algorithms always quested overall results i.e not based on particular cases. Therefore, the development of a tool to assist in this search quickly and effectively has always been a desire. Then comes the computing. The substantial development of computing technics starts with the search of Alan Turing for a theoretical device to respond to a challenge from the famous mathematician David Hilbert. In this context, it is possible to observe the interactions in the development of Mathematics and Computing. Based on this strong relationship between these two areas of knowledge, mathematics education can get many benefits of information technology with the use of websites, software and applications developed specifically for this purpose. The Brazilian National Curriculum Parameters (PCN's) suggests the use of computers as an important manner to combat school failure and to assist in the understanding of the meanings and relationships between objects and mathematical concepts. Therefore, it is necessary that more and more students have a solid training whatever the school level is in order to the computer technology to continue to develop continuously. According to Ponte and Canavarro (1997) "computers bring new opportunities for mathematics, mathematics is also what makes them incredibly effective (...) Computing and mathematics combination is a powerful system that produces results that could not be figured out sometime ago. Ponte and Canavarro (1997) pointed out "important indications for the use of computational tools in the teaching-learning process." In Brazil, information technology in education emerged in some Universities in the early 1970. In the 1980s, there was a significant increase in the area, including the digital inclusion in primary schools. However, according to Valente and Almeida (2007), "Computing in Education area has not yet penetrated the ideas of educators and therefore is not consolidated in our educational system." The question that arises is why the Brazilian schools have so many difficulties to use computing for educational purposes in a reasonable way and seems to beagainst this trend of society as a whole? Also according to Valente and Almeida (2007), insufficient funds injection and poor background of teachers are some of the possible causes for this situation. It is necessary, then, according to the authors, a transformation in teachers training Last names of the authors in the order as on the paper as well as innovative projects in the area so that full advantage of the educational possibilities that computing offers can be taken. In this context, this project aims to:

- Build a game related to mathematics education to support the teaching and learning process.
- Encourage the students to break with the stagnation of learning process, which is basically performed in the classroom.
- Enhance the development of mathematics skills.
- Offer to the teachers a tool that can contribute to the improvement of their classes.

METHODS

The project is being developed at Escola Técnica Santa Cruz (ETESC), under the guidance of a teacher of mathematics. The project, according to Jonassen classification (1996), has as its focus in the learning process by using technology (learning by) which the student programs the computer. The other focus is learning with technology (learning with) in which technological resources are used as cognitive tools in the development of knowledge. In this category, what is fundamental is not the technology itself, but how to use and hold this technology. Still, the other two categories: learning from the technology (learning from) which the student only receives the knowledge that is shown and learning about technology (learning about) which technology is the learning object that can be contemplated at some stage of project development. The main concerns of everyone involved in the development of the project have always been the following ones: the development of a game that make it possible to present a dynamic approach to mathematics, that the player may have the opportunity to test his knowledge by solving significant problems and the player may have the opportunity to clarify any doubts related to the topic. The subjects were selected taking into account the fundamental basic mathematics contents that are important prerequisites for both the development of other mathematical topics and other disciplines. The sequence has been defined in this way in order to tell a story in which the player is about to finish elementary school cycle and intends to organize a celebration trip and a party. The player will pass through eight scenarios that include the party organization with specific budget graduation, space planning where the party will take place, estimation of food and drink for the guests and the purchase of all required materials for the party and for the trip. For each scenario of the script, dynamic and meaningful activities were prepared. At the end of the each scenario the player is informed if the results are achieved or if revision of the content is necessary. Up to the moment, the web site where the game will be hosted has already been developed and the first scenario of the game has been fully completed, ie the script with the theoretical activities as well as the computer programming. Tests have been carried out and everything is working perfectly. As soon as the game development is completed, a short tutorial to help teachers and students will be drawn up. The next step will be a wide dissemination of the game for the teachers, especially the mathematics ones, and for students. The disclosure will include motivation workshops. The materials needed for the project development are quite simple ones: computers with internet access, paper and printing. All these needs are being supplied by ETESC.

RESULTS AND FINDINGS

According D'Ambósio (2003) it is of utmost importance "that students do not label mathematics as a set finished knowledge and techniques. Therefore it is essential to modify teaching methods that do not stimulate participation." Thus, as soon as the game construction is finalized, it is expected significant internalization of computing in Mathematics learning process. It is also expected greater interest in the discipline inside and outside the classroom. Moreover, the purpose of this project is to bring together tools that increase the possibility of testing results and data manipulation by the students. The idea behind is that students will become more and more autonomous in the learning process as long as they will be able to develop by themselves various problem-solving strategies that will stimulate a critical analysis of the results. This proposal provides for the students a perspective that goes beyond the classroom as it opens the possibility of using resources that can be accessed from anywhere and at any time. The quick and efficient manipulation of objects allows the development of a new vision, new ideas and new theories. Up to the moment, the web site where the game will be hosted has already been developed and the first scenario of the game has been fully completed and tested. Students are working to finalize the remaining stages of the game. These stages probably will be developed faster than the first one. Many items developed for the first scenario might be utilized in the other phases as well as some time consuming bugs can be avoided.

CONCLUSION

After the project being presented to reviewers students, all of them rely that the project as a feasible alternative to improve the teaching-learning process of mathematics. The construction of the game, including the ones, which are fully concluded, and the ones that are under development, have been carefully figured out in order to the students involved to participate intensively as central actors rather than supporting the process. The students have internalized this responsibility and are working extremely hard not to expiry the proposed deadlines. The students are often offering new ideas and alternatives to improve all stages of the processes. They are working on a collaboratively way and eager to advance with the construction of the remaining scenarios of the game. The development of the project made it clear that the use of technological resources facilitates the connection of mathematics with practical everyday problems and increases the interest in mathematics by the students. Several times, the working meetings to discuss a topic related to the game became a class on mathematics curiosities or even deepened discussions on mathematics topics. The whole process of preparing this first stage of the game lasted three months. This period, from the selection of the students who would participate in the project till the end result was extremely positive for the teaching practice. It was very interesting to define with students the issues to be discussed in the project. However, sometimes, different points of view concerning the development of the project or some specific topic were pointed out. The students not always agreed with the mentoring teacher and vice versa. Such situation has made the mentoring teacher to adopt a different approach. Instead of a simple explanation about the mathematics topics, it was necessary to invite experts in specifics topics for them to give their contribution to the project. Therefore, teacher had to understand the real needs and difficulties of students with regard to some topics related to mathematics. In this way, several times the teaching practice has been reinvented. Another interesting fact is that the knowledge of the mentoring teacher of the project on computing programming is limited. In many cases, as far as the computing programming is concerned, the students played the role of the teacher. This new format helps both the teacher to listen to the students and they are more comfortable while working. The result is product of a fully cooperative process, equally built by teacher and students. The project confirms the importance of developing scientific research in basic school. During the steps already developed, the benefits are many. Among them, we can mention: the teacher is improving the teaching skills and the students are fully involved with mathematics learnship. In any case, the commitment of each and everyone involved, regardless teacher or student, in addition to the positive results up to the moment is an extremely pleasurable and interesting experience.

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DOES SHADOW EDUCATION AGGRAVATE INEQUALITY OF EDUCATIONAL OUTCOMES

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ABSTRACT: The "shadow education" system of private supplementary tutoring has become quite common in East Asian countries nowadays. Based on the data of Programme for International Student Assessment 2012 (PISA 2012), the paper analyzes the influence of shadow education on the mathematical literacy of students of Shanghai, Hong Kong, Japan and Korea by means of a hierarchical linear model, and estimates the net effect of shadow education using the method of reweighting on propensity score matching (RPSM). The following findings are obtained from the study: First, supplementary math tutoring has a significant positive effect on the math score of students, and such an effect is more obvious on Japanese and Korean students than on Hong Kong and Shanghai students; second, supplementary math tutoring and supplementary science tutoring complement each other; and third, attending supplementary math tutoring may narrow the gap between students in learning performance that is caused by the difference in their families' economic, social and cultural status (ESCS), thus promoting the equality of educational outcomes. Therefore, governments and schools are advised to provide necessary opportunities of supplementary tutoring for low-capacity students from low-income families and waive their tuition fees; large-sized extracurricular education groups should be encouraged to establish after-school learning funds and/or incentive funds for students from poor families and grant fee remissions to those from ultra-low income families, so as to create a situation where the government, the school and the society jointly promote the equality of educational outcomes in the stage of compulsory education.

Keywords: Shadow Education; Inequality of educational outcomes; PISA; RPSM

INTRODUCTION

Over the past two decades, "shadow education" (or namely private supplementary tutoring) has developed to a considerable scale in some countries, where it has become a supplement to or even a duplication of mainstream education[1]. Such private supplementary tutoring refers to chargeable teaching activities outside the formal school education system that are conducted corresponding to school courses[2]. The forms of receiving private supplementary tutoring include hiring private tutors, or going to cram schools, etc (Xue Haiping and Ding Xiaohao, 2009). As Baker and LeTendre pointed out in 2005, shadow education is not meant to replace, but rather to supplement or support formal education. By means of supplementary tutoring after school, students want to better absorb and master the knowledge taught in class so that they can be more competitive in their classes or grades and parents expect their children to improve their examination results at school.

In various parts of the world, due to the impacts of globalization, social development indicator ranking and international student achievement assessment, education competition between different countries is being increasingly intensified, and the shadow education system of private supplementary tutoring is expanding continuously[3] (Bray 2005). This phenomenon has been very common in East Asia, especially in China, Japan and Korea (Stevenson & Baker 1992). In the mid-1990s shadow education began to rise in Mainland China, and now it has become quite common in Chinese urban areas. The prevalence of shadow education in these countries has much to do with their competitive entrance examination and the deep influence of Confucianism[4].

According to a telephone survey conducted in 2009 in Hong Kong for 521 students, 72.5% of elementary school pupils of higher grades received private supplementary tutoring (Ngai, Angela and Sharon Cheung 2010). Another survey (Caritas, Community and Higher Education. 2010) conducted for 898 Hong Kong middle school students revealed that private supplementary tutoring was received by 72.5% of lower-grade students (Grade 1 to Grade 3), 81.9% of middle-grade students (Grade 4) and 85.5% of higher-grade students (Grade 5 to Grade 7). According to a survey performed in 2007 in Japan, 15.9% of Grade-1 elementary school children attended tutorial school after class and this percentage steadily rose with the increase in school grade, reaching 65.2% for junior high school students of Grade 3 (Japan, Ministry of Education and Training. 2008). It is estimated that 87.9% of elementary school students, 72.5% of junior high school students and 60.5% of senior high school students in Korea received private supplementary tutoring in 2008 (Kim, Kyung-Keun 2010). The case of China was similar to that of Korea, with the percentage falling with the increase in school grade. Based on the 2004 education and employment statistics of Chinese urban residents, Xue Haiping, et al found that the percentage of students receiving private supplementary tutoring was respectively 73.8%, 65.6% and 53.5% for elementary, junior high and senior high school students, declining with the increase in school grade (Xue Haiping and Ding Xiaohao 2009). Based on the statistics of PISA 2009 for Shanghai, Hong Kong, Japanese and Korean students (See Table 1), we found that of all the four types of private supplementary tutoring (i.e., language tutoring, math tutoring, science tutoring, and other tutoring), math tutoring was attended by the highest percentage of students (except for Hong Kong): 71.3%, 48.5%, 76.6% and 77.5% respectively, while science tutoring was attended by the lowest percentage of students: 29%, 27.9%, 61.6% and 57% respectively. Japanese and Korean students were similar to each other in terms of the percentage for language tutoring, math tutoring, science tutoring, and other tutoring. Shanghai and Hong Kong students were much alike in terms of the percentage for science tutoring but quite different in the percentage for language tutoring and math tutoring. The percentage of Shanghai students receiving language tutoring and math tutoring was about 23 percentage points higher than that of Hong Kong students. According to the percentages for math tutoring shown in Table 1, the percentages of students receiving private supplementary tutoring in Shanghai, Hong Kong, Japan and Korea were not significantly different from the results of the above-mentioned five surveys.

Table 1: Statistics of PISA 2009 on private supplementary tutoring for Shanghai, Hong Kong, Japanese and Korean Students

Country/Region	Percentage for language tutoring [a]	Percentage for math tutoring	Percentage for science tutoring [b]	Percentage for other tutoring [c]
Shanghai, China	54.3%	71.3%	29.0%	62.1%
Hong Kong, China	30.6%	48.5%	27.9%	55.3%
Japan	64.4%	76.6%	61.6%	76.0%
Korea	68.0%	77.5%	57.0%	67.8%

Notes: a. Language tutoring refers to native language tutoring. For example, language tutoring for Shanghai students refers to Chinese tutoring. b. Science tutoring refers to tutoring in science-related courses of junior high school. It covers such courses as physics, chemistry and biology for Shanghai students, for example. c. Other tutoring refers to tutoring in courses not listed in the first three columns. For Shanghai students as an example, English tutoring is classified as other tutoring.

In China and some other countries, the expenditure on private supplementary tutoring has become an important part of a family's education spending (Li & Tsang 2003; Tsang 2002). According to a questionnaire survey for nearly 5000 students conducted by the Family Education Research Institute of China Youth & Children Research Center in 2011 in Beijing, Guangzhou, Nanjing, Harbin, Shijiazhuang, Xi'an, Chengdu and Yinchuan, the payment for private tutoring has constituted a major part of families' education expenditure: 76% of the families spend an average of RMB 3, 820 on private tutoring each year, with the highest hitting RMB 80, 000. For urban families, children's education costs account for 76.1% of their total cost, 35.1% of the family's total expenditure and 30.1% of the family's total income (Guangming Daily, 2012-02-27). In Japan according to the statistics of the Ministry of Education, a child needs a total education expenditure of 10 million yen (about RMB 800, 000) from elementary through to tertiary education, most of which is spent on private supplementary tutoring (Sina Education, 2012-07-18). A sampling survey made by Korean education authorities reveals that in 2007 the country's elementary, junior high and senior high school students attended 10.2 hours of private tutorial classes per person per week on average, which cost KRW 288, 000 per person per month or KRW 3.46 million (about USD 3, 460) per person per year (Xinmin Weekly, 2010-08-04).

Since shadow education not only concerns the studies and daily life of students but also produces a certain impact on families' education expenditure and social stratification, it has drawn wide attention from the government, policy makers and scholars (Bray et al. 2014). It is, therefore, important and necessary to study the causal effects of private supplementary tutoring on students' learning performance so that parents can better understand such effects, rationally choose the strategy of supplementary tutoring and improve the return on investment. Studying the causal effects of private supplementary tutoring can also provide a useful reference for the government to allocate education resources more efficiently and more fairly. Due to the high cost of supplementary tutoring, the percentage of students from low-income families who receive it may be smaller than that of students from high-income families, thus leading to unequal opportunities of extracurricular education. But, will such unequal opportunities expand the inequality of educational outcomes? The paper tries to answer this question by analyzing the causal effects of shadow education on the learning performance of Chinese, Japanese and Korean students, based on the statistics of PISA 2012 conducted for students in Shanghai, Hong Kong, Japan and Korea.

The subsequent text is organized as follows: The second section is a review of literature about the effect of supplementary tutoring on students' learning performance and about the social inequality that shadow education may cause. In this section, the authors will also point out the main questions the present study needs to answer and the research hypothesis that needs to be verified. The third section will introduce the basis of sample selection and describe the method of the econometric model and the definitions of variables. The fourth section will present the results of empirical analysis. First, based on descriptive statistics the paper will analyze the difference in the percentage of attending math tutoring between different groups of students as well as the difference in math scores between the students attending private supplementary math tutoring and those not attending private supplementary math tutoring. Second, the paper will estimate the causal effect of private tutoring by means of reweighting propensity score matching (RPSM); analyze the effects of the length of tutoring time (LTT) for different school courses on math scores using a two-level linear model; and verify whether shadow education will expand inequality of educational outcomes. The fifth section will draw a conclusion, have some discussions and make policy recommendations

LITERATURE REVIEW

When investigating the percentage of attending private supplementary tutoring, quite a number of researchers analyzed the factors affecting students' participation in private tutoring (Bray et al. 2014; Bray & Kwok 2003; Tansel & Bircan 2006). However, few researchers have studied the effect of private supplementary tutoring on students' learning performance (Zhang 2013). An early study by Stevenson and Baker, not only created the concept of shadow education but also analyzed its effect on Japanese high school students' college entry based on the data of a survey regarding private supplementary tutoring for high school students in Japan (Stevenson & Baker 1992). According to their study, private tutoring, by adopting appropriate teaching strategies, may satisfy the individual needs of students and help them to learn in a more efficient manner. Based on their studies in Japan, Sawada and Kobayashi found that a positive correlation exists between the amount of time students spend in attending private tutoring of math and their math scores (He Ruizhu et al. 2011). But according to a study conducted by Smyth in Ireland in 2008, there is no significant difference in the scores of final examination between students who receive private supplementary tutoring and those who do not. In his opinion, there are two reasons for this. One is that students receiving private tutoring are usually those who are already quite good at their studies yet still want to improve their scores, but it is very difficult for them to achieve the purpose due to the "threshold effect". The other is that the time spent in attending private tutoring is much less than that spent in attending formal education and examination scores cannot be increased significantly in a short period of time (Smyth 2008). This leads to some of the questions the paper tries to answer: In Shanghai or Hong Kong, will the effect of private tutoring be weakened due to the "threshold effect"? Will tutoring in a certain course be ineffective because only a very limited amount of time has been spent on it? Or will tutoring in a certain course occupy the time that should be used for the study of other courses and therefore adversely affect the student's scores of these courses?

Due to limitations of data and the endogenous nature, studies on the causal effects of private tutoring on students' learning performance are scarce. Using a multi-level linear model and a conditional quantile regression model, Zhang Yu comprehensively and thoroughly studied the causal effect of private supplementary tutoring on the college entrance examination scores of high school graduates in Jinan, China (Zhang 2013). According to her study, private tutoring on the whole does not have significant effects on the total score of college entrance examination for either urban or rural students, but significant positive effects are seen on low-capacity urban students and those from low banding urban schools. For some rural students, however, private tutoring even produces negative effects on the score of college entrance examination. Her studies also revealed that, with regard to college entrance examination, private tutoring not only produces quite different effects on the score of different courses and the total score, but also shows different effects on students from schools of different qualities. Using the method of instrumental variables, Suryadarma et al discovered in 2006 that private tutoring does not show significant causal effects on the scores of Indonesian fourth graders. In our present research we use the RPSM method to study the causal effect of private tutoring on the score of middle school students, and see whether it produces different effects on the learning performance of students from different countries/regions or from families of different economic and social backgrounds.

A lot of sociologists and educators focus their study on the problem of social inequality that shadow education may cause. Many of them worry that the existence of shadow education may threaten social fairness and become a mechanism for maintaining and expanding social inequality (Verdis, Athanasios 2002; Murawska, Barbara & Putkiewicz 2006; Smyth 2009). According to the latest research by Bray M. et al, the market of private supplementary tutoring has regenerated social inequality in the mainstream education system. Family income is a major factor influencing Hong Kong students between Grade 9 and Grade 12 when it comes to whether or not to take private tutoring; compared with students from elite government schools, fee-charging ESF schools and DSS schools, those from low banding schools and fee-free aided schools have much less opportunities to receive private tutoring (Bray M. et. Al., 2014)[5]. Studies by Lei Wanpeng (2005) and Xue Haiping et al (Xue Haiping and Ding Xiaohao 2009) also show that the opportunity for a student to receive private tutoring is closely related with the ESCS of his/her family: the higher the ESCS, the more the opportunities. Although there have been no empirical studies on the rate of personal economic returns that shadow education can generate, the human capital theory has already pointed out that education, as an important way of human capital investment, can bring a person good and lifelong economic benefits. For this reason, shadow education can become a mechanism for increasing human capital reserves. From this point of view, shadow education is very likely to maintain or even expand social inequality.

Since the test result of PISA 2012 was published at the end of 2013, the performance of Asian students has attracted worldwide attention, including the attention of foreign media. The Washington Post, for example, reported the test result on December 5, 2013 with an article entitled "Diligent Asian Students Dominate Global Exam". PISA 2012 tested about 510, 000 fifteen-year-old students from 65 countries and regions around the world, with students from Shanghai China ranking first in math, language and science literacy tests. Excellent results were also achieved by students from China Hong Kong, China Taiwan, Singapore, Japan and Korea[In most of the countries/regions that ranked high in PISA 2009 and PISA 2012, the percentage of students receiving private supplementary tutoring was big, indicating that their high PISA test scores were attributed to not only formal education but also private supplementary tutoring.]. American students did not enter Top 20 in any course tested.

How to understand and explain the excellent PISA scores of Asian students is also one of the tasks of this paper. Through a comparative analysis of private supplementary tutoring received by students of Shanghai, Hong Kong, Japan and Korea, we hope to reveal the characteristics of different groups of students who receive shadow education, see whether shadow education can really improve the learning performance of students and whether it has any heterogeneity, and estimate the effect of LTT on the scores of students. We will also discuss the question of whether shadow education may expand inequality of educational outcomes so as to provide an empirical basis for the government to formulate policies for regulating and controlling shadow education. Using the PISA 2012 data for Shanghai, Hong Kong, Japanese and Korean students, we attempt to examine the following four research hypotheses:

Hypothesis 1: The probability of receiving shadow education is higher for students from high-ESCS families than for those from low-ESCS families.
Hypothesis 2: Attending private supplementary math tutoring may significantly improve the math scores of students.
Hypothesis 3: Increasing the time of math tutoring may significantly improve math scores.
Hypothesis 4: Shadow education may aggravate the inequality of educational outcomes.

METHODS

Data Resources

Data used in the present research come from the official website of PISA (http://www.pisa.oecd.org) which is an internationally authoritative program for assessing the learning performance of students. The discipline literacy test and background questionnaire of PISA are designed by international disciplinary and measurement experts. Student discipline literacy is estimated using modern educational measurement theories (such as the item response theory) and professional statistical software (such as Conquest). The main object of assessment for PISA 2012 is mathematical literacy of students, which reflects not only their mastery of basic mathematical knowledge (about space & graphics; change & relationships; quantity; and uncertainty) but also their mathematical cognitive ability (the ability of mathematical expression, application and interpretation). The mathematical literacy scores ("math scores" for short hereinafter) of students are more comprehensive and representative than other scores.

Sample Selection

The PISA 2012 data for China Shanghai, China Hong Kong, Japan and Korea are used in the present research. The reasons why such data are used are that, first, the scale of shadow education is large in these countries/regions where people are deeply influenced by Confucianism, as is mentioned above; and second, these countries/regions outperformed others in three literacy tests of PISA 2012, and this paper is to explain to what an extent shadow education contributes to this excellent performance.

PISA 2012 tests were taken by 21, 231 Shanghai, Hong Kong, Japanese and Korean students aged from 15 years 3 months to 16 years 2 months, of whom 5, 177 came from 155 schools in Shanghai, 4, 670 from 148 schools in Hong Kong, 6, 351 from 191 schools in Japan and 5, 033 from 156 schools in Korea. Sampling was made using the method of two-stage probability proportional to size (PPS), with due consideration given to special-size schools (very small schools and very large schools). Therefore, the number of schools and the number of students sampled were different from country/region to country/region, but the two numbers should be more than 150 and 4500 respectively, so as to ensure the accuracy of estimated inter-school variance and intra-school variance. Seen from the above data, Shanghai, Japan and Korea met and Hong Kong basically met the sampling requirement on the number of schools and the number of students.

Variable Selection and Econometric Model

Based on the nested relations constituted by the data of PISA 2012 student questionnaire and school questionnaire, the paper tries to evaluate the effect of private supplementary tutoring on student math scores. Although the addition of control variables to the linear regression model can make the regression simulate experimental results, it is difficult to ensure that suitable control variables can be found to make conditional independence assumption (CIA). CIA is the core assumption that can give regression a causal explanation. Sometime it also means that selectivity bias comes from observable variables. In other words, selectivity bias will disappear when observable variables are introduced. validly established. Even if some control variables for student level and school level are introduced into the present research, it is still difficult to verify the validity of CIA. In the past two decades, matching became a tool for empirical research and attracted the interest of econometrists. The attractiveness of the matching strategy is that after some kind of propensity score matching both the experimental group and the control group are very close to the result of random assignment, which ensures that after a series of covariates have been brought under control the experimental result and the treated assignment become independent from each other, meaning that CIA is valid. By now we can get a causal explanation of the regression coefficient. The present research adopts the RPSM method proposed by Rosenbaum and Rubin in 1983 to estimate the causal effect of private tutoring on student learning performance. By this method, re-sampling is made through bootstrapping to obtain the standard error of the estimate of treatment effect so as to make up for the defect of the previous PSM method by which the standard error of treatment effect cannot be obtained. According to this method, the average treatment effect (ATE), average treatment effect treated (ATET) and average treatment effect non-treated (ATENT) are estimated via the following formulas (Giovanni Cerulli 2012):

$$\widehat{\text{ATE}}=\frac{1}{N}\sum_{i=1}^{N}\frac{[w_i-\hat{p}(\mathbf{x}_i)]y_i}{\hat{p}(\mathbf{x}_i)[1-\hat{p}(\mathbf{x}_i)]} \tag{1}$$

$$\widehat{\text{ATET}}=\frac{1}{N}\sum_{i=1}^{N}\frac{[w_i-\hat{p}(\mathbf{x}_i)]y_i}{\hat{p}(w=1)[1-\hat{p}_i(\mathbf{x})]} \tag{2}$$

$$\widehat{\text{ATENT}}=\frac{1}{N}\sum_{i=1}^{N}\frac{[w_i-\hat{p}_i(\mathbf{x}_i)]y_i}{\hat{p}(w=0)\hat{p}(\mathbf{x}_i)} \tag{3}$$

Where, "w_i" is a dummy variable indicating whether or not treatment is received (In this paper, it indicates whether or not math tutoring is received). If yes, $w_i=1$; if no, $w_i=0$. "$\hat{p}(x)$" is the estimated value of E (w|x). "y" is the outcome variable (In this paper, it represents math scores). "N" is sample size.

In addition to revealing the causal effect of private tutoring on learning performance using the RPSM method, we will also give the estimates of tutoring effects of the multi-level linear regression model after the same control variables are introduced in the robustness test, and compare these estimates with those obtained from the RPSM method.

The dependent variable in the present research is student math score. Why not choose reading score or science score as dependent variable of the econometric model？This is because the main object of assessment for PISA 2012 is mathematics, and the quantity of problems for reading and science literacy tests is not enough for comprehensively assessing student reading and science literacy. It should be noted that in the source data of PISA 2012, five plausible values (PVs) are provided. PVs are five values randomly drawn from a posterior distribution of student ability obtained based on student response, background variables and the marginal estimation technique of the item response theory. Intuitively speaking, they are values representing the scope of ability that a student may have. for each of the reading, math and science literacy tests. Generally speaking, since PVs have a certain degree of randomness, it is not suitable to report them as individual scores to the students. But they have irreplaceable advantages in estimating the population parameters. For instance, PVs can be used to obtain the unbiased estimates of population parameters, and in a complex sampling design they can be used to obtain the accurate estimates of standard errors.

By referring to the practice of PISA data analysis, in the present research we simultaneously use the 5 PVs in the multi-level model. Dependent variables are divided into two layers. The first layer consists of student-level variables including student gender, family ESCS and private supplementary math tutoring. The second layer consists of school-level variables including school type (public or private) and school location (urban or rural).

$$\begin{aligned} MS &= \alpha_0 + \alpha_1 gender + \alpha_2 escs + \alpha_3 mathoutschool + \varepsilon \\ \alpha_0 &= \gamma_{00} + \gamma_{01} public + \gamma_{02} location + \mu_0 \end{aligned} \tag{4}$$

In the above formulas, MS represents student math score. The meanings of other variables are listed in Table 2. When setting the education production function model for analyzing the variation of student learning performance, gender, family ESCS and school type are usually taken as control variables. This way, experimental results can be simulated even in the absence of random assignment and therefore, the regression coefficient of key explanatory variables can be regarded as an approximate estimate of the causal effect (Angrist & Pischke 2008). These variables are chosen by referring to the findings of related studies. According to the studies of Lei Wanpeng (2005) and Xue Haiping et al (2009), important factors influencing student access to private supplementary tutoring include family income, parents' education background, student learning performance, urban-rural disparity and regional disparity: students from big cities, public schools and higher-ESCS families are more likely to receive private supplementary tutoring than those from rural areas, private schools and low-ESCS families. In regard to the influence of student learning performance, however, the two scholars draw opposition conclusions. Xue Haiping's study (2009) reveals that students with good learning performance are more likely to attend supplementary tutoring, while Lei Wanpeng's research (2005) shows that students with poor learning performance are more likely to attend supplementary tutoring. According to a survey for Hong Kong secondary school students conducted by Bray M. et al (2004), girls spend much more money on private supplementary tutoring than boys, and the level of family income has a significant positive effect on private supplementary tutoring. A recent survey in Korea also shows that student access to private tutoring is directly related with parents' education background and family income level. Ninety percent of parents with a higher education background let their children attend private tutoring, while this percentage is only 50% for parents with a high school education background. Families with a monthly income of 7 million Korean won spend nearly10 times as much as those with a monthly income of 1 million Korean won on private tutoring for their children (China Education Daily, 2011-08-16). Therefore, these variables are also incorporated into the econometric model of the present study as independent variables that influence students' opportunity of receiving private tutoring. This is because when choosing the independent variables in the propensity score matching model we need to consider not only the factors that affect outcome variables but also those that affect the received treatment. So, the present study takes student gender, family ESCS, school type and school location as the covariates of the RPSM model in order that the estimates of tutoring effect are more approximate to the causal effect. In the present study, analysis results of the multi-level model are used as part of the robustness test of the results of the propensity score matching model. Therefore, the model is chosen mainly based on how the independent variables of the propensity score matching model are chosen. We use the same variables as those of the model to serve as the independent variables in the multi-level model so that the results of the two models are comparable.

Table 2: Names and Coding of Variables

Variables	Definition	Scoring
Student-level variables		
Gender	Student gender	Discrete variable, two-point scoring: 1-female, 0-male
ESCS	A combination of three indicators: highest occupational status of parents; highest education level of parents; the amount of family assets	Continuous variable
Mathoutschool	Whether or not to attend supplementary math tutoring on a weekly basis	Discrete variable, two-point scoring: 1-Yes, 0-No
Langoutschool	Whether or not to attend supplementary language tutoring on a weekly basis	Discrete variable, two-point scoring: 1-Yes, 0-No
Scioutschool	Whether or not to attend supplementary science tutoring on a weekly basis	Discrete variable, two-point scoring: 1-Yes, 0-No
Otheroutschool	Whether or not to attend supplementary other courses tutoring not listed in the above three tutoring variables on a weekly basis	Discrete variable, two-point scoring: 1-Yes, 0-No
Mathtime	The amount of time spent attending math tutoring	The variable is treated as 0 hour if the student does not attend any private tutoring at all; as 1 hour if the student spends less than two hours attending private tutoring per week; as 3 hours if the student spends 2-4 hours per week; as 5 hours if the student spends 4-6 hours per week; as 6 hours if the student spends 6 or more than 6 hours per week.
Langtime	The amount of time spent attending language tutoring	
Scitime	The amount of time spent attending science tutoring	
Othertime	The amount of time spent attending tutoring in other courses	
School-level variables		
Classsize	Number of students in the class	Continuous variable
Public(school type)	The school is public or private	Discrete variable, two-point scoring: 1-public, 0-private
Location [a]	The school is in the city or in the country	Discrete variable, two-point scoring: 1- in the city, 0-in the country

Notes: For PISA samples, school location is categorized into 5 types: village, small town, town, city and metropolis. In the present study, the first two types are classified as “the country”, and the last three types are classified as “the city”.

RESULTS AND FINDINGS

Descriptive Statistics of Student-level and School-level Variables

Descriptive statistics of student-level and school-level variables of Shanghai, Hong Kong, Japan and Korea are listed in Table 3, which shows the following information. (1) In terms of student-level variables, Shanghai students have the highest math scores, followed by Hong Kong, Korean and Japanese students successively, and the math scores of students of the four countries/regions are all higher than the average math score (494) of students of OCED countries. In Shanghai, more girl students participated in the PISA test than boy students, but the situation was opposite in the other countries/regions. Korean and Japanese students had a higher average value of family ESCS than Shanghai and Hong Kong students. In Shanghai and Japan, more than 70% of students attend private supplementary math tutoring and 50% - 60% of students attend language, science and other tutoring. In Korea and Hong Kong, not so many students attend private supplementary tutoring, but math tutoring is attended by more students than other tutoring. In the four countries/regions, students’ weekly mathtime is more than othertime, and the average weekly mathtime of Korean and Shanghai students (2.56 and 2.01 hours respectively) is longer than that of Japanese students (1.74 hours) and Hong Kong students (1.07 hours). (2) In terms of school-level variables, as many as 91% of the schools sampled from Shanghai are public ones, and this percentage for Japan and Korea is 70% and 53% respectively, but for Hong Kong it is as low as 7%, which is largely is largely due to the characteristics of Hong Kong’s education system[6].The average classsize of Shanghai and Japan is 39.29 and 36.29 respectively, slightly bigger than that of Hong Kong (34.08) and that of Korea (33.6). All the schools sampled from Shanghai and Hong Kong, 98.4% of the schools sampled from Japan and 93.7% of those sampled from Korea are located in the city, with rural schools accounting for only a small proportion.

Table 3: Descriptive Statistics of Variables (Mean /Standard Error)

	China Shanghai	China Hong Kong	Japan	Korea
student-level variables				
Math score	612.68(100.979)	561.24(96.31)	536.41(93.524)	553.77(99.077)
Proportion of girl students gender	0.51(0.500)	0.46(0.499)	0.47(0.499)	0.47(0.499)
ESCS	-0.36(0.964)	-0.79(0.973)	-0.07(0.713)	0.012(0.743)
Mathoutschool	0.71(0.455)	0.47(0.499)	0.70(0.459)	0.66(0.474)
Langoutschool	0.51(0.500)	0.24(0.430)	0.58(0.494)	0.53(0.499)
Scioutschool	0.55(0.497)	0.29(0.454)	0.54(0.498)	0.39(0.488)
Otheroutschool	0.57(0.495)	0.42(0.493)	0.69(0.461)	0.65(0.478)
Mathtime	2.01(1.905)	1.07(1.527)	1.74(1.814)	2.56(1.370)
Langtime	1.33(1.786)	0.44(1.019)	1.04(1.323)	1.99(1.108)
Scitime	1.49(1.820)	0.68(1.378)	0.95(1.279)	1.70(1.007)
Othertime	1.41(1.736)	0.90(1.438)	1.62(1.758)	2.37(1.281)
School-level variables				
Public	0.91(0.290)	0.07(0.251)	0.70(0.458)	0.53(0.499)
Classsize	39.29(7.558)	34.08(5.018)	36.29(5.662)	33.60(6.041)
Location [a]	1.00(0)	1.00(0)	0.98(0.127)	0.94(0.244)

Note a: For PISA samples, school location is categorized into 5 types: village, small town, town, city and metropolis. In the present study, the first two types are classified as "the country", and the last three types are classified as "the city".

Analysis of the Proportions of Different Groups of Students Attending Math Tutoring

As shown in Table 4, in all the countries/regions the percentage of attending math tutoring is bigger for students from high-ESCS families than those from low-ESCS families, which is a proof of Research Hypothesis 1. The gap is respectively 9.7 and 12.8 percentage points in Shanghai and Korea, and even as big as 17 percentage points in Hong Kong and Japan. Although the PISA questionnaire does not involve tutoring cost, the results of surveys in China, Japan and Korea, as mentioned above, show that private tutoring cost accounts for a large part of household education expenditure, which is unaffordable for low-income families. So, it is no wonder that in the four countries/regions the percentage of attending private tutoring is bigger for students from high-ESCS families than those from low-ESCS families. Will this difference in turn lead to a bigger gap in learning performance between the two groups of students? In other words, will private supplementary tutoring aggravate the inequality of educational outcomes? This is a question to be discussed in the text that follows.

In the three countries/regions except Hong Kong, the percentage of attending math tutoring is obviously higher for students of private schools than those of public schools, and this is largely because students of private schools are from relatively high-income families that can afford high tuition fees. In Hong Kong however, the percentage of attending private tutoring is higher for students of public schools than those of private schools. Since Hong Kong's per capita income is quite high[7], families of both private and public school students can afford to pay private tutoring cost[8]. In Hong Kong, private schools already provide high-quality education services so their students do not need to receive private supplementary tutoring. In Japan and Korea, the percentage of attending math tutoring is significantly higher for urban students than for rural students, although quite a proportion (58.5%) of Korean rural students attends math tutoring as well. In 2005 the Korean government launched an "After-school Education Program", according to which public schools shall provide after-school services such as care, custody, extra guidance to classroom lessons, art courses and recreational activities for their students. With central and local governments providing special funds for the program, universities and research institutes are responsible for developing specific projects of after-school education. With the financial support of the government, not only can urban students satisfy their individualized learning needs at a below-market price, but students from rural and low-income families can enjoy free after-school education, which narrows the education gap between students from high-income families and those from low-income families. In recent years, the Korean government has continuously strengthened the implementation of and investment in the "After-school Education Program". According to statistics of the Korean Ministry of Education, Science, and Technology, 99.8% of primary and secondary schools in Korea have started after-school education, benefiting nearly half of their students (China Education Daily, 2011-08-16).

Table 4: Percentage of Attending Math Tutoring and Difference Test for Different Groups of Students

		Shanghai		Hong Kong		Japan		Korea	
		Percentage	χ^2 test	Percentage	χ^2 test	Percentage	χ^2 test	Percentage	χ^2 test
SES[9]	High	75.4%	648.453***	55.6%	1332.020***	78.2%	24210.139***	72.1%	7151.200***
	Low	65.7%		38.6%		61.5%		59.3%	
School Type	Public	70.1%	88.683***	53.7%	68.363***	67.8%	3263.822***	63.5%	1206.743***
	Private	76.3%		46.2%		74.5%		68.8%	
Gender	Boys	67%	344.901***	45.3%	46.746***	67.2%	2560.520***	65.4%	74.605***
	Girls	74.1%		48.4%		72.6%		66.7%	
School Location	Urban	70.7%		46.7%		70.4%	7878.170***	66.5%	652.008***
	Rural	——		——		32%		58.5%	

Note: "*" indicates a significant difference from zero at the 0.1 level; "**" indicates a significant difference from zero at the 0.05 level; and "***" indicates a significant difference from zero at the 0.01 level; the same below.

The above significant differences in the percentage of attending math tutoring between different groups of students will be further examined in the Logit Model in the text that follows. The analysis results here are also the basis for incorporating into the Logit Model SES, gender, school type, and school location as explanatory variables.

Learning Performance Differences between Students Who Receive Private Tutoring and Those Not[10]

By gender as shown in Table 5, in Shanghai the math score of boy students who receive private tutoring is roughly 22 points higher than that of those who do not and this difference is approximately 17 points for girl students. The difference in girl students is about 4.5 points smaller than that in boy students, showing no significant difference. Among Shanghai students who attend math tutoring, the math score of girls is significantly lower than that of boys (by 9.7 points), while among Shanghai students who do not attend math tutoring, the math score of girls is about 5.2 points lower than that of boys, showing no significant difference. Evidently, the difference in math scores does not totally result from tutoring. Our basic inference is that in shanghai math tutoring brings roughly the same academic benefits to boy students as it does to girl students and that private tutoring does not aggravate the difference in math scores between boys and girls. In Japan, the math score of boy students who receive private tutoring is 60 points higher than that of those who do not receive private tutoring, and for girl students this gap is 65 points, only 5 points more than that of boys, showing no significant difference, either. Among Japanese students who attend math tutoring, girl students have their math score 19 points lower than that of boy students, while among Japanese students who do not attend math tutoring, girl students have their math score 24.3 points lower than that of boy students, showing a very significant difference. Our inference is that in Japan math tutoring brings roughly the same academic benefits to boy students as it does to girl students but contrary to the case of Shanghai, private tutoring may narrow the difference in math scores between boys and girls.

In Shanghai, seen from the perspective of family ESCS, the math score of students from families below the average ESCS value (hereafter referred to as "low-SES" students) who attend math tutoring is 20.3 points higher than the math score of the other low-SES students who do not attend math tutoring; but the math score of students from families above the average ESCS value (hereafter referred to as "high-SES" students) who attend math tutoring is only 1 point higher than the math score of the other high-SES students who do not attend math tutoring. So a significant difference exists between the two types of students in terms of whether or not to receive private tutoring. Among the Shanghai students who attend math tutoring, high-SES students have their math score 60 points higher than that of low-SES students; among those who do not attend math tutoring, high-SES students have their math score 79.4 points higher than that of low-SES students. Therefore, our inference is that math tutoring brings more academic benefits to low-SES students than it does to high-SES students in Shanghai, and may narrow the learning performance gap between the two groups of students. We will verify this hypothesis in the subsequent text by means of an econometric model.

In Japan, high-SES students who attend math tutoring have their math score 58.4 points higher than that of those who do not, and low-SES students who attend math tutoring have their math score 48.2 points higher than that of those who do not. But there is no significant difference between the two types of students in terms of whether or not to receive private tutoring. Among the Japanese students who attend math tutoring, high-SES students have their math score 44.2 points higher than that of low-SES students, and among those who do not attend math tutoring, high-SES students have their math score 34.1 points higher than that of low-SES students. Therefore, our inference is that math tutoring brings more academic benefits to high-SES students than it does to low-SES students, and may broaden the learning performance gap between the two groups of students. This hypothesis will also be verified in the subsequent text by means of an econometric model.

The definitions and scoring of the independent variables used in the model and those used in the descriptive analysis in the subsequent text are listed in Table 2.

Table 5: Math Score Differences between Different Groups of Shanghai and Japanese Students in Terms of Whether or Not to Attend Math Tutoring

		Attending	Not attending	Score difference between students who attend math tutoring and those who do not	Score difference between different groups of students in terms of whether or not attending math tutoring
Shanghai					
Gender	Girl	614.446 (93.476)	596.942 (109.792)	17.503*** (t=2.807)	-4.528 (t=-0.51)
	Sample size	1312	456		
	Boy	624.164 (97.651)	602.132 (112.588)	22.032*** (t=3.040)	
	Sample size	1123	545		
	Girl -Boy	-9.718** (t=2.446)	-5.189 (t=0.681)		
SES	High	646.010 (88.178)	645.040 (104.066)	0.97 (0.142)	-19.348** (t=-2.23)
	Sample size	1320	422		
	Low	585.946 (93.798)	565.628 (104.276)	20.319*** (t=3.319)	
	Sample size	1112	579		
	High - Low	60.064*** (t=10.390)	79.413*** (t=8.591)		
Japan					
Gender	Girl	547.875 (84.887)	482.687 (79.464)	65.188*** (t=10.617)	5.174 (t=0.68)
	Sample size	1463	564		
	Boy	566.981 (89.086)	506.967 (94.698)	60.014*** (t=11.628)	
	Sample size	1438	694		
	Girl -Boy	-19.107*** (t=-4.091)	-24.280*** (t=-3.778)		
SES	High	577.098 (83.885)	518.714 (90.031)	58.383*** (t=9.990)	10.136 (t=1.48)
	Sample size	1605	452		
	Low	532.896 (85.004)	484.648 (85.978)	48.248*** (t=10.155)	
	Sample size	1266	784		
	High - Low	44.202*** (t=8.620)	34.067*** (t=4.905)		

An RPSM-based Analysis of Tutoring Effects

As mentioned above, one of the advantages of matching strategy is that after some sort of propensity score matching, the experimental group and the control group both approach the results of random assignment, thus ensuring the validness of CIA so as to obtain a causal explanation of the regression coefficient. The present study adopts the RPSM model to reveal the causal effect of math tutoring on student math score.

Table 6: RPSM-based Estimates of Math Tutoring Effects

	Treated group sample size	Control group sample size	ATET (standard error)	ATENT (standard error)	ATE (standard error)
Shanghai	2432	1001	3.105 (23.576)	7.679 (57.017)	4.439 (16.660)
Hong Kong	1427	1608	-11.281 (34.457)	-9.911 (23.635)	-10.555 (14.224)
Japan	2871	1236	50.529*** (5.983)	46.947*** (17.132)	49.451*** (4.194)
Korea	2168	1107	50.222*** (9.524)	49.550*** (17.894)	49.994*** (6.150)

According to the descriptive statistics, after matching, mean values of the characteristic variables of the treated group and control group show no significant differences and have passed LR tests. The P values of LR test statistics of student samples of Shanghai, Hong Kong, Japan and Korea are respectively 0.323, 0.395, 0.959 and 0.063, meeting the requirement of CIA, indicating that matching quality is fairly good and the result is credible.

As shown in Table 6, the ATE of math tutoring on Shanghai students is 4.4 points, and math tutoring brings those who attend math tutoring a net effect of 3.1 points, 4.5 points lower than the tutoring effects on the students who do not attend math tutoring, indicating that students who do not attend math tutoring may benefit more from tutoring. However, the ATE of math tutoring is 49.5 points on Japanese students and 50 points on Korean students, and math tutoring brings Japanese and Korean students who attend math tutoring a net effect of 50.5 and 50.2 points respectively, 3.6 points and 0.7 point higher than the tutoring effects on the students who do not attend math tutoring. Obviously, Japanese and Korean students benefit much more from math tutoring than Shanghai students. This shows that Research Hypothesis 2 is valid for Japanese and Korean students who attend math tutoring but invalid for Shanghai and Hong Kong students who attend math tutoring. There are some negative values of tutoring effects for Hong Kong students, although none of the three types of effect values is statistically significant. As for the fact that tutoring effect varies greatly from country/region to country/region, we think this is due to two reasons. First, the quality of math tutoring is not high enough either in Shanghai or in Hong Kong, producing an insignificant effect on both "good" and "poor" students. Second, Shanghai students, especially high-SES students, have received very good formal education in school and their math scores are already high enough (see Table 5), leaving little room for further improvement. According to the "plateau phenomenon" in school education, high-SES Shanghai students have probably reached the plateau phase in their studies and therefore it is very difficult for them to raise their scores to a remarkable new height (what is called the "threshold effect") . That means private supplementary tutoring can hardly bring significant additional benefits, a fact that frustrates the parents who send their children to tutoring classes. The present study does not see any obvious effect of math tutoring on Shanghai students. In Japan and Korea, however, since most students have not entered the plateau phase, they can learn a lot of knowledge, methods and skills by receiving private supplementary tutoring so as to make up for their knowledge loopholes and significantly improve their scores in the end. Supplementary tutoring can bring obvious benefits to Japanese and Korean students whether they have attended or are going to attend math tutoring. Therefore, it is rewarding and advisable for Japanese and Korean parents to send their children to tutoring classes. In Hong Kong, the percentages of students who attend math, science or language tutoring are relatively low, which is probably the result of rational decision-making of some Hong Kong parents. It is also noteworthy that in Shanghai tutoring effects are more significant on students who have not received any prior tutoring than those who have been attending private tutoring for a period of time. Most of the students who have not received private tutoring probably come from low-income families. As mentioned above, the proportion of high-SES students who receive private tutoring is nearly 10 percentage points higher than that of low-SES students who receive private tutoring (As shown in Table 7, family ESCS is one of the most important factors that determine whether parents send their children to tutoring classes or not). If low-SES students have the opportunity to receive private tutoring, they will be able to improve their learning performance.

Seen from Table 7, gender, family ESCS, school type and school location are all important factors that influence students' attending or not attending math tutoring, a result consistent with that of Table 4; and in the four country/region models, the coefficient of the variable ESCS is significantly positive, once again proving Research Hypothesis 1: the probability of receiving shadow education is significantly higher for students from high-ESCS families than for those from low-ESCS families.

Table 7: The Logit Model Influencing Students' Attending or Not Attending Math Tutoring

Variables	Shanghai	Hong Kong	Japan	Korea
Gender	0.324*** (1.382)	0.156** (1.169)	0.247*** (1.280)	0.087 (1.091)
ESCS	0.296*** (1.345)	0.410*** (1.507)	0.710*** (2.033)	0.532*** (1.702)
Location			1.223*** (3.397)	0.166 (1.181)
Public				-0.203*** (0.816)
Intercept	0.852*** (2.345)	0.135** (1.145)	-0.382 (0.682)	0.593*** (1.810)

Note: 1. Data not in parentheses are coefficients of the logit model; those in parentheses are odds ratios. 2. The variable of school type is not incorporated into the models of Shanghai, Hong Kong and Japan, because if it is incorporated it will be impossible to pass the balancing test of the treated group and control group after matching.

Robustness check

Given the same control variables, Table 8 shows a comparison of estimated math tutoring effects according to the OLS model and RPSM model. Seen from the table, the tutoring effects corresponding to the two methods in the four country/region models are the same in sign and significance, differing in value only. This means that the result of RPSM is basically reliable. The assumption of OLS for estimating tutoring effects is that whether a student receives tutoring or not is totally random. In reality, however, low-capacity students are more likely to attend math tutoring than high-capacity students (Lei Wanpeng 2005; Yu Zhang 2013) because the latter have the ability to improve their scores through self-study. So, the OLS model may have underestimated tutoring effects because it does not take into consideration the variable of student capacity that has a negative correlation with the likelihood of receiving private tutoring. As for why tutoring effects on Shanghai and Hong Kong students are so different from the tutoring effects on Japanese and Korean students, the text below will give a detailed analysis and explanation from the perspective of how LTT and tutoring in other courses affect the math score of students.

Table 8: Estimated Math Tutoring Effects According to the OLS model and RPSM Model When Given the Same Control Variables

	OLS	RPSM(ATET)
Shanghai	0.332(3.274) [3433]	3.105(23.576) [2432/1001]
Hong Kong	-15.838***(2.826) [3035]	-11.281(34.457) [1427/1608]
Japan	13.468***(2.964) [4107]	50.529***(5.983) [2871/1236]
Korea	24.682***(3.366) [3275]	50.222***(9.524) [2168/1107]

Note: 1. Control variables in the OLS model of the four countries/regions are the same as the independent variables in Table 7. 2. The data in parentheses "()" are standard errors; the data in the square brackets "[ ]" beneath the OLS results are sample sizes; and those in the square brackets "[ ]" beneath the RPSM results are sample sizes of the treated group/control group.

Effects of LTT on student scores

Why are math tutoring effects so different among Shanghai, Hong Kong, Japanese and Korean students? According to the fore-mentioned descriptive statistics, the percentage of students receiving supplementary tutoring varies significantly from course to course and from country/region to country/region, and LTT of students in each country/region is obviously different.

For instance, on average Hong Kong students spend less time receiving math and science tutoring than students of the other three countries/regions. Will tutoring classes for different school courses produce an additive effect or crowding-out effect? We will use a two-level linear model to study the differences in tutoring effects on the students of the four countries/regions based on the differences in LTT.

Table 9: Effects of LTT on Math Scores: Results of A Two-level Linear Model

	Model 1		Model 2	
Variables	Shanghai	Japan	Shanghai	Japan
Fixed effect				
Intercept	192.184***	330.885***	201.503***	329.177***
Student-level variables				
Gender	-14.148***	-16.556***	-14.799***	-16.569***
Escs	7.716***	5.385**	7.641***	5.166**
$Escs^2$	-5.805***	0.870	-5.655***	0.714
Mathtime	1.107	8.025***	-0.038	6.344***
$Mathtime^2$	-0.336	-0.593*	0.003	-0.524
Langtime			-5.301***	0.567
Scitime			3.485***	-0.687
Othertime			1.547	2.261***
School-level variables				
Public	-33.611***	-3.681***	-33.376***	-3.796***
Classsize	24.466***	7.843***	23.899***	7.958***
	-0.308***	-0.057***	-0.301***	-0.059
Random effect				
Intra-school	5172.398***	3876.623***	5122.177***	3864.359***
Inter-school	3431.134***	3280.015***	3237.169***	3272.459***
N	3433	4107	3425	4095

Table 10: Effects of LTT on Math Scores: Results of A Two-level Linear Model (continued)

	Model 1		Model 2	
Variables	Hong Kong	Korea	Hong Kong	Korea
Fixed effect				
Intercept	524.043***	741.693***	532.539***	735.406***
Student-level variables				
Gender	-23.166***	-10.015**	-22.267***	-10.737**
Escs	8.352***	17.646***	9.221***	17.402***
$Escs^2$	0.581	5.348**	1.106	5.364**
Mathtime	-7.697**	13.709***	-10.002***	13.766***
$Mathtime^2$	0.621	-0.562	0.876	-0.705
Langtime			-9.649***	0.359
Scitime			8.647***	-3.096
Othertime			0.792	3.804***
School-level variables				
Public	31.150***	-17.033***	29.688***	-15.710***
Classsize	-1.175	-16.154***	-1.615	-16.043***
$Classsize^2$	0.083**	0.286***	0.087*	0.285***
Random effect				
Intra-school	5142.270***	5713.179***	4962.542***	5686.631***
Inter-school	3207.368***	2596.605***	3026.882***	2619.061***
N	3035	3275	3016	3238

Note: "***" indicates significance at the 0.01 level; "**" indicates significance at the 0.05 level; and "*" indicates significance at the 0.1 level.

Comparing the results of Model 1 and Model 2 in Table 9, we see that differences in the coefficients of gender, ESCS, school type and classsize are very small, indicating good robustness of the models and high reliability of the research results. Here, we focus on the effects of LTT on student math scores. Seen from the results of

Model 1 and Model 2, mathtime has a significant positive effect on student math scores, but such an effect is shown in an inverted U-shaped curve, according to which math tutoring effect reaches the maximum when weekly mathtime is around 7 hours (Currently, Japanese students have 1.74 hours of mathtime per week on average). Also seen from the results of Model 1 and Model 2, mathtime does not produce any significant nonlinear effect on the math scores of Korean students; its first-term effect is very significant; and unit mathtime may improve a student's math score by as many as 13.7 points. Thus, Research Hypothesis 3 that "increasing the time of math tutoring may significantly improve math scores" is verified in the cases of Japan and Korea. Significance (big value) of the effect of unit mathtime on Japanese and Korean students is also one of the reasons why the RPSM models give bigger ATT results for Japanese and Korean students than for Shanghai and Hong Kong students. By analyzing the sample of Shanghai students we find that mathtime has no significant effect, langtime has a significant negative effect and scitime has a significant positive effect on student math scores. These findings are consistent with the coefficients of scioutschool of Model 2 and Model 3 in Table 10, proving that science tutoring and math tutoring have a mutually additive effect. For Hong Kong students, mathtime shows an extremely negative effect on math scores, one of the reasons for which is probably that their weekly mathtime is too short (only 1.07 hours on average). Only when weekly mathtime is increased to at least 6 hours will it be possible to see substantial improvement in math scores. Another reason is probably that Hong Kong math tutors are not experienced enough, unable to teach students according to their aptitude or take targeted measures to improve their scores. Relatively speaking, science tutoring brings more benefits to Hong Kong students, with per unit of scitime improving math scores by as many as 8.6 points.

Does "shadow education" aggravate the inequality of educational outcomes?

Here in this part, we will discuss the question of whether shadow education aggravates the inequality of educational outcomes. For this purpose we use a linear regression model into which interaction terms are incorporated to see whether math tutoring produces different effects on the math score of students from different family backgrounds, in an attempt to provide an empirical basis for the government to formulate policies for regulating and controlling shadow education.

Table 11: Effects of Shadow Education on Math Scores: Results of A Two-level Linear Model

	Model 1		Model 2		Model 3	
Variables	Shanghai	Japan	Shanghai	Japan	Shanghai	Japan
Fixed effect						
Intercept	191.859***	326.862***	196.190***	325.535***	200.650***	325.810***
Student-level variables						
Gender	-14.161***	-16.119***	-15.151***	-16.009***	-15.152***	-16.008***
Escs	7.594***	5.539***	7.916***	5.498***	13.713***	6.923*
Escs^2	-5.842***	0.887	-5.798***	0.911	-5.319***	1.207
Mathoutschool	0.026	13.480***	4.224	8.481**	0.876	8.087**
Langoutschool			-11.959***	5.500*	-12.638***	5.475*
Scioutschool			4.438	2.260	4.625	2.271
Escs*mathoutschool					-7.774***	-1.985
School-level variables						
Public	-33.603***	-4.197***	-33.600***	-4.479***	-33.511***	-4.484***
Classsize	24.461***	8.064***	24.276***	8.113***	24.180***	8.110***
Classsize^2	-0.308***	-0.059***	-0.306***	-0.060***	-0.305***	-0.060***
Random effect						
Intra-school	5175.638***	3890.851***	5157.777***	3885.222***	5146.864***	3884.697***
Inter-school	3427.266***	3491.201***	3302.115***	3480.021***	3290.641***	3482.441***
N	3433	4107	3428	4104	3428	4104

Note: "***" indicates significance at the 0.01 level; "**" indicates significance at the 0.05 level; and "*" indicates significance at the 0.1 level.

Table 12: Effects of Shadow Education on Math Scores: Results of A Two-Level Linear Model (continued)

	Model 1		Model 2		Model 3	
Variables	Hong Kong	Korea	Hong Kong	Korea	Hong Kong	Korea
Fixed effect						
Intercept	518.973***	746.548***	524.957***	746.078***	524.028***	746.206***
Student-level variables						
Gender	-22.741***	-10.076**	-22.051***	-10.128**	-22.071***	-10.136**
Escs	8.118**	18.980***	8.780***	18.919***	11.062***	18.333***
$Escs^2$	0.466	5.728***	0.826	5.535**	1.167	5.439**
Mathoutschool	-15.777***	24.511***	-18.484***	23.588***	-21.434***	23.575***
Langoutschool			-17.490***	3.759	-17.749***	3.807
Scioutschool			21.544***	-2.207	21.571***	-2.200
Escs*mathoutschool					-3.924	0.882
School-level variables						
Public	30.847***	-17.300***	29.705***	-16.674***	29.640***	-16.688***
Classsize	-0.761	-15.669***	-1.063	-15.680***	-0.897	-15.692***
$Classsize^2$	0.076*	0.280***	0.079*	0.280***	0.076*	0.280***
Random effect						
Intra-school	5139.319***	5771.229***	5012.810***	5774.342***	5009.332***	5774.030***
Inter-school	3233.064***	2664.185***	3079.023***	2686.767***	3081.177***	2686.811***
N	3035	3275	3025	3248	3025	3248

First, looking at the coefficients of student-level independent variables we find that math scores of students of the four countries/regions vary significantly by gender, boys performing better than girls[11]. For Japanese and Hong Kong students, family ESCS exerts a significant positive effect on math scores. For Shanghai students, however, the effect of family ESCS on math scores is shown in an inverted U-shaped curve: for the students whose family ESCS is below a certain value (0.649), the effect of ESCS on mathematical literacy increases as their family ESCS rises, but for those whose family ESCS is above the certain value, the effect of ESCS on mathematical literacy decreases as their family ESCS rises[12]. Different from the case of Shanghai, the effect of family ESCS is presented in a U-shaped curve for Korean students. Math tutoring has a significant positive effect on Japanese and Korean students, a slight positive effect on Shanghai students but a significant negative effect on Hong Kong students. This result coincides with the fore-mentioned RPSM model result and the LTT model result. Language tutoring has a significant negative effect on the math scores of Shanghai and Hong Kong students[13], but a positive effect on the math scores of Japanese and Korean students, especially, a statistically significant positive effect on Japanese students. This is probably because the average langtime of Shanghai students is about 0.5 hour longer than that of Japanese students (as shown in Table 3), thus crowding out their mathtime. In addition, since language learning is very different from math learning in terms of method and way of thinking, it does not produce the same additive effect on math learning as science tutoring does. For Hong Kong students, science tutoring has a significant positive effect on math scores. For Shanghai and Japanese students, it also produces a positive effect on math scores although the effect is not statistically significant. This result also proves that math tutoring and science tutoring have a mutually additive effect.

Second, by looking at the coefficients of school-level independent variables, we find that school type has a significant effect on the math scores of students of all the four countries/regions. In Shanghai and Korea respectively, the math score of public-school students is 33 points and 17 points lower than that of private-school students, and this difference is 4 points in Japan. The case is just the opposite in Hong Kong, where the average math score of public-school students is 30 points higher than that of private-school students. Classsize exerts a significant inverted U-shaped effect on student math scores in Shanghai and Japan. In Shanghai when classsize reaches 40 students, it will produce the maximum positive effect on math scores, and in Japan this figure is 67 students. The average classsize in Shanghai is 39 students, already very close to the optimum scale, while in Japan there is still much room for increasing classsize. Unlike the situation is Shanghai and Japan, Hong Kong schools have some room for increasing classsize (the quadratic term of classsize is significantly positive but the first term is not so significantly positive), and in Korea a positive effect does not exist until classsize reaches 56 students, indicating that there is much room for classsize to increase.

Finally, by looking at coefficients of the interaction term of family ESCS and attending math tutoring in Model 3, we find that attending math tutoring may narrow the math score gap caused by different family ESCS. This effect is most significant in Shanghai where math score gap can be narrowed by about 8 points. In Hong Kong and Japan it can be narrowed by 4 and 2 points respectively. Coefficients of the Korean student learning performance model are positive, showing no statistical significance. Results of the Shanghai student learning performance model overturn Research Hypothesis 4 that "shadow education may aggravate the inequality of educational outcomes." According to the fore-mentioned descriptive statistics, in Shanghai math tutoring brings bigger benefits to low-SES students than to high-SES students. Therefore, shadow education may narrow the gap in student learning performance caused by the difference in family ESCS, thus promoting equality of educational outcomes. In Shanghai the average math score of low-SES students is 62.6 points lower than that of high-SES students, quite a big gap, and those low-SES students who have not received math tutoring have an average math score of a merely 565 points. If receiving math tutoring, they can markedly improve their scores because there is much room for improvement. The average math score of high-SES students who have not received math tutoring is already as high as 645 points, leaving little room for further improvement. For them, math tutoring is unlikely to bring significant benefits, or may even crowd out the time for them to develop their potentials in other aspects. Over the past two years China has made a lot of efforts to lighten the burden on primary and secondary students by shortening school time and substantially reducing the amount of homework, which has stimulated the enthusiasm of many parents and students to seek shadow education in an increasingly competitive way (Xue Haiping et al 2014). In this context low-SES parents may send children to tutoring classes so as to make up for their inability to academically instruct the children and narrow the score gap between their children and other students. The present study shows that in Shanghai it is financially advisable for low-SES parents to send their children to private supplementary tutoring classes but it is not so advisable for high-SES parents because the benefit is very limited. Seen from the coefficients of all the control variables in Models 1-3 shown in Table 10, the research results have good robustness and high reliability.

CONCLUSION

Based on the student sample data of PISA 2012 for Shanghai, Hong Kong, Japan and Korea and adopting an RPSM model and multi-level linear regression model, the present study has analyzed the effects of shadow education (private supplementary tutoring) on student math scores and come to the following conclusions:

1. Supplementary math tutoring may help Shanghai, Japanese and Korean students to improve their math scores, and such an effect is significantly positive for Japanese and Korean students. This conclusion is similar to the one drawn by OCED using PISA 2012 data (OECD 2013), although the measurement quantitative method used in the OCED PISA Report is different from the one used in our study. As mentioned above, Confucianism has a widespread influence in China, Japan and Korea, where the vast majority of parents want their children to go to high-quality universities so that they can have a good career in the future. They are willing to spend money on supplementary tutoring because, one the one hand, it helps children make progress in their studies and on the other hand, it enables children to achieve higher human capital which in the future will bring them higher returns on human capital investment. Numerous facts have shown that supplementary tutoring does enhance student performance, and therefore, parents are willing to pay high tuition fees in exchange for their children's advantage in competitive examinations.

2. Math tutoring effects are more significant on Japanese and Korean students than on Shanghai and Hong Kong students. We speculate that this is probably because the current overall mathematical literacy of Shanghai students is higher than that of Japanese and Korean students. The average math score of Shanghai students who receive math tutoring is already as high as 618.9 points, while this figure is only 557.3 for Japanese students and 575.4 for Korean students. Therefore, math tutoring in Shanghai is mainly intended for "top students" while that in Japan and Korean is mainly for "relatively poor students". Due to the "threshold effect" in learning, math tutoring creates less space for Shanghai students to further improve math scores than for Japanese and Korean students. In addition, the fact that per unit of mathtime generates a bigger tutoring effect for Japanese and Korean students is not only a reflection of the higher quality of math tutors of the two countries but may also be one of the reasons why the overall effect of math tutoring is more obvious for students of the two countries than for Shanghai and Hong Kong students. In Hong Kong the effect of math tutoring is negative. This is probably because, on the one hand, weekly mathtime is too short (1.07 hours on average) to produce any substantial effect and on the other hand, private math tutors in Hong Kong do not have a thorough understanding of the curriculum content of formal schools, thus making tutorial efforts untargeted and tutoring effects insignificant. Another possible reason is that the RPSM model for measuring the tutoring effect on Hong Kong students missed the key characteristic variables that explain why students attend supplementary tutoring, thus making the result unrealistic. We also speculate that the formal school education system plays a major role and the shadow education system plays only a very limited role in helping Shanghai and Hong Kong students perform outstandingly in PISA 2012. For Japanese and Korean students who also performed excellently in PISA 2012, however, the role of shadow education is relatively bigger. That is why over the past years the Korean

government has vigorously promoted investment in its "After-school Education Program", a program that has benefited a great number of students.

3. Tutoring in different courses produces different effects on math scores: science tutoring and math tutoring have a mutually "additive effect". In Shanghai, Hong Kong and Japan, tutoring in all science-related courses can improve student math scores. For Shanghai and Hong Kong students in particular, the effect of increasing the time length of science-related tutoring on math scores is significantly positive. This is mainly because science-related courses and mathematics have a lot in common, such as requiring logical reasoning and similar research paradigms. Language tutoring produces a significant negative effect on math scores in Shanghai and Hong Kong, but the case is just the opposite in Japan. We speculate that this is probably because the average weekly langtime of Shanghai students is longer than that of Japanese students, thus crowding out their mathtime, and that the weekly langtime of Hong Kong students not only is too short to produce any substantial effect but also reduces student mathtime, thus causing a decline in their math scores.

4. The opportunity of receiving private supplementary tutoring is obviously different for students with different family economic, social and cultural backgrounds. In the four countries/regions, the percentage of high-SES students who receive math tutoring is obviously higher than that of low-SES students: the gap is 10 percentage points in Shanghai and as big as 17 percentage points in Hong Kong and Japan. As has been previously described, the cost of attending supplementary tutoring is quite a big sum for low-income families either in China, Korea or in Japan and therefore, influences their decision whether or not to send their children to cram schools.

5. Attending supplementary math tutoring may narrow student performance gap caused by differences in family economic, social and cultural status (ESCS), thus promoting equality of educational outcomes. The learning performance of students from high-ESCS families is significantly higher than that of those from low-ESCS families. The gap in math scores between the two types of students is respectively 63, 41, 49 and 53 points in Shanghai, Hong Kong, Japan and Korea. By referring to the gender parity index developed by the UNESCO Institute for Statistics (UIS), family background parity indexes of all the four countries/regions we have calculated are bigger than 1.03, beyond the range of equality, although their gender parity indexes are within the range of equality (See attached Table 2). Therefore, it is necessary to take educational intervention measures to narrow the learning performance gap between students of different family backgrounds.

The big gap in learning performance mainly caused by differences in family background can be reduced by supplementary tutoring. In Shanghai for example, such a gap can be markedly narrowed by nearly 8 points. This conclusion may seem contrary to what people generally think. Most people regard private tutoring as an investment option of wealthy parents for their children, a thing that few ordinary parents are willing to do due to high costs. In their opinion, shadow education aggravates the inequality of educational outcomes or even social inequality. However, according to the data of PISA 2009 and PISA 2012 for Shanghai, around 70% students receive supplementary math tutoring, and this percentage is over 60% even for low-SES students. As mentioned afore, a survey conducted by the "Project Team for Research on Education Expenditure of Chinese Urban Families during the Compulsory Education Phase" reveals that 76% families choose to send their children to supplementary tutoring classes. It should be mentioned that according to the results of the RPSM model for Shanghai students, tutoring effects on the students who have not received any prior tutoring are more significant than on those who have been attending supplementary tutoring for a period of time. Most of the students who have not received any prior tutoring are very likely to come from low-income families, and as mentioned afore, their proportion of attending supplementary tutoring is almost 10 percentage points lower than that of high-income families (As shown in Table 7, family ESCS is an important factor influencing parents' decision whether or not to let their children receive tutoring). If low-SES students receive supplementary tutoring, they will be able to significantly improve their learning performance and catch up with those high-SES students, thus making shadow education an "equalizer" of human capital accumulation. From this perspective, the government and education policy-makers should see the rational elements of shadow education and give it a "legal" status.

The present study leads to the findings that although the effect of supplementary math tutoring varies from country/region to country/region, it does improve student math scores and narrow the learning performance gap caused by differences in family ESCS, thus playing a certain role in promoting the equality of educational outcomes (In Shanghai, such an effect is significant). Quite a few researchers have found that math tutoring has become a must for a lot of low-income families in East Asian countries (Bray & Kwo 2013; Lee et al 2009; Lin & Chen 2006). According to surveys conducted in China, Japan and Korea, the cost of supplementary tutoring constitutes a considerable part of the total income of low-income families or even lowers their living standard. For this reason, we suggest that the government and schools provide free necessary tutorial services for low-performance students from these families and give full play to the role of school education as a "social equalizer"[14]. To this end, other countries/regions may follow the example of the Korean government to implement their own "after-school education programs", by which full-time teachers tutor low-performance students from low-income families after school, with all or part of the cost covered by the central or local government. It is also suggested that large-sized extracurricular education groups establish after-school learning funds and/or incentive funds[15], for students from poor families, grant fee remissions to those from ultra-low income families and provide scholarships for poor students who have made substantial progress in their studies, so as to create a situation where the government, the school and the society jointly promote the equality of educational outcomes in the stage of compulsory education.

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APPENDIX:

Attached Table 1: Learning performance differences in Hong Kong and Korea between students who receive private tutoring and those who do not

		Attending	Not attending	Score difference between students who attend math tutoring and those who do not	Score difference between different groups of students in terms of whether or not attending math tutoring
Hong Kong					
Gender	Girl	553.662 (84.467)	554.047 (95.755)	-0.385 (t=-0.067)	-0.965 (t=-0.127)
	Sample size	681	723		
	Boy	570.909 (96.719)	570.329 (102.672)	0.58 (t=0.105)	
	Sample size	753	900		
	Girl -Boy	-17.247** (t=-2.221)	-16.282** (t=-2.385)		
SES	High	580.102 (89.134)	591.430 (96.475)	-11.328* (t=-1.920)	-6.931 (t=-0.909)
	Sample size	808	628		
	Low	540.199 (89.678)	544.596 (97.190)	-4.397 (-0.895)	
	Sample size	619	980		
	High - Low	39.903*** (t=6.066)	46.834*** (t=6.446)		
Korea					
Gender	Girl	560.404 (89.206)	513.631 (94.902)	46.773*** (t=7.100))	-28.664*** (t=-3.251)
	Sample size	1013	503		
	Boy	588.641 (95.652)	513.203 (101.713)	75.438*** (t=10.269)	
	Sample size	1157	606		
	Girl -Boy	-28.237*** (t=-4.193)	0.427 (t=0.051)		
SES	High	595.341 (92.033)	540.900 (102.153)	54.441*** (t=8.490)	-2.008 (t=-0.239)
	Sample size	1237	476		
	Low	549.391 (89.333)	492.942 (90.849)	56.450*** (t=7.797)	
	Sample size	931	631		
	High - Low	45.950*** (t=8.368)	47.958*** (t=6.691)		

Attached Table 2: Gender parity indexes and family background parity indexes

	Average math scores of girls	Average math scores of boys	Gender parity indexes(GPI)[16]	Average math scores of high-SES students	Average math scores of low-SES students	Family background parity indexes[17]
Shanghai	609.888	615.607	0.991	643.246	580.588	1.108
Japan	527.011	544.884	0.967	563.015	514.120	1.095
Hong Kong	552.957	568.378	0.973	584.382	543.451	1.075
Korea	544.193	562.114	0.968	579.537	526.501	1.101

Notes

[1]. According to Stevenson and Baker, when a change takes place in the courses of mainstream education, a corresponding change will take place in their "shadow courses", and the development of mainstream education will lead to the expansion of shadow education (Stevenson & Baker1992).

[2]. According to Mark Bray, "shadow education" does not include painting, piano playing, sports activities or other extracurricular activities that are not related to school courses.

3. Private supplementary tutoring is a common phenomenon in Asian countries, but it is also increasingly seen in Europe, North America, Africa, Australia and other parts of the world.

[4]. In the Confucian culture it is generally believed that a person's success depends on constant efforts, and most parents hope that their children could improve their school performance by receiving private supplementary tutoring. In addition, deeply influenced by traditional belief that a child can make a success by working hard at their studies, parents attach great importance to their children's education, including private supplementary tutoring..

[5] . In the school year of 2011-2012 Hong Kong had a total of 524 secondary schools, of which 497 were affiliated to the local education system and 27 were fee-charging ESF schools including those teaching in English. Of the 497 schools affiliated to the local education system, 32 were public schools directly owned and operated by the government and 365 were partly public schools funded or subsidized by the government. There were also 63 DSS schools covered by the Direct Subsidy Scheme and these schools were allowed to charge tuition fees and had some autonomy in curriculum setting and other aspects (Mark Bray et al, 2014

[6]. According to the Education Bureau of Hong Kong, the SAR's primary and secondary schools are classified into government schools, government funded/aided schools, DSS schools ("Direct Subsidy Scheme" schools), private schools, and fee-charging ESF schools. Government schools are schools established, operated and totally financed by the SAR government where all the teachers and administrative staff are civil servants. Of all the 1, 092 primary and secondary schools in Hong Kong in the academic year of 2011-2012, only 6% are government schools, or public schools.(http://www.edu.cn/xsc_12533/20130614/t20130614_963980.shtml)

[7]. Data released by the World Bank shows that Hong Kong's per capita GDP was USD 36, 708 in 2012, ranking the 27th place in the world.
http://data.worldbank.org/indicator/NY.GDP.PCAP.CD/countries

[8]. Studies by Mark Bray, et al in 2014 reveal that monthly expenditure on private tutoring accounts for 8.7% of a family's total monthly income on average in Hong Kong.

[9]. Generated from ESCS, SES is a discrete variable with two-point scoring. "1" means being above the average value of ESCS of students of the participating country, and "0" means being below the average value.

[10]. Due to limited space, here we only discuss the learning performance differences between students who receive private tutoring and those who do not, by taking Shanghai and Japanese students as examples. For information in this regard about Hong Kong and Korean students, please refer to Attached Table 1 in the Appendix.

[11]. Out of the 65 countries/regions involved in PISA 2012 tests, 37 see boy student math score significantly higher than that of girl students, and only 5 countries see the opposite situation. Similarly, among the 41 countries/regions involved in PISA 2003 tests, 27 see boy student math score significantly higher than that of girl students, 11 see boy student math score insignificantly higher than that of girl students, and only 1 country see boy student math score significantly lower than that of girl students.

[12]. This result is basically consistent with the research result achieved by Ren Chunrong, et al in 2013 (Ren Chunrong & Xin Tao, 2013). This is probably because, on the one hand, the parents of high-SES students in China are usually busy with their work, thus having little time to share with their children and guide their study, or do not have high expectations on their children, and on the other hand, some high-SES students are not highly motivated to learn, making their learning performance inconsistent with the ESCS of their parents.

[13] .The average weekly langtime of Hong Kong students is only 0.44 hour, which cannot produce a substantial effect or may even crowd out their mathtime, causing a decline in math scores.]

[14]. School education is an open path by which people may break through their family origin and other restrictions, move up the social ladder and improve their lives. Just as the human capital theory stresses in particular, in a totally competitive market economy all people may increase their future income by investing in their own education, thus promoting economic fairness.

[15] .By means of tax exemption or reduction, the government can encourage these large-sized extracurricular education groups to provide non-profit educational services for the poor.

[16]. Gender Parity Index (GPI) is an index designed by the UNESCO Institute For Statistics (UIS) to measure the relative access to education of males and females. In its simplest form, it is calculated as the quotient of the number of females by the number of males enrolled in a given stage of education. The more the quotient deviates from 1, the bigger the disparity. A quotient between 0.97 and 1.03 is considered in the parity range. This index is used in both 2010 and 2011 Global Education Digest

[17]. We calculate the family background parity index in a way that is similar to the way GPI is calculated.

TURN YOUR PHONES ON: USING ANDROID DEVICES TO COLLECT SCIENTIFIC DATA

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ABSTRACT: Data logging devices have been in use for about three decades but they have never quite developed into the automatic choice of device for taking measurements in educational contexts. This article reviews the reasons for this, citing difficulties with setting up, dealing with the software, and overcoming hardware incompatibilities. The literature suggests that these factors have discouraged many science teachers from embedding data loggers into their teaching.

Research by providers shows that 80% of teenagers now possess Android devices in the form of a mobile phone (cell phone) or tablet, and many schools have introduced schemes which supply pupils with their own tablet device for use in lessons. Android devices are now supplied with a range of sensors which can be relatively easily used for the capture of useful data in the Science laboratory. This paper evaluates four experiments carried out using a mobile phone to collect the data. The experiments are described in detail, and the errors are analysed to evaluate the effectiveness and accuracy of the device in each experiment. The measurements were taken making use of Apps which were downloaded free of charge. The Apps were used in collecting data to measure audio frequencies, magnetic fields from an electromagnet, the acceleration of a moving body, the and the coefficient of restitution of a bouncing ball. Data and images are presented to enable the audience to carry out and extend the experiments for their own use.

Keywords: Datalogging, cellphone, Android

INTRODUCTION

The development of the personal computer since the 1970s has resulted in widespread use of computers in UK education after numerous policy initiatives from successive governments. However Hammond (2014, 195) notes that while schools have invested in infrastructure, much of the investment has resulted in "an overemphasis on 'office' software". Policy and practice have therefore tended to lead away from the use of ICT in practical settings, while Wastiau et al (2013, 17) reports that "Digital resources such as … data logging tools … are still very rarely used by students during lessons".

However, Wastiau et al (2013) found that between 2006 and 2013, access to educational technology had roughly doubled, with broadband access available in 95% of EU schools. In the EU, there are approximately five pupils for every computer. More and more pupils are taking their own smartphones and tablets to school on a daily basis. For example 65% of UK teenagers (age 12-15) have a smartphone (Ofcom, 2014).

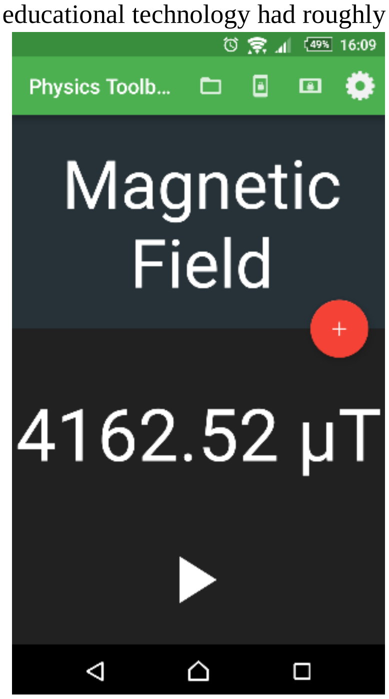

Figure 1: Screenshot from Magnetometer app

Smartphones offer a response to Hammond's (2014) assertion that while data logging devices allow for the capture of data in either difficult or remote circumstances, the exercise of data collection becomes an end in itself, rather than the analysis of the collected data being the focus of the exercise.

This article is not new in proposing the use of smartphones in collecting scientific data – see for example Monteiro et al (2016), Egri & Szabo (2015) and Patrinopoulos & Kefalis (2015). Smartphones now contain a range of sensors, enabling them to collect ambient data (temperature, humidity, pressure, light, sound level), as well as physical data (acceleration, magnetic field, sound frequency).

RESULTS

I describe here four experiments making use of some of the sensors available within most smartphones produced in the last five years, reviewing the experimenter's experience in collecting and analysing data, and making use of Apps that were available free of charge to gain access to the data.

The four experiments below have been chosen to provide a balance between 'quick-and-easy' experiments requiring little set-up, and those which require a degree of analysis before they can be utilised.

Magnetic field

App: Physics Toolbox Magnetometer (Vieyra software)

At 11th grade (age 16-17), Physics students study the effect of magnetic fields on electron beams, and a classic experiment in this field uses a pair of Helmholtz coils to generate a suitable uniform field. The formula for this is beyond the scope of most courses at this stage, and yet it is usually quoted and used in order to calculate the value of the field used in the experiment. Here, I used the Magnetometer app to measure the field between a pair of Helmholtz coils, and compared it with the value calculated from the formula.
A screenshot of the display is provided in figure 1.
Calculated value: $4.17 \pm .05 \times 10^{-3}$ T
Measured value: $4.16 \pm .04 \times 10^{-3}$ T

Discussion
The app is very easy to use; although the display of six significant figures is unwarranted because the last two figures are swamped by the Earth's magnetic field of approximately 40 μT. It also takes a few moments to identify the best position to hold the smartphone in order to take the optimum reading – this will vary with the position of the sensor within the smartphone used. Accuracy appears to be very good.

Heart rate
App: Unique Heart Rate Monitor (Meet Your Need Production).
This is a very straightforward standard experiment which can be carried out in classrooms to allow students to investigate their own heart rate.

This experiment is very simple to set up and run: heart-rate readings were taken every minute or so before, during and after drinking a cup of strong coffee. The app measures heart rate using its camera and lamp to detect light reflected from a fingertip – presumably detecting changes in the blood flow.

Discussion

Data must be recorded manually, but the displayed value is as accurate (and more reliable) than values measured manually. Changes in heart rate were detected, though these were likely to have been due to other factors, since the body's response to caffeine is complex. Light exercise (eg walking up a flight of stairs) will raise heart rate sufficiently for interesting results.

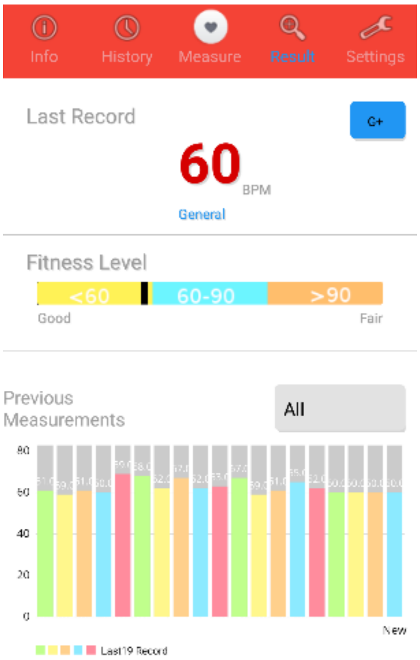

Figure 2: Screenshot From Heart Monitor App

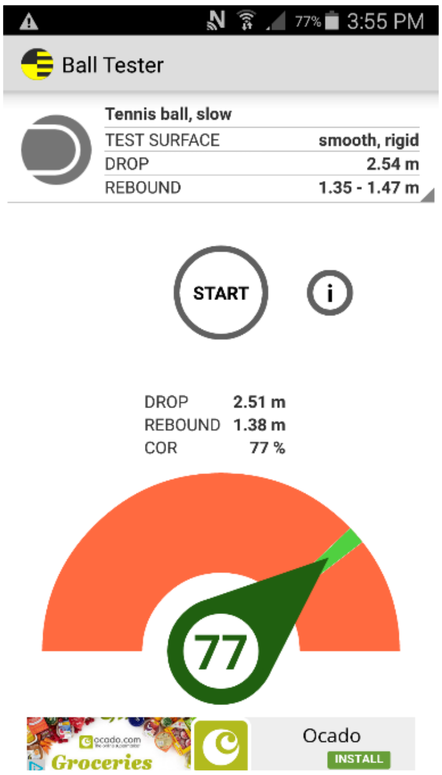

Figure 3: Screenshot From The Bounce Of A Tennis Ball

Ball bouncing
App: Ball Tester (Solbacca)
This app uses the sound detector in the smartphone to measure time intervals as a test ball bounces three times. Using equations of motion, it is possible to calculate the original height from which the

ball was dropped along with its coefficient of restitution ("COR"). The app is programmed with statistics relating to basket balls, tennis balls and others, and can be used to compare the resilience of the ball with the regulations.
With practice, releasing the ball from an appropriate height becomes simple, and the software yields a values within 5% of the calculated value.

Discussion

Calculating the COR from the data displayed yields a slightly different result (74% instead of 77%), which may be due to the value of gravitational field strength used in the software.
This exercise would prove useful to a group of students covering a mechanics course at about grade 11 requiring detailed use of equations of motion to derive the necessary formulae. Comparing the data with that collected using a stopwatch or timing gate would be interesting.

Measuring acceleration

App: Physics Toolbox Accelerometer (Vieyra software)
The use of a smartphone as an accelerometer is an inviting proposition – there are many situations in which data can be collected – for example in lifts, cars and aeroplanes.
A classic Physics experiment involves using a falling weight to provide the forward force on a dynamics trolley. The acceleration can easily be calculated, and by resting the smartphone on top of the trolley (secured with rubber bands), data can be collected to compare with the calculated value.

There is a significant problem with vibration – the sensitivity of the device is so acute that the values from the vibrations tend to swamp the actual data, and although a value can be obtained which approximates to the predicted value, this can only be achieved after a significant amount of data manipulation, which undermines the task considerably. Smoothing the data (by taking a running average of every 10 readings) improved the results such that measured results were within about 5% of the calculated values.

DISCUSSION

Unfortunately with this app the experiment became about the data manipulation and not about the experiment. Observed in other moving objects such as aeroplanes and lifts, the graphs produced by the app are swamped by vibrations. Other apps demonstrate the same difficulty, and experimenters such as Egri & Szabo (2015), who describe a similar experiment on a trolley oscillating between two springs, accessed the data directly from the device. This was beyond the scope of this exercise, which has the aim of evaluating freely-available software. Close examination of the data shows that readings are taken in less than 1ms, and because the gyroscope is tiny, values from quite modest vibrations can be very high. To make better use of this sensor, it would be better to smooth the data on collection.

Summary Of Investigations By Undergraduate Students

One of the final-year modules at Edge Hill University for trainee teachers undertaking a degree in Science (Physics) with Qualified Teacher Status is a Physics investigation. Students are invited to choose a topic to investigate, and many take advantage of the features of their smartphones to collect data. Topics have included:

- ***Rotational Dynamics Of Pool Balls:*** Using freeze-frame video capture to analyse the translational and rotational motion of pool balls;
- ***Sound Frequency:*** Measuring the resonant frequency of wine glasses to investigate the variation between liquid volume and frequency;
- ***Sound Levels:*** Analysing the distribution of sound from a surround-sound music system by measuring the decibel level at fixed points around the room.

CONCLUSION

There is at the moment no perceived standard for data logging in schools, and in Higher Education institutions data logging tends to be carried out by devices designed or programmed in-house. Apps provide a convenient, and for students, cheap alternative to solving some of the data collection problems they face. As a result, these students are motivated to develop better experimental design, and to consider more closely the accuracy and reliability of the results they record. The experiments described here offer solutions where the data collection is otherwise problematic – generally because it is either inherently difficult for young people to carry out manually (e.g. heart rate) or because the observations are too rapid (experiments involving motion), or unnecessarily complicated (measuring as opposed to calculating magnetic field). Or because the smartphone is just so convenient and easy to use, (measuring sound levels, video recording). More to the point, students have these devices and love to be using them.

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THE DEVELOPMENT OF PRE-SERVICE SCIENCE TEACHERS' REFLEXIVE PRACTICE AT THE LEBANESE UNIVERSITY FACULTY OF EDUCATION

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ABSTRACT: A major aim in teacher's preparation program is to promote reflective practice among future teachers. Literature in teacher education points out to the importance of reflection in the development of quality teaching (Coffey 2014; Jay & Johnson, 2002; Perrenoud 2012). Schon's (1983,1987), proposed a conceptual framework about reflective practice that involves two phases of reflection: reflection-on-action which refer to the reflection after doing the action anf reflection-in-action which occurs during the doing. The framework was adapted later to include reflection for action, that takes place before the doing of the action as the teacher reflects about the future experience informed by the past practice. The current study, aims to explore if the training program at the Lebanese University, Faculty of education, prepare reflective primary science teachers, on the basis of Schon's (1983,1987) framework. For this purpose a convenience sample of 30 participants from third year primary science pre-service teachers was selected to participate in the study along with their five trainers. Both quantitative and qualitative method including questionnaire, interviews, curriculum and reflection report analysis were used in the study. The results show that pre-service teachers develop to some extent "reflection-for-action" and "reflection-in-action", however they lack strategies for the "reflection on- action" as they face difficulties in regulation and self-improvement.

Key words: Reflective Practice; pre-service science teacher; professional development.

INTRODUCTION

Teacher education programs around the world have always raised the issue of the relationship between "theory" and "practice" to ensure better preparation of tomorrow's teachers. Tardif (2001) considered that the debate between "theory" and "practice" became more complicated when "theory" have been extended from knowledge grounded in scientific research by professional education researchers (typically associated with universities) to knowledge created through on-the-job-inquiry into practice by teachers acting as "action researchers" or "reflective practitioners" " (page 9). That constructivist approach has induced a reform in pre-service training programs illustrated mainly by the implementation of classroom-based research (action research), and the use of professional portfolios as a mean of self-assessment and regulation. So programs have become a blended form between external theories with the findings from classroom-based inquiry by trainee teachers. In this vein, Educators and stakeholders have developed frameworks and models that describe the teacher as a reflective practitioner.

Morissini, Cabrera and Felicetti, (2011) considered that pre-service teachers should demonstrate sound acquisition and use of competencies. In other word, competency refers to the knowledge, skills and attitudes that the pre-service trainee teacher should demonstrate. To state, Perrenoud (2001) developed ten core competences for professional teaching. According to him the pre-service trainee teacher should:

1. Organize and facilitate learning situations.
2. Manage the progress of learning.
3. Design and develop differentiating features.
4. Involve students in their learning and their work.
5. Work in team.
6. Participate in the school management.
7. Inform and involve parents.
8. Use of new technologies.
9. Facing the duties and ethical dilemmas of the profession.
10. Manage its own training.

Similarly, Danielson (1996; 2007; 2001; 2013) has developed a framework for teaching evaluation that identifies four domains of a teacher's responsibilities: Planning and Preparation; Classroom Environment;

Instruction; Professional Responsibilities. Each domain includes a set of components with theirs related-elements, making a total of 22 components and 76 elements.

That reform in teacher education programs made one of its major goals of teacher education programs is to help future teachers to put in place a "habitual mode of thought, practice and refinement or reflection" (Ryan, 2001, p2). Learning to become a teacher is not just a process of acquisition and application of knowledge, but also a practical action in which knowledge is endorsed in reflecting and developing a specific action (Altrichter, 2005). In this vein, Cornish & Jenkins, 2012 considered that learning to become a teacher is a developmental process, part of which is learning to become a reflective practitioner. They argued that teacher quality is an outcome of the engagement in regular reflection during their development and that this self-assessment promotes continual self-improvement. Similarly, Ryan (2007) pointed out that a "successful pre-service program is not a teacher-building factory, but rather the first step in a long, collaborative, and reflective process that influences the professional development of a teacher's career" (page 2).

So the main objective of pre-service teachers training programs is to train competent, professional teachers who effectively contribute to student learning (Tardif, 2001).

What Is Meant By Reflective Practice?

Dewey (1933) identified reflection as a way of thinking. According to him, reflection come for experienced situation and begins with experience and stresses on practice, in other words on "learning from doing", starting by detecting the problem, to formulating hypotheses to be tested. So Dewey argued that reflective thinking moved people away from routine thinking/action towards reflective action. Dewey's ideas provided a basis for the concept of 'reflective practice'.

Both the content and the process of reflection have been addressed in the research into the teaching of reflection; the content refers to what teachers reflect upon, and the process shows how teachers reflect (Jay & Johnson, 2002). Many authors have discussed different levels of reflection which generally progress from a preoccupation with the more technical aspects of teaching to a consideration of alternative approaches to the various dilemmas that arise in teaching (Cavanagh & Prescott, 2010 as cited in Coffey 2014; Perrenoud 2012).

The literature includes many models for reflection. Quinn (2000), as cited in Finlay (2008), sees that all models tend to involve three fundamental processes that start with "retrospection" that refers to the thinking back about the situation, then a "self-evaluation" which is a critical analysis and evaluation of the actions and feelings associated with the experience, and finally a "reorientation" by using the results of self-evaluation to influence future approaches to similar situations or experiences."

Kolb's (1984) developed the Model of Experiential Learning. It is based directly on Kolb's experiential learning cycle that includes four main components: concrete experience, reflective observation, abstract conceptualisation and active experimentation. Those four components of the cycle can be accessed at any point. The Model suggests that active experimentation leads to a transfer of learning from current cycle to a new cycle. The figure below illustrates Kolb's (1984) Model of Experiential Learning

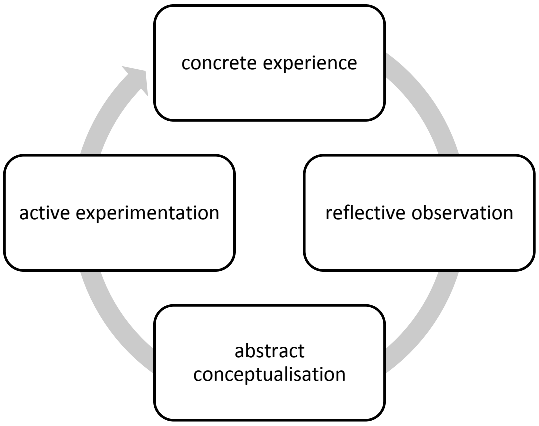

Figure 1: Kolb's (1984) Model of Experiential Learning

Inspired from Kolb's experiential learning cycle, Gibbs (1988) proposed a Reflective Cycle model that highlights the relationship between theory and practice, as they enrich each other in a never-ending circle.

The model invites the individual to think about different aspects of a given situation, to evaluate it, and establish an action plan for dealing with such a situation when it rises again. It helps the practitioner to consider how they think and react within a situation and provides insight into self and practice. Gibbs' cycle has been widely adopted in professional education as a way to facilitate reflection.

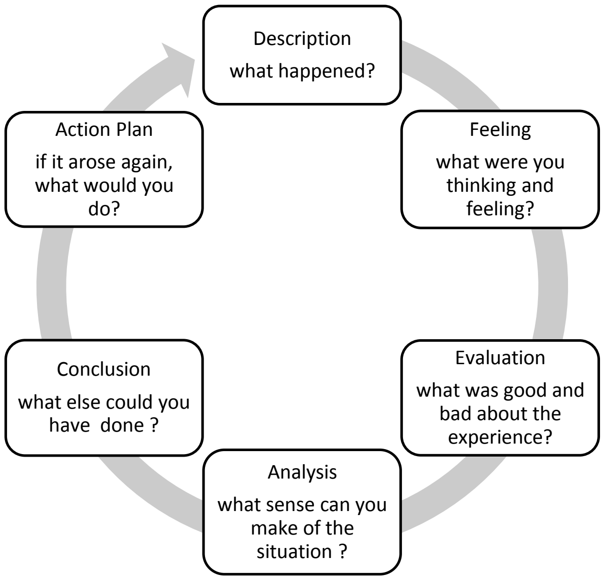

Figure 2: Gibbs (1988) Reflective Cycle model

Schon's (1983; 1987) believed that it is important to develop the reflective practice skills that allow to revise, modify and refine individual's expertise. Consequently , the author proposed reflection-on-action which refer to the reflection after doing the action so, in the educational context, the teacher reflects in hindsight about the lesson, student engagements, and other components of the practice, and reflection-in-action which occurs during the doing, so the teacher reflects during the teaching of the lesson.

In the educational context, Freese (1999) perceived reflective practice as a process to help teachers modify and improve instructional practices by asking probing questions. Grushka, Hinde-McLeod and Reynolds (2005), adapted Schon's model and identified a third phase of reflection: "reflection for action" where teachers are advised to consider their planning and preparation e.g. resources and how long the lesson will take (technical); how to make the resources relevant to different learning styles (practical); and to question why they are teaching this particular topic (critical).

Rolfe, Freshwater and Jasper (2001) developed also a three level reflective model based upon three simple questions: What? So what? Now what? The first level, the "What?" one, reflection addresses the description of the situation, and the second level, "So what?", consists on the process of learning from the situation by developing the personal theory of understanding. The final level, "Now what" is the reflection level on action, about what can be done for improvement.

Jay and Johnson (2002) developed a typology model that involves three dimensions: descriptive, comparative and critical reflection. In the descriptive dimension, the student teachers describe the matter for reflection, e.g. "What is happening?" In the comparative dimension, they reframe the matter for reflection in the light of alternative views, perspectives and research: "How do other people who are directly or indirectly involved describe and explain what is happening?" "What does research contribute to an understanding of this matter?" "How can I improve what is not working?" Then in the critical dimension a new perspective is established: "What are the implications of the matter when viewed from these alternative perspectives?

It well noticeable the dominance of the three phases level of reflection that has been considered by educators and researchers as multidimensional and complex , where the past, present and the future are all involved in the process of reflective practice (Smith, 2001).

Pre-Service Teaching Course At The Lebanese University, Faculty of Education

At the Lebanese University, Faculty of Education pre-service primary science teachers undergo three year teacher education course, Following LMD program that was implemented in 2009-2010. The program includes formal university studies with practical experiences in schools. İt typically comprises units in curriculum, psychology, pure science, classroom management, evaluation and assessment, teaching methodology, action research as well as classroom practice, with a total of 180 credits. Throughout those years students are encouraged to develop their reflective skills through different means, especially in the teaching methodology and practicum courses through practicing micro and macro teaching, writing reflection papers, portfolios and projects.

The Practicum course represents 11 % (20 credits) of the whole program (180 credits). It includes 4 units disturbed over the second and the third year: School Observation (2 credits), Practicum I (6 credits); Practicum II (6 credits) and Practicum III (6 credits) for Pre-service minor science teachers.

The staff members at the faculty vary between formal and practice courses. For formal theoretical courses, a PhD degree in the field is required for all staff members, whereas for practice courses trainers must hold a master degree in the teaching of the related area and at least five years of experience in the field, in addition to training in professional development.

The literature lacks studies about the implementation of LMD at the faculty, however a single research study was lately conducted by a group of researchers at the faculty lead by Professor Antoine Sayah about the practicum program at the faculty of education in The Lebanese University (Sayah et al, 2015). The study presents an overall assessment of the practicum course and highlight the major problems faced by both trainers and trainees. However, the research does not address the reflective practice in the program.

Problem of the Study

Being science educators at the Lebanese University, Faculty of Education, we have noticed that science pre-service teachers do not perceive the inter-relationship between teaching and the development of reflective skills. They are often worrying about satisfying the requirements of the course rather than for the purpose of deeper analysis and reflection. Reviewing the literature, it is found that reflective practice is developed across all units in the teaching preparation program, however, it can be best detected and implemented in the practical training units, where pre-service trainee teachers are expected to plan, implement and reflect on their practice. So the main question is that “does the training program develop trainees reflective practice skills?”

For that reason, the current study investigates pre-service trainee science teachers’ perceptions of their reflective practice at the end of the practical program that involves four units described above, in addition to an analysis of the training program curriculum. The following research questions are addressed

1) How do the pre-service primary science teachers at the Lebanese University, Faculty of Education perceive their reflective practice?
2) Does the training program at the Lebanese University, Faculty of education, prepare reflective primary science teachers?

METHODS

Both quantitative and qualitative methods are used in the study to answer the research questions. A questionnaire, interview, reflection reports and curriculum analysis were conducted. The protocol of analysis was modelled after Schon’s (1983, 1987) adapted for, in and on conceptual framework which has been widely used in educational studies by researchers, e.g. Fox, Campbell and Hargrove (2011). The framework is presented in table 1.

Table 1: Schon’s (1983, 1987) Adapted For, In and On Conceptual Framework.

Phase	Description
For the action	the planning of the lesson
In the action	during the teaching of the lesson
On the action	after the teaching lesson

Sample

A convenient sample from third year primary science pre-service teachers was selected to participate in the study. The sample included 30 participants. All participants had completed three practical unit and were undergoing the fourth one. In addition a sample of five trainers was interviewed.

Data Collection and Analysis

To answer the first research question about the perception of the pre-service teachers of their professional development, a questionnaire was developed, validated and completed.

To answer the second research question an analysis of the practical units program and written reflections collected from the participants' portfolios, and an interview with the trainers were conducted. Data was collected over a period of 12 weeks.

Curriculum

The curriculum of the practicum course includes, Goals of the training program, general objectives and learning outcomes for each unit. The analysis was conducted to examine if the concept of "reflective practice" was identified in the goals, objectives and learning outcomes. Two criteria were taken into consideration:
- The notion of "reflective practice" is explicitly present in the items of goals, objectives and learning outcomes.
- The notion of "reflective practice" is implicitly present in the items of gaols, objectives and learning outcomes.

Questionnaire:

The questionnaire is designed to include open-ended and Likert-scale response (never, sometimes, and often) response items. It consists of three main sections, respecting Schon's (1983, 1987) in, on and for conceptual framework. The first section addresses the phase of planning the lesson which refers to "reflection for the action", the second section addresses the implementation of the lesson phase that refers to the "reflection in action" and the last section deals with the reflection after the lesson which refers to the "reflection on action" according to the framework.

The first two sections are three Likert-scale items where participants were asked to select one response per item regarding the frequency of engagement in reflection "for" and "in" their practice (Schon, 1983). The third section consists of an-open-ended question that addresses participants' refection "on" their practice.

The first section of the questionnaire asks the participants about their planning and preparation for a teaching session. It includes items about the coherence of their plan, instructional outcomes, resources, knowledge of students and assessment.

The second section asks about the implementation of the teaching lesson in class. It includes four sub-section: 1) introduction; 2) Development; 3) Closure; 4) Ethics and personalities. The sub-sections " introduction", "development" and "closure" include categories of items. Table 2 illustrates the sections, sub-sections and their categories, in addition to the number and examples of items.

The third section of the questionnaire represents an-open ended question that addresses "reflection on action". Participants were required to answer the following question: *"After class, write a reflective analysis on your teaching"*

The participants' answers were coded and analysed according to two main criteria:
1. Regulation , e.g the trainee is able to
- Detect the gaps in their planning and preparation.
- Reorient if necessary the organization of their teaching.
2. Openness to criticism, e.g. the trainee is able to
- Value the feedback from the trainer
- Show positive attitude to criticism from peers and trainers

The computer software computed response frequencies and percentages for each section and sub-sections where available. In the analysis, scores were divided into three percentile sand the desired outcome of the reflective practice was considered as “non- achieved”, “fairly achieved” and “ achieved” according to the following criteria.

- The lowest through the 50 percentile of the score the outcome is considered as “not achieved”
- Between the 50th and the 75th percentile, the outcome is considered as “fairly achieved”
- Above 75 percentile, the outcome is achieved.

Reflection Papers from Trainee Portfolios

To support the data collected from the questionnaire, an analysis of trainee reflection reports from their portfolios was conducted, referring to Schon’s (1983, 1987) in, on and for conceptual framework.

Trainers’ Interview

Five trainers were interviewed about the pre-service trainee reflective practice. The questions of the interview were in line with Schon’s (1983, 1987) in, on and for conceptual framework. Trainers answered in writing.
The following questions were addressed:

1- Reflection for the action:
- Do trainee reflect on their lesson planning before the teaching session? If yes, how?

2- Reflection in the action:
Do trainee
- reflect on their practice during the implementation of the lesson?
- record comments in relation to their practice during the teaching session?
- Adjust the teaching process based on events occurring on spot in class?

3- Reflection on the action
Do trainee
- detect the gaps in their planning when the desired outcomes are not achieved?
- reorient, if necessary, the organization of their teaching, basing on the proceeding one to improve the upcoming ones?
- improve the adopted approach following the trainer feedback?
- show positive attitudes to feedback and criticism from trainer and peers?
- think critically and creatively over, their educational practice?

Table 2: Categories, Numbers and Examples of Items in the First Two sections of the Questionnaire.

Section	Sub-Section	categories/nb of items	Examples of items
Planning Reflection “For the action”		10 items	Outcomes are well defined Prerequisites are well defined Assessment is prepared
Implementation Reflection “In the action”	Introduction	Motivation 3 items	Students interest and motivation are developed
		Teaching strategies 2 items	The objectives of the lessons are explicitly/implicitly set
	Development	Knowledge 2 items	Scientific content is well mastered
		Teaching strategies 6 items	Open and closed questions are addressed
		Organisation 4 items	Time is well managed
		Language 3 items	Appropriate language is used clearly and correctly
		Differentiated learning 3 items	Teaching strategies are adapted according to the level of students
		Assessment 2 items	Oral/written assessment are used to ensure students’ understanding
	Closure	Assessment and evaluation 5 items	Students summarise the concept explained
	Personality and Ethics	8 items	Appropriate physical appearance Students are respected

RESULTS AND FINDINGS

Curriculum

It was found that all the objectives, generals and specifics ones, lack the notion of "reflective practice". However, the reflective practice was implicitly included in the curriculum, presented by nuances that may lead to the concept of reflective practice.

Goals

The curriculum includes 7 goals for the practical program. Only three out of seven present key words related to "reflective practice". Table 3 presents curriculum goal items with the key words related to "reflective practice".

Table 3: Curriculum Goal Items Presenting Key Words Related to "Reflective Practice".

Goal	Keyword
apply the acquired knowledge and professional skills in the teaching process"	*professional skills*
organize the activities that enhance the daily life learning	*the daily life learning*
practice self-development to improve the professional performance	*self-development; professional performance*

Observation Unit

The syllabus of the observation unit includes three objectives and three learning outcomes. Only one objective out of three leads implicitly to reflective practice.
The course aims to "an accurate observation and critical sense".
Similarly to the learning outcomes, only one contributes implicitly to reflective practice
The trainee should be able to analyze the general framework of the teaching process

Practicum I Unit

The syllabus of the practicum I unit includes five objectives and four learning outcomes. None of them is related to reflective practice.

Practicum II & III

Practicum II and III have the same syllabus, as practicum II is addressed to major science pre-service trainees and practicum III to minor science pre-service trainees. The syllabus includes three objectives and five learning outcomes. Only one objective out of three leads implicitly to reflective practice.
*The course aims to "*Develop the practice to meet the requirement of the profession"
Similarly to the learning outcomes, only one contributes implicitly to reflective practice
"The trainee should be able to invest the assessment to improve their performance"

Pre-Service Teachers' Perception about Their Reflective Practice in the Training Program

According to the data analysis, 80% of the participants have achieved the outcome of the first phase "for the action", while the rest 20% have fair achievement. Table 4 shows the distribution of frequencies and percentages of participants' perceptions of their reflective practice during the "for the action" phase.

Table 4: Distribution of Frequencies and Percentages of Pre-Service Trainee Science Teachers' Perceptions of Their Reflective Practice During the "For the Action" Phase.

Reflective practice outcome		Frequencies	Percentage %
Not achieved			0
Fairly Achieved		6	20
Achieved		24	80
	Total	30	100

Regarding the second phase of the reflective practice "in the action", 83.3% of the participants achieved the outcomes, while 6.7% achieved fairly and 10% didn't achieved them. Table 5 shows the distribution of frequencies and percentages of the participants' perceptions of their reflective practice during the "in the action" phase.

Table 5: Distribution of Frequencies and Percentages of Pre-Service Trainee Science Teachers' Perceptions of Their Reflective Practice During the "In the Action" Phase.

Reflective practice outcome		Frequencies	Percentage %
Not achieved		3	10
Fairly Achieved		2	6.7
Achieved		25	83.3
	Total	30	100

As mentioned in the methodology, the "in the action" phase represents the implementation of the lesson in class, and includes four sub-section.

It was found that the outcomes of the reflective practice during the introduction were achieved by 73.3% of the participants, where as 26.3 % did not achieve them.Table 6 shows the distribution of frequencies and percentage of the participants' perceptions of their reflective practice during the introduction in the "in the action" phase.

Table 6: Distribution of Frequencies and Percentages of Pre-Service Trainee Science Teachers' Perceptions of Their Rreflective Practice During the Introduction in the "In the Action" Phase.

Reflective practice outcome		Frequencies	Percentage %
Not achieved		0	0
Fairly Achieved		8	26.7
Achieved		22	73.3
	Total	30	100

During the development of the lesson, it was found that 66.7% of the participants achieved the outcomes of the reflective practice, 30 % achieved fairly and 3.3 % did not achieve. Table 7 shows the distribution of frequencies and percentages of participants' perceptions of their reflective practice during the development of the lesson in the "in the action" phase.

Table 7: Distribution of Frequencies and Percentages of Pre-Service Trainee Science Teachers' Perceptions of Their Reflective Practice During the Development in the "In the Action" Phase.

Reflective practice outcome		Frequencies	Percentage %
Not achieved		1	3.3
Fairly Achieved		9	30
Achieved		20	66.7
	Total	30	100

During the closure of the lesson, it was found that 63.3% of the participants achieved the outcomes of the reflective practice, 30 % achieved fairly and 6.7 % did not achieve. Table 8 shows the distribution of frequencies and percentages of participants' perceptions of their reflective practice during the closure of the lesson, during the "in the action" phase.

Table 8: Distribution of Frequencies and Percentages of Pre-Service Trainee Science Teachers' Perceptions of Their Reflective Practice During the Closure in the "In the Action" Phase.

Reflective practice outcome		Frequencies	Percentage %
Not achieved		2	6.7
Fairly Achieved		9	30
Achieved		19	63.3
	Total	30	100

"Personality and ethics" represent a component of the teaching process. It was found that 83.3% of the participants achieved the outcomes of the reflective practice regarding this component, 6.7 % achieved fairly and 10 % did not achieve. Table 9 shows the distribution of frequencies and percentages of participants' perceptions of their reflective practice in relation to their personality and ethics during the "in the action" phase.

Table 9: Distribution of Frequencies and Percentages of Pre-Service Trainee Science Teachers' Perceptions of Their Reflective Practice in Relation to Personality and Ethics in the "In the Action" Phase.

Reflective practice outcome		Frequencies	Percentage %
Not achieved		3	10
Fairly Achieved		2	6.7
Achieved		25	83.3
	Total	30	100

Regarding the reflective practice in the last phase, the "on the action", which occurs after the implementation of the lesson, it was found that all participants did not achieved the desired outcomes. Table 10 shows the distribution of frequencies and percentages of the participants' perceptions of their reflective practice during the "on the action" phase.

Table 10: Distribution of Frequencies and Percentages of Pre-Service Trainee Science Teachers' Perceptions of Their Reflective Practice During the "On the Action" Phase.

Reflective practice outcome		Frequencies	Percentage %
Not achieved		30	100
Fairly Achieved		0	0
Achieved		0	0
	Total	30	100

Refection Reports

The result of analysis of the refection reports collected from trainee portfolios supports to some extent the findings from the questionnaires.

The analysis of the report indicates that trainees focus on their emotional responses to the teaching experience with few attempts to examine teaching styles and techniques. It is well noticeable that all reports are very brief where trainees narrate about their experience in class, some present self-assessment and only two of them present suggestions for improvement.

Most of the reports, twenty reports out of thirty represent brief descriptions that highlight basically some aspects of their planning and teaching process.

> Reflection
>
> The time was enough to give my students time to think and answer and conclude the concepts, also there was no time for the group work that benefit the students to work in more enjoyable and interesting way because they share the ideas and learn from each other, thus I did not do the assessment that I wrote in my lesson plan, the materials also were not enough, but if I want to speak about the environment, it was good my students were calm and there was interaction between us and they were active.

Eight reports include a brief reflection, identifying the problem during the teaching session and suggesting an action for possible remediation. However, the reflection was limited to the "In action" phase.

> Reflection paper
>
> - The time was not accurate because I thought they are in grade one they will take long time to get the idea.
> - When the group work started the students were confused of what they should do, then I was supposed to give the students the instructions at the beginning of the activity (before giving them the masks)
> - The students didn't know how to act like the animal they got, and they didn't understand the information that I gave it to them so I had to pass to each group to explain it.

Within this category, some trainees identified the problem, however they go to blame students for rather than trying to suggest remediation. For the example listed below, the trainee stated that three out of six groups (the half) faced difficulties in completing the task thought she defended her choice for the activity and blamed students.

> Reflection
>
> The teaching session was good for me. I was comfortable with the class, the students interacted with me in the three different parts of my explanation. I should have made sure of the outer sources, I planned o explain in the lab but the teacher that has the keys was absent, and the computer lab was not that good to use, but I had no other choice otherwise I would have had explained in the classroom and not all students were able to watch clearly the video. My preparation was very clear and easy for all students to understand (I had to talk in Arabic most of the time), the video was a bit fast for them (the English) but it was very clear. I made a good point by stopping the video and explaining each part to them in order to make sure that they are getting the ideas smoothly. I thought the video based activity is easy for them but I think I should have made it easier (there were 7 students that weren't able to answer half of the sheet). The group work needed more time, I should have also left the first activity with them until they finish the group work because three out of six groups had troubles solving the questions (they didn't have enough time to memorize well everything). The problem is in the students not in my activity.

Only two reports show a sound reflection that includes regulation and criticism. In the example below, the trainee approach different aspects of the teaching process: planning; classroom management; motivation and teaching strategies. She listed her strong points and approached the weak one.

> Refection
>
> I was explain chapter 5: Sound and musical instruments for elementary grade 4. I have already explained for this class before, so I felt no stranger. That's make me and the students feel comfortable.
>
> I was fascinated by the interaction between us; it's a positive term of successful management. They discover the idea due to my activities. This is my goal to encourage self-learning in addition to learning by doing. They were active and feel the soul of competition due to the gift I promised to give. I may use my way in my future explanations, it's a good strategy to students for understanding quickly without forgetting the concept.
>
> However, I was frustrated since the school suffers from the loss of technology including LCD and electricity. That obliged me to play the video on the lab top screen and grouped the students around the laptop which makes a bit of mess, but it is normally since they are children and in need for playing and having fun while studying. In addition, to the next time I should give all students a small simple gift as a positive reinforcement, since there was a girl that felt lazy and started to cry. I can't encourage one and forget the others. This is a good point.
>
> I was happy during the lesson. I will take into consideration all my faults for the next time to be more skillfully in teaching.

Interview

The interview consisted of three main parts. As for the first part, regarding the reflection for action, all the trainers agree that trainee pre-service teachers practice reflection on their planning informally in class by participating in classroom discussion about their lesson planning.

"Normally, every session one of the trainee presents their planning in class, discuss it with their peers and with me, defend their plans by talking about its strong and weak points."

"The trainees don't write a formal reflection about their lesson planning, but we do group discussion for lesson planning that help them regulate their plans."
"During classroom discussion, the trainees practice self-assessment by asking: is the plan well prepared? Is it coherent? Did I use the right resources? Is the equipment chosen available in school? Etc…"

Regarding the second part of the reflection that occurs during the implementation of the lesson in class trainers agree that their trainees apply very limited modifications in class, and they don't record comments in relation to their practice during the teaching session.

"During the class session, most of the trainees adjust their language, as students may not understand English, they explain in Arabic…however, they don't put effort to find other strategies for language problem. Trainees rarely record any comments during their teaching, they rely on the trainer's feedback."

"Our trainees are still facing problems in reacting according to the situation in class, so they stick to their plans and avoid changing their actions… they only write notes during the session when the trainer asks them to do it".
"The most kind of modification they can do in class, is to switch to blackboard teaching when the school lacks resources e.g. computers…however that kind of modification makes them very passive and confused… it is not meant to improve their teaching rather than to deal with the situation in a negative way". "our trainees find difficulties in adjusting their prepared plans"

Regarding the third part of the interview that addresses reflection on their teaching process, trainers agree that trainees detect the gaps in their planning with the help of the trainer, they can't figure out the problem by themselves, therefore they can't reorient and adjust their approach without the intervention of the trainers. However, they all considered that trainees show positive attitudes towards feedback from their trainers, but not always from their peers.

"Trainee face difficulties in picking up the problem in their planning…only few of them may reorient their practice without my help…."
"they (trainees) take into consideration my feedback, share it with their peers but they are not open to peers feedback, as they may consider it as negative criticism."

As for creativity and critical thinking, all trainers considered that the trainee are passive in their thinking. They lack creativity and critical thinking skills strategies for self-improvement.
"they don't show any initiative in their work… they are followers, they only modify their action according to feedback… they lack critical thinking and creativity in their work"
"critical thinking and creativity skills are not well developed…they don't have strategies for self-improvement".
"when reading other work, they try to adopt it without taking into consideration the different context…they lack flexibility and critical thinking skills in this area"

CONCLUSION

Data collected from the questionnaire about pre-service trainee science teachers' perceptions of their reflective practice show that they reflect on the "for the action" and "in the action' phase, with a total failure of the "on the action' phase.

However, the analysis of portfolios reflection paper show that trainees reflect partially only on the 'in the action" phase, with the absence of the two other phases; two third of their reports do not represent reflection, and the reflection in the rest is very limited.

This difference in the findings between the participants' perceptions of their reflective practice and their written reports was well clarified by the trainers' interview when they pointed that trainees reflect in an informal way, mainly by oral class discussion, about the "for the action" phase, which is the planning of the lesson phase before its implementation

In addition, trainers consider that the reflection during the teaching session is very limited. This finding may be explained that the reflection is taken place after the teaching session and is reduced to self-assessment rather than real reflection that requires changes of plans when needed during the implementation of the lesson. A similar finding was reported by Fox, Campbell and Hargrove (2011), where few pre-service teachers practice "in

action" reflections. The authors considered that this might be due to the lack of "control in making pedagogical decisions…they may not have a repertoire of strategies and tools to change course in practice" (page 45).
Those findings may also be justified by the result of the curriculum analysis, that show an almost denial of the reflective practice in its goals and objectives. In fact, there is no clearly articulated definition and rationale for reflective practice in the program, and all the related learning outcomes, activities and assignment including the reflection papers written in the portfolios are vague and non-structured.

Consequently, referring to the definitions of reflective practice proposed by Freese's (1999) and smith (2001) which it as a multidimensional and complex process that aims to help teachers modify and improve instructional practices by asking probing questions , we may conclude that the participants in this study practice to some extent reflection before teaching the lesson and during the teaching session, with merely a total denial of the third phase of the reflective practice which is "on the action", that requires self-assessment and regulation for improvement.

In addition, we may conclude that the pre-service trainee science teachers are just practicing a reflective thinking in retrospect about their teaching session, rather than a well-defined reflective practice leading to the desired outcomes.

Moreover, the findings imply that pre-service science teachers don't know what is meant by "reflection" and "reflective practice", and the trainers are not showing explicitly a reflective practice in their work with their trainees. Finally, the results reveal that the pre-service science teacher training program at the Lebanese university partially prepares reflective practitioner teachers.

RECOMMENDATIONS

The results shed the light on the need to include explicitly reflective practice skills in the goals, objectives and learning outcomes of the pre-service science training curriculum. In addition, trainers are required to implement explicitly the skills of reflective practices with trainees, by referring to a well-defined framework using the three phases of reflection: for, in and on practice. For that purpose, it is recommended that all trainers would undergo specialized workshops for modelling reflective practice and trainees must be provided with rubrics that include the three phases of reflective practice for the assessment of their reflection reports in portfolios.

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ENVIRONMENTAL EDUCATION THROUGH ORNITHOLOGY LIKE OPTIONAL CLASSES

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ABSTRACT: Students from the primary and secondary schools manifest a huge curiosity for nature and special high interest for the animals' life and behaviours. Unfortunately, the ordinary curriculum in *Biology* classes provides just summary information about animals' ecology, while data on their behaviour and complex interspecific relations established inside the ecosystems are completely missing.

The *Ornithology* classes can be included in the students' curriculum through the *curriculum in schools' decision*. The birds are very attractive through their plumage and songs, presenting a complex and very interesting breeding behaviour, but also a spectacular migration phenomenon. The birds are present near everywhere around us, populating a wide range of habitats, including the anthropogenic ones, which facilitate their study and observation. More than this, the birds are present any time during the seasons, even if their diversity is changing from one season to other. This allow us to identify the complexity of relations established between birds and their environmental, to understand the important position of birds in the trophic pyramids, to use these vertebrates like bio-indicators to assess the environmental quality and the trends in the ecosystems' dynamic.

Keywords: ornithology, environmental education, birds, fieldwork.

INTRODUCTION

As we see during our classes, but also during our meetings in extracurricular activities, the students from the primary and secondary schools manifest a huge curiosity for nature and special high interest for the animals' life and behaviours. Unfortunately, in our country, the present ordinary curriculum in *Biology* classes provides just summary information about animals' ecology, while the data on their behaviour and complex interspecific relations established inside the ecosystems are completely missing. More than that, the number of *Biology* classes presents a negative trend in the whole curriculum starting from one or two hours per week during the primary and secondary school level till one or none per week in the high school level, especially in the last two years (thirteen years in this moment, from the primary school to ending of high school level). For this reason, our students have less and less knowledge in the environmental sciences and this situation becomes completely incomprehensible if we look to the profound and huge environmental crisis that takes its toll on our daily life.

In Romania, the *Ornithology* class can be included in the students' curriculum through the *curriculum in schools' decision* for the all pre-university education levels. One class of ornithology can sensitise the young students waking their desire to learn more about the birds, to discover their ecological necessities and the complexity of their behaviours, to understand the importance of birds inside the ecosystems, but also to learn how the people can help to improve the quality of birds' life and, finally, of their environment, too. Through the fieldwork activities, the students can learn also about the eco-tourism, traditional economic activities, including fisheries like friendly forms of local sustainable development in harmony with the biodiversity of one region.

The birds are very attractive animals through their plumage and songs, presenting a complex and very interesting breeding behaviour, but also a spectacular migration phenomenon. The birds are present near everywhere around us, populating a wide range of habitats, including the anthropogenic ones, which facilitate their study and observation. More than this, the birds are present any time during the seasons, even if their diversity and effectives are changing from one season to other. This may allow our students to identify the complexity of relations established between birds and their suitable environment, but also to understand the important position of birds in the trophic pyramids and ecosystems like whole. Our students can learn to use these vertebrates like bio-indicators to assess the environmental quality and the trends in the ecosystems' dynamic starting from the monitoring of birds' populations present in different types of habitats and their trends, by one side, respectively, the prompt response of the birds to the changes in their living conditions and the environmental degradation, too.

Step by step, following the discovery of bird life and the surrounding world, the desire for knowledge of our students can turn into a passion for the study and protection of nature, contributing to the formation of a responsible attitude towards the problems of the contemporary world.

METHODS AND EDUCATIONAL STRATEGIES

We assumed that after completing the optional *Ornithology* class, our students will gain complex theoretical knowledge about birds and the ecosystems where these animals live and will develop their practical skills to explore the world around us. At the same time, the students will improve their communication abilities, solving skills to confront new situations and will develop the desire for an active involvement in the community life generally and in the projects regarding the nature's conservation in order to improve the environmental quality, especially.

Following to propose one optional class in the curriculum, first of all, the professor must establish the principal setting goals and some reference targets. The first ones are:

- ✓ development of interest for knowledge and discovery of the living world;
- ✓ correlating of the specific ornithology knowledge with other sciences (physics, chemistry, geography, mathematics etc.);
- ✓ development of creativity and skills to analyse, scientific interpret and process the observations on the surrounding environment;
- ✓ training and development skills of involvement and practice action to protect the environment's quality;
- ✓ training and development of eco-civic attitudes and behaviour.

In order to achieve these goals, the contents of the optional *Ornithology* class follow like reference targets for our students: to learn and understand the knowledge, concepts and methods specific to ornithology; to develop the skills and abilities to explore the nature around us; to develop their abilities of communication and one eco-civic behaviour.

The syllabus of the optional *Ornithology* class is structured in order to provide the covering of three stages: initiating, development and deepening of knowledge and practical skills. The learning activities performed with the students are specific for each topic and stage of learning process, combining classical and modern strategies of teaching and learning (lectures and discussions, direct and indirect observation, field trip and bird-watching activity, experiment and modelling, learning through discovery, solving-problem, simulation, learning through play, game-contests etc. – Costica. 2008), following an active involvement of students, but also the involvement of their parents in the development of educative process. For the end of each section of the optional *Ornithology* class, we planned a summary activity that allows the evaluation of acquired knowledge and the progress to the next section.

We designed also some activities with contest character providing different motivations and stimulations for our students, including the participation in some regional summer ornithological camps organised with the logistic support of the Branch Iasi of the Romanian Ornithological Society/SOR Birdlife Romania, while the most active students will be awarded with a participation in the ornithological national summer expedition organised by SOR/Birdlife Romania inside the perimeter of the Biosphere Reserve Danube Delta, during the summer holiday, in August.

The assessment of knowledge was provided for each level of learning, using the principles of formative and summative assessment.

RESULTS AND DISCUSSIONS

We present our experience in teaching an optional *Ornithology* class for the secondary and high school levels, but also for the biologist students in the third year of university education level. We had no direct experience in teaching optional *Ornithology* class for the primary school level, but we worked with children under ten years old during our practical activities in field scientific trips or ornithological summer camps. The structure of contents is similar, but the difficult level of knowledge is different from one age to other, considering the common level of previous accumulated knowledge and the existing ordinary practice skills. If for the theoretical knowledge we noticed a slight increase in the capacity of assimilation and understanding reported to the age of our students, for the practice skills and abilities in ornithology field we can mention the strong influence of long-time practice. Nor once we met students from secondary schools level that proved bigger abilities in birds' observation or identification than our university students if the first ones were involved in summer ornithological camps starting from early ages. More than this, the interest towards the birds and nature is not decreasing if the children start this kind of activities at 8 – 10 years old and don't give up it during the secondary and high school level of education, despite an eventually diminution of intensity in their direct participation during the puberty period. Perhaps, it worth emphasis the fact that the most qualified students selected like phD students in the doctoral school from our university during the last five years are coming from the children involved in ornithological activities starting from their ten – twelve years old through the optional *Ornithology* class or in the events and ornithological camps organised by the Romanian Ornithological Society/SOR Birdlife Romania.

The first part of our proposal optional *Ornithology* class in the stage of initiating is related to the achievement of the reference target regarding the learning and understanding the knowledge, concepts and methods specific to ornithology field using the Romanian or foreigner references (Ciochia. 2007, Ion & Stanescu. 1992, Brooke & Birkhead. 1991). First of all, we teach element of birds' morphology, anatomy and physiology. Our students learning to correlate these structural and physiological elements to the lifestyle and ecological niches occupied by the birds inside the ecosystems – for example, the flight features in birds and other living organisms (insects and bats, for example), terrestrial or aquatic locomotion of birds, high metabolism rate and special features of respiratory apparatus and it physiology, food resources and how the birds acquire their food, the nests, refuge and wintering necessities. The teaching means and materials consist in living or naturalised birds, atlases, birds' field guides and charts, slides and short documentaries movies.

We teach this theoretical part in the same time with some practical activities related to the activity of birds' feeding and birds' observation. For this, the students learn to build and manage one artificial feeding place for birds organised in the green areas around or from the immediately vicinity of school (Munteanu & co. 2000). They learn about the variety of food eaten by the birds, to use the binocular, telescope and a field guide in order to identify and recognize the birds (Bruun & co. 1999), but also how we can observe the birds without disturbing them and to complete a field observation sheet. We use to organize our students in small teams with different responsibilities in the practical area of our optional class and to achieve a periodical rotation of the teams in order to involve each student in the all practical activities. As we recorded during the years, these activities permit developing of individual work skills and of the teamwork abilities, too.

The second part of this segment of Ornithology class represents an introduction in the ecology (Ion & Stanescu. 1992, Parvu. 2001, Bennett & Owens. 2002) and ethology of birds, too (Ion & Stanescu. 1992, Cociu. 1990, Krebs & Davies. 1991). The students start by learning generalities about ecosystems and it components – the biotope and the biocenosis. Starting from the achieved knowledge about the food regime of birds, the students understand the mechanisms and complexity of the trophic relations existent in every ecosystem, discovering the manner of how each living organism represents a link of the food chains, producing and consuming organic substances. In this way, the students can understand the position and the importance of birds inside the biocenosis, the strong inter-relationships between very different living organisms, too. By continuing the practical activity of monitoring at the artificial birds' feeders, the students can discover the seasonal presence of the birds in our country and the existence of one seasonal dynamic in the qualitative composition of bird fauna's in one territory, the birds belonging to different phenological categories. From this point, we can teach about the birds' migration phenomenon (causes, preparations and development of migration, navigation). In the same time, we can pass to the introduction in the study of birds' ethology, starting with the territoriality and mating display, going to the breeding season (nests, incubation, hatching and parental care). In this section, like new practical activity, during the winter time, the students learn about the artificial nests for birds (Munteanu & co. 2000); in the late February - early March, they build and install artificial nests in the green spaces surrounding the school's area and in some large parks or gardens from the city (for example, in the Botanical Garden). Starting from the middle March, we organise the students in working-teams that survey the occupation of artificial nests by different bird species.

The contents and practical activities for the development level of the optional *Ornithology* class can be described like a transition to the applied ornithology. Our students begin to discover the differences between the bird fauna in different ecosystems and habitats from their area and our country, but also to identify the main ecological categories of birds starting from their preferences for food and habitats. In the second part of this level course, the teaching and learning activities follow the diversity of birds on the Earth, connecting the birds' presence with the main biomes and ecosystems from the rain-forests to the polar areas. In this section, the students learn theoretical aspects of the birds' conflicts and manner to solve its, territories, mating systems and incubation strategies, social behaviour and systems of communication using visual signals and sounds in the birds' world.

For the practical part of this section, we continue the previous monitoring activity – we stop to assure food supplying in the artificial feeders, but the students focus their attention on the artificial nests collecting information about the bird species that occupies the nests, the birds' activity and behaviour. They complete special observation sheets. In the same time, we teach about the methods for birds' study and monitoring (Munteanu. 2000). After this, we organise one-day field trips to observe, identify and recognise birds in the Botanical Garden from the city and in one wetland from vicinity. The students are organised in working-teams with different responsibilities, each of it doing a specific part of the practical survey – for example, during our field trips, we used to pay our attention for the physic and chemical parameters of biotope, vegetation and habitats, insects, amphibians and reptiles, respectively, birds. We elaborated or adapted some field observation sheets that each team must complete with the collected information during the trip. After the trip, the students learn to organise and analyse the collected information in order to assess different aspects of birds' presence and dynamic, but also their relationships with the other components of biocenosis in the investigated sites. Finally, they learn to write and present an ornithological report. All these activities assure to our students the development of abilities to organise one correct scientific investigation project, an obviously increase of their capacity and skills to focus their attention on the main aspects in one field research approach, to assume specific responsibilities inside one working-team and to establish correct connections between the observed facts, analysing the biological aspects of biocenosis' components and their inter-relationships, writing a first scientific report.

The third level follows the deepening of knowledge in ornithology field. For this reason, we designed the contents and practical activities through one multidisciplinary approach, taking account both by the ornithology knowledge and human ecology domain, too. By one side, our students can learn about birds as very sensitive and valuable bio-indicators, giving us information - through their diversity, effectives and trends - about the habitats and ecosystems' alteration, sometimes for apparently invisible or unknown causes. By other side, they identify the anthropogenic activities with low to very strong impact on the birds and biodiversity, understanding the mechanisms of this impact. Looking for the other countries experience and cultural approach, the teaching and learning process confront our students with different manners of environmental issues' management and with the real possibility of human communities' development in harmony with the surrounding environment by encouraging the traditional agricultural, fisheries and animals' husbandry, eco-tourism and rational long-term exploitation of the natural resources. We present also the ecological restoration like a very new approach for the rehabilitation of the profound damaged ecosystems that exist in our country, sometimes in the immediately proximity of the school. In the section dedicated to the birds' protection, we teach about international and national environmental legislation, presenting some action plans elaborated and implemented with the goal of saving from extinction or to improve the present situation of threatened bird species present in the Romania's bird fauna, too. Finally, we teach our students to read the mythology, legends, ethos creations and other traditional practices through one ornithological lecture, identifying the elements that generated ancient and present beliefs regarding some bird species.

For the practical part of this level class, we proposed to our students projects on two different topics: using birds as bio-indicators in order to assess the environmental quality in one territory, respectively, using birds as bio-indicators in order to assess the success of one ecological restoration programme. The first topic was applied with students from secondary and high-schools, organising the birds' monitoring in some green areas inside the city or in the surrounding cultivated lands in the rural areas. The second topic was designed for the students from specialisation biology-chemistry in high-schools and with university students in their third bachelor year or in the master degree level (the last one, like practical activity for the discipline *Ecological Restoration* in the curriculum of two specialisations – Biodiversity Conservation, respectively, Environmental Consultancy). The students form teams with different tasks, working from the documentary step, through the project elaboration and development, to the writing and public presentation of one final report. The teacher is the coordinator and supervisor for the all teams not only for the field and office working for analysing, processing and interpretation of collected information in order to finalise the scientific report, but also is the manager and moderator that encourage the communication and exchanging experience between the members of each team, respectively, between the all teams.

For the all three teaching and learning levels designed for the optional *Ornithology* class we established criteria and periods for the formative and summative assessment of the accumulated knowledge, but also different manners of motivation and stimulation the students' active participation in the segments of theoretic and practical activities in this class. For example, we organised informative panels inside the classrooms with periodically updating, related to the events from the ecological calendar. Using the field observation activities around the artificial feeders and nest boxes, respectively, the information collected during the one-day field trips, the students learn to compile and write scientific reports that they can present in different scientific meetings and symposiums organised at regional or national level, sometimes with contest character. We organised also contest-exhibitions related to different events, our students presenting original drawings or photos inspired by birds' life or behaviour and the habitats where the birds are living. The students that achieved the best results were awarded with a free participation in summer ornithological camps organised with the logistic support of the Romanian Ornithological Society/SOR Birdlife Romania.

Our students appreciated positive the possibility of learning out-side of classroom and regarded like very important the possibility of working inside one team for one project, but also the meetings with invited ornithologists from which they could discover one interesting and yet unusual job in Romania. The participation in the summer ornithological camps and in the ornithological national summer expedition organised by the Romanian Ornithological Society/SOR Birdlife Romania every year during the summer holiday, in August, inside the perimeter of the Biosphere Reserve Danube Delta, was regarded like a big challenge and opportunity by all the participants.

Finally, we can notice also the interest and active support that we received from our students' families that found the optional *Ornithology* class like an useful and very attractive manner to take away their children from one sedentary lifestyle that becomes a dangerous habit in the present very high-tech society.

CONCLUSIONS

In Romania, the *Ornithology* class can be included in the students' curriculum through the *curriculum in schools' decision* for the all pre-university education levels, meeting the curiosity related to the nature of students.
The syllabus of the optional *Ornithology* class is structured in order to provide the covering of three stages: initiating, development and deepening of knowledge and practical skills.
The scientific contents are correlated with the previous level of knowledge and experience of the students.
We designed specific practical activities for each level of teaching and learning process, increasing the complexity of practical component step by step.
For the theoretical knowledge, we noticed a slight increase in the capacity of assimilation and understanding reported to the age of our students, while for the practice skills and abilities in ornithology field, we can mention the strong influence of long-time practice.

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ENVIRONMENTAL SCIENCES IN THE CURRICULUM FOR LOCAL COMMUNITY DEVELOPMENT

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ABSTRACT: In Romania, in the rural areas, the curriculum of high school level can be related to the local community’s necessities and interests, but also to the local resources through the segment of the *curriculum for local community development*. We present our school experiences in this field, using like case study the educational module of *Pollution and environmental protection in the rural area*. This course is designate for the students from classes of technology high schools. The scientific component of the education through this course follows to assess the quality of air, soil and waters in our villages, learning about pollution’s impact on organisms’ health and ecosystems’ functions, to identify and elaborate a monitoring scheme for the local pollution sources, but also to develop a control system of environmental qualities, to implement mechanism to reduce the pollution impact and to improve the quality of environmental parameters in our villages.

About 50% of classes are rolled outside of classroom, like fieldwork activity in the school’s vicinity but also in different points inside the villages and in its vicinity. The evaluation process using individual working sheets, but also team working projects on topics related to pollution problems in our villages’ area.

Keywords: environmental sciences, curriculum, local community, school.

INTRODUCTION

The national curriculum in the Romanian pre-university public education system comprises one *curriculum nucleus* representing 70% from the national curriculum and a *curriculum on the school’s decision* that represent the rest of 30%. The first one represents the base for different evaluation types, including the national exams, but also for the elaboration of curricular standards of performance, existing one official methodology guide for each obligatory curricular area, including for *Mathematics & Natural Sciences*. The second one gives opportunities for one more particular and personalized educational offer in schools.

In Romania, in the rural areas, the curriculum of high school level can be related to the local community’s necessities and interests, but also to the local resources through neither the segment of the *curriculum for local community development* in order increase nor only the level of education, but also the general level of welfare for the whole community.

In the general context of environmental crisis problem, the common level of knowledge in ecology, pollution, natural resources’ exploitation and biodiversity management is still one low, especially in the rural areas. This was one reason for our school to create a new education specialisation – *technician in ecology and environmental quality assessment*. The curriculum for this specialisation comprises seven educational modules and provides scientific training and support, so, our graduates will hold an overview on the complexity of environmental issues and interest of economic development, will be able to understand and analyse different environmental problems, acquiring the methodology of solving these problems and to develop strategies for intervention and manage its. This curriculum permits, also, the development of skills in communication, practical abilities in the assessment and management of different environmental issues that can appear in the daily life of local community.

Using the *curriculum for local community development*, we proposed one educational module on the topic *Pollution and environmental protection in the rural area* for the students from the tenth class in high-school level. This module is designate for the students from classes of technology education high schools and its principal aims are related to two domains of competences: identification and monitoring of environmental quality in the rural areas, respectively, management of interpersonal relationships. The curriculum is developed in a framework of partnership between our school and the local community, using the resources of local training (material basis of our high-school, teachers, collaborating with economic operators from the area), but also taking into account the local requirements for training in various skills in order to serve the existing or potential economic activities in the area.

METHODS AND EDUCATIONAL STRATEGIES

We designed the teaching project for the educational module *Pollution and environmental protection in the rural area* keeping in our minds the content of learning units and the principal aim to develop specific competences and skills, cut-off the theoretical learning with practical activities. The designing of teaching units and the learning evaluation aims were drawn up in pursuit of established goals, assessment suitability of interactive activities and adaptation to the specific elements of geography, demography and ethnicity, economy social and cultural needs of the local community.

In order to develop the expected skills and abilities of our students, we used interactive methods of teaching and learning correlated to the proposed competences – learning through discovery, solving problems, playing roles, case study and small projects of environmental quality's evaluation, creation of portfolios etc. (Costica. 2008). Professor adapts the scientific language to the previous knowledge of the students, the information being selected on criteria of essentiality by correlating the scientific contents and details to the specific abilities, interest level and learning training of our students. In the same time, the professor must choice the best teaching training methods by individualizing and adapting to the learning peculiarities and abilities of students.

The number of course hours is different from one topic to other and about middle part of activities are practical hours, mostly outside of school in the field, the students working individual or in teams about 5 – 8 students, using specific working sheets or/and standard field observation sheets. The role of professor is not only to transmit information but to supervise the students' activity, directing and correcting them through encouraging their interactive dialogues and participation in the experimental observation of environmental particularities around their daily space.

The on-going and final evaluations regard only the specific competences achieved during this educational module. The main method of assessing the specific skills and abilities developed through this module is the practical test. The evaluation and self-assessment test are designed like individual working or observation sheets, scorecards and self-assessment tests. We used also the evaluation through systematic observation, development of one environmental project on topics related to pollution problems in our villages' area, theme classroom, creation and presentation of portfolios.

RESULTS AND DISCUSSIONS

The natural ecosystems and the environment like whole represent dynamic systems that are very sensitive to every change due the strong and complex interactions established between the components, leading to partial or overall change of the whole system. Sometimes, the factors that have an influence with latent character on the components of environment, so not obviously or permanent visibility, are more dangerous; often, their identification is too late to permit the remediation of produced damages. More than this, during the last decades, the humanity understood that the natural resources become scarcely and their amount is lower every day, so we must change our traditional approach to the exploitation of natural resources in order to achieve our development and welfare like community.

Environmental factors like air, water and soil have suffered important qualitative and quantitative changes during the recent decades in our region, like everywhere in the world. The adoption and implementation of measures for the environmental protection were neglected for many years due the economic pressures and interests. In addition, we must mention the lack of concern for the environmental education or of the training for ecological skills and behaviour among the rural communities.

Starting from this situation and using the possibility given through the *curriculum for local community development*, our school decided to include one educational module on the topic *Pollution and environmental protection in the rural area* in the educational offer for the specialisation *technician in ecology and environmental quality assessment*. We followed to cover two domains of competences: identification and monitoring of environmental quality in the rural areas, respectively, management of interpersonal relationships.

The active participation of our students in the teaching and learning activities of this educational module will permit them to develop the scientific research spirit and abilities, but also their creative skills, to acquire supplementary competences required by the local labour market and, finally, to create new job opportunities for our students.
Between the expected results through the design of educational module on the topic *Pollution and environmental protection in the rural area*, we can mention:

1. facilitates the transition of students from the school learning stage to the working life by adapting the training of our students to the local labour market needs;
2. contributing to the increase of socio-professional insertion and mobility;
3. expanding the occupational horizons and deepen the core competencies of our students with general and specialised techniques competences;
4. assures the increase of flexibility in the educational offer of our high-school;
5. contribute to the correlation of the educational offer to the local community needs;
6. create the opportunities to improve the relationship between the school, local community and local labour market.

The design of contents for this educational module requires a multi-disciplinary approach, needing knowledge of biology, chemistry, physics, geography and geology, social sciences and enginery. Step by step, through the theoretical contents and practical activities, our students can learn that the humanity's development and welfare are possible through the sustainable development and long-term conservation of the surrounding environment. By other hand, we follow to stimulate our students' capacities to establish and develop professional interpersonal relations, respectively, the training of their skills and abilities to manage the human conflicts and the expectations of stakeholders, too.

The scientific component of the education through this course follows like main learning objectives for our students:

- to assess the quality of air, soil and waters in our villages, learning about pollution's impact on organisms' health and ecosystems' functions,
- to identify and elaborate a monitoring scheme for the local pollution sources, but also to develop a control system of environmental qualities,
- to implement mechanism to reduce the pollution impact,
- to improve the quality of environmental parameters in our villages.

We must notice that the scientific contents combine the general presentation with the information about the regional and local situation for each topic. In the same time, for the all topics, we used to cut-off the theoretical learning process with the practical activities. About 50% of classes are rolled outside of classroom, like fieldwork activity in the school's vicinity but also in different points inside the villages and in its vicinity.

In order to cover the achievement of first domain of competences by our students through this educational module, we designed the teaching and learning process starting from the following competences:

a. introduction in the general problems of environmental pollution, knowledge the impact of pollution phenomenon on the daily life quality and long-term evolution of ecosystems, wildlife and humanity, too (Danet. 2005).

b. monitoring of pollution phenomenon related to the water's quality (Duca & co. 1999, Danet. 2005, Lazaroiu. 2006) – the contents are related to the identification and classification of the sources of pollution for waters (natural and anthropogenic, continuous and discontinuous, incidental and organised), the main categories of pollutants (physical, chemical, biological, solid, liquid or gaseous, thermal), the dispersion of pollutants (leak into the ground, discharge into the rivers and lakes, transverse streams and turbulence) and assessment of water pollution impact on the organisms and environment.

c. monitoring of pollution phenomenon related to the air's quality (Ursu. 1981, Danet. 2005, Moldoveanu. 2007, Burtica & co. 2005) – the contents regard the sources of pollution for the air (fixed and mobile, natural and anthropogenic), the main pollutants (looking for their aggregate state, respectively, for their impact on the organisms and abiotic components of ecosystems), the dispersion of pollutants (related to the action of meteorological parameters – winds, humidity and temperature) and management of the air's pollution.

d. monitoring of pollution phenomenon related to the soil's quality (Burtica & co. 2005, Danet. 2005, Lazaroiu. 2006) – the contents concerns the sources of pollution for soil (indoor and outdoor sources, anthropogenic sources – household waste, industry, agriculture and animal husbandry, radioactivity), categories of pollutants (solids and liquids wastes, pathogens, radioactive substances), the dispersion of pollutants (direct or indirect), assessment of soil pollution impact on the environment and organisms, the management of soil degradation through pollution and erosion phenomenon.

e. elaboration, implementation and control of measures for protection of water, air and soils (Ursu. 1981, Danet. 2005) – the contents are related to the main pathways and methods for the wastewater's treatment (mechanic, chemical and biological, respectively, wastewater treatment plants and small or domestic devices for wastewater treatment), the means and methods for the air purification (physical – dry, moist or combined, respectively, chemical – by washing, reduction, separation, absorption or adsorption), but also, to reduce the air pollution (retention of suspended solids, filters etc.), the prevention of soils degradation (especially through agricultural practices), the ecological restauration for waters and soils, the environmental legislation.

f. analysis of collected data from the field, laboratory tests and writing reports (Danet. 2005) – the students go outside of school taking water and soils samples, using instruments to measure the chemical and physical parameters of waters, air and soil; they record the information in individual observation sheets and apply different laboratory tests in order to assess the quality of this three environmental parameters in their native region.

g. elaboration of one project in order to assess and to manage the quality of waters in the students' village – the students have a work-team project and learn to go through all the steps starting from documentation to the final presentation with a simulated public debate on the this type of projects.

For the second domain of competences, the management of interpersonal relationships, we designed the following main teaching and learning objectives:

1. creating and maintaining professional relationships – the contents and trainings through active listening, cooperation and constructive dialogues, reporting their individual roles to the team's objectives, identification and development of the indicators for social cohesion; we expect to improve the existent capacity of professional development for our students.
2. managing the conflictual situations – accountability, identification of the sources for conflicts, management and mediation ways.
3. managing the expectations of stakeholders – the contents and trainings regards the simulation and assimilation of stakeholders' positions (directly or indirectly involved in the conflict), their roles (managers – partners – colleagues - friends), respectively, their interests; the students will learn to communicate with the stakeholders, anticipating, mediating and satisfying their expectations.

Since the initiation of the proposal of this educational module in our school, we thought that the practical activities are very important in order to develop the skills and abilities of our students like future *technicians in ecology and environmental quality assessment*. For this reason, the mostly part of the practical activities hours are conducted out-side of the classroom like practical field trips following to identify, assess and manage the main pollutants and sources of pollution existing on the territory of our village. The students formed small teams about six to ten persons, working for each topic: pollution of waters, air and soils. We had choice to present our experience for the section of monitoring and managing the pollution phenomenon related to the water in our region.

We established the principal objectives for our practical trips before going out-side of classroom: to identify the main pollutants for the waters and their sources from the territory of our village and its neighbourhoods and to assess the impact of this phenomenon on the environmental of our village (natural ecosystems, cultivated lands, our daily life and long-term welfare of our community). Analysing the existing situation, we tried to develop an environmental project that could permit through it implementation - with the support of the local authorities and economical stakeholders - to improve the quality of the waters from the territory of our village and it neighbourhoods by controlling and limiting the impact of the identified sources of waters' pollution in our area.

During their field-work and by laboratory tests, our students identified the main problems correlated with the phenomenon of waters' pollution in our region using the direct observations, the measurement of different parameters in order to assess the waters' quality, documentation and the interview or collection of testimonies with the principal economical stakeholders, local authorities and people from the local community. Between the identified problems, we can mention like very important:

- direct contamination of hydrographical networks and the local aquifer with chemical components (from pesticides and artificial fertilizers) and organics elements (through the direct discharge of wastewaters from households and livestock farms);
- indirect contamination of waters with inorganic and organic elements through the wrong agricultural and animal husbandry practices, including incorrect chemical treatments, respectively, the inappropriate platforms for the animal manure storage allowing incidental or permanent improper spills of organic materials;
- absence of one common sewer system in our village and the insufficient arrangement of individual septic tanks in the households from the village's territory;
- long-term consequences of the old deforestation practices in the area – despite the fact that we cannot talk about present deforestation activities, the disappearance of some forest surfaces increased the phenomenon of topsoil washing and erosion, generating the risk of landslides, respectively, process of small ponds' silting and increasing of the solid suspensions presence in water.

Beyond the phenomenon of water's pollution in our region, the students could see that the local community has numerous complaints related to the water supply situation on the territory of our village. First of all, the volume of the existing sources of water is deficient one. Secondly, the current system of water supply is not available in the appropriate configuration from the technical and legal conditions in rules (source of water – adduction – treatment for drinking water – storage and distribution to the households). In the same time, the sources of water supply are not centralised surveyed and the quality of water is not corrected to the accepted standards for the drinking waters. In the end, but not ultimately, the quantity and quality of distributed water in the households from the villages territory show significant deficiencies, especially during the summer time, when the level of rainfalls is low to very low.

In order to improve the waters' quality and to manage the phenomenon of waters' pollution, our students proposed some measures that could be the point of starting in order to elaborate and implement one local project with financial support from the European Union's funds and Romanian national budget:

a. creation of one or more water reservoirs;
b. arrangement and improvement of the existing water supply system;
c. development of one common sewer system in the all villages from the local administration Cotusca;
d. development of one or more plants of waters' treatment, combining modern technologies and local resources;
e. improvement of the waters' quality control system;
f. development of one educational campaign designed for the local community and for the economical stakeholders, too, viewing the current agricultural, animal husbandry and industrial activity practices and popularising the friendly practices in these areas of activity.

All the time, the professor played the role of one team coordinator and neutral observer trying helps and encourages his students distinguish between the facts and interests, opinions and feelings. All the exercises followed to develop the abilities of communication and the capacities of analysis of our students, too. We notice that our students appreciated that two of the most important skills achieved through this educational module were learning to work inside one team, respectively, to evaluate themselves their receptivity and abilities necessary for this type of socio-professional activity.

It is very important to mention the partnerships developed by our school with the regional authorities in environmental problems department (Agency of Environmental Protection – Botosani County and Environmental Guard – Botosani County), but also with the Romanian Ornithological Society/SOR Birdlife Romania (the oldest non-governmental environmental organisation in our country) which give us an important technical support for the theoretical component, but also for the practical activities segment of this educational module. Part of the practical activities associated with this educational module was possible through the partnerships of our school with the local economic stakeholders (SC Gerard SRL, SC Valcot SA, SC Special Milk, SC Crasnaleuca SRL).

For the ongoing and final evaluation we used the individual working sheet and elaboration of one environmental project. We designed different types of individual working sheets, correlated with each proposed competence. For example, in the section dedicated to the soil's pollution, the student must identify the main sources of pollution for the soil, the existent pollutants in our village and to assess the impact of the soil's pollution on the natural ecosystems, wildlife and our daily life like individual human beings and community. The best results obtained in the educational process through the model of environmental projects were presented in the regional annual symposium *Biodiversity and Sustainable Development*, organised every year around the celebration of the 5th June - International Environmental Day.

More than the classic evaluation, we applied also different motivation way for our students that were involved in this educational module. For example, we motivated and encouraged their participation through the exploitation of the results for each practical activity by conducting regular classroom and Cotusca Village Hall displays, temporary exhibitions, scientific presentations and articles in volumes of regional or national symposiums, respectively, regional and national contests addressed to the students of high schools, creation and updating of informative panels (using also materials offered by our partners, especially, the Agency of Environmental Protection – Botosani County and Romanian Ornithological Society/Birdlife Romania) etc. As we noticed, these modalities of motivation recorded positive impact not only between our students, but stimulated the interest of local community, too.

To conclude, our experience proved that a school which shapes it development and educational offer to the local requirements and needs is more likely to become a modern and special attractive school. The school is a provider of educational services, so, the students will take an option for those schools that present an adapted educational offer and a well-defined personality, different from other ones.

CONCLUSIONS

In the Romanian educational system, the segment of the *curriculum for local community development* permits to the schools from the rural areas to correlate their educational offer to the needs of local labour market and communities.

An educational module on the topic of *Pollution and environmental protection in the rural area* is very welcomed in the Romanian rural areas in the educational offer for the specialisation *technician in ecology and environmental quality assessment* from the high-school level.

The contents must combine the general presentation with the information about the regional and local situation for each topic.

The theoretical teaching and learning process can be cut-off with the practical activities, permitting the development of practical abilities and skills to the students, including an active involvement to identify and manage of the local environmental issues.

The obtained results can be valued through development of some environmental projects in order to improve the welfare of local communities attracting the local economical stakeholders' involvement by partnerships, but also, by the participation in regional or national scientific meetings or contests, contributing to our students' formation and self-confidence increasing.

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PROBLEM SOLVING METHOD: AN INNOVATIVE METHOD FOR INDEPENDENT LEARNING IN MATHEMATICS

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ABSTRACT: There is only surface learning which causes rote learning among students. The students cannot apply the subject knowledge in their real life and hence do not continue with the subject and cannot become the independent discover as well. Polya's Problem solving method is the method by which students can be made independent discoverer. The focus of the method is not what to learn but how to learn. It is a method by which ability of problem solving can be developed. The intent of the study was to find out the affect of this method on the learning of mathematics with special reference to solve daily life problems. The objectives of this study were (i) to find out the affect of problem solving method of teaching on the solving of daily life problems independently and (ii) to know the strength of the method on the traditional method of teaching. The sample of the study was thirty 8th grade students of a public school in Islamabad. For collecting the quantitative data regarding the effect of problem solving method on solving the daily life problems the pretest-posttest design was used. T-Test was applied on the scores of pre-test and post-test which showed a significance difference in results. This fact revealed that by teaching through problem solving students can solve the daily life problems independently and this method showed better results as compare to traditional method. Hence it can be used for teacher training purpose.

Key words: Independent learning, problem solving method, mathematics

INTRODUCTION

Science and technology do essentially contribute to national development and progress. The base for science and technology development is Mathematics. Stepelman (2004) as cited by Andrews (2006) argued that among all the sciences cultivated by mankind, none had been more useful than Mathematics.It is also an accepted fact by the Mathematicians that Mathematics is the queen of all sciences (Amirali &Halai, 2002; VanHattam, 2011; cited by Yaun, 2013)

This subject is always involved in every move of science and without it, science cannot stand alone. Inventions have been made and innovations have been developed through Mathematics. Christian Wolff's mind theory as cited by Andrew (2006), states that mind has the mental powers or faculties, such as reason, memory, judgment, will, attention, observation, and the like, each of which functions as a separate entity that can be improved through exercise or use. This fact indicates that mental abilities can easily be developed through Mathematics especially in solving problems (Aravena, 2007; Betne, 2010; Ellis, 2011). The objectives stated by the National Curriculum for Mathematics (2006) in Pakistan focus on creating the abilities among the students such as to communicate Mathematically, reason and analyze, think and act in positive ways, comprehend the key concepts, evaluate the effectiveness of using different strategies to address the same problem, use a variety of strategies to problem solving and to make Mathematical connections, discriminate between relevant and irrelevant attributes of a concept in selecting examples, integrate and to make sense of Mathematical concept and procedures and examine real life situations by reasoning Mathematically. This has the reflection of international objectives in the curriculum (Government of Pakistan,2006, 2009).

In Pakistan, Mathematics is taught as one of the compulsory subjects in all public and private schools at elementary and secondary levels. The curriculum covers a wide range of topics and concepts related to subject as well as to daily life. But unfortunately, this subject is not of much interest for students studying in public and private schools butit is a nightmare in Pakistan. The curriculum of Mathematics covers a wide range of knowledge which are desired specific attitude, abilities, analytical and logical thinking and practices form the learner's part(e.g..Rojan, 2008; Government of Pakistan, 2009, Ellis,2011 cited by Amirali, 2011).

Most of the teachers transfer the knowledge to the students according to the textbook through 'rote memorization' and traditional ways, to asses' students' learning through lower level of cognition. In Pakistan, Mathematics learning consists mainly of rules for solution, memorization, and solution of textbook problems. Surface information/knowledge is provided to the students without in-depth understanding of the subject

(Amirali &Halai, 2002; VanHattam, 2011; cited by Yaun, 2013).According to the reports of OECD, (2014) and PIAS, (2012) that in the present world of knowledge, almost every country is trying to improve the quality of society through the quality of education introducing appropriate measures in curriculum, school systems, assessment and teachers' training. Likewise, Pakistan is also the part of these activities, the Ministry of Education and its supporting sister institution are working for the improvement of quality education. The new Mathematics curriculum 2006 was designed in accordance with international standards which promote conceptual understanding and logic among the students and make them able to use all that in practical life.(Government of Pakistan, 2009; Ellis,2011 cited by Amirali, 2012).

For the empirical evidence a number of studies conducted on national, provincial and district level in Pakistan endorsed the fact that achievement of students in the subject of Mathematics is very poor. These studies have been consistent in justifying the fact of low level achievement in the subject. The studies indicated many reasons for this low achievement and one of them is the teaching method of the teacher (e.g. Academy of Planning and Management, 1999; Benoliel&Miske, 1999; Government of Pakistan, 1999, Government of Baluchistan, 1999; Government of Sindh, 2000; Abdeen&Jone,2000; Samo,2009 cited byAmirali, 2012).

According to National Research Councilas cited by Zaman (2011), much of the failure in the subject of Mathematics at school level is due to the traditional ways of teaching of Mathematics that is inappropriate to the way most students learn. Several scientific studies have shown the ineffectiveness of the traditional method of teaching. In order to make students knowledgeable, teachers have to equip themselves with new teaching methods. Learning is not limited within the four walls of the classroom. Being resourceful is a big help to update what has previously been learnt.In the words of Yaun (2013), "The most basic concept of all is that math is merely a problem solving technique. If students can learn to see math problems as just a formal, codified version of any other kind of problem, perhaps their phobias will disappear. But how can a math instructor get students to make this connection? To answer that question I turned to a Hungarian Mathematician himself obsessed with teaching problem solving".

According to Schoenfeld (2001) cited by Tutkun (2012), Problem solving is a method through which students encounter a problem for which they are not ready to solve it immediately. Then they do efforts and examine carefully, work step by step and then find a solution by themselves. In this process the students read the problem carefully, analyze it and collect all the possible information regarding the problem, try to find out the relationship between known and unknown, and then devise a plan keeping in view his/her Mathematical knowledge. After these steps starts implementation and finally he/she becomes able to solve similar examples (Tutkun, 2012).Problem solving method is a source of developing problem solving ability, through which students could be able to solve daily life problems. It is also a source of developing in-depth knowledge about the subject. According to Lester & Charles (2003), cited byYaun (2013), most of the Mathematicians were inspired by the classical work of Polya (1981) and Dewey (1933). Teaching of Mathematics through problems solving method (PSM) is a source of making the students independent discoverers or learners. PSM is helpful in developing Higher Order Thinking (HOT). Many research studies (Paris, 1991, Schoenfeld, 1992, Marzano, 2000, Weber, 2008, Anthony, 2010, Caballero, 2011) cited by Walshaw (2012), argued that problem solving method was an effective method of teaching for Mathematics.

Different studies have opted different strategies of inquiry like qualitative and quantitative e.g.Blnco, 2000, Riasat, 2011, Zaman, 2011, Mustafa, 2011 carried out the experimental studies, Herreid, 2003, Roh, 2003, Tick, 2007 undertook the survey studies, whileSchoenfeld, 1992, 1993, 1999, Yager2003, Walker,2007worked on the qualitative studies to find out the effect of problem solving method of teachingMathematics on Mathematics (Walshaw, 2012).George Polya was known as a great Mathematician due to his work on problem solving. He was Hungarian and taught at the Swiss Federal Institute of technology Zurich. He also served the Stanford University. He was respected and considered an authority in Mathematics' pedagogy. He was born in Budapest, Hungary on 13th December, 1887. George Polya is known as the father of the modern focus on problem solving in Mathematics education. He was a renowned Mathematician and had written many books on the subject of Mathematics but "How to solve" was his famous book. In that book Polya suggested the four step method of solving a problem. According to Schoenfeld, 1992; Marzano, 2000; Weber, 2008, that this method of teaching gained a lot of currency.

It is a four step method which works systematically to reach the solution of a Mathematical problem.

Step-1 Understanding the problem

In this step, the given problem is understood with respect to given data. For understanding several questions, figures and diagrams may be asked and constructed. All these quires depend upon the nature of the problem(Polya 1976).

Step-2 Devising a Plan

At this step, students are motivated to find out links between data given and the unknown. This stage provides deeper understanding about the problem. The way from understanding the problem to conceiving a plan may be long and difficult. The plan for a problem can be prepared through a 'bright idea' or an 'auxiliary problem (Polya 1976).

Step-3 Carrying out the Plan

After a careful planning at the step-2 what has been decided is now implemented for reaching a solution. To devise a plan and to conceive the idea for the solution is not an easy task. It takes a long exercise (Polya 1976, p.13).

Step-4 Looking back

This is the step where students have to confirm their solution by applying it in a new situation. In this step, students seek new arguments and try to recheck their findings by comparing the known with unknown. (Polya 1976, p.15).

1.2 Revised Bloom's Taxonomy

Anderson who was the Bloom's student, with a team of eminent cognitive psychologists revisited the Bloom's Taxonomy and provided its revised version in 2001. Keeping in view the new developments in the field of education, students' learning ways, new assessment and evaluation methods and teachers' lesson planning, the old taxonomy was revisited and the Revised Bloom's Taxonomy (RBT) was introduced (Anderson, 2001).Tutkun (2012) argued that in Revised Bloom's Taxonomy; significant changes were made to address the limitation of old Bloom's taxonomy. The revised Bloom's Taxonomy has three main areas of changes with respect to the old taxonomy. Through these changes, it became more comprehensive and relevant to modern learning theories (Aravena, 2007; Betne, 2010; Farzad, 2010;Ellis, 2011).

1.3 Cognitive Process Dimension of Revised Bloom Taxonomy

This dimension of the taxonomy is divided into six categories which are described in 'verb'. It represents the process of learning and students are expected to learn in the result of teaching (Anderson, 2001).

1**-Remembering**

In this dimension it is expected that students may recognize and recall the relevant information and knowledge from the long term memory. This dimension consists of two main sub classes i-e recognizing and recalling or it is an ability to remember the previous knowledge and recall it at the time when it is required (Anderson, 2001).

2-Understanding

This dimension of the cognitive process deals with the ability among the students that they can grasp meaning, explain and restate ideas, can provide their own meaning to the knowledge. It has its sub-levels which include interrelating, exemplifying, comparing and summarizing (Anderson, 2001).

3-Applying:

This dimension of cognitive process deals with the ability of using acquired knowledge in a similar or new situation. It shows its learning outcome in the form of executing and implementing in either new or old situation (Anderson, Lorin& David Krathwohl, 2012).

4-Analysing:

This is the cognitive process which deals with the division of knowledge into its parts and studies the parts to understand the whole (Anderson, Lorin&David Krathwohl, 2012).

5- Evaluating:

This ability also belongs to higher order thinking skill. The learning outcome of this ability includes checking and critiquing (Anderson, Lorin& David; Krathwol, 2012).

6- Creating:

This dimension is new in Revised Bloom's Taxonomy; it was not included in the old taxonomy. This is the highest ability and replaced by the synthesis of the previous taxonomy. It involves putting knowledge together for the creation of new knowledge and developing something new. It includes generating, planning and producing(Anderson, 2001).

1.4 Statement of the problem:

Many studies showed that problem solving method has an effect on cognition but few studies discussed its effect on revised Bloom's taxonomy of educational objectives.The intent of this true experimental study will be to find out the effect of George Polya's problem solving method of teaching on revised Bloom's taxonomy of educational objectives, in the subject of mathematics at elementary level. In the study true experimental pretest-posttest (double control group) method will be used to measure the effect of independent variable problem solving method on dependent variable cognitive domain.

1.5 Objectives of the study:

The objectives of the study were:

1. To find out the effect of problem solving method of teaching on the achievement of cognition sub-level remembering.
2. To assess the effect of problem solving method of teaching onthe achievement of cognition sub-level understanding.
3. To explore the effect of problem solving method of teaching on the achievement of cognition sub-level applying.
4. To determine the effect of problem solving method of teaching on the achievement of cognition sub-level analysis.
5. To find out the effect of problem solving method of teaching on the achievement of cognition sub-level evaluation.
6. To check the effect of problem solving method of teaching on the achievement of cognition sub-level creating.

1.6 Hypotheses of the study:

Following null hypotheses for quantitative analyses will be checked through the study:

Ho1: There is no significant effect of problem solving teaching method on the achievement scores of cognition sub-level remembering in the subject of mathematics.

Ho2: There is no significant effect of problem solving teaching method on the achievement scores of cognition sub-level understanding in the subject of mathematics.

Ho3: There is no significant effect of problem solving teaching method on the achievement scores of cognition sub-level applying in the subject of mathematics.

Ho 4: There is no significant effect of problem solving teaching method on the achievement scores of cognition sub-level analysis in the subject of mathematics.

Ho5: There is no significant effect of problem solving teaching method on the achievement scores of cognition sub-level evaluation in the subject of mathematics.

Ho6: There is no significant effect of problem solving teaching method on the achievement scores of cognition sub-level creating in the subject of mathematics.

1.7 Research Design and Methodology:

The present study is an applied study with respect to application, exploratory by objective and quantitative by paradigm. The study is based on deductive theory with positivist's philosophy. The control group design helps the researcher to quantify the impact that can be attributed to extraneous variables, it does not separate out the other effects that may be due to the research instruments (such as the reactive effects), or, respondents(such as the maturation or regression effects). When the researcher needs to identify and separate out these effects, a double-control design is required. In a double-control study, the researcher has two control groups instead of one. To quantify, say, the reactive effect of an instrument. (Kumar, 2009).

1.7.1 Population of the study:

The population of the study will be consisted of all 1936, 8th grade boysstudents studying in federally administrative institutions in urban areas of Islamabad. The population of the study will be taken from Islamabad Model Schools, because institution may be available for experiment and also the homogeneity factor among the respondents.

1.7.2 Sample:

The present study is based on true experimental pretest -posttest design. A purposive sample of 120 male students from randomly selected Islamabad Boys School will be taken and after pretest, through random sampling by applying fishbowl draw technique, will be used to form three groups.

1.8 Results:

Table 1: Normal Distribution Analysis of Study Variables among Control Group-I

	Kolmogorov-Smirnov			Shapiro-Wilk		
Variables	Statistic	*df*	*p*	Statistic	*Df*	*P*
Remembering	.20	43	.67	.49	43	1.22
Understanding	.24	43	.25	.55	43	3.23
Applying	.19	43	1.00	.49	43	.45
Analyzing	.28	43	3.02	.31	43	.56
Evaluating	.16	43	.98	.13	43	1.53
Creating	.25	43	.09	.01	43	.29
Overall abilities	.12	43	.67	.20	43	.11

Table 2: Normal Distribution Analysis for Study Variables among Control Group-II

	Kolmogorov-Smirnov			Shapiro-Wilk		
Variables	Statistic	*df*	*p*	Statistic	*df*	*P*
Remembering	.24	43	.34	.37	43	3.45
Understanding	.01	43	.12	.08	43	.33
Applying	.15	43	.85	.45	43	.40
Analyzing	.18	43	1.01	.27	43	1.09
Evaluating	.24	43	2.23	.38	43	5.04
Creating	.23	43	1.45	.07	43	2.12
Overall abilities	.16	43	.21	.39	43	.23

Table 3: Normal Distribution Analysis for Study Variables among Experimental Group

	Kolmogorov-Smirnov			Shapiro-Wilk		
Variables	Statistic	*df*	*P*	Statistic	*Df*	*P*
Remembering	.16	44	.21	.13	44	.57
Understanding	.03	44	.33	.16	44	.98
Applying	.07	44	1.21	.19	44	.87
Analyzing	.04	44	.40	.18	44	5.24
Evaluating	.07	44	.67	.12	44	3.27
Creating	.03	44	.32	.14	44	.80
Overall abilities	.18	44	.56	.13	44	2.13

Table 4: One Way ANOVA Analysis for effect of Problem Solving Method& Conventional Method on Outcome variables for Experimental Group, Control Group 1 and Control Group 2

	Experimental Group		Control Group-I		Control Group-II				
Variable	*M*	*SD*	*M*	*SD*	*M*	*SD*	*F*	*P*	*Ή*
Outcome	65.34	18.24	50.16	10.34	47.07	10.77	22.37	.00	.34

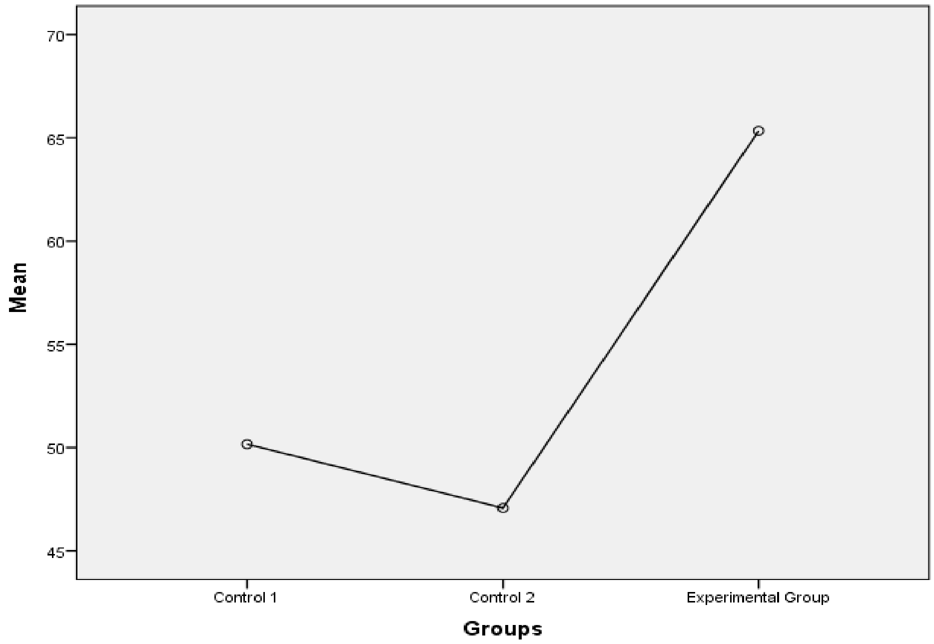

Figure 1: The effect of Problem Solving Method on Outcome variables for Experimental Group, Control Group 1 and Control Group 2

Table 5 Descriptive Statistics and t-test Results for Problem Solving Method on Outcome variables for Experimental Group

	Pretest (n = 43)		Posttest (n = 43)				95% CI		
Outcome	*M*	*SD*	*M*	*SD*	*r*	*t*(42)	*LL*	*UL*	*Cohen's d*
Remembering	5.77	2.34	8.80	1.72	.82**	14.98**	-3.43	-2.61	1.49
Understanding	5.80	2.49	8.68	1.70	.86**	14.36**	-3.29	-2.48	1.36
Applying	7.73	4.18	12.91	3.79	.93**	22.47**	-5.64	-4.71	1.31
Analyzing	7.02	4.31	12.77	4.25	.94**	25.76**	-6.20	-5.30	1.35
Evaluating	5.48	3.11	12.50	4.22	.91**	24.86**	-7.59	-6.45	1.91
Creating	2.36	2.48	9.68	3.42	.77**	22.53**	-7.97	-6.66	2.47
Overall abilities	34.16	17.98	65.34	18.24	.96**	42.12**	-32.67	-29.68	1.74

**p< .01

DISCUSSION

Problem solving method was a source of developing problem solving ability, through which students could be able to solve daily life problems. It was also a source of developing in-depth knowledge about the subject. According to Lester &Charles (2003) cited Yaun (2013) that the most of the Mathematicians were inspired by the classical work of Polya (1981) and Dewey (1933). Teaching of Mathematics through problems solving Method (PSM) was a source of making the students independent discover. A one Way ANOVA analysis for effect of PSM on outcome variables for three groups was applied. Results showed that experimental group has significant greater mean (M = 65.34, SD =18.24; F= 22.7, p<.01, $\acute{\eta}$ = .34), than control group 1 (M = 50.16, SD =1034; t = 6.65,) and control group 2 (M = 47.07, SD =10.77). This showed that PSM has performed better than the conventional method. These results were supported by the results of the studies done by Kloawole, Olasosu&Ajetunmobi (2013) which showed that Problem Solving Method of instructions was significantly better than the conventional method. For this they concluded that method of instruction used by the teacher has effect on student's achievement in Mathematics. The same results were endorsed by the findings of Nikandrov (1990) cited by Kloawole (2013) whichshowed that ability to solve problem could be developed through a very good strategy of teaching. This result also indicates that the conventional method was not effective for teaching of Mathematics This finding was supported by Kloawole (2013) by quoted that, The 'chalk and talk' or conventional method was no longer effective for the development of higher level ability in Mathematics. Traditional methods of teaching cannot satisfy the complexity of the modern technological society (Ubuz, 1994; Dongpong, 2000; Wang, 2001; Carson, 2007; cited by Kloawole, 2013).Descriptive Statistics and t-test Results for Problem Solving Method on Outcome variables for Experimental Group was performed. Results showed that there were significant differences found in posttest on remembering (M = 8.80, SD =1.72; t = 14.98, p<.01, *Cohen'sd* = 1.49), understanding (M = 8.68, SD = 1.70; t = 14.36, p<.01, *Cohen's d* = 1.36), applying (M = 12.91, SD = 3.79; t = 22.47, p<.01, *Cohen's d* = 1.31), analysis (M = 12.77, SD = 4.25; t = 25.76, p<.01, *Cohen's* d = 1.35), evaluation (M = 12.50, SD = 4.22; t = 24.86, p<.01, *Cohen's* d = 1.91), creating (M = 9.68, SD = 3.42; t = 22.53, p<.01, *Cohen's* d = 2.47), and on overall abilities (M = 65.34, SD = 18.24; t = 42.12, p<.01, *Cohen's d* = 1.74). It could be concluded that results shows significant differences and high effect sizes were found among all study variables. These results were supported by the research study of Yuan (2013) that through problem solving method students could be made able to learn the abilities of reasoning and solve daily life problems. According to the conclusion drawn by Amirali&Halai (2010) in their research study that the reforms in the curriculum of Pakistan and other parts of the world strongly recommend the problem solving approaches for teaching of Mathematics at schools level. Conventional methods cannot stay longer to address the new advancement. Revised Bloom's Taxonomy was used to assess the both methods and pre-test and post-test provided the difference of both methods on RBT. This fact was supported by Haklikari et al (2007) that the student's achievement was the main concern of educational psychologists over the last decades. Similarly, in the revised Bloom's taxonomy(Anderson &Krathwohl, 2001) quoted byHailikari et al (2007) that the division was made between different types of knowledge and cognitive processes which were four knowledge level and six level of cognitive process. The Revised Bloom's Taxonomy was a reliable tool for the assessment of achievement of different levels.Hence form the above discussion it may be concluded that the Polya's Problem Solving Method of teaching Mathematics is better than the Conventional Method of teaching. This method is also helpful in developing the Problem Solving ability among the students. The study does not rule out the role of the innovative teacher, because the improvement in the achievements scores of Control Groups reflects the contribution of teachers. The study also confirms the effect of Conventional Method of teaching on Mathematics but it only effective to develop Lower Order Thinking Skills. So for development of Higher Order Thinking Skills required for further study of Mathematics this is a suitable method. It also helps the students to learn the problem solving ability by which he/she can solve the daily life problems. It is also a useful method of developing in-depth learning of Mathematics.

CONCLUSIONS

Following conclusions were drawn on the basis of findings of the study:

1. It may be concluded on the basis of One Way ANOVA that Experimental Group taught by PSM showed better results on pre-test. Hence PSM was an effective method for teaching Mathematics at Elementary level.
2. It may be concluded that the achievement scores of Control Group-I that was taught by Conventional Method, showed lower results than the Experimental Group taught by PSM on the basis of One Way ANOVA.
3. It may be concluded that the Control Group-II taught by Conventional Method showed lower results than the Experimental Group taught by PSM on the basis of One Way ANOVA.
4. It is concluded that on Post Hock analyses of Experimental Group, Control Group-I and Control Group-II on outcome variables (Remembering, Understanding, Applying, Analyzing, Evaluating and Creating). PSM showed better results as compared to Conventional Method. Hence PSM was better than Conventional Method on Revised Bloom's Taxonomy.
5. It is concluded that PSM performed better on outcome variables as compared to Conventional Method. Hence it supported that all null hypotheses may not be accepted.
6. It is concluded on the bases of t-test that PSM showed significant difference of performance in achievement scores as compared to Conventional Method and had high effect size on all outcome variables.

5.4 Recommendations

Keeping in view the finding and conclusion of the study the following recommendation are suggested:

1. As PSM has shown its strength on the Conventional Method so it may be suggested that teacher use this method in the classroom for teaching of Mathematics.
2. The Problem Solving Method has proved its strength on Higher Order Thinking Skills so it is suggested that it may be used specifically for developing HOTS.

3. As PSM helps in developing the ability of problem solving, therefore, it is suggested it may be used to develop the ability among the students.
4. PSM is effective for teaching of Mathematics so it may be used for making the base of students at elementary level.
5. It has an effect on Revised Bloom's Taxonomy, so it is suggested that lesson plans may be prepared according to RBT.
6. As PSM is an effective method of teaching Mathematics so it is suggested that it may be included in teacher's training programmes.

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MODEL OF STUDYING ELECTROMAGNETIC FIELD AND WAVES THEORY VIA COMPUTER SIMULATION

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ABSTRACT: Model of studying the electromagnetic theory, mathematics, computing and data visualization in purpose to comprehend the main ideas of theories and practical applications are proposed. To learn physical processes and system's properties by computer simulation and to learn simulation by solution of physical tasks is the concept of proposed model. Integrated course of electromagnetic (EM) field and wave theories, mathematical solution of equations, computing techniques based on solutions of well known tasks as well as current problems of applied electrodynamics are considered. Application examples of electromagnetic in scientific research, modern technologies represent the abstract theories in realistic existence, help to understand deeply theoretical course, appreciate significance of (EM) theories in many fields of daily life. Knowledge of main theories of electromagnetic combined with mathematics and computing is necessary for solving the electrodynamics problems such as (EM) waves scattering and diffraction, interaction of (EM) field and objects of different electric and geometric properties, basis of linear and nonlinear optical techniques, etc.

Selected tasks of electrodynamics are constructed of several modules: formulation of physical problem, theories and methods of solution – physical and mathematical, specifics of problem, approximation and application cases, computer simulation, analysis. Each completed module expands outlook, develops skills, intuition, self-confidence, encourages participants be more motivated, active in learning and improvement of knowledge in multi disciplines. Proposed model is presented by considering one task - EM waves scattering on a single cylindrical body, applicable in radio physics, transmitting and detecting systems, aerosol studies for particles of different origin. Estimation of EM field components, scattering characteristics, theoretical predictions based on analytical solutions and numerical simulations are considered.

Keywords: electrodynamics, wave scattering, simulation

INTRODUCTION

The way to comprehend the physical phenomenon and main properties of systems pass through the deliberate study of well-known tasks and model systems. At any level of education, solution of physical tasks is based on multi-disciplinary knowledge of physics, mathematics, computing as well as skills and ability of analytical thinking. Modeling, simulation and visualization are the tools simplifying the study of systems and processes however simulation itself is the subject of deep learning and analysis. To learn physical processes and system's properties by computer simulation and to learn simulation by solution of physical tasks is the concept of proposed model of learning [1].

Study of model tasks and applications in scientific research and advanced technologies represent the abstract theories in realistic existence, helps to understand deeply and appreciate significance of electromagnetic (EM) field theories in many directions of radio physics and optics, spectroscopic techniques, detecting and transmitting systems, aerosol and medical studies, etc. Specific knowledge and experience needed for solving of modern physical problems should be gained and expanded step by step alongside with topics rising from process of investigation and research. This approach is known and well-proven in practice of scientific and educational activities.

Proposed model is demonstrated for studying EM field and wave theories, related mathematics, computing and data visualization, namely for one task of electrodynamics - EM waves scattering on a single cylindrical body. Solution of task gives possibility to analyze the physical picture of phenomena, understand the process of interaction of EM field and body, estimate characteristics and scattering properties of body of different electric and geometric parameters, find out the appropriate solutions of mathematical equations, learn the developing of computing program and specifics of computing and visualization.

Selected task is constructed of several modules. Subtasks chosen on the basis of skills and experience of participants, which makes the work in team more efficient and motivative. Each completed module expands outlook, improves knowledge in multi discipline, develops skills, intuition, self-confidence.

Scattering of EM waves on single objects, as cylinders and spheres is of great interest because of its wide application in antennas, detecting systems, aerosol studies [2-5].

Single body solutions are been used as the models for testing a complex tasks, single body properties are taking into account while combining and studying the multi-element system, etc. There are many naturally occurring particles, such as some viruses, ice needles, fibers, which are best represented as cylinders long compared with their diameter [6]. In our research studies single particles of cylindrical and spherical shapes are considered as approximated physical models of virions (of viruses, bacteriophages) of icosahedral, prolate and rod-shaped morphology, and used for studying virus-like particles (VLPs) of biological or artificial origin [7].

FORMULATION OF PHYSICAL PROBLEM

The treatment of EM scattering by a bodies is the problem of EM theory. Based on macroscopic approach to the problem, Maxwell equations for homogeneous, isotropic, free of charge medium are considered using time-harmonic dependence by time-factor $\exp(-i\omega t)$:

$$\nabla\times\vec{E} = i\omega\mu_q\mu_0\vec{H} \quad , \qquad (1)$$

$$\nabla\times\vec{H} = -i\omega\varepsilon_q\varepsilon_0\vec{E} \quad , \qquad (2)$$

where $\vec{E}$ and $\vec{H}$ are electric and magnetic field vectors; ω is the angular friquency; ε_q - permittivity and μ_q - permeability of q medium; $\varepsilon_o = 8,85\cdot10^{-12}$ F/m; $\mu_o = 1,26\cdot10^{-6}\,\mathrm{H/m}$.
Some mathematical transformations of eq.s (1), (2) leads to Helmholtz's (wave) equation:

$$\Delta\vec{E} + k_q^2\vec{E} = 0 \quad , \qquad (3)$$

where $\Delta = \nabla^2$ is Laplace scalar operator. Wave vector $k_q = k\sqrt{\varepsilon_q\mu_q}$ is prescribed to (q) medium and $k = \omega\sqrt{\varepsilon_o\mu_o}$ to the free space, using subscripts q =1 for core, q =2 for coat, q =3 for surrounded areas.
Study of EM scattering on single coated cylinder of circular (in XOY plane) cross section is considered. Cylinder long (L/d>>5) compared with its diameter (d) may be approximated by cylinder of infinite (L) length [6]. Incident plane monochromatic EM wave from positive direction of axis (x), makes angle θ with the direction of x . If incident wave is indipendent on coordinate z ($\partial/\partial z \equiv 0$) and $H_z \equiv 0$, $E_r \equiv 0$, $E_\varphi \equiv 0$, the scattered wave will be of the same stucture as incident wave, so electric component of incident EM wave could be written as follows (E_o =const):

$$E_z^{(o)} = E_o e^{-ik_3(x\cos\theta + y\sin\theta) - i\omega t} \quad , \qquad (4)$$

coordinates and wave vector are given in Cartesian (x, y, z) and Cylindrical (r, φ, z) coordinate systems

$$x = r\cos\varphi\,, \qquad y = r\sin\varphi\,, \qquad z = z \qquad (5)$$

$$k_x = -k\cos\theta\,, \qquad k_y = -k\sin\theta \quad . \qquad (6)$$

Magnetic component of EM wave is derived from eq. (1) $\quad H_\varphi = -\frac{1}{i\omega\mu_q\mu_0}\frac{\partial}{\partial r}E_z \quad . \qquad (7)$

Definition of scattered field in outside area ($b \le r \prec \infty$), inside areas of coat ($a \le r \le b$) and core ($0 \le r \le a$) of cylinder is goal of problem in purpose of study physical charecteristics of system, as well as the effects caused by EM field – body interection.

METHOD OF SOLUTION

Problem in view should be studied as physical and mathematical tasks. In these respects, let us consider:

1. Physical Subtasks:

1.1. Determination of scattered fields, which should satisfy an eq. (3), radiation condition outside the cylinder ($kr >> 1$) and finiteness inside the areas of cylinder under the condition [4]: $(E_z \cdot grad\,\varepsilon) = 0$. (8)

1.2. Definition of boundary conditions for electric and magnetic field components at the boundary surfaces separating the surrounding medium-coat-core. It requires the continuity of tangential components of EM field and leads to relations:

$E_z^{(o)} + E_z^{(sc)} = E_z^{(co)}$ and $H_\varphi^{(o)} + H_\varphi^{(sc)} = H_\varphi^{(co)}$ at $r = b$ $0 \le \varphi \le 2\pi$ (9)

$E_z^{(co)} = E_z^{(in)}$ and $H_\varphi^{(co)} = H_\varphi^{(in)}$ at $r = a$ $0 \le \varphi \le 2\pi$ (10)

1.3. Estimation of scattering characteristics of system for:

a) Near field as the lines of equal amplitudes (E_z) and equal phases ($\varphi_E = arctg \frac{\mathrm{Im}\, E_z}{\mathrm{Re}\, E_z}$),

b) Far-field ($kr \to \infty$) as extinction (σ_{ext}) cross section and an angular dependence $F(\varphi)$ of scattered EM field ($E_z^{(sc)}$) [6,8]. The presence of the particles in EM field has resulted in extinction of the incident wave, therefore the extinction cross section is defined by the sum of scattering and absorbing cross sections $\sigma_{ext} = \sigma_{sc} + \sigma_{abs}$. If the medium in which the particle is embedded is nonabsorbing, extinction cross section $\sigma_{ext} = \sigma_{sc}$. Using asymptotic expression of Hankel functions [2, 9] $H^{(1)}{}_s(\eta) \sim \sqrt{\frac{2}{\pi\eta}} e^{i(\eta - \frac{2s+1}{4}\pi)}$, in a case of cylindrical bodies the formula for σ_{sc} and scattering pattern $F(\varphi)$ take the forms:

$$\sigma_{sc} = \frac{4}{k} I \quad , \qquad (11) \qquad\qquad F(\varphi) = e^{-i\pi/4}\sqrt{2/\pi k} \cdot f(\varphi) \quad . \qquad (12)$$

Expressions for I and $F(\varphi)$ are defined by solution of physical problem, by means of the values of coefficients A_s as well as geometric and electric parameters of system:

$$I = \frac{1}{2\pi}\int_0^{2\pi} f(\varphi) f^*(\varphi) d\varphi = \sum_{m=-\infty}^{m=\infty} |A_m|^2 \quad , \quad (13) \qquad\qquad f(\varphi) = \sum_{m=-\infty}^{m=\infty} i^{-m} A_m e^{im\varphi} \quad . \quad (14)$$

“*” denotes the complex conjugate of function.

2. Mathematical Subtasks:

2.1. Determination the solutions of an eq. (3) in cylindrical coordinate system.

Using expression [2,10] for $\Delta = \frac{1}{r}\frac{\partial}{\partial r}\left(r\frac{\partial}{\partial r}\right) + \frac{1}{r^2}\frac{\partial^2}{\partial\varphi^2} + \frac{\partial^2}{\partial z^2}$ (15)

and seperation of variables method applicable if boundaries of body coincide with coordinate surfaces of coordinate system in which the wave equation is separable. E_z component of EM field could be presented as

$$E_z(r, \varphi, z) = \Re(r)\Omega(\varphi)Z(z) \quad . \qquad (16)$$

It leads to well-known ordinary differential equations

$$\frac{d^2\Re}{dr^2} + \frac{1}{r}\frac{d\Re}{dr} + (p^2 - \frac{m^2}{r^2})\Re = 0 \;, \quad (17) \qquad \frac{\partial^2\Omega}{\partial\varphi^2} + m^2\Omega = 0 \;, \quad (18) \qquad \frac{d^2 Z}{\partial z^2} + \chi^2 Z = 0 \;. \quad (19)$$

$k_q{}^2 = p^2 + \chi^2$, $m = 0,1,2,...,$. In a case, considered above, we have taken into account that $\partial/\partial z \equiv 0$, therefore we could write down the separable solutoion to (17), (18): $E_z = \Re(k_q r)e^{im\varphi}$, (20)

function $\Re(k_q r)$ is the solution of Bessel equation (17).

2.2. Determination of EM fields in each area of cylinder.
Fields in the areas of cylinder are expressed by the sum of multi-pole waves, using Bessel functions of m order and first (Bessel), second (Neumann) or third kind (Hankel) based on conditions under consideration.

$$E_z^{(sc)} = \sum_{m=-\infty}^{\infty} A_m \mathrm{H}_m^{(1)}(k_3 r) e^{im\varphi - i\omega t} \quad , \quad b \le r \prec \infty \quad , \quad 0 \le \varphi \le 2\pi \tag{21}$$

$$E_z^{(\mathrm{in})} = \sum_{m=-\infty}^{\infty} B_m J_m(k_1 r) e^{im\varphi - i\omega t} \quad , \quad 0 \le r \le a \quad , \quad 0 \le \varphi \le 2\pi \tag{22}$$

$$E_z^{(\mathrm{co})} = \sum_{m=-\infty}^{\infty} [C_m J_m(k_2 r) + D_m N_m(k_2 r)] e^{im\varphi - i\omega t} \quad , \quad a \le r \le b \quad , \quad 0 \le \varphi \le 2\pi \tag{23}$$

$\{A_m\}, \{B_m\}, \{C_m\}$ and $\{D_m\}$ are unknown multipole coefficients.

2.3. Presentation of incident $E_z^{(\mathrm{o})}$ field by Bessel functions.

Using (4)-(6), and Fourier representation for Bessel function [2]: $e^{-i\eta\cos\psi} = \sum_{s=-\infty}^{\infty} i^{-s} J_s(\eta) e^{is\psi}$, (24)

incident wave may be expressed as $E_z^{(\mathrm{o})} = E_o e^{-i\omega t} \sum_{m=-\infty}^{\infty} i^{-m} J_m(k_3 r) e^{im\varphi} e^{-im\theta}$ (25)

2.4. Functional transformations.
Using boundary conditions (9)-(10), field expressions (21)-(23), (25) and relation (7) between electric and magnetic components, we get the functional relations:

$$E_o \sum_{m=-\infty}^{\infty} i^{-m} J_m(k_3 b) e^{im\varphi} e^{-im\theta} + \sum_{m=-\infty}^{\infty} A_m \mathrm{H}_m^{(1)}(k_3 b) e^{im\varphi} = \sum_{m=-\infty}^{\infty} [C_m J_m(k_2 b) + D_m N_m(k_2 b)] e^{im\varphi} \tag{26}$$

$$E_o \sum_{m=-\infty}^{\infty} i^{-m} J_m^{/}(k_3 b) e^{im\varphi} e^{-im\theta} + \sum_{m=-\infty}^{\infty} A_m \mathrm{H}_m^{(1)/}(k_3 b) e^{im\varphi} = W_{23} \sum_{m=-\infty}^{\infty} [C_m J_m^{/}(k_2 b) + D_m N_m^{/}(k_2 b)] e^{im\varphi} \tag{27}$$

$$\sum_{m=-\infty}^{\infty} [C_m J_m(k_2 a) + D_m N_m(k_2 a)] e^{im\varphi} = \sum_{m=-\infty}^{\infty} B_m J_m(k_1 a) e^{im\varphi} \tag{28}$$

$$\sum_{m=-\infty}^{\infty} [C_m J_m^{/}(k_2 a) + D_m N_m^{/}(k_2 a)] e^{im\varphi} = W_{12} \sum_{m=-\infty}^{\infty} B_m J_m^{/}(k_1 a) e^{im\varphi} \tag{29}$$

where "/" denotes the derivative with respect to an argument, $W_{pq} = \dfrac{W_p}{W_q} = \dfrac{k_p \mu_q}{k_q \mu_p}$, $\quad W_q = \sqrt{\dfrac{\varepsilon_q}{\mu_q}}$. (30)

Integrate (26)-(29) over the interval (0, 2π), using Wronskian determinant [9] of cylindrical functions

$\overline{W}\{J_s(\eta), N_s(\eta)\} = \dfrac{2}{\pi\eta}$ (31) and the Kronecker delta [9] $\delta_{m,s} = \dfrac{1}{2\pi} \int_0^{2\pi} e^{i(m-s)\varphi} d\varphi$, (32)

($\delta_{m,s}$ is 0 if $m \ne s$ and 1 otherwise), we get the set of algebraic equations with respect to multipole coefficients $\{A_s\}, \{B_s\}, \{C_s\}$ and $\{D_s\}$.

2.5. Determination the multipole coefficients of scattered fields.
Solving the system of algebraic equations, $\{A_s\}, \{B_s\}, \{C_s\}$ and $\{D_s\}$ coefficients are determined by formulas:

$$B_s = \frac{E_o i^{-s} e^{-is\theta} \dfrac{2i}{\pi k_3 b}}{\dfrac{\pi k_2 a}{2} \{U_s \Gamma_s - G_s \Lambda_s\}} \quad , \tag{33}$$

$$A_s = -E_o i^{-s} e^{-is\theta} \frac{\{U_s \Im_s - G_s L_s\}}{\{U_s \Gamma_s - G_s \Lambda_s\}} \quad , \tag{34}$$

$$D_s = -\frac{\pi k_2 a}{2} B_s G_s^m(k_2 a, k_1 a) \quad , \tag{35}$$

$$C_s = B_s U_s \frac{\pi k_2 a}{2} \quad , \tag{36}$$

where the notations Γ_s, Λ_s, $\Im_s$, L_s, G_s, U_s define the functions as follows:

$$\Gamma_s = \mathrm{H}_s^{(1)/}(k_3 b) J_s(k_2 b) - W_{23} \mathrm{H}_s^{(1)}(k_3 b) J_s^{/}(k_2 b) \quad , \tag{37}$$

$$\Lambda_s = \mathrm{H}_s^{(1)/}(k_3 b) N_s(k_2 b) - W_{23} \mathrm{H}_s^{(1)}(k_3 b) N_s^{/}(k_2 b) \quad , \tag{38}$$

$$\Im_s = J_s^{/}(k_3 b) J_s(k_2 b) - W_{23} J_s(k_3 b) J_s^{/}(k_2 b) \quad , \tag{39}$$

$$L_s = J_s^{/}(k_3 b) N_s(k_2 b) - W_{23} J_s(k_3 b) N_s^{/}(k_2 b) \quad , \tag{40}$$

$$G_s = J_s(k_1 a) J_s^{/}(k_2 a) - W_{12} J_s^{/}(k_1 a) J_s(k_2 a) \quad , \tag{41}$$

$$U_s = J_s(k_1 a)N_s^{/}(k_2 a) - W_{12} J_s^{/}(k_1 a) N_s(k_2 a) \quad . \tag{42}$$

3. Special Cases:

By formulas (33), (34) we could estimate the multi-pole coefficients for special cases, namely:

3.1. Single dielectric cylinder without coat. If consider nonmagnetic ($\mu_q \approx 1$) medium and assume that $k_3 \equiv k$, $k_2 \equiv k_1$, $b \equiv a$, we will define $w_{23} = \sqrt{\varepsilon_1}$ and $W_{12} = \frac{W_1}{W_2} = 1$. The expressions for B_s and A_s are of exactly the same as that for B_s and A_s obtained in [1,6]. The expression for A_s is of the form:

$$A_s = -E_o i^{-s} e^{-is\theta} \frac{[J_s^{/}(ka)J_s(k_1 a) - \sqrt{\varepsilon_1} J_s(ka) J_s^{/}(k_1 a)}{[\mathrm{H}_s^{(1)/}(ka)J_s(k_1 a) - \sqrt{\varepsilon_1}\mathrm{H}_s^{(1)}(ka)J_s^{/}(k_1 a)]} \quad . \tag{43}$$

3.2. Single metallic cylinder of infinite length. Assuming $\varepsilon_1 \to \infty$, in (43), multipole coefficient A_s takes the form $A_s = A_s = -E_o i^{-s} e^{-is\theta} \frac{J_s(ka)}{\mathrm{H}_s^{(1)}(ka)}$, (44)

3.3. Relativly low ($ka < 0.5$) and high $ka > 3$ frequencies.
Based on asymptotic expressions of Bessel and Hankel functions formulas derived above may be used for analysis of fileds qualitatively different for low ($ka < 0.5$) and high $ka > 3$ frequencies [4] as well as particles of small ($ka \ll 1$) and large ($ka \gg 1$) sizes in comparision with the wave lenght (λ) of incident wave.

SPECIFICS OF PROBLEM

For numerical estimation and visualization the programs based on Matlab v7.0.4. are created. Bessel function J = besselj(m, ξ) computes the Bessel function of the first kind, H = besselh(m, ξ) computes the Hankel function, for each element of the complex array ξ. The order m need not be an integer, but must be real. Computing (EM) fields and characteristics by formulas (21)-(23), (11),(12) we determine the number m of terms of series along with estimation of convergence of series and multi-pole coefficients with algorithm within the given accuracy 10^{-6}. The number of terms of series may be determined by the empirical formula: $\mathrm{m} \geq 2\left[\left(\mathrm{k_1 a}\right)+1\right]$.

VIZUALIZATION

For constructing the complete picture of system we have to calculate and analyze the main characteristics of system. In this paper we demonstrate some of them in a case of normal incident of wave $(\vartheta = 0°)$. In Fig. 1, is presented the near field characteristic by the lines of equal amplitudes in the interval ($-\frac{\lambda}{2}, \frac{\lambda}{2}$) along the axes x and y, for homogeneous cylinder ($ka = 2$) of permitivity $\varepsilon_1 \equiv \varepsilon = 1.7$, and far field characteristic by the scattering pattern of cylinder of $\varepsilon_1 \equiv \varepsilon = 1.7$ and 5 in polar coordinate system. The scattering pattern describing the angular dependence of scattered field is given in Cartesian coordinate system for cylinder of different parameters $ka = 1$; π , $k_1 a = \pi$, $\varepsilon = 55$ (Fig. 2 (left)) and coated cylinder of parameter $ka = 1$; permittivities of core and coat of cylinder correspondingly are equal $\varepsilon_1 = 55$, $\varepsilon_2 = 2$, coat parameters are $kb = 1.1$ and 1.4 (Fig.2 (right)). The value of permittivity $(\varepsilon = 55)$ for cylinder has been used while modelling the virus as a long thin rod of a homogeneous bulk material [11].

CONCLUSION

Model of studying the electromagnetic (EM) field and wave theories, related mathematical equations, computing and visualization techniques based on solutions of well known tasks of applied electrodynamics are considered. EM wave scattering on a single particle, namely coated cylinder as an example system for model demonstration is proposed. Theoretical and numerical solution of tasks applied for investigation of physical characteristics of virus-like particles (VLPs) is presented. Analysis shows that deliberate consideration and study of subtasks makes possible to achieve the intended goals - gaining the higher level knowledge and getting the complete physical picture of system under consideration. The proposed concept simplifies the process of understanding the difficult themes and theories targets the answers on questions “why” and “how”, its findings are applicable to other disciplines as well.

ACKNOWLEDGEMENT

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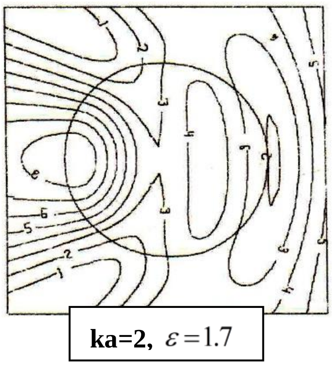


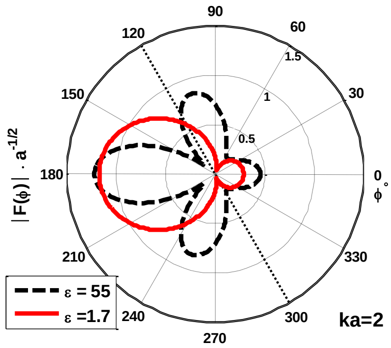
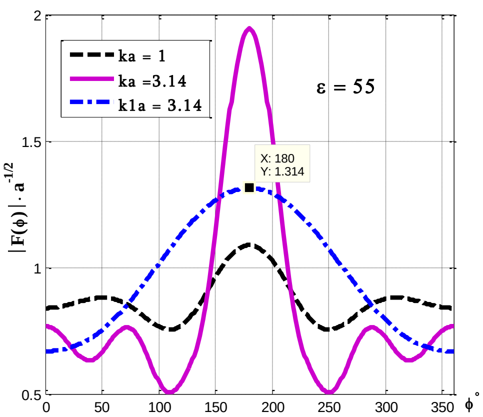


Figure 1. Lines of Equal Amplitudes (Left), Scattering Pattern in Polar Coordinate System (Right), for $\vartheta = 0^\circ$



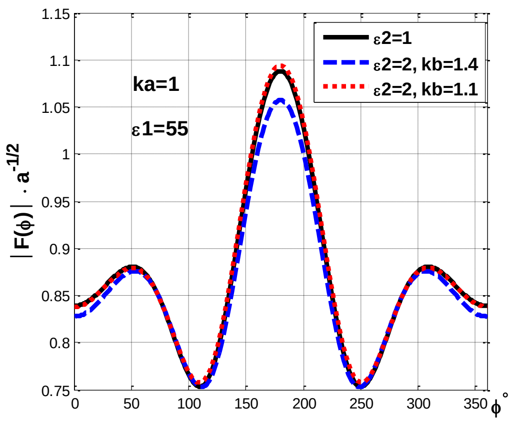


Figure 2. Scattering Pattern of Cylinder in Cartesian Coordinate System, for $\vartheta = 0^\circ$ Cylinder (Left), Coated Cylinder (Right)

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COLLEGE STUDENTS' PERCEPTIONS OF LEARNING MATHEMATICS AND USING COMPUTERS

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ABSTRACT: Mathematics is the key course to interpret the science and nature. A positive attitude should be improved by learners to comprehend the logic of mathematics. However, most of the research indicated that they were not interested in learning and studying mathematics. Instead of understanding the basic principles, many students preferred to use sophisticated software packages or graphing calculators for solving mathematics problems. Thus, these tools prevent the improvement of their mathematical skills. This study investigates students' confidence when learning mathematics and using computers. Besides, the research examines the effects of computers and graphing calculators in the learning of mathematics on the students' opinions. The study was conducted with 230 technical vocational school students. The data of the research was collected using a survey of "Attitudes to Technology in Mathematics Learning Questionnaire". The results of the study indicated that many students were not interested in learning and understanding the subjects while studying mathematics on pen and paper. They preferred to solve mathematics problems with the help of sophisticated mathematics software packages or graphing calculators. Detailed results and recommendations based on the students' confidence and perceptions are presented in the study.

Key words: computer education, confidence, higher education, mathematics education

INTRODUCTION

STEM (Science, Technology, Engineering and Mathematics) education has become very important for the future generations of our country recently. *Science* provides knowledge to us about the universe (sun, moon, plants, food, weather, etc.). *Technology* is helpful for our daily lives with the help of computer, smartphone, etc. Engineering (building, roads, bridges, etc.) makes our lives easier. College students' motivation and confidence in mathematics, science, and engineering education declined in recent years although students always come across mathematics in their daily lives (at the bank, supermarket, etc.).

"A true STEM education should increase students' understanding of how things work and improve their use of technologies. STEM education should also introduce more engineering during precollege education (Bybee, 2010)". Therefore, the researcher, educators, teachers, etc. primarily should promote and encourage all students from elementary level to university level for STEM in our educational systems (Kennedy & Odell, 2014). Although these career fields are very important for countries' future, many students do not give importance to them. Thus researchers in the education field should direct the students to these career fields and they should explain the importance of these fields to the students.

Many of college students have difficulty in concentrating on learning mathematics, have not mathematical/logical intelligence, and have the fear and lack of self-confidence of students for learning mathematics. Besides they find it difficult to comprehend mathematical concepts and they have anxiety while studying and solving the problems too much. Therefore they do not like to learn mathematics. These challenges are resulted from conventional instruction. On the other hand, the majority of students like spending time with technology (a variety of mathematical computer software, calculators, graphic calculators, etc.) except for studying mathematics. They have interest in using computer and/or graphics calculator while learning mathematics. These devices could help the students solving problem, enhancing mathematical concepts' exploration, improving the representations between mathematical concepts and ideas. These devices could encourage metacognitive abilities (planning, and checking) (Duncan, 2010; Pierce, Stacey & Barkatsas, 2007). Also students believe that these devices could help them to learn mathematics.

Mathematics is very important to understand for everybody but learning mathematics is needed to follow logical procedures. Thus educators should develop and apply new teaching methods on their course instead of conventional instruction and these developed new teaching methods may improve learning through cognitive, metacognitive and affective processes (Pierce et al., 2007). Besides the educators should encourage students to learn and explore mathematics and they should provide positive feedback on the developing of students' positive attitudes on their course. The behaviors of mathematics educator play a central role in learning mathematics for students. Therefore they should be careful the students' affective and cognitive domains.

The purpose of this study is to examine the college students' confidence by learning mathematics and using computers and the college students' opinion about computers and graphics calculators during learning mathematics. The research questions (RQ) investigated were as follows:

1. What is the college students' confidence related to learning mathematics?
2. What is the college students' confidence related to using computers?
3. What is the college students' opinion about computers and graphics calculators during learning mathematics?

METHOD

The present study used survey methodology with questionnaire items measured on Likert scales. The questionnaire was developed by Fogarty, Cretchley, Harman, Ellerton, & Konki, 2001. The questionnaire provided the opinion, feeling, and confidence of the student related to learning mathematics, using computers and graphics calculator. The questionnaire with 34 items consisted of three main parts. The first part including 11 items is about the students' confidence by learning mathematics. The second part covering 12 items is on the students' confidence while using computers. The last one including 11 items is about the feelings of the students about computers and graphic calculators in the learning of mathematics. The statistical analyses of the questionnaire were calculated by Fogarty et al. (2001). Cronbach's alpha coefficient for internal consistency reliability for subscales was reported as 0.89 for mathematics confidence, as 0.92 for computer confidence, and as 0.84 for attitude towards use of technology in learning mathematics. The detailed statistical analyses of the questionnaire can be obtained in literature (Fogarty et al. 2001). The items of the questionnaire were coded on a scale of 1 to 5, with 1 being "Strongly Agree" and 5 being "Strongly Disagree". The students were given approximately five minutes to fill out the questionnaire. The research was performed on four departments offering two-year programs (Industrial Glass and Ceramics, Geotechnic, Drilling Technology, Natural Building Stone Technology) in Torbali Technical Vocational School of Higher Education at Dokuz Eylul University, Turkey. The study sample consisted of 230 volunteer college students whose ages were between 18 and 20. The collected data were analyzed by IBM-SPSS Statistics 22. The frequency distributions, means and standard deviations of student' responses were calculated.

RESULTS AND FINDINGS

The students' responses were evaluated according to subscale as follows:

1. The Confidence of Students in Learning Mathematics

Table 1 presents the descriptive statistics related to the students' confidence while learning mathematics. The data obtained from the questionnaire are generally examined, the students did not have confidence in learning, studying, and solving mathematics themselves. According to the findings; 17% of the students had less trouble in learning mathematics than other subjects, 72% of the students did not have a mathematical mind, 61% of the students had never felt themselves capable of learning mathematics, 83% of the students found mathematics frightening, 78% of the student did not understand how some people seemed to enjoy spending so much time on mathematics problems, 78% of the students were never very excited about mathematics, and 76% of the students found mathematics confusing.

Table1. The Descriptive Statistics Related to the Students' Confidence in Learning Mathematics

QN	Items	N	M	SD
1	I have less trouble learning mathematics than other subjects.	228	4.30	1.36
2	When I have difficulties with mathematics, I know I can handle them.	225	4.86	1.20
3	I do not have a mathematical mind.	227	1.09	1.34
4	It takes me longer to understand mathematics than the average person.	224	1.94	1.24
5	I have never felt myself able to learn mathematics.	223	1.31	1.36
6	I enjoy trying to solve new mathematics problems.	222	4.01	1.23
7	I find mathematics frightening.	229	1.19	1.35
8	I find many mathematics problems interesting and challenging.	225	4.15	1.18
9	I don't understand how some people seem to enjoy spending so much time on mathematics problems.	228	1.35	1.38
10	I have never been very excited about mathematics.	229	1.26	1.34
11	I find mathematics confusing.	229	1.54	1.34

Note: 1- Strongly Agree; 2- Agree; 3- Neutral; 4- Disagree; 5- Strongly Disagree

2. The Confidence of Students in Using Computers

Table 2 shows the descriptive statistics related to the students' confidence while using computers. When the data obtained from the questionnaire were generally evaluated, 74% of the students had less trouble in learning how to use a computer than learning the other things, 80% of the students had difficulties in using a computer. They knew that they could handle the problems/difficulties, 12% of the students had never felt themselves capable of learning how to use computers, 77% of the students enjoyed trying new things on a computer, 13% of the students found using computers frightening, 16% of the student did not understand how some people seemed to enjoy spending so much time using computers, and 81% of the students did not find computers confusing.

Table 2. The Descriptive Statistics Related to the Students' Confidence in Using Computers

QN	Items	N	M	SD
1	I have less trouble learning how to use a computer than I do learning other things.	229	2.05	1.10
2	When I have difficulties using a computer I know I can handle them.	229	1.87	0.96
3	I am not what I would call a computer person.	229	3.48	1.23
4	It takes me much longer to understand how to use computers than the average person.	230	3.52	1.26
5	I have never felt myself able to learn how to use computers.	226	4.17	1.13
6	I enjoy trying new things on a computer.	227	2.00	1.15
7	I find having to use computers frightening.	226	4.16	1.13
8	I find many aspects of using computers interesting and challenging.	222	2.72	1.30
9	I don't understand how some people can seem to enjoy spending so much time using computers.	227	3.79	1.21
10	I have never been very excited about using computers.	227	3.85	1.14
11	I find using computers confusing.	220	4.05	1.13
12	I'm nervous that I'm not good enough with computers to be able to use them to learn mathematics.	228	3.51	1.13

3. The Opinions of Students about Computers and Graphics Calculators

Table 3 demonstrates the descriptive statistics related to the students' feeling about computers and graphics calculators in the learning mathematics. When the data obtained from the questionnaire are generally investigated, 46% of the students believed that computing on a devise makes it easier to explore mathematical ideas, 45% of the students realized that computers were important but they did not think that they needed to use them to learn mathematics, 66% of the students thought that computers and graphic calculators were good tools for calculation, but not for their learning of mathematics, 27% of the students reported that using technology wasted too much time in the learning of mathematics, 27% of the student preferred to do all the calculations and graphing by themselves, without using a computer or graphics calculator, 56% of the students wanted to get better at using computers to help students in mathematics, and 35% of the students revealed that the symbols and language of mathematics were difficult all by themselves even without the addition of technology.

Table 3. The Descriptive Statistics Related to the Students' Feeling about Computers and Graphics Calculators in Learning Mathematics

QN	Items	N	M	SD
1	Computing power makes it easier to explore mathematical ideas.	230	2.63	1.07
2	I know computers are important but I don't feel I need to use them to learn mathematics.	227	2.73	1.14
3	Computers and graphics calculators are good tools for calculation, but not for my learning of mathematics.	230	1.27	1.19
4	I think using technology is too new and strange to make it worthwhile for learning mathematics.	228	3.06	1.04
5	I think using technology wastes too much time in the learning of mathematics.	219	2.21	1.22
6	I prefer to do all the calculations and graphing myself, without using a computer or graphics calculator.	228	4.17	1.19
7	Using technology for the calculations makes it easier for me to do more realistic applications.	223	2.41	0.99
8	I like the idea of exploring mathematical methods and ideas using technology.	230	2.88	1.16
9	I want to get better at using computers to help me with mathematics.	227	1.58	1.17
10	The symbols and language of mathematics are bad enough already without the addition of technology.	229	2.00	1.23
11	Having technology to do routine work makes me more likely to try different methods and approaches.	227	2.58	1.05

CONCLUSION

The results obtained from findings indicate that the majority of the students had great difficulties in learning mathematics. The learning difficulties of the students by studying mathematics can be given according to RQ1 (What is the college students' confidence related to learning mathematics?) as follows:

1) They have a prejudice against mathematical thinking and learning.
2) They believe that mathematics is very difficult to achieve and is complex to understand therefore many students do not generally want to learn mathematics.
3) They think that learning mathematics causes the students to waste time and they prefer to perform different social activities to learn mathematics.
4) They believe that they do not have logical/mathematical intelligence and do not adequately have confidence in learning mathematics.

The results obtained from findings reveal that the majority of the students have interest in using computers and have confidence in understanding computers. The results obtained from findings according to RQ2 (What is the college students' confidence related to using computers?) report that many students do not have any problems while using computers therefore they would like to use the computers, they really enjoy spending more time with the computers, and find the computers entertaining.

The results obtained from findings present that the majority of the students need to use computers and graphics calculators in learning mathematics. The results obtained from findings according to RQ3 (What is the college students' opinion about computers and graphics calculators during learning mathematics?) demonstrate that the majority of the students use calculators because mathematical operation is easy to do/solve for them. Actually these graphics calculators may prevent improving of mathematical operation skills of the students because students are accustomed to use these devices instead of pen and paper. After certain period of time, these devices might be caused the lack of motivation and confidence in the students. Besides the students' mathematical operations performance can increase the possibility of failure on the examination and they almost begin to think that they have not mathematical intelligence.

RECOMMENDATION

It is clear that college students do not like to study mathematics. Therefore, mathematic educators should motivate students to the courses with the help of active learning techniques. The mathematics educators should present practical knowledge instead of more theoretical knowledge, they should teach problem solving strategies to the students instead of problem solving, they should improve the problem solving skills of the students, they should use plain mathematical language for more easy understanding of the students in the courses, they should give comprehensible and achievable homework problems instead of a lot of assignments in order to gain students' motivation and confidence, they should frequently encourage the students, and they should not threat the students with score. The students nowadays spend more time on the computers. For this reason, the educators should promote to the students for using a variety of mathematical educational software. Thus students could learn mathematics by using educational software. The educators should not allow students to use the computer (Tablet PC, Notebook, etc.) and/or calculators and graphics calculators in the courses and examination. The educators should explain the importance of calculators and computers to students and should express to students that these kind of devices are insufficient for learning mathematics. Finally, the educators should periodically provide in-service training about active learning techniques and educational software.

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ASPECTS OF USING CLOUD TECHNOLOGIES IN VIRTUAL LEARNING ENVIRONMENT

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ABSTRACT: There are increased using the e-Learning technologies at the modern institutions of higher education, which favored to integrate the various instruments in the virtual learning environment. Recently, the cloud technologies have become the most popular, which offer e-Learning internet technologies based dynamical and actual new opportunities to the educational institutions. The cloud technologies provide a high level of the service and they impact on the design of the training courses, offered services and logistics. Although, the cloud technologies include the new risks, at the same time their use for educational institutions and students can get a better service at the lower cost. In the article, it is discussed the comparative analysis of the learning services with the modern LMS systems and the cloud technologies and shown the perspectives of the implementation in the educational organizations.

Key words: e-Learning Technologies, Cloud Technologies, Virtual Learning

INTRODUCTION

Nowadays, higher education organizations actively used on information technology based virtual learning environment. Every day, the possible functions of virtual learning environment gets more important with its information filling degree. For today, we have not exactly cleared meaning of virtual learning environment, because the developing continues, constantly getting the increasing integration with internet and in accordance with a variety of new tools to adapt in their environment. One of the most popular kind of the virtual environment is Learning Management System (LMS) (Kapanadze D....).

LMS systems have specific functions, which implementation is possible on the base of the social networks or on the base of the multiple servers using with the educational programs. This is the opportunity to give the specific content for the closed groups, which learn the concrete course in the certain period. It is important during the formal (traditional) learning a number of reasons:

- The learning institutions may put the investment in the contents development, but its spread by internet may be warning for their marketing condition. But, with the most Universities' opinion open learning projects can get into a source of financial gain. There is a good example, MIT's some learning resource reformed as public;
- Teaching in the "Learning Environment" has its preferences, which depends on the partnership of the group members and existing of the united common objects. During the using of LMS there is blocked unauthorized access to spammers and other destructive approach customers, which is very important;
- If necessary, the educational institution is given the opportunity to control learning environment and its elements, from some legal, ethical and cultural considerations;
- The educational institutions have access of the students in the system. It has possibility to improve the content and the delivery service experience for the improvement of the students' knowledge acquisition.

The part of teachers, they use free opportunity during the learning process due to the LMS systems' restrictions. Particularly, they use Web 2.0 technologies based on social networks (Facebook) and various internet outlets blog, wiki and etc., which is available for everyone (Sclater Niall, 2-11). With the giving capabilities to the students they use partnership with the live environment by the usage and sharing own learning material. During the formal learning process, this type of working is impossible with the little group of the students and from the teachers it is very hard, because it depends on the recourses, a lot of time and the high knowledge in the sphere of IT.

At present, e-Learning is becoming an alternative model of the two previous models, which aims to provide educational resources and activities in the form of services. Two companies – Google and Microsoft started the suggestion of the new services to the learning institutions and the students. These services change university systems or their functions filling, they are: e-mail, instant exchange of information, calendar plan, creating and saving personal documents, their joint access, creating web pages. The services of Google Apps for Education and Microsoft Live@edu have a wide set of tools, which is made by adjusting the customers demand, also it is possible to connect them to the kind of the educational institution brand. Moreover, these systems are placed to an external service provider, called "Cloud Computing" or simply in "Cloud".

Cloud Computing in e-Learning

Cloud – this is available and great consolidation of the easily usable virtual resources (as they are: devices, platforms, and/or services). According to the load changes (scalability), it is possible the dynamic reconfiguration of the resources, which gives the possibilities of the used resources optimization. Such kind exploitation of the consolidation, as a rule, based on models – Pay only for what you use (Pay-as-you-go). Within the models, the guarantees of the service define to each specific case by provider, according to the agreement of the service level.

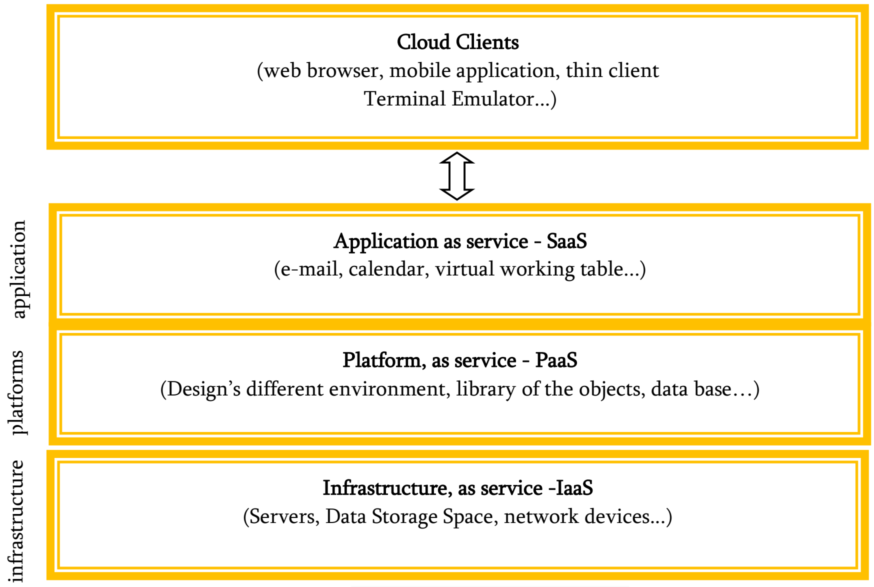

Figure 1. Cloud-Computing Layers

There are three main issues of cloud service category for the distributed infrastructure (Fig. 1). At the lower level there is infrastructure, as service - IaaS (servers, data storage space, network devices and etc…), for example, Amazon's Elastic Compute Cloud (Amazon EC2), which gives the possibilities to the organizations to run their Linux-servers on the virtual machines and if necessary fast loading scalability. On the next level there are the platforms, as service - PaaS (design's different environment, library of the objects, data bases and etc...). At this level, the developers have opportunities to write the applications. At the upper level, there are Cloud computing applications, as service - SaaS (e-mail, calendar and etc.), which introduce the applications in the clouds for the learning organizations. It is possible to access on these services with the web browsers from the different devices (computers, mobiles, thin clients, terminal emulators and etc.) In clouds, not only dates, but applications saving changed computing paradigms for the benefits of the traditional client-server model, according to which there are minimal functions remained to the user's side. Therefore, such functions as: software updates, checking on viruses and other services, depends on the provider of the cloud service. As the system locates on the network and to access on it is possible by internet, therefore it is easier common access, to manage the versions and joint editing.
Arguments for benefit the cloud service using:

- Reduce the costs on resources;
- Possibility of scalability;
- To compare different components and combining possibility, that they were not chained to a computer infrastructure;
- Reduce the costs on staff.

e-Learning Service Migration In Cloud

E-mail is one of the most important catalyst from the universities data centers the migration of the learning services with cloud computing providers. Most of the students do not use by e-mail server, because they have their own accounts on the service servers, such are Microsoft Hotmail or Google Gmail. According to this matter, e-mail server changing by the learning institutions will be overlooked for lots of students. If a student decides to use the university mail, this will be simple, because he will be automatically on the Cloud service. Nowadays, in many universities, among them the universities of Georgia signed the contract with Microsoft or Google to collaborate and to give the students free e-mail with the same domain name, which domain name assigned the university. The arguments to move the mail server in cloud space is more and more stable. There is shown in the table, from LMS systems two mostly popular – comparing blackboard and Moodle functions to cloud services of Microsoft and Google. In mind, that the changes have permanent nature in this sphere and constantly, they add the new capabilities for above systems. As there is shown from the table, there is possible to realize a lot of necessary function for virtual learning environment. The exception is the evaluation tool. For example, there is not necessary instrument for testing such essential tools in an assessment e-system as they have Moodle and Blackboard in Google App. Also, there is not academic assessment journal in Cloud using program This is due to the fact that initially, when the cloud services are being created, there was not education specific. However, Microsoft and Google started collaborating with the educational area and supposedly, not so far from the time when they show to us the created specific educational program apps.

The Transition Risks To The Moving Of Cloud Services

To move e-Learning in cloud space have some risks for the learning educations:

- Service reliance to a single supplier;
- The main changes may get large costs in service working, because they have no access to software code and in the worst case - on the bases;
- software updating risks of Cloud services;
- Storage security and privacy-related risks;
- Different types of seizures caused by delays in the work;
- The risk caused by one of the company's cloud-management services.
- Technical problems caused by the transition to new technology;
- The absence of network which the consumers' computers will remain functionless.

Thus, a highly credible cloud service provider programs for companies within the agreed service levels, can give guarantees to the IT service of learning institutions their products with full compliance on their technical requirements, fault tolerance, unauthorized invasion of strangers, access management and data protection. Learning institutions also will have possibilities, in order to improve the quality of services for monitoring the actions of users. There is started the realization of cloud technologies, for example, the creators of Moodle processed MoodleCloud version and offered it to costumers for free from 2015 (https://moodle.com/cloud/). Complex web-based application is built on the scalable and economical Moodle - hosting platform. About this platform based portal always works Moodle's latest version. There is possible to create the website in MoodleCloud, as the individual teacher as the little schools or organizations.

CONCLUSION

Thus, LMS systems (Blackboard, Moodle and etc.) will realize in near future by cloud technologies, but cloud services (Live@edu, Google Apps for Education and others) will be more usable for e-Learning requirements, but which technologies will choose the learning institutions, at present it is impossible to predict. One thing is clear, that the learning institutions will have great choice during the learning process to implement modern, advanced built technologies.

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ANALYSIS OF SCIENCE TEACHER CANDIDATES' ATTITUDES, BEHAVIOR AND SELF-EFFICACY TOWARDS RENEWABLE ENERGY AND ENVIRONMENT

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ABSTRACT: In this study, it is aimed to analyze attitudes, behavior and self-efficacy levels of science teacher candidates towards renewable energy and environment. The study is conducted over three research questions. These are, "Is there a significant difference among pre-test, post-test and retention-test scores of science teacher candidates regarding environmental behavior and environmental self-efficacy?" Participants of this study consist of 37 science teacher candidates, who applied to the project titled as 'Environment and Energy with Pro-Fe(Science)ssional Education' held between the dates 17th-23rd June, 2014. Pre-test, post-test and retention-test of renewable energy, environmental behavior and environmental self-efficacy are used to determine changes in attitudes, behaviour and self-efficacy of Science teacher candidates towards these variables. The scales used as data collection tools are respectively, "Environmental Behavior", "Renewable Energy Attitude" and "Self-Efficacy Beliefs through Environmental Education". In the light of findings obtained from data, post-test scores are found to be higher than pre-test scores and retention-test scores are observed to be lower compared to post-tests. According to analysis of variance and Bonferroni multiple comparison test, statistically significant difference is found between post test - retention test and pre-test scores. When the obtained results are considered, it is concluded that 8-day-nature education makes a major contribution to the participants' attitudes towards renewable energy, environmental behaviour and environmental self-efficacy.

Key words*:* Science Education; Environment; Renewable Energy; Attitude; Behavior; Self-Efficacy.

INTRODUCTION

Nowadays, renewable energy and environmental issues are one of the very popular subject. With the developing technology, the increasing of environment pollution and consequently the protecting of environment is very important. The gaining and giving the environmental consciousness and awareness, which ensured to be sustainable, are necessary for they can have a healthy life of future generations. The traditional energy kinds (such as fossil fuels) provide the greatest contribution to environmental pollution. The transfering to individuals the need using renewable energy to a healthy environment and it is extremely important to ensure their awareness in this regard. The studies are being conducted on the raising the teacher candidates' awareness, especially in science education, related to renewable energy and environmental issues and the investigating of their attitudes, behaviors and self-sufficiency (Önder and Kocaeren, 2015). The reason for preferred of teacher candidates in scientific studies is to reach a common and widespread community by the transferring their knowledge to their students in the future. Accordingly, in an article published by Önder and Kocaeren in 2015 year (Önder and Kocaeren, 2015) a study is included on environmental information, behavior and self-sufficiency of teacher candidates. In this study, the obtained data by applying "Environmental Education Self-efficacy Test", "Environmental Knowledge Test" and "Environmental Behavior Test" to the science teacher candidates consisted of 37 people were analyzed. According to the analysis results, between applied pretest and posttest scores it was found that there are significant differences.

In 2015, published by Önder and Kocaeren in another study to create awareness of renewable energy to 37 participants tests such as environmental behavior test, environmental perception test, renewable energy attitude test were applied. When the obtained results are evaluated it can be said that there are significant differences between the applied pretest and posttest scales ana these studies increase the level of knowledge of teacher candidates dramatically positive. The presented this study to literature was prepared via the project titled as "Environment and Energy with Pro-Fe(Science)ssional Education" supported by TUBITAK (Önder and Kocaeren, 2015). It is aimed to investigate the differences between the applied pretest, posttest and permanence test scores on renewable energy, attitude, environmental behavior and self-efficacy issues to science teacher candidates consisting 37 people. In scope of work, these scales were used in order to specify changes in teacher candidates' attitude, behavior and self- efficacy on the environment and renewable energy the scales such as "Environmental Behavior Scale", "Renewable Energy Attitude Scale" and "Environmental Education Self-Efficacy Scale". The presented in this article, which the above-mentioned and as a continuation of studies performed by our group, the questions which diverting us to do this research are given below.

1. Is there a significant difference between renewable energy attitude pretest, posttest and permanence test scores of science teacher candidates?

2. Is there a significant difference between environmental behavior pretest, posttest and permanence test scores of science teacher candidates?

3. Is there a significant difference between environmental education self-efficacy pretest, posttest and permanence test scores of science teacher candidates?

METHOD

2.1. Working Model

This study was performed as a weak experimental design. The research based on poor experimental design is the study without a control group.

2.2. Working Group

The working group forms 37 science undergraduate students participating from Akdeniz University in Antalya, Afyon Kocatepe University, Denizli Pamukkale University and Suleyman Demirel University in Isparta to the project entitled “Environment and Energy with Pro-Fe(Science)ssional Education” held between the dates 17 to 24 June 20014. 31 participants (83.8%) were female and 6 (16.2%) were male.

2.3. Data Collection Tools

In the project study performed under science and nature education schools the program and supported by TUBITAK, “Environmental Behavior Scale” developed by Kışoğlu (2009), “Renewable Energy Attitude Scale” prepared by Yücel and Morgil (1998) and “Environmental Education Self-Efficacy Scale” developed by Özdemir *et al.* (2009) were used as data collection tools. Scales were implemented at the beginning of the project, at the end of the project and as a retention test after 1 month from the end of the project.

2.3.1. Environmental Behavior Scale

In this study to measure students' environmental behavior, environmental behavior scale was used that its reliability coefficient (α) is calculated as 0.79 and developed by Kışoğlu (2009). This component of environmental literacy scale is prepared in triple Likert type (1 = never, 2 = sometimes, 3 = always) to determine what they do as often environmentally sensitive behaviors of the teacher candidates and it involves 20 behavior sentences. The scoring of expression in the scale was built as 2 points. The scoring in the scale, “Always” 3 points, “Sometimes” 2 points and ”Never” is made as 1 point. Accordingly, the lowest and the highest scores on the scale can be taken as 20 and 60, respectively.

2.3.2. Renewable Energy Attitude Scale

In this study, “Renewable Energy Scale” consisting 39 Likert-type questions and prepared by Morgil and *et al.* (2006) in order to determine the attitudes of the teacher candidates related to renewable energy, which was administered to all participants. This scale “I completely agree”, “I agree”, “I am undecided”, “I disagree”, and “I never disagree”, and 5-point Likert-typed 39 of gradation expression is formed. Accordingly, a teacher candiate can take 195 point as the highest score from the survey and also, 39 point as the lowest score. The reliability of the measurement tool was calculated (Cronbach-alpha) and the reliability coefficient of the test was found to be 0.85.

2.3.3. Environmental Self-Efficacy Scale

“Environmental Education Self-Efficacy Scale” is used in order to determine teacher candidates’ the environmental self-sufficiency, and this scale was developed by Özdemir and et al. (2009) in this study. The reliability coefficient of this scale is 0.76 and also it explains 61.80% of the total variance. Additionally, this scale is four sub-dimensional (These are “Academic Competence Perception”, “Responsibility Perception”, “Tutorial Competence Perception” and “Referring ability Perception”). This scale developed to measure environmental education self-sufficiency of participants consists of 15 questions and it is a Likert-typed with percentage (%). Resultantly, a teacher candiate can take 75 point as the highest score from the survey and also, 15 point as the lowest score.

2.3.4. Data Analysis

SPSS 21.0 software was used to analyze the data and for evaluation of the obtained results after applying of the scales. Before analysis, loss and extreme values were determined. According to the sub-problem situations, it has investigated whether there is a significant difference between single factored ANOVA and pretest, posttest and the retention test scores in the repeated measurements. If there are significant differences, Bonferroni multiple comparison test was conducted to determine these differences. A commonly used multiple comparison test that Bonferroni method depends on student t-statistic, and “equal sample number” principle does not require (Miller, 1969). Descriptive statistics were accommodated in the findings.

RESULTS AND DISCUSSION

3.1. Evaluation of Teacher Candidates' Renewable Energy Attitude Pretest, Posttest and Retention Test Scores

As seen in Table 1, teacher candidates' renewable energy attitude pretest, posttest and retention test scores ($\overline{X}$) are found as 114,16; 123,58 and 123,50, respectively.

Table 1. Descriptive statistics related to teacher candidates' renewable energy attitude pretest, posttest and retention test scores.

Variables	N	$\overline{X}$	SS
Pretest	37	114,16	12,582
Posttest	37	123,58	7,062
Retention test	37	123,50	6,841

According to the obtained results, it can be said that the average of posttest and retention test scores was a little bit higher from pretest score average. As investigated in Table 2, the calculated F value was found meaningfully for unidirectional variance analysis in the repeated measurements (F (df1, df2) =10,175; p<0,01). In other words, differences between averages related to teacher candidates' renewable energy attitude pretest, posttest and retention test scores were statistically significant.

Table 2. ANOVA results related to teacher candidates' renewable energy attitude pretest, posttest and retention test scores.

The source of variance	KT	Sd	KO	F	P
Intra-subject	3295,623	37	89,071		
Measurement	2229,807	1,623	1373,789	13,441	0,00
Error	6138,193	60,055	102,210		
Total	11663,623				

The performed Bonferroni multiple comparison test results to understand that, among which tests the difference between the score averages are given in Table 3. When we see Table 3, the meaningful difference was found between posttest and retention test and pretest score averages. This difference is a benefit for posttest and retention test. In other words, it can be said that with conducted environmental education was provided significant contribution to teacher candidates' renewable energy attitudes and be persistent of the learned information of teacher candidates.

In the analysis and evaluation, the effect size value was calculated. But it might be necessary to briefly describe the effect size, which is a a statistical value that show the level of deviation from the expectations defined in hypothesis of the absence of the results obtained from the sample (Cohen, 1994; Vacha-Haasse ve Thompson, 2004). Generally, the effect size is defined as the magnitude of the difference between the null and alternative hypotheses. This is an indication of the practical significance of the research results. According to result of the tests, the calculated effect size was found as (η^2=0.27) in this study. In Green' opinion (2005) it can be said that this difference has a large effect.

Table 3. The multiple comparison test results based on Bonferroni analysis related to teacher candidates' renewable energy attitude scores.

(I) Groups	(J) Groups	Average Difference (I-J)	SH	P
Pretest	Posttest*	-9.421	2.521	0.002
	Retention test*	-9.342	1.989	0.000
Posttest	Öntest*	9.421	2.521	0.002
	Retention test	0.079	1.669	1.000
Retention test	Posttest*	9.342	1.989	0.000
	Posttest	-0.079	1.669	1.000

*Difference is the meaningful at .01 level.

3.2. Evaluation of Teacher Candidates' Environmental Behavior *Pretest, Posttest and Retention Test Scores*

As seen in Table 4, teacher candidates' environmental behavior pretest, posttest and retention test scores ($\overline{X}$) were calculated as 41,51; 49,57 and 48,32, respectively.

Table 4. Descriptive statistics related to teacher candidates' environmental behavior pretest, posttest and retention test scores.

Variables	N	$\overline{X}$	SS
Pretest	37	41,51	6,127
Posttest	37	49,57	5,510
Retention test	37	48,32	6,138

According to these results, it can be said that the average of posttest and retention test scores was higher from pretest score average. As seen in Table 5, the calculated F value was found meaningfully for unidirectional variance analysis in the repeated measurements (F=22.840, p<0.01). In other words, differences between averages related to teacher candidates' environmental behavior pretest, posttest and retention test scores were statistically significant.

Table 5. ANOVA results related to teacher candidates' environmental behavior pretest, posttest and retention test scores.

The source of variance	KT	Sd	KO	F	P
Intra-subject	1607,640	36	44,657		
Measurement	1391,207	2	695,604	22,840	0,00
Error	2192,793	72	30,455		
Total	5191,64				

The performed Bonferroni multiple comparison test results to understand that, among which tests the difference between the score averages are given in Table 6. As seen in Table 6, the meaningful difference was found between posttest and retention test and pretest score averages. This difference is a benefit for posttest and retention test. In other words, we can say that with conducted environmental education was provided significant contribution to teacher candidates' environmental behavior and be persistent of the learned information of teacher candidates. Additionally, the calculated effect size was found as (η^2= 0.39) in test final. According to Green (2005) it can be said that this difference has a large effect.

Table 6. The multiple comparison test results based on Bonferroni analysis related to teacher candidates' environmental behavior scores.

(I) Groups	(J) Groups	Average Difference (I-J)	SH	P
Pretest	Posttest*	-8.054	1.132	0.000
	Retention test*	-6.811	1.357	0.000
Posttest	Pretest*	8.054	1.132	0.000
	Retention test	1.243	1.348	1.000
Retention test	Pretest*	6.811	1.357	0.000
	Posttest	-1.243	1.348	1.000

*Difference is the meaningful at .01 level.

3.2. Evaluation of Teacher Candidates' Environmental Self-Efficacy Pretest, Posttest and Retention Test Scores

As seen in Table 7, teacher candidates' environmental self-efficacy pretest, posttest and retention test scores ($\overline{X}$) were calculated as 46,70; 54,68 and 53,70, respectively.

Table 7. Descriptive statistics related to teacher candidates' environmental self-efficacy pretest, posttest and retention test scores.

Variables	N	$\overline{X}$	SS
Pretest	37	46,70	4,054
Posttest	37	54,68	6,347
Retention test	37	53,70	7,306

According to the obtained results, it can be said that the average of posttest and retention test scores was higher from pretest score average.

As seen in Table 8, the calculated F value was found meaningfully for unidirectional variance analysis in the repeated measurements ($F=22.144$, $p<0.01$). In other words, differences between averages related to teacher candidates' self-efficacy pretest, posttest and retention test scores were statistically meaningful.

Table 8. ANOVA results related to teacher candidates' self-efficacy pretest, posttest and retention test scores.

The source of variance	KT	Sd	KO	F	P
Intra-subject	1618,432	36	44,956		
Measurement	1442,649	1,593	905,556	22,144	0,00
Error	2345,351	57,352	40,894		
Total	5406,432				

The performed Bonferroni multiple comparison test results to understand that, among which tests the difference between the score averages are given in Table 9. When we see Table 9, the meaningful difference was found between posttest and retention test and pretest score averages. This difference is a benefit for posttest and retention test. In other words, it can be said that with conducted environmental education was provided significant contribution to teacher candidates' self-efficacy and be persistent of the learned information of teacher candidates. Additionally, the calculated effect size was found as ($\eta^2= 0.38$) in test final. According to Green and Salkind (2005) it can be said that this difference has a large effect.

Table 9. The multiple comparison test results based on Bonferroni analysis related to teacher candidates' self-efficacy scores.

(I) Groups	(J) Groups	Average Difference (I-J)	SH	P
Pretest	Posttest *	-8.162	0.947	0.000
	Retention test*	-7.000	1.542	0.000
Posttest	Pretest*	8.162	0.947	0.000
	Retention test	1.162	1.417	1.000
Retention test	Pretest*	7.000	1.542	0.000
	Posttest	-1.162	1.417	1.000

*Difference is the meaningful at .01 level.

CONCLUSION

In scope of the project titled as "Environment and Energy with Pro-Fe(Science)ssional Education" supported by TUBITAK, the following conclusions were reached in this study investigating of the effectiveness and durability on science teacher candidates' environmental information, environmental behaviors and environmental education self-efficacy levels.

As seen in teacher candidates' renewable energy attitude pretest, posttest and retention test scores, posttest scores showed an increase compared to the pretest scores and retention test scores showed a small decrease compared to the posttest scores. According to the analysis of variance and Bonferroni multiple comparison test, a statistically significant difference was found between pretest and posttest-retention test. Found this difference is in favor of posttest and retention test. As considering the environmental behavior pretest, posttest and retention test scores, the posttest and retention test scores are higher than pretest scores. According to the analysis of variance and Bonferroni multiple comparison test, a statistically significant difference was found between pretest and posttest-retention test in order to determine that these differences are in favor of which tests. Found this difference is in favor of posttest and retention test. As investigating in environmental self-efficacy pretest, posttest and retention test scores, posttest scores showed an increase compared to the pretest scores and retention test scores showed a small decrease compared to the posttest scores. According to the analysis of variance and Bonferroni multiple comparison test, a statistically significant difference was found between pretest and posttest-retention test. Found this difference is in favor of posttest and retention test.

Besides this statistical analysis performed effect size value (η^2) was calculated depending on three different scales. It can be said that the value of the calculated effect size in study is higher than normal value. According to the literature effect size takes values between 0.00 and 1.00. η^2 values at .01, .06 and .14 levels are considered as small, medium and large effect size, respectively (Green and *et. al*., 1997). According to the renewable energy attitude scale applied for teacher candidates, the calculated effect size value (η^2) is 0.27. Additionally, according to the test results of scale applied for their environmental behavior the effect size value (η^2) is 0.39.

Moreover, according to environmental self-efficacy test results, the effect size value (η^2) was calculated as 0.38. At the end of the study this effect size values (η^2) may be several reasons for the high. The first of these is that teacher candidates participating in the study are not encounter with detailed information about renewable energy and environment before. Secondly, in the renewable energy and environmental issues positively being of the change in the level of teacher candidates' knowledge or its increasing that affects their attitudes. Depending on the studies performed by Önder (2015); Kahyaoğlu, Daban and Yangın (2008); Kayalı (2010) it can be said that environmental information has been found to increase the environmental attitude. This may lead to overestimation of effect size value.

The overall evaluation of results achieved it can be said clearly that with the participants' performed an 8-day outdoor education programmes on the environment, contribute significantly to their renewable energy attitude, environment behavior, environmental education self-sufficiency. These results show related to this project that highly effective increasing in renewable energy attitudes, environmental behaviors and self-efficacy for environmental education of teacher candidates.

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DETERMINING AND COMPARING THE SCIENCE PROCESS SKILL LEVELS OF 5TH AND 8TH GRADE STUDENTS

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ABSTRACT: The aims of this study are to determine and compare the levels of scientific process skills of 5th and 8th grade students. The skills which were examined specifically for this research are as following: Observation, classification, measurement, recording data, establishing space and number relationships, predicting, identifying variables, interpreting data, inference, hypothesizing, modelling, and experimenting.

Research was conducted with a total of 200 students, 100 students at 5th grade and 100 students at 8th grade, attending to a middle school in the province of Kars. In this research the survey method was utilized. Science Process Skills Test (SPST) consisting of multiple choice questions administered to students of each grades to determine their level of science process skills. Data was examined by utilizing frequency and percentage distributions.

The findings show that the percentage of success achieved by the 8th grade students is higher than the 5th grade students. In addition, both 5th graders and 8th graders' performance level for experimenting and establishing space and number relationships are lower compared to other process skills. Findings also showed that 5th grade students are better in recording data, and 8th graders are better in creating a model in compare to other science process skills.

Key words: science process skills, teaching science

INTRODUCTION

In today's information and technology era scientific knowledge grows exponentially, technological innovations progress rapidly and science and technology affect every area of our lives significantly. Under these conditions, it is evident that science and technology education plays a key role for the future of a society. Topsakal (2005) defines science and technology course as a window that helps students to acquire necessary knowledge, skills, attitudes and values that will allow them to be conscious and responsible citizens and successful in their future professions. In this regard, all communities, particularly the developed countries are in a constant effort to improve the quality of the science and technology education (Aydogdu & Kesercioğlu, 2005). Science and technology education has an extremely important role in training individuals who possess science process skills such as observing, collecting data, and inferring, as well as skills of searching information, critical thinking, identifying problems, and problem solving.

Science process skills are basic skills that facilitate learning, help students to acquire necessary knowledge and methods to perform an inquiry, and develop a sense of responsibility for their own learning (Çepni, Ayas, Jonhson and Turgut, 1997). According to Lind (1998), scientific process skills are thinking skills that persons use in constructing knowledge, reflecting on a problem and formulating the results (Tan &Temiz, 2003). Acquiring these skills in science and technology courses in the teaching process has an important place. Students can be helped to acquire science process skills by planning activities which are appropriate for their mental and physical status. As Bağcı-Kılıç (2003) stated, students might not be expected to design and conduct scientific research in very early grades, however, they might be helped to acquire basic process skills. Skills such as observation, measurement, classification, and prediction can be acquired to students by planning short term activities. These preliminary skills then can be a basis for the higher grades in developing more complex skills such as recording data, interpreting data, formulating hypothesis, and experimenting.

Çepni et al (1997) classify science process skills in three categories: **basic science process skills**, **causal science process skills**, and **experimental science process skills**. Basic skills are measurement, classification, number/space relations, and recording data, whereas causal skills includes predicting, identifying variables, data interpretation, and inference. The experimental skills are formulating hypothesis, analysing data, creating a model, controlling and changing variables, and decision-making.

Observing

Observation is identifying the properties of an object or event using our senses (Arslan &Tertemiz, 2004). When children make observation, they use five senses to gather information about objects or events in the environment. Observation is the simplest of all scientific process skills and the primary means for obtaining information (Monhardt & Monhardt, 2006).

Measuring

Measurement is using standard measures or estimations to describe specific dimensions of an object or event. (Padilla, 1990). These measurements can be made to determine properties such as length, mass, volume and the time (Monhardt & Monhardt, 2006).

Classifying

It is simply organizing the data collected through observation. It can be expressed as a grouping or arranging of the events or objects according to similarities or differences (Karamustafaoğlu & Meşeci, 2014).

Recording Data

Students collect both qualitative and quantitative data in experimental processes. These data are recorded as charts, tables, graphs or models. Organizing data in this way simplifies interpretations and results (Kesercioğlu & Aydoğdu, 2005).

Setting Number and Space Relations

Students try to understand and describe objects according to their planar or three-dimensional shapes in order to learn space-related processes. Number relationship can be defined as the process of using numbers to define the outputs or ongoing properties of an activity (Çepni et al., 1997).

Predicting

Predicting is guessing the most likely outcome of a future event based upon evidence. Information about what will happen after continuation or modification of a process is determined by predicting (Arslan & Tertemiz, 2004).

Identifying Variables

This skill means ability for figuring out the factors that can affect an experiment. Students should perform controlled experiments to develop this process skill. It is important to change only the variable being tested (independent variable) and keep the others constant in controlled experiments. The aim of this process is to monitor the changes occurring in dependent variable by the changes in independent variable (Aydoğdu & Kesercioğlu, 2005).

Interpreting Data

Delen and Kesercioğlu (2012) explain the interpretation of data as transferring information by using graphs and tables. Aydogdu and Kesercioğlu (2005), in addition, includes the meaning to be given to the results of experiments and observations in process of interpretation of data.

Inference

An inference is an explanation based on an observation or experience. Inference is usually confused with prediction. However, while prediction is guessing what will happen as an outcome of an event, inference is drawing conclusion from an observed event. Our conclusions must be based on data. We make inferences about causes of phenomena we observe based on the data which was collected through observation (Aydoğdu & Kesercioğlu, 2005).

Hypothesizing

A hypothesis is a testable statement of the investigator's best guess depending on experience and observation as to the relationship between two variables. When a student formulates a hypothesis, he suggests an explanation consistent with available observations, questions and evidence (Arthur, 1993, 12-13; cited by Tan & Temiz, 2003).

Making Models

A model is a verbal, structural, or graphic representation of the physical world. Models can be magnified samples of small objects, reduced size samples of large objects, or conceptual models which are prepared for understanding of complex ideas (Kesercioğlu & Aydogdu, 2005). Therefore, making models can be explained as making a concrete design of objects, events or ideas.

Experimenting

Conducting an experiment contains the skills of asking appropriate questions, formulating hypotheses, identifying variables and controlling these variables, designing experiment, performing the experiment and interpreting the results (Padilla, 1990). The aims of this study are to determine and compare the levels of scientific process skills of 5^{th} and 8^{th} grade students.

METHOD

Descriptive survey research model is used in this study in order to determine and compare the 5^{th} and 8^{th} grade middle school students' level of scientific process skills. Survey model is a research approach which aims to describe a current or past situation as it is. The event, individual or an object subject to the research is tried to be described as it is in its own conditions. (Karasar, 2005). Research was carried out with 5^{th} grade(N=100) and 8^{th} grade(N=100) students who are attending a middle school in Kars city centre.

Science Process Skills Test consisting of 21 multiple choice questions is utilized as data collection instrument. Number of questions to measure each skill is as following: Observation=2; classification = 2; measurement= 3; recording the data= 1; the number and space relationships= 2; prediction= 2; identifying the variables= 3; interpreting data= 2; inference= 2; formulating hypothesis =2; modelling= 1; and experimenting= 1. Since the questions for measuring observation skill were also used to measure two other skills, test consists of 21 questions in total. The test was developed by the researchers. Content validity of the test was established by experts in science education. Frequency and percentage distributions were utilized in the analysis of the data.

RESULTS AND DISCUSSION

Each correct answer on Science Process Skills test was scored as 1 point; and each wrong answer was scored as 0 point. Accordingly, the lowest score on the test will be 0, while the highest score is 21. Fifth graders' average score on the test is $\bar{X}$=12.31, while the average score of 8^{th} graders' is calculated as $\bar{X}$=14.75. The success rate of 5^{th} grade and 8^{th} grade students' are 58.61 %, and 70.23% respectively. These results showed that science process skills of 5^{th} grade students were at a moderate level, whereas 8^{th} grade students' science process skills were found to be at a more advanced level. Table 1 shows question numbers measuring each skill in the test; and frequency and percentage of the students who answered the questions for each skill correctly.

Table 1. Frequency And Percentages Of Correct Responses By 5^{th} Graders On Science Process Skills Test

Questions	SPS	Frequency (f)	Percentage (%)
7 & 19	Observing	129	64,5
1 & 2	Classifying	137	68,5
3, 5, v&11	Measuring	171	57
8	Recording data	74	74
9 & 10	Number Space relations	62	31
4 & 13	Prediction	138	69
7, 14, & 15	Identifying variables	197	65,6
16 & 17	Interpreting data	125	62,5

6 & 12	Inference	106	53
18 & 19	Hypothesizing	106	53
20	Making models	72	72
21	Experimenting	43	43

Middle School 5th grade students' most advanced skills are determined as recording data (74%) and modelling (72%). In addition, students reached a relatively high level for the skills of observation, classification, prediction, identifying variables and data interpretation (62.5% -69%). They showed a moderate ability in inference and hypothesis (53%-57%). However, their skills in number and space relationship (31%) and conducting experiments (43%) were at a low level.

Table 2. Frequency And Percentages Of Correct Responses By 8th Graders On Science Process Skills Test

Questions	SPS	Frequency(f)	Percentage (%)
7 & 19	Observing	147	73,5
1 & 2	Classifying	169	84,5
3, 5 , & 11	Measuring	197	65,6
8	Recording data	79	79
9 & 10	Number Space relations	91	45,5
4 & 13	Prediction	156	78
7, 14, & 15	Identifying variables	230	76,6
16 & 17	Interpreting data	127	63,5
6 & 12	Inference	144	72
18 & 19	Hypothesizing	136	68
20	Modelling	86	86
21	Experimenting	60	60

Eighth grade students' highest level of success were determined in classification (84.5%) and making models (86%). They were also found to be highly successful in making observations, recording data, prediction, identifying variables and inference skills (72%-79%). However, their skills in measuring, interpreting data, and formulating hypotheses were found to be at a moderate level (60-68%). The lowest success was determined for number and space relationship. Only 45.5% of the students reached at a good level in number and space relationship.

Table 3.Frequency And Percentages Of Correct Responses By 5th And 8th Graders On Science Process Skills Test

SPS	5th Grade students		8th Grade students	
	Frequency (f)	Percentage (%)	Frequency (f)	Percentage (%)
Observing	129	64,5	147	73,5
Classifying	137	68,5	169	84,5
Measuring	171	57	197	65,6
Recording data	74	74	79	79
Number Space relations	62	31	91	45,5
Prediction	138	69	156	78
Identifying variables	197	65,6	230	76,6
Interpreting data	125	62,5	127	63,5
Inference	106	53	144	72
Hypothesizing	106	53	136	68
Modelling	72	72	86	86
Experimenting	43	43	60	60

Comparison of the results for 5th and 8th grade students in science process skills showed that they were nearly at the same skill level for recording data and interpreting data. However, 8th grade students' skill levels for observation, measurement, prediction, identifying variables, formulating hypothesis and modelling are moderately higher than the 5th graders. In addition, there is a large difference in classification, inference and experimenting skills in favour of 8th graders. However, for both grades the lowest success rate was for number and space relationships. Fifth grade students were found to be most skilful in recording data while 8th graders' most developed skill was modelling.

Analysis of the data showed a moderate success level in science process skills by 5th grade students. This result is consistent with the results of the research by Özdemir (2009), which determined a moderate level of scientific process skills by 5th grade students as well. However, low level of success in experimenting skills (43%) which is essential in science learning raises concern. Similarly, low ratio of students (31%) who are advanced in number and space relationships skills. This result suggest that activity based science classes are absent or students are not provided with opportunities to facilitate their learning of abstract concepts by using concrete models or simulations.

Eight grade students' science process skills were found to be more developed compare to 5th graders. However, their level in experimenting and number and space relationship were quite low comparing to other process skills. This result suggest that students do not have enough opportunities for doing experiments, which might be as a result of not sparing time for hands on learning, or the school's deficiencies concerning laboratory facilities.

Çakar (2008) study which was carried out with 5th grade students determined the level of students' science process skills. The data obtained from the study showed that 5th grade students did not fully realized science process skills which were an essential goal of the science and technology course curriculum. Özdoğru (2013) study also showed that 6th grade students' performance level of scientific process skills were below 50%. Similarly, Aydogdu (2006) study with 7th grade students, reported that they were at below average level. Another study by Ünal-Çoban (2009), conducted with 7th grade students, found mean score on science process skills test by experimental and control groups as $\bar{X}$= 3.81 and $\bar{X}$ =3.19 respectively while the highest attainable score was 23. These averages indicate very low levels of the scientific process skills. However, research by Öztürk (2008) carried out with 7th grade student students reported a positive result in which students reached above moderate level in science process skills.

CONCLUSION

Comparing science process skill levels of 5th and 8th grade students showed that most of the skills developed through the years of schooling or by age of the students. However, some skills such as recording data and interpreting data remain at the same level. This result suggests that students have showed less development regarding cause-effect relationships. Based on the results of the study, it is suggested that students should perform activities that they need to think about the results of an event. In addition, during the activities students should be given opportunities to comment and express their opinions and discuss about their comments or opinions.

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TEACHING THROUGH THE BLENDED MODE OF LEARNING: BENEFITS, ISSUES AND CHALLENGES

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ABSTRACT: The concepts of online and blended learning have gained considerable importance in academia and programmes are developed where educational concepts are presented by utilizing the said modes. The idea of blended learning revolves around an education programme in which information is shared through an intermix of online media and face-to-face interaction with the instructor. The blended mode of teaching and learning makes students autonomous learners as they face the challenges to adjust between online and face to face interaction. The interaction also engages them in critical inquiry as they investigate learning materials presented through an unconventional mode.

Blended mode of learning is well suited for university students where the possibility of experiencing self-directed learning runs supreme. The paper, therefore, discusses the results of the efficacy of the blended mode of learning as experienced by undergraduate students at a private university. In addition, the paper also highlights the issues and challenges that impede the successful implementation of blended learning programmes in higher education. Moreover, the paper also gives recommendations for the smooth integration of the blended mode of learning for various education programmes at the university level.

Key words: blended learning, English language teaching, online mode, higher education

INTRODUCTION

The goal of education is to prepare individuals who can make rapid yet smooth adjustments in society. This is only possible if education standards keep pace with the changing world and modify themselves according to the changing realities. Zinsar (2012) opines the same and states that since technology and globalization are transforming the world into one interconnected society, a new set of skills – in fact, a new education – is needed for future citizens. These new set of skills are incomplete without ample weight given to technological literacy. Technological literacy is, "the ability to use, manage, evaluate and understand technology." (ITEA, 2006, p.4). In education, it has therefore, become incumbent that literacy skills combine with technological skills to create a new educational paradigm. Co-existence with technology has become a vital need and therefore ways need to be paved for the smooth amalgamation of technology in education.

Use of technology not only adds value to the educational process but also extends students an opportunity to experience learning beyond the borders of a traditional teaching learning set up. One of such active technological fields is the blended learning (BL) mode. Krasnova and Sidorenko (2013) define BL as a method of teaching that combines the most effective face-to-face (f2f) teaching techniques and online interactive collaboration, both constituting a system that functions in constant correlation and forms a single environment.

Blended mode of learning can be successfully integrated in the education domain at all levels, however, at the tertiary level it significantly carves out a niche for itself. Dziuban, Hartman and Moskal (2004) state that BL offers potential for genuine transformation in higher education. Garrison and Kanuka (2004) further imply that BL plays a very important role in transforming and promoting the quality of higher education. Tian and Fu (2004) view BL as one of the top trends in knowledge dissemination. Through BL, education thus comes out of a traditional single mode operation and is transmitted through multiple modalities. This multiple mode operation is necessary to face the existing challenges that a modern day world offers to students. It makes them autonomous learners on one hand and brings learning to their door step. Students access quality education in their own time frameworks and without the rigours of f2f learning all the time. Moreover, self-paced learning brings self-discipline and provides more time for critical reflection. Both are key expectations in higher education.

Background of the Problem

In institutions of higher learning it is becoming increasingly difficult to meaningfully engage students with skills and subjects that do not directly impact the core technical areas. One such area is the learning and teaching of English language. English language, though a compulsory requirement at the undergraduate level, has failed to gain attention and merit as students as well as institutions consider it as a subsidiary compulsion. Krasnova and

Sidorenko (2013) opine the same and lament that in spite of the understanding of the language importance it is not in priority for a technical institution. Johnson and Marsh (2014) also hint at the unclear sense of the importance of EFL for professional development. Moreover, what students and institutions fail to conjecture is that English as a medium of instruction is a highly important skill to develop as it cross cuts through all disciplines and is a major source of effective and professional communication. Adequate and systematic learning of English enables students to successfully cope with the rigours of academic courses and prepares them to articulate their thoughts well at a professional level.

As a marginalized area of learning it is highly desirous to teach English language through the provision of pedagogical variety and inclusion of an unconventional mode like BL. The said paradigm shift will attract student attention and benefit the educational process as a result.

Statement of Problem

The overpowering presence of technology has exerted an influence on all aspects of human life. Education cannot remain distant from the prevailing reality. Rather than staying aloof it is a prudent step to move forward and benefit from the powers of technology, BL in particular. As an instructional tool it makes students the center of learning and makes them experience educational autonomy, pedagogical variety, and self-reflection. Garrison and Vaughan (2008) suggest that BL provides a more engaged learning experience to students.

In institutions of higher learning, the teaching of English language has emerged as an enormous challenge as students do not regard it as a major focus area as it is not a subject that directly impacts their professional and technical knowledge. Moreover, the instructional input given for the teaching of English is not stimulating and challenging enough to generate interest in the said skill. Further, no innovative processes including the BL mode have been investigated in the past to improve the teaching and learning of English

This small scale research study looks at the possibility of introducing the BL mode of instruction for the teaching of English at an undergraduate level. The study is based on the premise that a shift in instructional practice from a total f2f to BL may generate more interest among students about language learning, make them avid language learners and increase their language competence with respect to oral communication skills. Moreover, the study endeavours to explore the challenges and issues that may arise during the BL process.

Literature Review

Blended learning is an underutilized medium in academia despite the fact that it offers rich opportunities for learning. Higgins and Gomez (2014) opine the same and state that BL is often under-used by academics and students. However, a lot of potential exists in terms of utilizing the online medium of instruction with f2f learning. Watson (2008) opines that BL combines the online delivery of educational content with the best features of classroom interaction and live instruction in such a way as to personalize learning, allow thoughtful reflection, and differentiate instruction from student to student across a diverse group of learners. This is specifically meaningful in higher education where the nature of courses taught demand a certain kind of autonomy and independent thinking. Garrison and Kanuka's (2004) explore the benefits of BL in higher education and state that the incorporation of it in higher education programmes redefines the role of higher education institutions as they move towards more learner centered and self-directed modes of teaching and learning.

The incorporation of BL in English language teaching is a widely acceptable tool in higher education. Whittaker (2013) defines blended language learning (BLL) as a particular teaching and learning environment where the f2f is combined with computer assisted language learning (CALL). Sharma and Barrett (2007) exemplify BLL as f2f teaching with an appropriate use of technology. Dudeney and Hockly (as cited in Whittaker, 2013) explain BLL as a mixture of f2f and online course delivery. The possibility of BLL is thus a widely acknowledged phenomenon in terms of enhancing and facilitating language learning at the tertiary level.

BL thus affords students the opportunity to experiment with learning in a computer-generated mode together with f2f interaction with the instructor. Woodall (2010) values the benefits of a virtual classroom and indicates that a virtual classroom allows instructors and learners to be in different places at the same time. It also allows the instructor to archive the event for later viewing. This definitely allows extensive time for better reflection and analysis as teachers and students can both recluse and carefully examine the shared material and discourse patterns. There are studies that authenticate the successful application of BLL with positive results. Huang and Li (2014) successfully implement a unit of English teaching through the BL mode consisting of class preparation, classroom teaching and after-class assignment. The results show that learners perform better in cooperation awareness and learner autonomy. Higgins and Gomez (2014) share a successful BL module on English studies where students together with f2f teaching worked online to post their analysis of poetry and blogging on topics related to modules. The said exercise is reported to have enhanced their experience of the module. Jin, Zhang and Shen (2012) share an empirical study, on a writing course, where the combination of f2f and online course seems to have lessened the writing anxiety among students and increased their confidence. Sharma (2007) advocates the use of classroom instruction with online practice. He further envisages the use of BL in language teaching through the use of websites in which pages can be edited, creation of computer audio files and blogs. Liu and Zha (2009) quote a study focused on English learning motivation and strategies under BL environment. The results taken from 800 students show positive effect of BL on students' English performance and learning motivation.

The benefits of BLL are immense as they give way to self-directed learning and prepare students to take charge of their learning. However, the challenges that may beset the said mode of learning cannot be overlooked. So and Bonk (2010) rightly claim that blended teaching and learning offer a complex and challenging new model for many teachers, as well as their students. At the fore set, students may not be motivated enough to self-regulate themselves while doing online work. Traditional f2f classrooms also take the spirit out of them to self-direct their learning and experience independent learning paradigm. Johnson and Marsh (2014) hint at lack of autonomous motivation, time management, patience with slow to load online applications and importance of online work as major challenges in the successful implementation of BLL. Moreover, lack of teacher preparedness in handling BLL comes out as another impediment towards the successful running of the said programmes. Teachers need to re-envisage their roles in order to teach with improved and modern pedagogy. Senior (2010) points at the same need and reiterates that BL offers teachers an opportunity to deal with the changing roles of teachers in the 21st century and requires a reconsideration of the "valuable part they play in supporting the learning opportunities of their students in our progressively interconnected world." (p.146) Garrett (2009) too points at the requirement of well-trained language teachers for better student learning outcomes. Ocak (2011) claims that sometimes inadequate clarification of roles in blended courses confuses both teachers and students and therefore lead to problems of content delivery and online application of skills. The need therefore is to initiate BLL with absolute professional skill so that maximum benefit can be derived from it and the challenges minimized for effective outcomes.

Güzer and Caner (2014) thus perceive BL as a useful, enjoyable, supportive, flexible tool for learning. Marsh (2012) is of the view that BL offers language teachers a different range of learning opportunities through the use of technology. Ruthven-Stuart (2003) cites a study in which a poll taken from 300 language teachers from 36 countries consider CALL as a complement to classroom teaching. The need is therefore is to seamlessly incorporate the online component of language with f2f to achieve the desired results and reach optimum student learning.

Research Methodology

The study is based on the premise that language can be learnt effectively through the BL mode by complementing classroom teaching with the online component of language learning. The preferred strategy affords students an opportunity to practice language independent of the teacher and in one's own time framework.

The study which made BLL mode of learning as its basis was conceptualized and practiced with one batch of undergraduate business studies' students at a private sector university. The research design for the purpose of this small scale study was qualitative in nature. Qualitative research involves highly detailed but rich descriptions of human behaviours and opinions (Savenye & Robinson, 1996). Moreover, this particular study followed the observational case study approach towards the investigation of the stated phenomenon. According to Bogdan and Biklen (2003) a case study is a detailed examination of one setting, or one single subject, or one single depository of documents, or one particular event. McMillan (2008) defines an observational case study as a type of case study where the participant observation is the primary method of gathering data to study a particular entity or some aspect of the entity.

The Intervention

The BLL approach was applied in the two Oral and Communication Skills (OCPS) language sections of the BBA programs. The BL programme was brought in by an outside agency and the scheme of studies was merged with the regular OCPS course requirements. The objectives of the regular OCPS course was to focus on various aspects of oral communication and public speaking. The BL approach was used in the first 12 weeks of the course where the f2f learning components, proposed by the outside agency, were reinforced through the online mode. The concepts taught through f2f learning were given as online exercises for practice. Together with the BL mode the regular teaching of the OCPS course also continued. The intervention is diagrammatically presented below:

12 weeks (36 hours)			**3 weeks (9 hours)**
Regular OCPS	+	BL f2f + Online Exercises	Regular OCPS

Figure 1. Oral communication and Presentation Skills (OCPS) Course for 15 weeks

Sampling Procedure

The type of sampling procedure used for the purpose of this particular study was purposeful. According to McMillan (2008) in qualitative studies participants were selected purposefully. He went on to claim that in purposeful sampling, the researcher selected particular individuals or cases because they would be particularly informative about the topic.   37 students were selected from the two sections of the OCPS class to participate in the study. All the selected students were students of the undergraduate business programme of a private sector university.

Data Collection Tools

After the students underwent the intervention for a period of 12 weeks, questionnaires were distributed to gauge their responses on the BLL sessions, the technical quality of the online component, the quality of learning through the BL mode and their satisfaction with the BLL mode. Moreover, focused group interview and feedback was also taken from students regarding the BLL sessions and their oral communication was also analyzed for the examination of the content learnt through the online session.

Data Analysis

In qualitative research, "data analysis means the process of systematically searching and arranging the interview transcripts, field notes, and other materials that you accumulate to enable you to come up with findings" (Bogdan & Biklen, 2003, p.147). Data analysis, therefore, involves working with the data, organizing them, breaking them into manageable units, coding them, synthesizing them, and searching for patterns. This process is known as categorical aggregation which according to Stake (as cited in McMillan, 2008) is a process in which the data is coded and instances are collected from which meanings emerge. The data collected through questionnaires, focused group interview and examination of language content used in quizzes was codified and information synthesized for analysis.

The various forms of data collection tools used in the study also rendered credibility to the data through triangulation. McMillan (2008) calls triangulation one of the most common techniques to enhance the credibility of a qualitative study. Triangulation renders credibility to qualitative studies through comparison of findings by using various data collection techniques. The idea of triangulation is based on the premise that a single method of data collection exposes the data to researcher's bias and, therefore, more than one method is necessary to counter check the credibility of the data and findings. The same was done in the study for the verification of data and achieve fuller understanding of the phenomenon under study.

RESULTS AND FINDINGS

The following section will outline the results of the study. The results are derived from questionnaires, focused group interviews and analysis of quizzes taken for online work:

Table 1 shares the results of students' responses on the effectiveness and appropriacy of BLL materials

Table 1.Effectiveness and Appropriacy of BLL materials

How did you find the online component of the British Council LEP course?	**Very effective**	**Effective**	**Appropriate**	**Ineffective**	**Very ineffective**
	0%	30%	46%	19%	2.7%
How would you rate the structure and content of the British Council	**Very Difficult**	**Difficult**	**Appropriate**	**Easy**	**Very easy**
	0%	13.5%	35%	40.5%	10.8%
The British Council LEP course was useful in the improvement of your oral communication skills.	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
	0%	27%	27%	46%	0%
The material was not interesting and/or challenging enough	13.5%	11%	30%	21.67%	0%
The website had technical problems	16.2%	38%	32%	11%	2.7%
It was difficult to attempt online work with full course load.	21.6%	27%	24.3%	11%	0%
I was not regular in practicing the British Council online materials	2.7%	24.3%	19%	29.7%	5.4%
With appropriate changes, would you like to learn and practice language through the blended learning mode?	2.7%	51%	24.3%	0%	5.4%

Table 2 shares the results of students' responses on the contribution of the BLL course in improving English language skills.

Table 2.Contribution of the BLL course in improving English language skills

Skills	Very Good	Good	Fair	Poor	Very Poor
Writing	2.7%	35%	40.5%	8%	0%
Reading	5.4%	59.4%	27%	2.7%	0%
Oral Communication	8%	19%	30%	2.7%	0%
Grammar	32%	40.5%	21.6%	2.7%	0%
Vocabulary	16.2%	27%	40.5%	16.2%	0%

Table 3 outlines the responses of students' with respect to the preference for more online language learning courses

Table 3.Preference for more online language learning courses

Yes	No
62%	38%

Table 4 shares the results of the weight given to language skills in quizzes

Table 4. Assessment of Quizzes

Quizzes	Reading Comprehension	Grammar	Pronunciation	Vocabulary	OCPS
Quiz 1	22%	67%	11%	0%	0%
Quiz 2	22%	67%	0%	0%	0%
Quiz 3	55%	44%	0%	0%	0%
Quiz 4	50%	50%	0%	0%	0%
Quiz 5	25%	50%	0%	17%	0%
Average	34.8%	55.6%	2.2%	3.4%	0%

Analysis of the Study

The following section will present a cross analysis of the study through the results generated from questionnaires, focused group interview and student work:

Positive attitude towards the BLL mode of teaching

Most of the students responded positively to the introduction of the BLL mode of learning. 51% of the students showed eagerness to learn language through the BL mode and 61% of students wanted to have more BL courses. This response was taken in a positive regard as BL mode was introduced for the first time in contrast to typical f2f learning. In a study, Leakey and Ranchoux (2006) also reported that students found the BLL experience positive and motivating and more preferable to a traditional classroom.

The students, therefore, accepted the challenge and regarded it as an innovative and progressive tool to augment language learning. However, some students in their interviews highlighted the need for more modifications to align the contents of the course well with the specific objectives of the course. Hancock and Wong (2012) supported the BL approach and regarded it as an effective strategy aimed at meeting the challenges of the modern and technological world.

Language challenge presented by the BLL course

As outlined in the results most students found the course contents of the BLL mode easy and not challenging enough. 40.5% of the students received the content as easy and 10.8% regarded it as very easy. On the contrary, 35% perceived it as appropriate. The interviews taken from the students reiterated the fact that the content of the BLL course was very easy and did not pose enough challenge to the students. One of the students reported that the contents were, "very basic and repetitive". (Personal Communication, November 20, 2015). Moreover, the students generally got excellent marks on the assessments set on the online quizzes. Very few of them secured below average marks. This pointed at the lack of challenge posed by the online materials as they students effortlessly obtained above average marks.

The said responses pointed at the lack of planning and preparedness by the outside agency to align and develop the materials according to the needs of the students. On one hand, the BL mode of course operation was well received by the students, but there was clear dissatisfaction with the course contents and the language challenge they posed.

BLL Course and Its suitability with the OCPS course expectations

The results of the study indicated that generally students accepted the integration of the BLL component in their regular OCPS course, however, they did not regard the materials as suitable to the needs of an OCPS course. 46% of the students felt that the contents of the course did not improve their oral communication skills. 35% of the students thought that the oral communication inclusion in the course was poor. 35% of the students indicated that the BLL course focused more on writing in a good way where as 40.5% regarded attention to writing as fair. 59.4% of the students highlighted that reading was given good attention in the course whereas 40.5% of the students regarded grammar being catered to more. This was further attested by the assessments prepared by the outside agency to check online material proficiency. Most of the quizzes were based on reading comprehension and grammar. On the average reading comprehension was given 35% and grammar 56% weightage. Five quizzes, based on the online materials, were taken during the course and none of them made oral communication as the focus. This authenticated students' claim that the materials did not align well with the objectives of the OCPS course guidelines.

The results clearly pointed at the fact that the oral communication skills were not the focus of the online course content. The results also pointed at the possibility that a 'one size fits all' course was implemented by the outside agency. The needs and the objectives of the course were not kept in mind prior to the implementation of the course. This calls for further deliberations regarding the suitability of materials vis a vis particular courses. Krasnova and Sidorenko (2013) also contended that the success of BL depended upon a well-structured and planned syllabus. Kaur (2013) argued that even if the institution realized the efficacy of BL, it failed to understand that this was a complex process that needed thought beyond an individual programme. The usefulness of the BL mode of operation could be completely jeopardized if the suitability of course materials were not aligned well with the overall objectives of the courses.

Technical quality of the BLL course

The results signified that technical glitches emerged as a standing issue with the BLL mode. Higgins (2014) contended that virtual learning environments were not always user friendly. 38% of the students agreed and 16% strongly agreed to having technical problems while doing online exercises. The interviews also suggested the same and many students pointed at the difficulty they had in their effort to access online language materials.

Some of the students' work taken through assessments and quizzes also revealed that the concepts were not internalized adequately as they were unable to access the materials on time.

Some of the issues cited were connectivity problems, slow internet and hanging of the website. Smyth, Oughton, Cooney, and Casey (2012) also cited a study in which first year post graduate nursing students reported poor internet connection as a challenging factor which disallowed them to use the BL system properly. Technical issues, therefore, emerged a challenge which must be taken seriously to ensure the smooth functioning of the courses. Such issues, if persisted, could lower down the interest of students in online work together with the loss of efficacy of the BL programme.

Regularity in attending to the BLL mode

Amongst the factors that lowered down the effectiveness of the BLL programme was the regularity of students in attempting the online exercises. Li (2015) contended that learner's elf-regulation remained a major challenge in the BL context. 24.3% of the students agreed that they were not regular in attempting time-bound online exercises. However, 29.7% disagreed with the notion. One of the major factors outlined by students for remaining irregular was the pressure of the full course load. 27% of the students agreed and 21.6% of the students strongly agreed that the full time course load became an inhibiting factor in making them give quality time to online exercises. In the interviews one of the students remarked, "it was very difficult to manage online work with full term course load". (Personal communication, November 20, 2015). However, it could be argued that effective time management might be the cause of not giving enough time to online exercises. Awan, Azher, Anwar and Naz (2010) also contended that university students needed to break out of the mold of relative passivity and nervousness with second language (L2) acquisition**.** BL as a flexible mode involved self-discipline and self-monitoring. Generally students were more used to attending f2f classes, and therefore, could not have disciplined themselves well with the more flexible BL mode. Technical problems with the website might have also played a role in transcending the allotted time boundaries for work completion.

Suggestions for the improvement of the course

The students came up with several suggestions for the improvement and effective and successful functioning of the BLL mode. A firm suggestion which came from the students was that for the successful application of BLL programmes it was important to align it well with the overall objectives of the course. Shibley, Amaral, Shank, and Shibley (2011) too stressed that appropriate alignment and purposeful integration of ICT and teaching strategies in a blended course could enhance both F2F and online student learning because it offered students "more structured learning opportunities outside of class than they have had previously [and this] increased time-on-task seems to improve learning" (p. 84). Yang (2001) too contended that online mode was not an add-on to f2f learning. True effectiveness could only be reached once the two modes were synergized for meaningful language learning.

The students also opined that interesting online materials were necessary for sustained attention in the course. They further elaborated that the online materials should not be repetitive, lengthy, time consuming and too easy as these factors gave rise to boredom and monotony. They further suggested that the materials must pose a kind of language challenge for them to get an intense experience of language learning. As outlined in the results about 23.5% of the students agreed and strongly agreed to the fact that the materials were uninteresting and not challenging. They also recommended a booklet for the better internalization of operational procedures.

The suggestions indicated that the students were genuinely interested in the BLL programme and with appropriate amendments and alterations this could become a strong component of language teaching and learning.

CONCLUSION

The study revealed that the BLL mode exercised a sound potential at the undergraduate level and the students displayed a positive inclination towards the implementation of the said mode in education. Szeto (2014) shares a similar view and contends that blended synchronous approaches are gaining currency in changing the higher education landscape. Watson (2008) informs that, "the blended learning model is likely to emerge as the predominant model of the future" (p.3). The need, therefore, is to carefully incorporate BLL in higher education by overcoming organizational challenges, building training capacity of students and others in using the BL mode and most of all making all stakeholders aware of its benefits. Moreover, it is highly desirable to run BLL courses in alignment with the overall objectives of the courses. The online and f2f components must complement each other. Li (2015) opines that learning contents, learner factors, learning objectives should be given consideration in preparation of BL courses. Further, it is imperative that the online materials are developed keeping in mind the learner language needs. 'One size fits all' materials are not suitable in situations where learners have diverse language needs. Also, it is worthwhile for the language teaching faculty to extend their roles beyond teaching and become material developers. Tomlinson (1998) contends that teachers are best suited to be material developers because they are cognizant of the language needs of their students and therefore must get grounding in materials development. It is worthwhile to solicit technical help form outside agencies but the mandate to tailor material to specific leaner q

Krasnova and Sidorenko (2013) are of the view that BL has a tremendous potential in teaching a foreign language as it offers an opportunity to integrate innovative and technological advances of online learning with interaction and participation of best traditional practices. BLL approach is therefore a successful mode of operation as it enhances emancipatory and self-directed learning on one hand and on the other enables learners to critically analyze concepts in their own allotted time. However, efforts should be geared towards making it more relevant and appropriate to student context so that maximum benefit can be derived from it.

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MOROCCAN TEACHERS' CONCEPTIONS ON FOOD EDUCATION

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ABSTRACT: Food education is a component of health education which plays an important role in the development of citizenship and human resources of a country (Jourdan, 2010). School is a vital element in implementing some positive behavior and making students drop out other dangerous behaviors. Today educating students to healthy nutrition allows them to develop the abilities to act, choose, decide on an autonomous and responsible manner and capacity face reality and deal with conflict (Jourdan, 2010). Food is present in our daily lives and in our curricula but the problem lies in the manner/ way in which it is processed, hence the importance of this study. And as the teacher constitutes a strong link of the didactic transposition, he may influence this transposition by his conceptions, values and practices (Clément, 2004). In this context, we are interested in this study to identifying the teacher' conceptions about food education, and answering the following question: - What are the Moroccans teachers' conceptions about food education? We have thus used as a tool of investigation in the form of a questionnaire administered to 200 teachers at all grade levels. The conception of Moroccan high-school teachers towards food education is more often expressed by implementing the Promotion of Health (HP) approach, while those at primary and middle school adopt a Biomedical approach (BM) in their definitions. This could be in relation to each grade level teachers' educational background of each level school.

***Keywords*:** Food Education, Conception, Didactic transposition, Teacher, Promotion of health, Biomedical approach.

RESEARCH CONTEXT AND PROBLEMATIC

Food education is a component of health education which plays an important role in the development of citizenship and human resources of a country (Jourdan, 2010). Food Education is seriously taken into account by the international education systems, as it is subject to numerous studies and programs fund-raised by international public organisations' including the World Health Organisation (WHO) and Food Aid Organisation (FAO).This is evidence that food is an essential condition for the physical, mental and psychoaffective growth of the child and the adult. It serves as a major determinant for health and a key factor to a country's development (Moroccan Ministry of Health, 2011).

In Morocco, foodstuffs take a major place among the vital concerns of the citizens; that is clearly apparent in the outcomes of the investigation undertaken by the High Commissioner of Plans (Statistics Division) in order to determine the consumer price index , all along the years 2007 and 2013).The study reveals that foodstuffs (as well as alcohol-free drinks) make the first priority among other products Moroccans consume and throughout the years of the study there has been a dramatic increase in the consumption of these products (HCP, 2015).

In relation to all developing countries Morocco is undergoing consequences of the deviation from the Mediterranean diet model. In this context, there have been profound and rapid changes in the Moroccan nutrition patterns as a result of the growth of food production industry, and the role of the media in encouraging the consumption of products generating obesity and other metabolic disorders, as well as setting up a nutrition transition.

This transition is characterized by the coexistence within the same social segments, even within the same family, of various diseases including obesity among adults and malnutrition of young children (Moroccan Ministry of Health, 2011).

By dint of these changes, challenges relating to the education of young people, the future generation, are increasingly demanding. To convey the best necessary training to all young people, against the backdrop of a complex and changing social environment requires a constant and continuous readjustment of practices; from this stand point emerges the indispensible/crucial role of school that is actively involved in adopting certain positive behaviors and abandoning other risky practices (and harmful habits) for young people.

School is a vital element in implementing some positive behavior and making students drop out other dangerous behaviors. Today educating students to healthy nutrition allows them to develop the abilities to act, choose, decide on an autonomous and responsible manner and capacity face reality and deal with conflict (Jourdan, 2010).

Food is present in our daily life and in our curricula but the problem lies in the way with which it is tackled in class; hence the concern of this study In fact, the choice of contents of knowledge to teach is made according to school programs and teaching instructions which underline the considerable role of the teacher as one of the main actors in the process of the didactic transposition of knowledge; he could thus influence the transposition by his own conceptions, values and practices. (Clément, 2004) (Figure1).

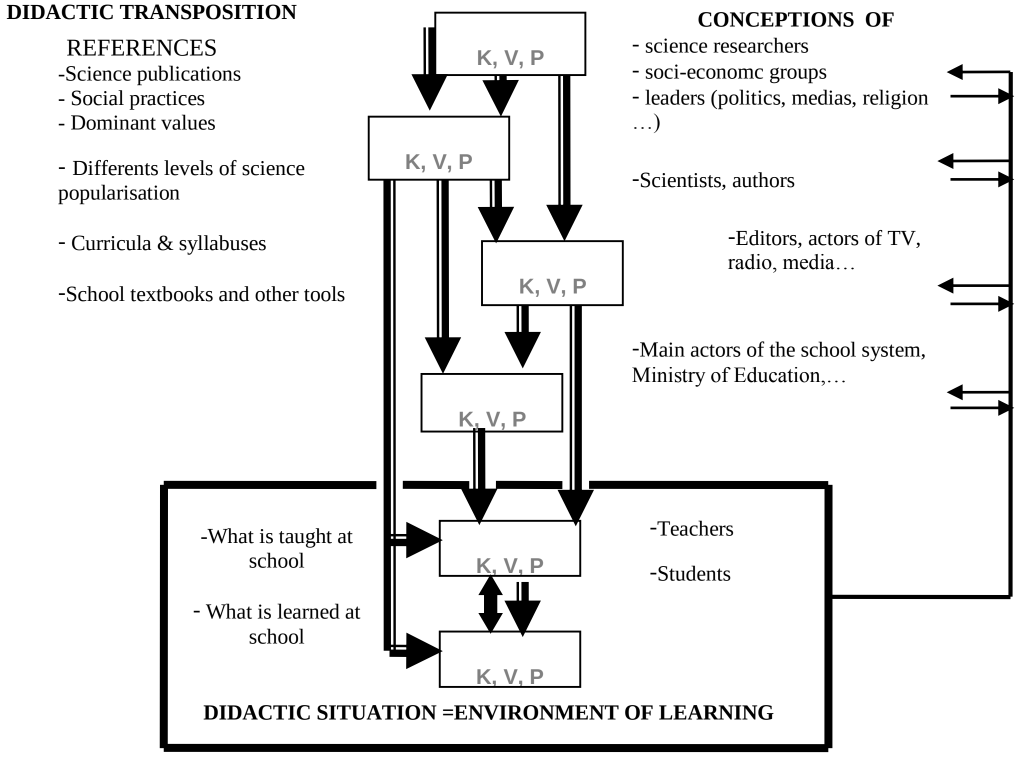


Figure 1 - Schema Of The Didactic Transposition, Linked To The Analysis Of The Conceptions Of The Main Actors Of The Transposition (Modified From Clément 2006).

In the present work, the conceptions of some actors of the educational system are analysed as being the emergences from interactions between the 3 poles K, V and P, as proposed by the model KVP (Clément 1998, 2004, 2006). The 3 poles are: the scientific knowledge (K), the systems of values (V) (The values are defined in a large sense, including opinions, beliefs and ideologies) and the social practices (P) (either professional, family's, or citizen) (figure 2)

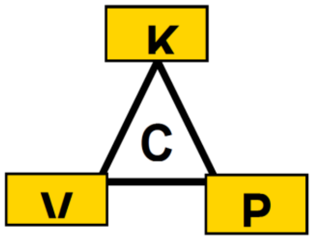


Figure 2: The KVP Model: Conceptions (C) Can Be Analyzed As Interaction Between Scientific Knowledge (K) Values (V) And Social Practices (P) (Clément, 2004; 2006).

Nevertheless, the KVP model is useful to analyse important features of the taught knowledge: the epistemological one, to try to understand what is related to science or to values in a scientific presentation, and also its interaction with social practices.

The teacher's beliefs and values have a direct influence on the way of understanding and teaching a topic: the teaching practice. They frequently constitute true obstacles with the teacher's professional development and the improvement of the processes of teaching-training. These beliefs must be taken into account in the contents and strategies of the teachers training but also their conceptions related to the students present and future social practice of (their future professional job but also their present and future responsibility as citizens).

In this framework, we are interested in this study, to identify the conceptions of teachers relating to the Food Education (FE), by answering the following question:

- What are the Moroccan teachers' conceptions relating to the FE?

METHODOLOGY

Data Collection Instrument

To identify teachers' conceptions, we chose as a tool of investigation a questionnaire
The questionnaire is in Arabic, it was validated after its elaboration. The people involved in the research were all volunteers and the questionnaires were preserved anonymous.

Participants

Educators teaching in public institutions of three school levels: primary school (elementary education), middle school (former high school) and high school (secondary school).
We were able to collect only 200 questionnaire copies afterwards.

We analyzed the results concerning training on the food education (initial or continuing training) and the definition given by teachers relating to FE only.

The collected definitions of FE were categorized according to both conceptions related to health: Biomedical Model and (BM) and Health Promotion model (HP).

- **Biomedical Model (BM)** focused on the diseases and the prevention, in a reductionist cause- effect perspective, with information about health problems, ways to handle and cure them, and how to avoid them by using persuasion by teachers and/or health professionals (Leininger,1984)
- **Health Promotion model (HP)** defined by the charter of Ottawa (1986) as a process which imparts the populations the means by which they can ensure a bigger control over their own health and can improve it.

There are indicators in the speeches used in the definitions given by the teachers, making it possible to detect each model of health. We used the categorization developed in the European project Biohead-Citezen (Carvalho et al., 2004)[1]. (cf. grid in annex).

- Indicators for the biomedical conception of health: pathological, curative, and preventive concepts.
- Indicators for health promotion conception: healthy, empowerment and environmental concepts.

With regard to the emphasis on the *Biomedical Model* and the *Health Promotion* approaches.

[1] BIOHEAD-CITIZEN. Biology, health and environmental education for better Citizenship. CITC-CT-2004-506015. (2004-2008). Project Coordinator : Graça S. Carvalho , Pierre Clément, Franz Bogner. Morocco is one of 19 countries participating in this European project (the Participant Group).

In each definition we find expressions associated with the Biomedical Model (BM) or the Health Promotion (HP) approach.

Table 1.Characteristics Of The Sample:

Institutes	Primary school	Middle school	High school	Total
Number	6	30	14	50
Sex Male	16	46	18	80
Female	60	26	34	120
Total	76	72	52	200
Level of study *< Bac*	6	8	0	14
Bac	40	54	2	96
Bac+2	2	4	0	6
Bac+4	24	8	50	82
No answer	4	0	0	4

In Terms of seniority, the sample is very heterogeneous; teachers with more than 30 years of teaching experience are the most dominant with a percentage of 27%. All teachers got some job training in teachers' training centers (CFI[2], CPR[3], ENS[4], CRMEF[5]) appropriate for each grade level.

The processing of the results' analysed from the collected questionnaires is done using:
- Microsoft Office Excel;
- SPSS: Where khi two tests of independence were performed to test whether the differences between the grade levels are significant or not.

RESULTS' ANALYSIS

Concerning training on the food education (initial or continuing training)

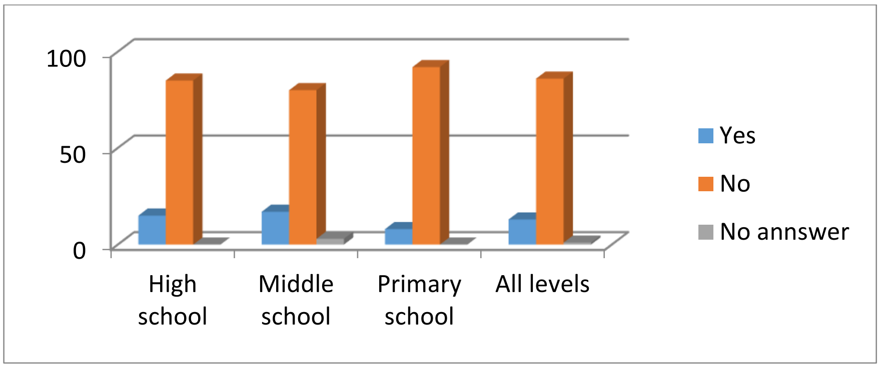
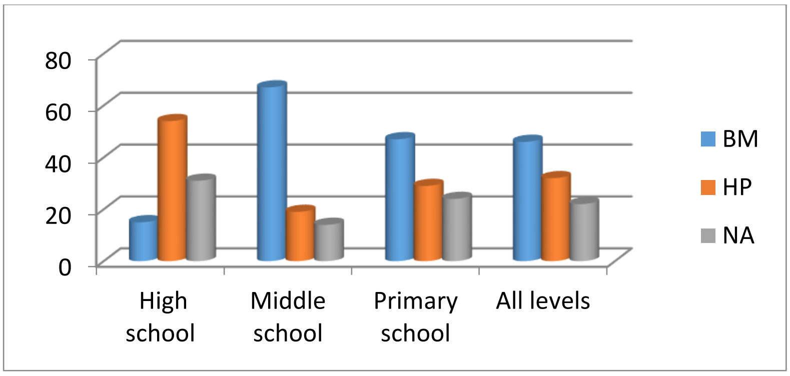


Figure 3: Percentage Of Teachers According To Their Training In FE

The majority of teachers (86%) of all levels did not have training on FE during their vocational teaching formation while only 13% of teachers have been on topics such as: food rations, food composition and roles, and nutritional deficiencies.

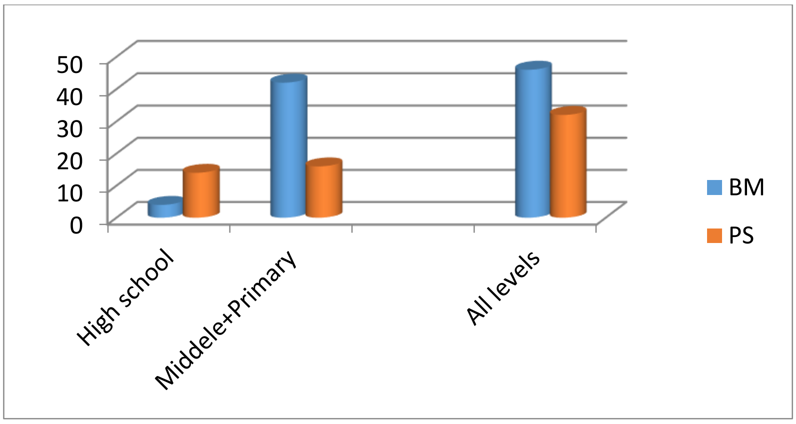
Definitions of Food Education:

[2] CFI : Primary teacher training center
[3] CPR : college school teacher training center (Middle school former high school)
[4] ENS : High school teacher training center (secondary school)
[5] CRMEF : All teacher training center



(BM: Biomedical Model. HP: Health Promotion. NA: No answer)

Figure 4: The Percentage Of Teachers Depending On The Conception Of Their Definition Of EA (For Each Level)



(BM: Biomedical Model. HP: Health Promotion. NA: No answer)

Figure 5: The Percentage Of Teaching(S) Depending On The Conception Of Their Definition Of EA (For Regrouped Levels)

Most of the teachers (46%), the majority of whom belongs to the middle and primary school (42%). 67% in the middle school and 47% in the primary school provided definitions that reflect BM conception.

Examples of definitions relating to biomedical conception:
- *FE is the need to know what we have to consume so that we can live without disease;*
- *FE refers to educating the citizens to consume nutrients they need without exaggeration, in order not to get sicknesses like obesity and diabetes.*

32% of the teachers, most of which make part of the high school (14%), provided definitions that adopt as HP conception. 54% in the high school compared with other levels Primary school (29%) and middle school (19%).

Some examples of definitions relating to Health Promotion:
- *FE can develop in citizens' responsibility to choose the proper food stuffs to build a healthy body, allowing it to be active and productive.*
- *FE is a set of concepts and knowledge we should gain awareness about in order to adopt appropriate form of behavior for a mental and physical stability, for a healthy well-being and an active life.*

We note that 22% of the teachers did not give a definition to FE.
The difference between the conceptions adopted by the teachers in their definitions and the level taught is significant (0.02(=αcal)<0.05).

This significance could be in relation to each grade level teachers' educational background of each level school. That more the level of study is high (as high as a university degree) more the conception relates to the health promotion approach is adopted.

DISCUSSION OF RESULTS

Food Education is 'one strategy of Health Promotion. It aims to develop in students skills to better manage their health and their environment's (Odile, 2011). In effect, Food Education should be taught according to a well-determined program which clearly defines the skills to develop and which is part of a policy to promote health.

The conception of high school teachers towards Food Education expresses itself most often by the adoption of a HP approach while primary and collegial secondary cycle teachers adopt a BM approach in their definitions. This could be according to the level of study of the teachers of each level since in the primary and collegial secondary cycles; teachers with a baccalaureate degree prevail whereas at secondary qualifying cycle the teachers there have achieved at least a higher university degree (baccalaureate+ 4 years study).

Our results match with those found in a comparative study of teachers' and future teachers' conceptions from 16 countries relating to health education (Carvalho & al., 2007 et Carvalho & al., 2014), a study carried out in the framework of European project Biohead -Citizen[6] (project involves nineteen countries including Morocco). In this study, it has been shown that more the level of study is high (as high as a university degree) more the conception held by current and future SVT (life and earth sciences) and Arabic language teachers from primary and secondary schools , relates to the health promotion approach.

Jourdan & al, (2012)[7] have shown that, among the factors influencing the vision of teachers and future teachers from 15 countries (Morocco is part of these countries) on health and Health Education is the age and the level of study. Seniors and people with a high academic education, have a more positive vision on health making part of the approach to health promotion.

In another study, the majority of the Moroccan teachers at primary school are in the inability to define education to health and most of their definitions fit to biomedical approach (Khazami & al.; 2008).

But the Moroccan primary textbooks (for the age group of 6 to 9 years) adopt the HP approach and in the other levels (most age) adopt the BM approach (Selmaoui and al., 2007a ; Selmaoui et al., 2007b ; Selmaoui et al., 2007c, Selmaoui et al., 2009; Khzami and al., 2010).

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ANNEX

Table: INDICATORS for the BIOMEDICAL CONCEPTION of Health: Pathologic, Curative, and Preventive concepts;
INDICATORS for the HEALTH PROMOTION CONCEPTION: Healthy, Empowerment and Environmental concepts.

BIOMEDICAL CONCEPTION OF HEALTH (BMc)	
CONCEPTIONS	INDICATORS
PATHOLOGIC	- words: "disease", "illness", "sickness", "infirmity", "infection", "disorder"
	- disease name(s)
	- patient image (photo, drawing, etc.)
	- disease symptoms or other disease signals
	- direct causes of diseases mentioned (infectious agents, genetic inheritance, etc.)
	-"normality" (normal/abnormal, common/ uncommon person, image of *"abnormal person*"), blaming the victim (or the patient)
CURATIVE	- Disease treatment
	- Doctor as the expert in disease diagnosis, its prevention or its treatment
PREVENTIVE	- Presence of the words: "prevention", "protection", "caution"(danger).
	- Risk factors mentioned (exposition to environmental factors, behaviour factors, etc.)
	- Person's image showing risk behaviour
	- Behaviour rules, behaviours to avoid, authoritarian recommendations, paternalism, culpability

HEALTH PROMOTION CONCEPTION (HPc)	
HEALTHY	- Words/expressions : “health promotion”, “health gain”, “healthy lifestyle”, “healthy body”, etc.
	- Assuming diverse health dimensions: physical, mental, emotional, social, spiritual.
EMPOWERMENT	- Personal skills development, empowerment, informed healthy choices or decisions
	- Awareness of health demoting factors
ENVIRONMENTAL	- Social environment (working places, domestic…) - Physical environment - Quality of life, living conditions

CAUSAL SEM OF MATHEMATICAL COMPETENCES IN ELEMENTARY EDUCATION

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ABSTRACT: In this paper, authors defined mathematical competences for 7th year elementary school. The basic objective was to measure the mathematical competence or mathematical knowledge, skills and abilities in mathematical educations. Mathematical competences were grouped in following areas: Algebra and functions, Space and shapes, Measurements and Data. Statistical set for the research consisted of 48 children from the Elementary school Dr. Ivan Merz in Zagreb, Croatia. Authors had 15 measuring variables together with the evaluated results of described tasks. With statistical set with variables as measured mathematical competences the authors make the causal structural equation model (SEM) of mathematical competences. The authors use free software Tetrad 5.2.1-3 (Tetrad project 2015). In the results we describe structural equations between the mathematical competitions for 7th year elementary school children. This paper is a result of our previous research on causal modeling of mathematical competences in kindergarten (Tepeš at. all. 2013, 2014 and 2015)

Keywords**:** mathematical competences, structural equation model and causal model

INTRODUCTION

Mathematical Competences in Elementary School

Mathematical competence as a term is being defined as knowledge, ability and skills of applying the mathematical way of thinking or concluding with the purpose of solving of all kinds of mathematical or interdisciplinary problems as well as understanding mathematics as a cultural value, with the aim of understanding and creating the perception about things that surround us in our everyday life. It is important to emphasize that intuitive ways of solving tasks are supported by rules of logical opinion in the form of thinking and making adequate conclusions, using arguments, modeling, formulating and solving the problem.

Mathematical competences defined by lesson plan or curriculum with the acceptance of historical development and can be divided into four basic areas: Algebra and functions, Space and shapes, Measurements and Data. Each of these areas contain specific knowledge, abilities and skills which are presented.

Algebra and functions competences are:

- Apply percentages and percentage calculations in correct tasks and situations.
- Present simple dependence between two variables using words and tables of joined values, formula and graphic presentation, and explain the procedure by translating the variables in both forms.
- Recognize and apply proportionality and reversed proportionality in simple tasks Solve linear equations and simple systems of two linear equations with two unknowns. Apply solutions with the goal of verifying the results.
- Translate the problem by using algebra signs (like number sentences, linear equation, and the system of two linear equations with two unknowns). Explain the procedure of solving, get the solution and determine the main points in final solutions.
- Recognize the process of joining which represents the function.

Shape and space competences are:

- Draw a specific point within the rectangle coordinate system determined by specific coordinates and a direction proposed by an equation. Recognize, draw, outline, and classify a geometrical figure in a plane (angle, triangle, polygons, circle, ring and its parts). Apply the similarity and compliance by solving geometrical problems.

Measuring competences are:
- Compare, estimate and measure the length and size of the angle and the average speed.
- Convert measuring units for length, surface, size of the angle and average speed.
- Apply the formula concerning the volume and size of geometrical figures and the formula used for summation of angles and polygons with the example of simple and practical problem solving.

Data competences are:
- The main goal is to classify, gather and organize the collected data and present them by using plain tables, tables of frequency, lined and circled diagrams. Study, analyze, explain, and interpret the named information which have been presented in various ways. Recognize accidental, impossible, probable and possible outcome. Recognize which outcomes of an accidental experiment are favorable considering the event and calculate the probability of such final outcome.

Statistical Set and Measuring Variable

Elements of our statistical set were 48 children from the Elementary school Dr. Ivan Merz. Testing was performed as a part of an ordinary testing of the children's competences, which is part of the school education's curriculum. [4] The gender structure of children examined is shown in Table 1:

Table 1. Children's gender

Children's gender	Number of children
male	27
female	21
Total	**48**

The measuring variables for algebra and functions competences are:
- Ratio and proportions (RATPRO)
- Proportionality (PROPOR)
- Inverse proportionality (INVPRO)
- Method of substitution (MRTSUB)
- Method of elimination (METELI)
- Graphing linear function (GRLIFU)

The measuring variables for shape and space competences are:
- Coordinate system (COORSY)
- Similarity of triangles (SIMTRI)
- Polygons (POLYGO)

The measuring variables for measuring competences are:
- Perimeter and an area of similar triangles (ARSITR)
- Peripheral and central angle (PECEAN)
- Perimeter and area of circle (ARECIR)

The measuring variables for data competences are:
- Percentage (PERCEN)
- Statistics (STATIS)
- Probability (PROBAB)

Every variable on this list was described separately through the tasks. Every task was evaluated with 1(needs improvement), 2(satisfactory), 3(good), 4(very good) and 5(excellent).

Task for measuring variables is:
Ratio and proportion (RATPRO). Determining any unknown participant of the ratio and applying normal sizes in reinforcement of the task. Example: In what ratio are the turtles? (Figure 1)

Proportionality (PROPOR). Recognizing and graphical presentation of proportionality and applying it in tasks concerning everyday existence. Example: Using this table, determine how many kunas (HRK) will you get for 200 Euros? (Figure 2)

Inverse proportionality (INVPRO). Recognizing and graphical presentation of reversed proportionality and determining the unknown value using practical tasks. Example: Two workers will redecorate an apartment in 15 days if they work 8 hour per day. In how many days will the apartment be redecorated if there are 3 workers working 10 hours per day?

Method of substitution (METSUB) and Method of elimination (METELI). Example: Find the solution for the system of two linear equations with two variables using: a) Method of substitution, b) Method of elimination. (Figure 3)

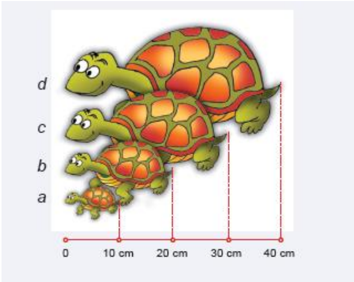

Figure 1

EUR	HRK
0.50	3.75
1	7.50
5	37.50
10	75
20	150
50	375
100	750

Figure 2

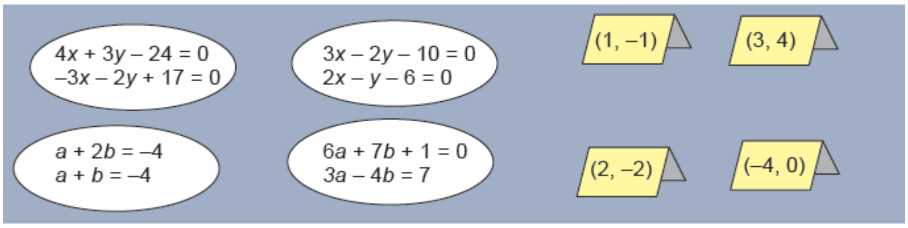

Figure 3

Graphing linear function (GRLIFU). Recognizing a chart presenting a function. Drawing a chart of a linear function emphasizing the dependence between two values using the chart and various tables. Example: Using the given chart, determine which day in a week was the hottest. (Figure 4)

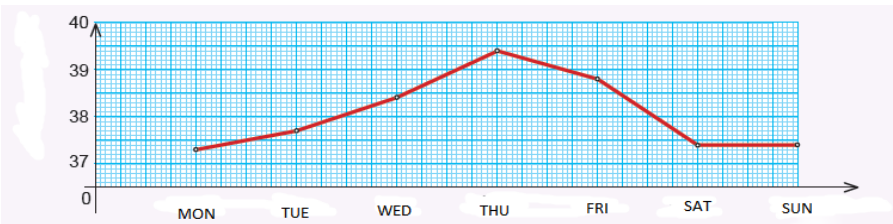

Figure 4

Coordinate system (COORSY). Pupils were asked to determine the position of a point in a plane using coordinates within the rectangle coordinate system. Each point was assigned to a rational number directed by rules. Example: Find the coordinates of marked points on a boat. (Figure 5)

Similarity of triangles (SIMTRI). Applying rules about triangle resemblances and determining the coefficient of similarity. Calculating the unknown lengths of triangle sides of different sorts of triangles. Example: Help the painter measure the man's height in ratio. (Figure 6)

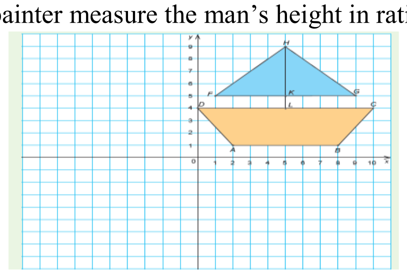

Figure 5

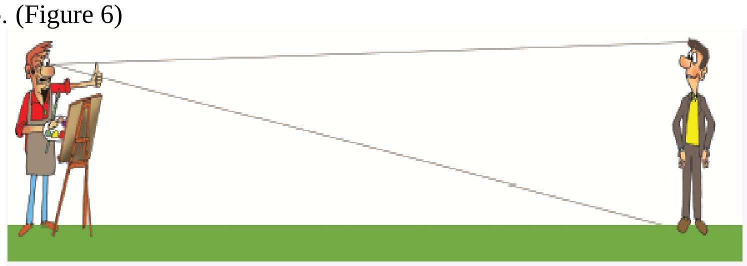

Figure 6

Polygons (POLYGO). Drawing and constructing polygons. Determining the total number of diagonals within the polygon. Calculating the total summing of all inner polygon angles and all angles of the specific triangles within the regular polygon. Example: Using the given data, find out the area of the polygon. (Figure 7)

Perimeter and an area of similar triangles (ARSITR). Comparison and calculating of volumes and sizes of similar triangles. Example: Using the given data, find out how wide is the lake? (Figure 8)

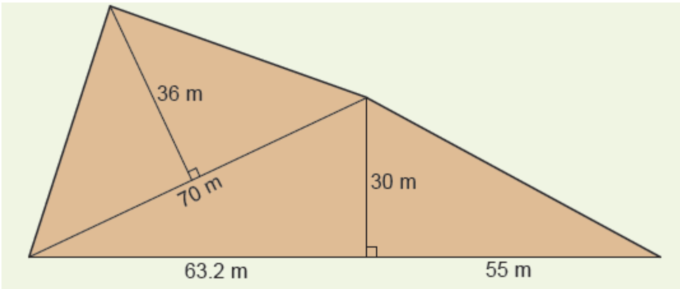

Figure 7

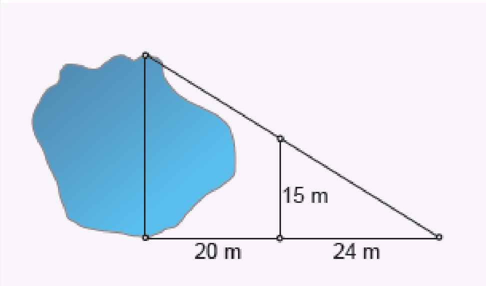

Figure 8

Peripheral and central angle (PECEAN). Determining the relation between the two sizes of two different angles and applying of Pythagoras rule in constructive tasks. Example: Determine the size of unknown angles. (Figure 9)

Perimeter and area of circle (ARECIR). The required understanding of how circle volume is proportional to its diameter. Calculating the area and size of a circle with having an area for his radius. Example: Determine an area of given circles. (Figure 10)

Percentage (PERCEN). Expressing the percentage using a rational number related to everyday situations. Example: Write down the percentage of colored parts in these shapes. (Figure 11)

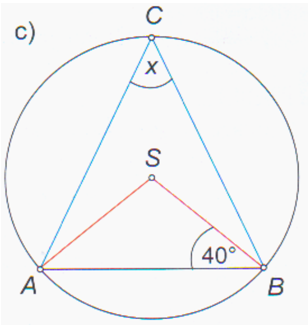

Figure 9

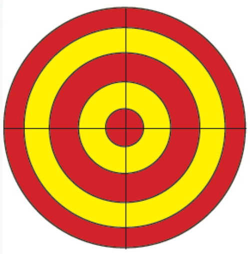

Figure 10

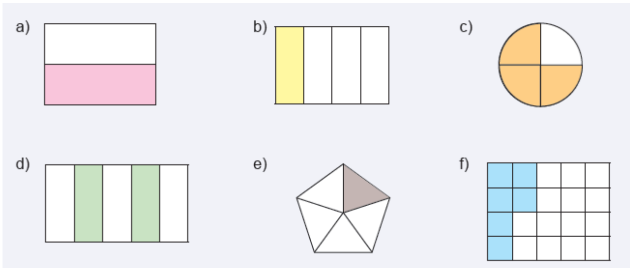

Figure 11

Statistics (STATIS). Recognizing the features of a certain information group, showing, sorting, and organizing the data from everyday situations. Presenting the information by using simple tables, charts or circled diagram. Example: Which class has the most absent students on Monday, and which the least absent students on Wednesday? (Figure 12)

Probability (PROBAB). Recognizing the impossible, probable and safe event. Calculating the probability of happening of an event (result). Example: Who do you think will win a 100 m race? (Figure 13)

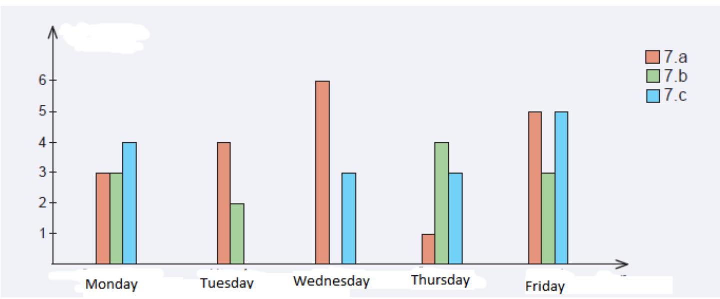

Figure 12

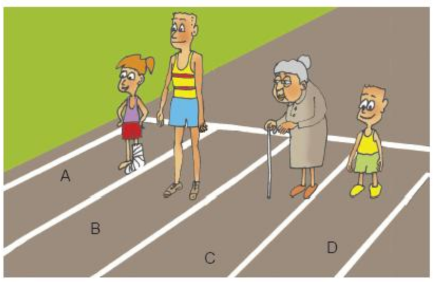

Figure 13

METHODS

Structure Equation Model (SEM)

At the beginning we have to describe structural equations model (SEM) (Boolen 2007). The variable of our model are measured mathematical competences or x_1, $x_{2,}$ $_{\ldots}$, x_{15} $\in$ {COORSY, RATPRO, PROPOR, INVPRO, PERCEN, STATIS, PROBAB, SIMTRI, ARSITR, POLYGO, PECEAN, ARECIR, METSUB, METELI, GRLIFU}. Structural equations are:

$$x_i = \sum_{j=1}^{17} b_{ij} x_j + e_i \qquad (i = 1, \ldots 17) \qquad (1)$$

where e_{i} are exogenous variables. In the matrix notation we can write equations.

$$x = Bx + e \qquad (2)$$

The causal structure model (CS) (Pearl 2000) can be represented with directed acyclic graph (DAG). In DAG we have vertices and edges between vertices. The vertices are mathematical competences in our SEM and the edges are causal relation between edges. For example edge $x_j \rightarrow x_i$ represent cause x_{j} and effect of cause x_{i}. Acyclic graph change structural equation (1) in new structural equations:

$$x_i = \sum_{j<i} b_{ij} x_j + e_i \qquad (i = 1, \ldots 17) \qquad (3)$$

And in the matrix equation notation (2) B is strictly lower triangular matrix. In the equation (3), if the coefficient $b_{ij} \neq 0$ we have edge $x_j \rightarrow x_i$ in directed acyclic graph (DAG) for causal structure model (CS).

In our paper we use free software Tetrad 5.2.1-3 (Tetrad project 2015). Main part of this software is Linear Non-Gaussian Acyclic Model (LiNGAM) (Simizu at al. 2006). LiNGAM work with independent component analysis (ICA) with estimation of coefficients with maximize log likelihood together with all the possible causal ordering. In the software Tetrad 5.2.1-3 we use program Linear Non-Gaussian Orientation Fixed Structure (LOFS). This program generates many different DAG.

RESULTS

The authors of this paper, teacher on Elementary School Dr. Ivan Merz in Zagreb (Paić at al. 2014a, 2014b, 2014c) together with professor (Tepeš at. all. 2009, 2013, 2014,2015) and methodologist on Faculty of Teacher Education at the University of Zagreb, choose the most appropriate model in mathematic on 7$^{\mathrm{th}}$ year Elementary school represented in this paper.

Directed acyclic graph (DAG) mathematical competences on 7$^{\mathrm{th}}$ year elementary school is shown in Figure 14:

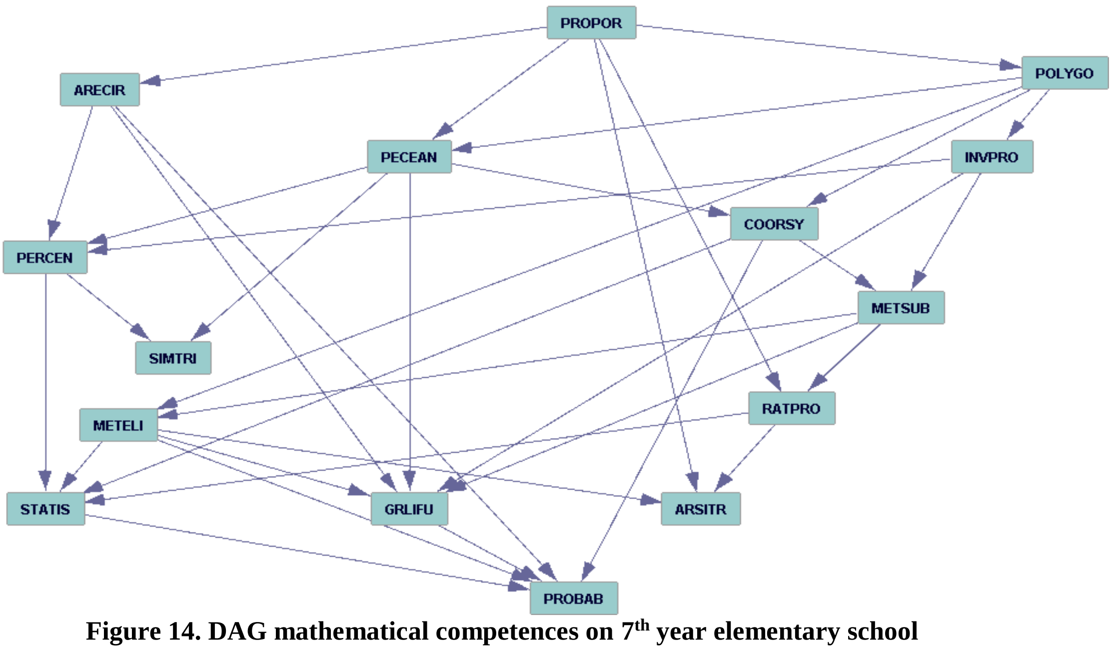

Figure 14. DAG mathematical competences on 7$^{\mathrm{th}}$ year elementary school

From Figure 14 we can see eight levels of causal structure. On the first level there are causal mathematical competences PROPOR. This competences are fundamental and cause all other mathematical competences. On the second level there are mathematical competences ARECIR and POLYGO. This competences are effect of competences from the first level. On the third level there are competences effect causes from the first and the second level. Third level competences are PECEAN and INVPRO. On the fourth level there are PERCEN and COORSY. On the fifth level there are competences SIMTRI and METSUB or effect competences from previous levels. On the sixth level there is mathematical competence METELI and RATPRO. On the seventh level there is competence STATIS, GRAFLI and ARSITR. The last eighth level is competence PROBAB.

Using estimator from software Tetrad 5.2.1-3 we can describe causal structure equations (3) in our research:

$$\begin{aligned}
&PROPOR = e(PROPOR)\\
&ARECIR = 0{,}8768 PROPOR + e(ARECIR)\\
&POLYGO = 0.8393 PROPOR + e(POLYGO)\\
&PECEAN = 0.8124 PROPOR + 0.1044 POLYGO + e(PECEAN)\\
&INVPRO = 0.8574 POLYGO + e(INVPRO)\\
&PERCEN = 0.0349 PECEAN + 0.4089 ARECIR + 0.4455 INVPRO + e(PERCEN)\\
&COORSY = 1.7644 PECEAN + 0.1101 POLYGO + e(COORSY)\\
&SIMTRI = 0.5042 PECEAN + 0.4930 PERCEN + e(SIMTRI)\\
&METSUB = 0.4872 COORSY + 0.4933 INVPRO + e(METSUB)\\
&METELI = 0.2541 POLIGO + 0.7068 METSUB + e(METELI)\\
&RATPRO = 0.6679 PROPOR + 0.2924 METSUB + e(RATPRO)\\
&STATIS = 0.0985 RATPRO + 0.3957 METELI + 0.3677 PERCEN + 0.0707 COORSY + e(STATIS)\\
&GRAFLI = 0.0886 METELI + 0.1529 ARECIR + 0.2080 METELI + 0.2161 INVPRO + 0.3397 PECEAN + e(GRAFLI)\\
&ARSITR = 0.2589 METELI + 0.5608 RATPRO + 0.2016 PROPOR + e(ARSITR)\\
&PROBAB = 0.3870 METELI + 0.1997 ARECIR + 0.1758 GRLIFU + 0.3087 STATIS + 0.3318 COORSY + e(PROBAB)
\end{aligned} \tag{4}$$

Exogenous competences are estimate with standard normal distribution $normal(0, s^2)$:

$$\begin{aligned}
&First\,level:\\
&e(PROPOR) \approx normal(0, 3.4221)\\
&Second\ level:\\
&e(ARECIR) \approx normal(0,1.6750), e(POLYGO) \approx normal(0,1.6103)\\
&Third\,level:\\
&e(PECEAN) \approx normal(0,1.3849), e(INVPRO) \approx normal(0,1.6369)\\
&Fourth\,level:\\
&e(PERCEN) \approx normal(0,1.2442), e(COORSY) \approx normal(0, 3.4949)\\
&Fifth\,level:\\
&e(SIMTRI) \approx normal(0,1.1550), e(METSUB) \approx normal(0,1.2060)\\
&Sixth\,level:\\
&e(METELI) \approx normal(0,1.2270), e(RATPRO) \approx normal(0,1.2315)\\
&Seventh\ level:\\
&e(PROBAB) \approx normal(0,1.0584)
\end{aligned}$$

Coefficients in causal structure equations (4) are the average causal effect cause competence to competence on the left side of the equation. For example, competence PROPOR has greater average causal effect to competence PERCEAN than competence POLYGO because coefficient with PROPOR is 0.8124 and coefficient with POLYGO is 0.1044. All coefficients in equations are nonnegative. It means that every case competence has positive effect to competences on the second, third, fourth, fifth, sixth and seventh level.

CONCLUSION

Paper demonstrates the causal structure of mathematical competences in school education. For the purposes of adopting mathematical competences, causal model refers to the order of adopting of mathematical competences. For the purpose of further research, it is necessary to increase the statistical set or the number of children examined. Test materials must be standardized and must allow for higher gradation of results. The study should include part of mathematical competence relating to the data that have both numeric and descriptive characteristics expressed by words and letters. The curriculum for children in elementary schools in Croatia is based on social relations, and should have the educational structure of mathematical competences accustomed to the age and level of competences that children acquire by using information and communication technologies of contemporary society.

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DRAMA FOR INCLUSION IN SCIENCE

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Independent researcher

ABSTRACT: Role plays, using given roles or simulated and improvised enactments, are claimed to improve learning of concepts, understanding the nature of science and appreciation of science's relationship with society (Ødegaard, 2001). Historical events often provide well-established examples of scientific discoveries, with the process of the discovery described and justified in fine detail. Adjacent to each discovery, we can find other investigations and outcomes, to set each one in scientific context. This enables researchers and teachers to construct the web of scientific advance at that time. In addition, each event takes place in a social context, often in the midst of political and social revolutions. However, these are rarely advertised in the journal accounts, which mostly focus on pure scientific aspects. Unearthing this complex interplay between the science, the nature of science itself which was developing throughout history, the social environment, is not straightforward for busy classroom teachers. The paper also notes that accounts feature the celebrities, and not the contributions of others such artisans, whose work was crucial to each and every discovery. This paper aims to document a particular Case Study involving explorations of the chemical properties of water-soluble gases, in Lavoisier's laboratory in the 1770s. The carpenter and a stonemason, provide the Lavoisiers with a pneumatic trough, containing mercury, in which to manipulate the gases. To promote social justice, it uses dramatic licence to give them a voice.

Ødegaard M 2001, Unpublished Dr. scient., Dissertation, University of Oslo.

Keywords: nature of science; history of science; drama; social justice

INTRODUCTION

Braund (2015) stated 'Constructivist teaching methods such as using drama have been promoted as productive ways of learning, especially in science. Specifically, role plays, using given roles or simulated and improvised enactments, are claimed to improve learning of concepts, understanding the nature of science and appreciation of science's relationship with society (Ødegaard, 2001). So far, theorisation of drama in learning, at least in science, has been lacking and no attempt has been made to integrate drama theory in science education with that of theatre. [Braund's] … article draws on Brook's (1968) notion of the theatre as the '*empty space*' to provide a new theoretical model acting as a lens through which drama activities used to teach science can be better understood and researched. There are many other similar articles concerning the contribution of drama to science education. The scenarios adopted directly pertinent to science education are twofold: a) dramatic models such as using students to model particle movement in different phases; b) historical narratives of eminent sciences, often to illustrate the nature of science. It is relatively rare, if at all, to read accounts of the contribution of those other than eminent scientists who have made their contribution to scientific discovery. Since their accounts are not recorded it is although they did not exist.

Nevertheless, despite the prodigious output of eminent scientists, it must be the case that they depended on the valuable inputs of artisans of significance. Dramatic licence afforded by the construction of plays provides opportunities to imagine what these inputs could have been, without necessarily implying historical accuracy. This paper provides an example of an input that is plausible and credible, involving a carpenter and a stonemason.
In addition to concept development, drama can impact on student attitude (e.g. Hendrix *et al*, 2012). Drama can also contribute to historical and philosophical understanding (see HIPST: http://hipst.eled.auth.gr/).

> 'HIPST pursues general objectives: a better integration of science in society and society in science, the promotion of young people's interest in science, to encourage their critical and creative ways of thinking and to improve science education, and the uptake of scientific careers. Sustained learning of science implies many different dimensions. One often ignored, but important dimension is the process of knowledge generation in science itself. Moreover, the objectives and motivations to do science, the disposition of scientific skills and methods, the empirical fundament of science, social and cultural aspects are as important as philosophical foundations of science, scientific concepts and their use. The acquisition of knowledge about the nature of science is essential for democratic and knowledge based societies which partly rest their decision making on rational and scientific criteria.'

The HIPST project in the UK (detailed at http://hipst.eled.auth.gr/) used, as one of its tools, drama to focus on historical and philosophical aspects. The HIPST web site provides details of the challenges and successes of drama, especially the challenge of 'whiggishness', looking at the past through the knowledge lens of the present, leading to misunderstandings of historical knowledge development.
Drawings of Lavoisier's laboratory provide many indications that it was not the work of one person, given its complexity. The Chemical Revolution of the late 18th century was based in large part on Antoine-Laurent Lavoisier's new understanding of the chemical role of a gas, oxygen, in explaining combustion, respiration, and metallurgical processes like smelting. This advance in the theory of material change drew upon earlier work by other chemists, such as Joseph Priestley, who demonstrated that the air we breathe, previously thought to be uniform and not a kind of matter like solids or liquids, is in fact made up of several gases with different properties. Lavoisier's successors further explored the character of gases. Their theoretical advances eventually proved of great importance to modern society: many industrial processes require gases and their compounds and rely on a thorough understanding of the reactions that produce them.

Lavoisier required a pneumatic trough to contain the gases he worked with, using mercury as the containing liquid since many of the gases were soluble in water. A typical tough contained a shelf, usually immersed, on which to stand the jars upside-down. Gases do not have an innate volume but only when trapped by the faces of solids or liquids. Lavoisier invited an artisan (carpenter) to build a trough from wood and filled it with mercury. In the morning, he found that the mercury had leaked out during the night as the wood contracted opening up the joints. He found another artisan (a stonemason) to make one from marble, and this did the trick. The play tells the story from the point of view of the carpenter, and incorporates history and philosophy into its telling.

The carpenter and the stonemason: their contribution to 18th century chemistry discovery.

Actors

Jacques Cabinet: an expert cabinet-maker who provided wooden components for the Lavoisier laboratory. He was a permanent employee of the Lavoisier family and a trusted artisan.

Robert Graves: an expert stone-mason who constructed cemetery headstones, marble coffins, and carved ornate stone furniture for the outside of buildings such as churches. He was not a permanent employee but did work from time to time on special projects

Marie Lavoisier: wife of Antoine, an expert translator French-English, and eventually a chemist of some significance, having been taught by one of Antoine's students

Antoine Lavoisier: husband of Marie, tax collector, eminent chemistry researcher and government expert in matters such as gunpowder quality.

Table1: Relevant Background To Context of The Drama, Followed By The Drama

Selected history of the time	History of Science	Related philosophy (Nature of Science)	Commentary
The environment of the 18th century was one of political revolution. In France, the excesses of the King and the poverty of the most of the people, with widespread starvation and disease were major causes of the French Revolution. Peoples' Courts were set up and being found guilty usually led to immediate execution. The King had set up the General Farms where taxes were sold to these Farms at a discount, who then did their best to collect the full taxes, usually making a big profit accompanied by violence towards those who would not or could not pay. In England, the revolution was not quite as violent and centred round the new Protestant	1703 Isaac Newton elected President of the Royal Society 1710 Jakob Le Blon invents three colour printing 1710 Porcelain factory in Meissen, Saxony, founded 1714 D Anel invents fine-pointed syringe 1714 DG Fahrenheit constructs mercury thermometer 1717 Inoculation against smallpox by Lady Montagu 1726 S Hales measures blood pressure 1730 Réaumour constructs alcohol thermometer 1732 Boerhaave writes 'Élements of Chemistry', a textbook 1736 Manufacture of glass begins in Venice 1742 Anders Celsius invents	The nature of stuff is explored in this century. In particular chemists were interested in whether a material was a single material (an element) or a combination of elements. The idea of publishing discoveries in scientific journals was developing. Much news came out in books, or in discussions at the newly formed Scientific Academies, which were springing up in the 18th century.	This play is set in the 1780s in the home of husband Antoine-Laurent Lavoisier and wife Marie-AnnePierrette Paulze. See http://www.metmuseum.org/toah/works -of-art/1977.10 for a Jacques David portrait of the couple. A century before Marie Curie made a place for women in theoretical science, editor, translator, and illustrator Marie Paulze Lavoisier (1758-1836), wife and research partner of chemist Antoine Laurent Lavoisier, surrounded herself with laboratory work. As assistant and colleague of her husband, she became one of chemistry's first female

religions. Many religious ministers were very strong in their views, and gave very controversial sermons to their congregations. This often made their congregations very angry. Joseph Priestley, for example, was attacked at his house in Birmingham and forced to flee to London for safety. There are many wars over power and land for national leaders, especially Kings. Great Britain came into existence in 1707 and more people were able to read. Slavery is common. 1751 British Calendar adopts January 1st as beginning of New Year 1752 Britain adopts Gregorian Calendar by leaving out 3-13 September. 1760 Josiah Wedgwood founds pottery works in Etruria, Staffordshire 1771 R Arkwright produces first spinning mill in England 1787 Dollar currency introduced. 1789 French revolution starts 1792 Louis XV guillotined in Paris	centigrade thermometer 1748 Platinum comes to Europe from South America 1754 Joseph Black discovers carbonic acid gas (carbon dioxide) 1761 M Lomonosov discovers atmosphere of Venus 1766 Cavendish: hydrogen is less dense than air 1772 D Rutherford and J Priestley independently discover nitrogen 1774 KW Scheele discovers chlorine 1777 A Lavoisier: air is mainly nitrogen and oxygen 1787 Lavoisier writes 'Méthode de nomenclature chimique.' 1790 A Lavoisier writes 'Table of thirty-one chemical elements' A Lavoisier guillotined Metric system adopted in France	1734 The Koran was translated into English by George Sale	researchers. In addition, she cultivated the arts and welcomed intellectuals to her Paris salon for stimulating conversation. After her husband's execution she unhappily married Benjamin Thompson, Count Rumford, the American-Bavarian military adviser, and founder of the Royal Institution of Great Britain Read more at http://biography.yourdictionary.com/ma rie-paulze-lavoisier#eud1zQuj4HQ1mGQS.99 Oxygen by Carl Djerassi and Roald Hoffmann is one play that is fictionalised, with conversations between chemists' wives in the sauna.

The Drama			
Scene 1: in the Lavoisier Laboratory. Present: Monsieur Jacques Cabinet, Monsieur Antoine Lavoisier, Madame Marie Lavoisier			
Dialogue	**Relevant history**	**Relevant science and philosophy**	**Commentary**
Jacques Cabinet Good morning Monsieur and Madame Lavoisier. How can help today? I have finished the shelves, as you can see. I have only to paint them with the varnish you gave me. This should make sure they are not attacked by chemical gases you use!	Antione was a rich man, with much money made from running a Tax Farm. Although he and Marie had no children, their wealth had given them much comfortable living, and a fine house. The house was big enough to have a large and well-equipped Laboratory, with hand-made equipment. The wooden equipment would have been made especially for the job by Jacques. He could make large equipment, as well as very fine small scale items. He could only work in wood, though, but he had many artisan friends he could call on.	Antoine and Marie were fascinated by gases. Thanks to Marie's skills in translation, they were both familiar with discoveries, and how other chemists had learned how to trap gases and then investigate their behaviour. Without this, they could not hope to make their contributions to the chemistry of gases.	Jacques is no ordinary artisan. He has been closely involved with the work of the Antoine and Marie. He was expected to understand their requirements with only a little explanation, and to use his combined expertise and creativity to construct what they wanted.
Marie Lavoisier Good morning Jacques. As you know, we have need for a container that can contain mercury to trap the gases. It will need a shelf to one side, on which to stand the upside down jars which will contain the gases. It needs to have a table next to it for the gas manufacture	Artisans were sometimes treated as part of the family. Respect for the husband and wife, though, would always continue.	Antoine and Marie were keen to study the interactions between the gases they made.	Marie is no passive wife. She had learned English to translate papers for Antoine, and she had learned chemistry from one of his students. She is also a superb illustrator.

equipment. It should also be easy to move it near to the furnace, in case strong heat is needed.			
Antoine Lavoisier Jacques, please make the container from the best wood you can buy. It must be strong, with no knots that can be pushed out, or holes through which the mercury liquid we will use can leak out. I recommend you use a very strong joint, some as dovetail. Please varnish it to stop the mercury leaking through.	Porcelain might have been a better material to use but at this stage of development, it was being used mainly for fine dining ware, such as plates, cups and saucers.	Making porcelain is not easy. You may see how it is made on the Wikipedia web site (https://en.wikipedia.org/wiki/Porcelain) but be careful about using Wikipedia as sometimes its accuracy is not so good.	Although they were no expert artisans, Antoine and Marie knew enough about wood to think of some of the problems that could arise.
Three days later, back in the Laboratory. Present: Monsieur Jacques Cabinet, Monsieur Antoine Lavoisier, Madame Marie Lavoisier			
Marie Lavoisier			Marie is something of an expert in her own right.

Jacques, show us what you have made, and talk us through it.			
Jacques Cabinet You have room in the laboratory to make a good size container. I made this from the best Rosewood I could find, sawn by the best sawyers into planks. I used large planks 2 feet wide for the sides and the edges, and dovetailed to make very strong joints. You will see that I have only used a single piece of wood for the container bottom. I have used the best wood glue I could buy. The shelf is freely moving, and made in a similar way. I have cut a hole in the side, and on the top. This should allow the clay pipe to be fed in so that the gas will bubble up into the jar, filled with mercury and placed upside down.		Rubber tubing for a gas delivery tube was not available at this time. Often clay tubing was used, as this was known through clay pipes that were used for smoking tobacco. It was easier to use than glass at this stage of chemistry.	
Antoine Lavoiser A good job, I think Jacques. It will need a lot of mercury to fill it. The mercury is in these pots here. Will you help me to lift them and fill the container, please? Then we can start our practical investigations tomorrow.		The mercury was stored in earthenware (http://www.britannica.com/art/earthenware) pots as these were commonly available. They were galxed on the outside to stop the mercury leaking out.	
The next day, back in the Laboratory. Present: Monsieur Jacques Cabinet, Monsieur Antoine Lavoisier, Madame Marie Lavoisier			

Jacques Cabinet Oh dear! I thought this might happen. The mercury had leaked out.			
Marie Lavoisier I cannot see how this would happen. You used the best wood, the best joints, and the best glue. Also, you varnished it very well. What do you think happened Jacques?			Marie tries her best to explain. Here her knowledge of wood is not enough. Jacques is a well-known member of the community of artisans, and can find good advice and help from many of these knowledgeable friends.

Jacques Cabinet I think I can explain this. You usually have the furnace on during the day. At night, the temperature drops and the room air becomes drier. I think this makes the wood shrink. This then opens the joints enough for the mercury to leak out. I do not think that using wood can solve this problem. I have a friend who may be able to help. See me here tomorrow, please. See if you can someone to take up the mercury. We can use it again.			Jacques is the expert here. He is trusted by Antoine and Marie to find the best explanation. In addition,
The next day, back in the Laboratory. Present: Monsieur Jacques Cabinet, Monsieur Antoine Lavoisier, Madame Marie Lavoisier, and joined by a stone mason Robert Graves			
Jacques Cabinet Good morning Monsieur and Madame. Let me introduce my friend, Robert Graves. He is a stone mason. He may be able to help.			
Marie and Antoine Lavoisier (together) Please to meet you Robert. What idea do you have?			
Robert Graves It is an honour to meet you, too. Sometimes, I am asked to make a coffin which is impermeable, that is, water and creatures in the ground outside cannot get in. I use whole piece of marble, which I then carve out from the inside, to make a kind of box. It needs to be done very carefully to make sure it is very strong. I have the skills to choose the best block of marble from the stonecutter, so that it can stand the force of mercury			Stone masons were experts in handling stone in many different ways.

without cracking. Shall I get to work, now? I will work inside the Laboratory since the marble is heavy. Once I start work on it, I			
do not wish to drop it. Where do you wish it to sit?			
The next week, back in the Laboratory. Present: Monsieur Jacques Cabinet, Monsieur Antoine Lavoisier, Madame Marie Lavoisier			
Robert Graves You will see that the container is finished now. I filled it with mercury yesterday, with my apprentice. What do you think?			Artisans rarely worked alone, and the apprenticeship process was very strong.
Antoine Lavoisier Robert, it is indeed, an excellent design. Your craftsmanship is superb. We are very impressed. It looks as though it will last a lifetime. Jacques, it is very lucky for us that you found Robert. We really did need this piece of equipment. Without it, we cannot make our discoveries.			
Marie Lavoisier So now we see that it is not enough to be an expert in chemistry. We need to work together with expert artisans to carry on our work.			Marie realises the points that chemists and artisans must work together to make discoveries. Sadly, the artisan input is rarely recorded.

So, the community of scientists and artisans continue their joint work in the interests of scientific discovery!

PEDAGOGY

We are greatly influenced by our experiences as adults, especially in areas of pedagogy which are unfamiliar. Most of our experiences of drama is gained by attending plays, where professional or experienced amateurs put on a performance, **in front of** an audience, who have often paid to watch. Much of the experience is passive for the audience. With young learners, they are not professional or experienced amateurs. In a single class, there will be a range of confidence. In addition, I believe it is significant and beneficial for learning if the young learners can be involved. I also believe that a major contribution to learning can come from the discussions that follow from the drama. It is an advantage for the play to be relatively short, since it is possible for it to be repeated without using up too much class time. Here is a proposed pedagogical sequence:

1. Copy the play for each class member, in the form of four columns. The context of the play is just as important as the dialogue.
2. Ask the young learners to read the play, and the context, for homework, to prepare for the next lesson.
3. At the next lesson, divide the class into groups of 4 – 6. The groups allocate members to take on roles, or to be the audience. For the performances, it may be helpful if the actors face the walls so that they are not speaking at the other groups.
4. I suggest that they repeat the play with the roles changed. This will give them an insight into different perspectives.
5. After they have performed the play (one, two or three times), they discuss what they have learned.
6. The teacher, who has been listening, draws the points about learning together.

CONCLUSION

This paper has integrated history of chemistry, evidence concerning the roles of drama in science education, ideas about social justice, and an engaging pedagogy. It provides a Case Study as an exemplar to demonstrate the processes of constructing a drama to give hitherto unrecognised artisans their rightful place in scientific discovery.

FURTHER RESEARCH

A next stage is to see how this works with different classes, and with different contexts for the plays and their histories.

IMPLICATIONS

Engaging young learners in their own learning is a challenge many teachers face. This paper describes one method of doing this.

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CAUSAL SEM OF MATHEMATICAL COMPETENCES IN TEACHER EDUCATION

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ABSTRACT: In this paper, authors defined mathematical competences in teacher education. The basic objective was to measure the mathematical competence or mathematical knowledge, skills and abilities in mathematical education. Mathematical competences were grouped in following areas: Basic mathematical competences, Arithmetic competences, Functions competences, Combinatory competences, Geometry competences. Statistical set for the research consisted of 80 students from the Faculty of Teacher Education, University of Zagreb, Croatia. Authors had 17 measuring variables together with the evaluated results of described tasks. With statistical set with variables as measured mathematical competences the authors make the causal structural equation model (SEM) of mathematical competences. The authors use free software Tetrad 5.2.1-3 (Tetrad project 2015). In the results we describe structural equations between the mathematical competitions for students in teacher education. This paper is a result of our previous research on causal modeling of mathematical competences in kindergarten (Tepeš at. all. 2013, 2014 and 2015) and in elementary education.

Keywords**:** mathematical competences, structural equation model and causal model

INTRODUCTION

Mathematical Competences in Teacher Education

Mathematical competence in teacher education is defined as knowledge, ability and skills for future teachers for elementary schools. At the same time Faculty of Teacher Education, University of Zagreb have curriculum and lesson plan together with strategy, mission and vision of Teacher Faculty. The basic areas of mathematical competences are: Basic mathematical competences, Arithmetic competences, Functions competences, Combinatory competences and Geometry competences. The most important part in teacher education is to learn mathematical concepts, relations and arithmetic operations. Each of these areas contain specific knowledge, abilities and skills which are presented.

The basic mathematical competences include:

- Mathematical logic,
- Total mathematical induction,
- Basics of set theory,
- Relations,
- Algebraic structures.

The arithmetic competences include:

- Natural numbers and integers,
- Number systems,
- Rational numbers,
- Real numbers,
- Complex numbers.

The functions competences include:

- Basics of functions,
- Linear function and linear equation,
- Quadratic function and quadratic equation,
- Word problems.

The combinatory competences include:
Basics of combinatorics.
The geometry competences include:
Plane geometry,
Solid geometry.

Statistical Set and Measuring Variable

Elements of our statistical set were 80 students from the Faculty of Teacher Education. During the 1st year students have six preliminary exams. That exams were performed as a part of the student's mathematical competences, which is part of the teacher education's curriculum. [4] The gender structure of students examined is shown in Table 1:

Table 1. Student's gender

Student's gender	Number of students
male	4
female	76
Total	**80**

The measuring variables for the basic mathematical competences were:
Mathematical logic (LOGIC)
Mathematical induction (INDUC)
Basics of set theory (SETTH)
Relations (RELAT)
Algebraic structures (ALGST)
Measuring variables for arithmetic were:
Natural numbers and integers (NATIN)
Number systems (NUSYS)
Rational numbers (RATIO)
Real numbers (REALN)
Complex numbers (COMPL)
Measuring variables for functions were:
Basics of functions (FUNCT)
Linear function and linear equation (LINEA)
Quadratic function and quadratic equation (QUADR)
Word problems (WORDP)
Measuring variables for combinatorics were:
Basics of combinatorics (COMBI)
Measuring variables for geometry were:
Plane geometry (PLANE)
Solid geometry (SOLID)

Every variable on this list was described separately through the questions in preliminary exams. Every question was evaluated with 0 (nothing), 1(needs improvement), 2(satisfactory), 3(good), 4(very good) and 5(excellent).

Task for measuring variables is:
Mathematical logic (LOGIC). Students were asked to compute the value of a logic formula or to prove a statement dealing with logic operations. Example: 'Prove: $(a \Rightarrow b)$ & $(a \Rightarrow c) = a \Rightarrow (b$ & $c)$.'
Mathematical induction (INDUC). Students were asked to prove a simple mathematical statement using the principal of mathematical induction. Example: 'Using the principal of mathematical induction prove that expression $7^n - 1$ is divisible by 6 for all natural numbers n.'

Basics of set theory (SETTH). Students were asked to prove a statement / answer a question / draw Venn's diagram for expressions dealing with set operations. Example: 'Using Venn's diagram prove: $A \setminus (B \setminus C) = (A \setminus B) \cup (A \cap C)$.'

Relations (RELAT). Students were determining the elements of given relations and drawing the graph in coordinate plane. Example: 'Determine the elements of relation $\rho = \{(x, y) \in \mathbb{N} \times \mathbb{N}: x + y = 10\}$ and draw the graph.'

Algebraic structures (ALGST). Students were asked to recognize algebraic operation or structure or to examine the properties of given algebraic operation. Example: 'Examine if operation $\circ$ defined by $a \circ b = 2a + 2b - ab + 2$ is associative.'

Natural numbers and integers (NATIN). Students were solving arithmetic problems with integers, finding least common multiple (LCM) and greatest common divisor (GCD) or decomposing numbers into prime factors. Example: 'Decompose number 67392 into its prime factors.'

Number systems (NUSYS). Students were recalculating given number from one number system into some other number system. Example: 'Number $(2DC)_{16}$ write in number system with base 4.'

Rational numbers (RATIO). Students were solving arithmetic problems with rational numbers, computing given fraction into decimal number or vice versa, or determining percent or ratio in given word problems. Example: 'Write number $-0.12\dot{3}5\dot{7}$ as a fraction and then reduce.'

Real numbers (REALN). Students were solving arithmetic problems with real numbers. Example: 'Compute $\sqrt{3} \cdot \sqrt{\sqrt{7} + \sqrt{2}} \cdot \sqrt[4]{9 - 2\sqrt{14}}$.'

Complex numbers (COMPL). Students were solving arithmetic problems with complex numbers or simple complex equations. Example: 'Find complex number z so that $2z + 4\bar{z} = 7 + i^{153}$.'

Basics of functions (FUNCT). Students were asked to solve a problem dealing with function, draw a graph, find inverse function or compute composition of functions. Example: 'For given functions $f, g: \mathbb{R} \longrightarrow \mathbb{R}$, $f(x) = \frac{1}{2}x - 3$, $g(x) = 2x^2 - x$, determine the compositions $f \circ g$ and $g \circ f$, and compute $g(2 + f(0))$.'

Linear function and linear equation (LINEA). Students were solving a problem dealing with linear equation. Example: 'Compute the area of the triangle bounded with line $2x - 13y + 7 = 0$ and coordinate axes.'

Quadratic function and quadratic equation (QUADR). Students were solving a problem dealing with graph of quadratic function in coordinate system or quadratic equation / inequality. Example: 'For which values of parameter m equation $mx^2 - 2mx + 3m - 2 = 0$ has two different real solutions?'

Word problems (WORDP). Students were asked to solve a word problem that leads to solving linear equation or system of two linear equations. Example: 'The numerator of the fraction is smaller than denominator for 18. If we increase both the numerator and denominator by 8, we get number $\frac{1}{3}$. What is the value of the fraction?'

Measuring variables for combinatorics were:
Basics of combinatorics (COMBI). Students were asked to recognize and solve simple combinatory problem. Example: 'How many 4-digit numbers has at least one digit 5?'

Measuring variables for geometry were:

Plane geometry (PLANE). Students were solving geometric problems dealing with angles, polygons and circle. Example: 'Interior angle of a regular polygon equals $165°$. What is the number of its sides?'

Solid geometry (SOLID). Students were solving geometric problems dealing with the measurements of surface areas and volumes of various three-dimensional figures - prisms, pyramids, cylinders, cones and spheres. Example: 'Calculate the volume and surface area of the circumscribed sphere of the cube which surface area is $216\ \text{cm}^2$.'

METHODS

Structure Equation Model (SEM)

At the beginning we have to describe structural equations model (SEM) (Boolen 2007). The variable of our model are measured mathematical competences or $x_1, x_2, \ldots, x_{17} \in \{$ LOGIC, INDUC, SETTH, RELAT, ALGST, NATIN, NUSYS, RATIO, REALN, COMPL, FUNCT, LINEA, QUADR, WORDP, COMBI, PLANE, SOLID$\}$. Structural equations are:

$$x_i = \sum_{j=1}^{17} b_{ij} x_j + e_i \qquad (i = 1, \ldots, 17) \tag{1}$$

where e_i are exogenous variables. In the matrix notation we can write equations.

$$x = Bx + e \tag{2}$$

The causal structure model (CS) (Pearl 2000) can be represented with directed acyclic graph (DAG). In DAG we have vertices and edges between vertices. The vertices are mathematical competences in our SEM and the edges are causal relation between edges. For example edge $x_j \to x_i$ represent cause x_j and effect of cause x_i. Acyclic graph change structural equation (1) in new structural equations:

$$x_i = \sum_{j<i} b_{ij} x_j + e_i \qquad (i = 1, \ldots, 17) \tag{3}$$

And in the matrix equation notation (2) B is strictly lower triangular matrix. In the equation (3), if the coefficient $b_{ij} \neq 0$ we have edge $x_j \to x_i$ in directed acyclic graph (DAG) for causal structure model (CS).

In our paper we use free software Tetrad 5.2.1-3 (Tetrad project 2015). Main part of this software is Linear Non-Gaussian Acyclic Model (LiNGAM) (Simizu at al. 2006). LiNGAM work with independent component analysis (ICA) with estimation of coefficients with maximize log likelihood together with all the possible causal ordering. In the software Tetrad 5.2.1-3 we use program Linear Non-Gaussian Orientation Fixed Structure (LOFS). This program generates many different DAG.

RESULTS

The authors of this paper are lecturers together with professor (Tepeš at. all. 2009, 2013, 2014,2015) on Faculty of Teacher Education at the University of Zagreb, choose the most appropriate model in mathematic on 1st year students studying mathematics on Faculty of Teacher Education.

Directed acyclic graph (DAG) mathematical competences on teachers education is shown in Figure 1:

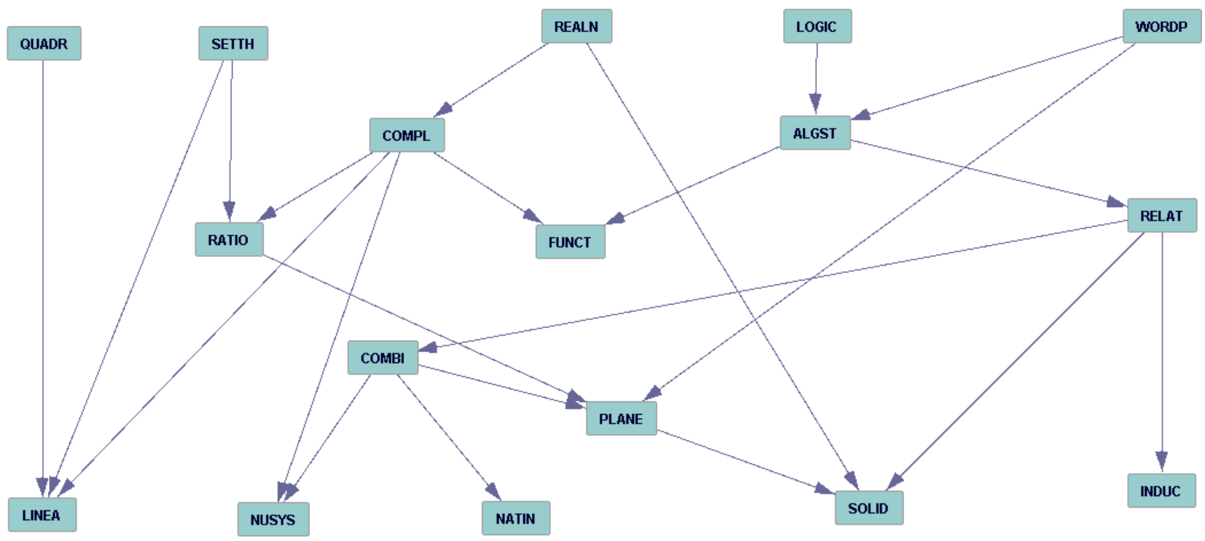

Figure 1. DAG mathematical competences on teacher education

From Figure 1 we can see six levels of causal structure. On the first level are causal mathematical competences QUADR, SEATH, REALN, LOGIC and WORDP. This competences are fundamental and cause for all other mathematical competences. On the second level are mathematical competences COMPL and ALGST. This competences are effect of competences from the first level. On the third level are competences effect causes from the first and the second level. Third level competences are LINEA, RATIO, FUNCT, REALT and INDUC. On the fourth level are competences COMBI or effect competences from previous levels. On the fifth level is mathematical competence NUSYS, NATIN and PLANE. On the sixth level is competence SOLID.

Using estimator from software Tetrad 5.2.1-3 we can describe causal structure equations (3) in our research:

$$
\begin{aligned}
&QUADR = e(QUADR)\\
&SEATH = e(SEATH)\\
&REALN = e(REALN)\\
&LOGIC = e(LOGIC)\\
&WORDP = e(WORDP)\\
&COMPL = 0.7776 * REALN + e(COMPL)\\
&ALGST = 0.5833 * LOGIC + 0.1694 * WORDP + e(ALGST)\\
&LINEA = 0.3066 * SETH + 0.2916 * QUADR + 0.3686 * COMPL + e(LINEA)\\
&RATIO = 0.5805 * COMPL + 0.5187 * SETH + e(RATIO)\\
&FUNCT = 0.6474 * COMPL + 0.4953 * ALGST + e(FUNCT)\\
&REALT = 0.5282 * ALGST + e(REALT)\\
&COMBI = 0.6754 * REALT + e(COMBI)\\
&NUSYS = 0.0042 * COMBI + 1.0732 * COMPL + e(NUSYS)\\
&NATIN = 0.5752 * COMBI + e(NATIN)\\
&PLANE = 0.5437 * RATUIO + 0.2616 * WORDP + 0.3035 * COMBI + e(PLANE)\\
&SOLID = 0.4018 * PLANE + 0.2221 * RELAT + 0.2150 * REALN + e(SOLID)
\end{aligned}
\tag{4}
$$

Exogenous competences are estimate with standard normal distribution $normal(0, s^2)$:

$First.level$:

$e(QUADR) \approx normal(0, 2.6296), e(SETTH) \approx normal(0, 4.0000), e(REALN) \approx normal(0, 3.2942),$
$e(LOGIC) \approx normal(0, 4.6524), e(WORDP) \approx normal(0, 3.6042)$

$Second\ level$:

$e(COMPL) \approx normal(0, 1.7610), e(COMPL) \approx normal(0, 1.7610)$

$Third\ level$:

$e(LINEA) \approx normal(0, 1.8375), e(RATIO) \approx normal(0, 1.8156), e(FUNCT) \approx normal(0, 1.9114),$
$e(RELAT) \approx normal(0, 2.5653), e(INDUC) \approx normal(0, 2.0053)$

$Fourth\ level$:

$e(COMBI) \approx normal(0, 2.2793)$

$Fifth\ level$:

$e(NUSYS) \approx normal(0, 2.2035), e(NATIN) \approx normal(0, 3.3799), e(PLANE) \approx normal(0, 1.6953)$

$Sixth\ level$:

$e(SOLID) \approx normal(0, 1.5146)$

Coefficients in causal structure equations (4) are the average causal effect cause competence to competence on the left side of equation. For example competence LOGIC have greater average causal effect to competence ALGST than competence WORDP because coefficient with LOGIC is 0.5833 and coefficient with WORDP is 0.1694. All coefficients in equations are nonnegative. It means that every case competence has positive effect to competences on second, third, fourth, fifth and sixth level.

CONCLUSION

Paper demonstrates the causal structure of mathematical competences in teacher education. For the purposes of adopting mathematical competences, causal model refers to the order of adopting of mathematical competences. For the purpose of further research, it is necessary to increase the statistical set or the number of faculties and students examined. Preliminary exams materials and questions must be standardized. The curriculum for students on Faculty of Teacher Education at the University of Zagreb in faculty in Croatia is mainly based on pedagogy and should have the educational structure of mathematics for future job of students or teachers in elementary schools. It means that we have to look together mathematical competences in kindergarten, elementary and teacher education. Students on Faculty of Teacher Education at the University of Zagreb will be teachers in kindergarten and elementary schools.

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FOSTERING PRIMARY SCHOOL STUDENTS' METACOGNITION USING PROJECT-BASED LEARNING

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ABSTRACT: Primary school students have difficulties in understanding the physical content due to insufficiently developed abstract reasoning skills and metacognition. Metacognition refers to the processes used to plan, monitor, and assess one's understanding and performance. It is "cognition about cognition", "thinking about thinking", or "knowing about knowing". Metacognition includes a critical awareness of one's thinking and learning, as well as awareness of oneself as a thinker and learner. There are three distinctive components of metacognition: (1) metacognitive knowledge, (2) metacognitive regulation and (3) metacognitive experiences. Since metacognition includes knowledge about when and how to use particular strategies for learning or for problem solving it is very important in learning physics. Project Based Learning can help fostering primary school students' metacognition. Project Based Learning enables students to gain knowledge and skills by investigating and responding to challenging question or problem. Since the projects are focused on student learning goals, including skills such as critical thinking, problem solving and self-management, while working on projects students must use metacognitive activities. Also project design includes that students make decisions how they work on a project and they reflect on learning, the effectiveness of their inquiry and project activities; they discuss the quality of their work, obstacles and how to overcome them. Because of that students benefit in respect of mentioned metacognitive components by the use of project-based learning.

Keywords: metacognition, physics, project-based learning, primary school

INTRODUCTION

Abstract reasoning skills are important for understanding physics contents. A student who has developed good abstract reasoning skills easily uses symbols instead of concrete objects when learning new information unlike the beginning learner who usually needs concrete aids. For example in mathematics, to represent the number "five" the teacher or child might put out five blocks. A child who has made the shift to abstract reasoning understands the concept of "quantity" without relying on objects. So in mathematics, abstract reasoning enables the child to understand that the abstract character "5" might stand for five of any specific object or just the numerical idea of five. Abstract thinking is necessary in physics as well. Physics uses mathematics for solving problems; also, various symbols are used in physics and physics deals not only with classic laws applicable in everyday life but with abstract ideas as well (quantum physics, relativistic physics and similar). Metacognition is related to abstract reasoning performance (Williams & Jones, 1997). Ackerman and Thompson (2014) have developed a framework for understanding metacognitive processes in the context of reasoning. They used the phrase "meta-reasoning" to refer to the processes that monitor and control reasoning, problem solving and decision-making. Also, metacognition enables students to learn efficiently, think on their own and acquire applicable long-lasting knowledge.

Contemporary teaching methods enable active participation of the learners in the teaching process, as well as improving the quality of science teaching and fostering students' metacognition (Obadovic et al., 2013; Obadovic et al., 2012).

In this paper the idea of using project-based learning for fostering primary school students' metacognition is discussed.

METACOGNITION

Understanding the concept of metacognition is very useful in order to learn how to learn. Metacognition refers to the processes used to plan, monitor, and assess one's understanding and performance. It is "knowledge and cognition about cognitive phenomena," or simpler "thinking about thinking", "knowledge about knowledge" (Cross and Paris, 1988, Kuhn and Dean, 2004, Martinez, 2006).

Metacognitive awareness can be categorized into awareness of: (1) metacognitive knowledge, (2) metacognitive regulation and (3) metacognitive experiences. Metacognitive knowledge (knowledge of cognition) includes: (1) declarative knowledge - how to do something, (2) procedural knowledge - skills, strategies and resources required to perform the task (knowledge of how to perform something) and (3) conditional (strategic) knowledge - when to apply certain strategy. Regulation of cognition refers to awareness of the need to use certain strategies (Schraw & Dennison, 1994, Schraw & Moshman, 1995): planning, information management, monitoring, debugging and evaluation. Metacognitive experiences comprise metacognitive feelings, metacognitive judgments/estimates, and task-specific knowledge (Efklides 2006), for example feeling-of-knowing, judgments-of-learning…

PROJECT-BASED LEARNING

Project-based learning is a dynamic approach to teaching in which students explore real problems and challenges in the everyday world outside the classroom. Project Based Learning engages students' interest and motivation and students are inspired to obtain a deeper knowledge of the subjects they're studying. A well-designed project provokes students to teach content and develop communication and presentation skills, organization and time management skills, research and inquiry skills, self-assessment and reflection skills, and group participation and leadership skills. While working on project students reflect upon their own ideas and opinions, make decisions that affect project outcomes and the learning process in general. Usually project is realized by group of students working together toward a common goal. Evaluation is on an individual basis and takes into account the quality of project realization, the depth of content understanding demonstrated, and the contributions made to the project realization.

Project can be broken down in the following steps:
- Teacher introduces students with real-life problems and they formulate the theme of project they will be doing.
- Students take on the role of project designers.
- Students discuss and accumulate the background information needed for their designs.
- Students accumulate the materials necessary for the project.
- Students create their projects.
- Students prepare to present their projects.
- Students present their projects.
- Students reflect on the process and with teacher they evaluate the projects.

In Project-based learning phases that teacher should assess are following:

1. Project launch
   - Do students understand the project?
   - Do students "need to know" core content and concepts? Do they know it?
   - Do students know the first benchmark and have a clear "next step"?
2. Early phase
   - Are students on good direction; are they researching the right things?
   - Have the students teams become organized with roles and assigned tasks?
   - Is each team member engaged and contributing?
3. Middle phase
   - Are students learning and understanding the material they are researching and the variables to consider in their solution?
   - Are students making the connections between their research and the project?
   - Are teams working effectively with clarity of next steps?
4. Late phase
   - Are students evaluating their work?
   - Have students mastered the content and apply it both in and outside of the project?
5. Culminating event
   - Did students accurately apply the key knowledge and thinking to realize the project?

- Were students able to effectively communicate the elements of their project?
- Did the team collaborate effectively?

USING PHYSICS PROJECTS FOR FOSTERING PRIMARY SCHOOL STUDENTS' METACOGNITION

Project Based Learning enables students to gain knowledge and skills by investigating and responding to challenging question or problem. Since the projects are focused on student learning goals, including skills such as critical thinking, problem solving and self-management, while working on projects students must use metacognitive activities. Also project design includes that students make decisions how they work on a project and they reflect on learning, the effectiveness of their inquiry and project activities; they discuss the quality of their work, obstacles and how to overcome them. Because of that students benefit in respect of mentioned metacognitive components by the use of project-based learning.

It is proposed that during the realization of projects students use instructions (questions) given on the instructional sheet. Following proposal of questions can be given based on the checklists of questions for encouraging metacognition (Schraw, 1998; Miščević, 2006):

- What is my goal?
- What do I have to do?
- What types of information and strategies I need?
- How much time will I need?
- Is everything clear to me?
- What data do I know?
- What details are irrelevant?
- What similar real-life examples I know?
- What materials do I need?
- What should I be aware of during the experiment?
- What do I think will happen?
- Are my assumptions correct?
- Did I achieve my goal?
- Do I need to change something?
- Can the problem be solved in an easier way?
- What was not successful?
- What was successful?

With proposed questions physics project will fostering students' metacognition.

CONCLUSION

Metacognition enables students to solve new problem by retrieving and deploying strategy that they have learned regarding to similar context. Metacognition is important for working on cognitive styles and learning strategies. Metacognition implies that the individual has some awareness of his/her thinking or learning processes. Students' metacognitive awareness is very important in learning physics. The paper points out the significance of mini-projects in order to encourage students' metacognition.

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UNIVERSITY STUDENTS' KNOWLEDGE ABOUT EPIGENETICS PERSISTENCE OF GENETIC DETERMINISM

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ABSTRACT: In recent decades, Genetic issues play a large role in health and public policy and new knowledge in this field continues to have significant implications for individuals and society. In spite of this increased exposure to genetics, recent studies of the general public's genetics knowledge show a relatively low understanding of genetics concepts. Eepigenetics is a new paradigm in biology. Nevertheless, the notion of genetic determinism is still present in syllabuses and textbooks. The present research explores the future Biology teachers' conceptions related to the genetic determinism of human performances. The research method is a questionnaire elaborated by the Biohead-Citizen consortium. The findings revealed that future Biology teachers still reducing the biological identity to a genetic program. The set can also enhance the danger of hereditarian ideology and justifies the fatalism and racism. We concluded that the teaching of epigenetics becomes a scientific and citizen challenge.

Key words: Genetic determinism, Students, conceptions, epigenetics.

INTRODUCTION

In the twentieth century, the nature-versus-nurture debate was one of the most important themes of genetics (Castera et Clement 2008). Now, most scientists accept that both factors have a crucial role and that phenotypes result from the actions and interactions of both, which often change over time (Petronis 2010).

Most phenotypes show some degree of heritability, a finding that formed the basis for a series of molecular studies of genes and their DNA sequences (Nicol-Benoit et col 2013). In parallel to such genetic strategies, thousands of studies have been carried out to identify environmental factors that contribute to phenotypes (Georgel 2015). The new paradigm is not one of nature versus nurture, but of a complex and dynamic interaction between DNA sequence, epigenetic DNA modifications, environment, gene expression, and environmental factors that all combine to influence phenotype (Gibson 2008 ; Kilpinen & Dermitzakis 2012).

Over the last years, several university programs introduced bit by bit epigenetics as part of the genetics (regulation of the expression of multiple genes, cell differentiation,…). However, in most countries, university programs of Biology do not include the wealth of information gathered over the last 30 years of investigation of epigenetics.
This article aims to explore the students' understanding of Epigenetics and to identify their conceptions related to the genetic determinism of human performances.

METHODS

This study is mainly qualitative, our methodology was mixed. We used a questionnaire and interview. this qualitative analytical methods were supplemented with statistical analysis to identify students' misunderstanding in Epigenetics.

Students sample. All students surveyed in the study were enrolled in a graduate science program at the University of Cadi Ayyad, The sample is composed of 86 Graduate Students (baccalaureate plus 3 years of study) and 20 Master' students (baccalaureate plus 4 or 5 years). Females comprised 46 percent of the sample.

The questionnaire. We composed an questionnaire to acquire information on several key issues: (a) the students' understanding of Epigenetics and interaction between Genotype and Environnement in expression of the phenotype (b) the students' conceptions of the genetic determinism of human performances.

Some of the questions were inspired by previous studies especially those relating to the genetic determinism of behaviour and intellectual performance (Clement & col 2006). However, we developed many new questions appropriate for students at the graduate level.

The responses to all the questions about genetics are based on a Likert scale on which each teacher was asked to tick one of four boxes, ranging between 'I agree' and 'I don't agree'. The majority of the questions concern genetic/biological determinism of human behaviour. These questions can be grouped into four different categories: 12 (1) Genetic determinism of personal or individual features: questions about clones and twins (A3, A6, A19, A24, A43 and A53). (2) Genetic/biological differences related to gender (A9, A14, A21, A25, A36, A38 and A46). (3) Genetic determinism of human behaviour (B8, B10, B14 &nd B20).

The interview. Interview was conducted on six students. The interviews lasted approximately 30 minutes. Thematic interview questions are used to explore in greater detail the most commonly held misconceptions identified by the questionnaire analysis.

RESULTS AND DISCUSSIONS

More than six students out of ten states that the phenotype is determined solely by the genotype (62%) and that the action of the environment on the phenotype requires a change in the DNA sequence (60%°). This reflect that a majority of students don't know epigenetic mechanisms. This is confirmed by the fact that more than the half of them state that chromatin is a DNA carrier and is not involved in the expression of the phenotype (58%) (Table 1).

Table 1. Students' Responses Related To Genotype-Phenotype Relationship (in %)

Responses in %	I strongly agree	I rather agree	I rather disagree	I strongly disagree	I don't know
The phenotype is determined solely by the genotype	35	27	13	11	14
The action of the environment on the phenotype requires a change in the DNA sequence	42	18	14	17	9
Chromatin is a DNA carrier and is not involved in the expression of the phenotype	35	23	9	12	21
DNA methylation / demethylation is a signal for activation or deactivation of a gene	27	25	16	9	23

One student out of two state that DNA methylation / demethylation is a signal for activation or deactivation of a gene (52%).

In the interview, we identified a common perception held by the students which stipulates that genes, as units of information controlling various traits, are distinct and totally separate from the environment (Fig 1).

This perception is certainly true of the physical-structural- chromosomal entity called gene, but it does not apply to genes as units of information or function. The notion that information resides in the genes and that the environment simply provides the medium through which information is displayed is incorrect. The only sure evidence of epigenetic inheritance involves methylation of genes through which identical genes coming through the two parents can behave differently in their expression (Singh 2015 ; Agorram 2010).

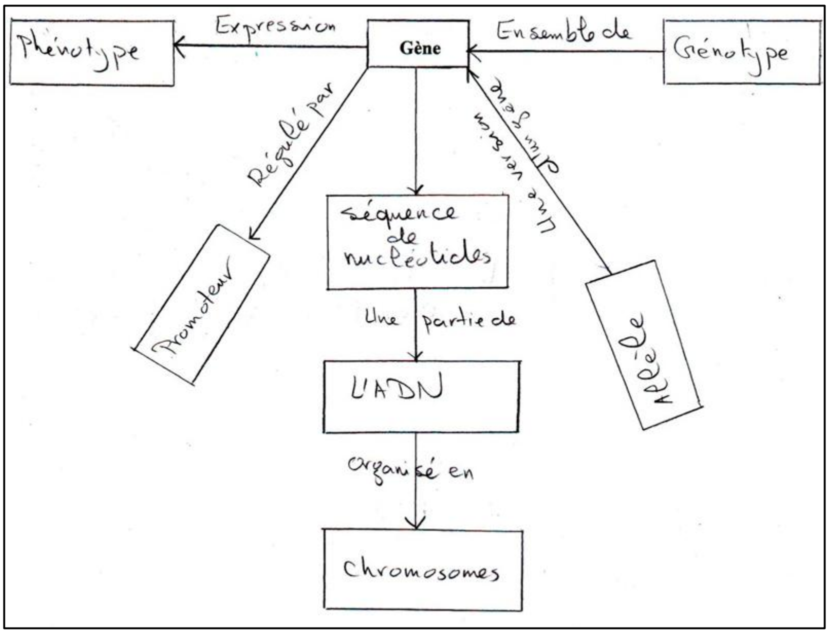

Fig 1: An example of Students' responses about gene-phenotype

About half of the students surveyed say that similarity of the reactions to different factors (immune response to micro-organisms and to transplantation) or similarity of behaviors of identical twins is due to the identity of their genes (Fig 2).

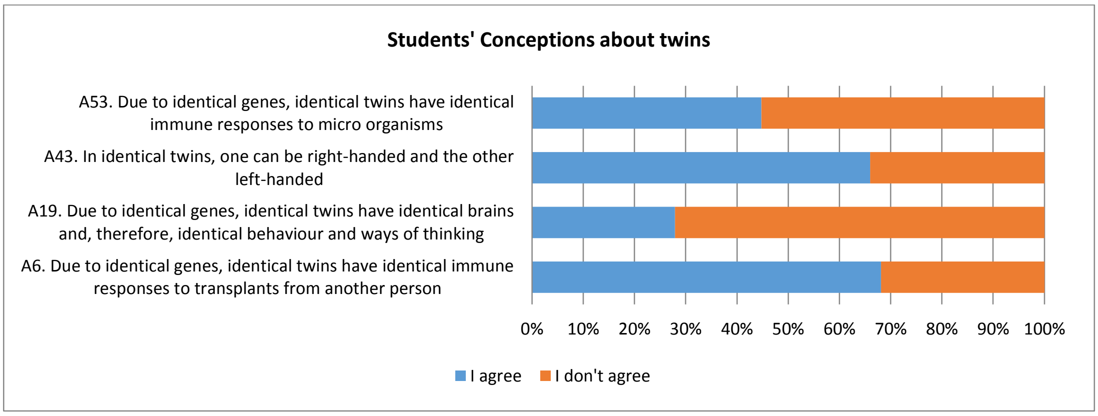

Fig 2 : Students' responses about genetic determinism among twins

It is generally agreed that epigenetics provides sufficient flexibility and latitude to the developmental program of a given genotype such that even identical twins become "unidentical" as they proceed through life (Haque & col. 2009).

Numerous studies show that it is clear that identical twins have substantial differences in obvious phenotypes like disease, and in epigenetic DNA modification patterns. Earlier twin studies were based on the premise that monozygotic twins are genetically identical, and that phenotypic differences must arise from nonshared environment. However, knowledge of epigenetic mechanisms such as differential DNA methylation, skewed X-inactivation, and imprinting provides a new model to understand monozygotic twins discordance (Gibson 2008 ; Bhalla and Iyengar 1999).

We notice that some of the students think that the differences between men and women (intelligence, sensitivity) are due to biological and genetic factors. Women are biologically different from men, these differences make them suitable for some household activities but that make them less able to do other activities. According to these students, the difference in behavior of men and women is due to the identity of their genes (Fig 3).

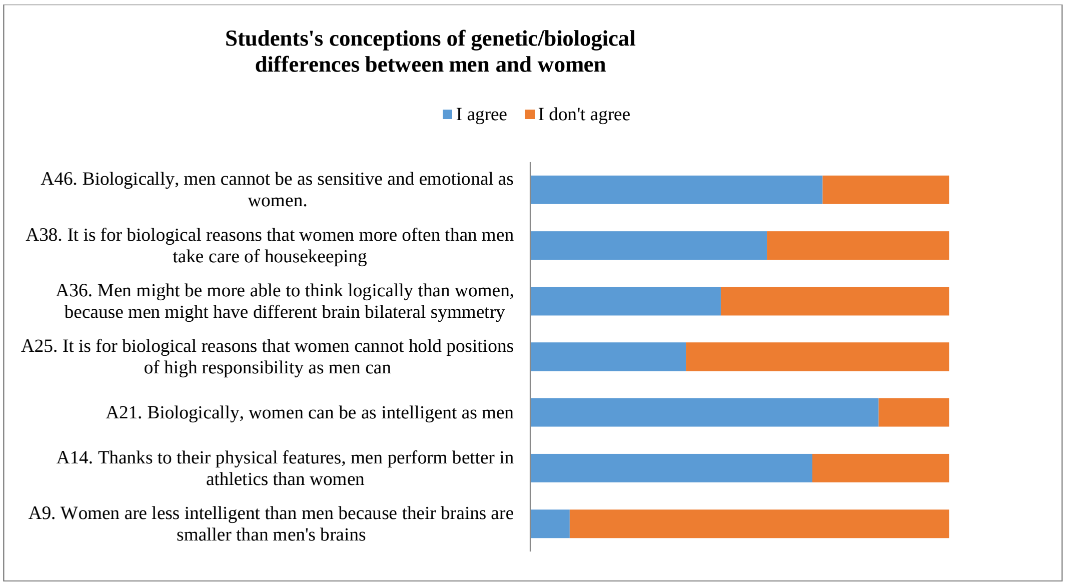

Fig 3: Students' responses about genetic/biological causes of differences related to gender

Genes determine all of characteristics, and cloned organisms are exact copies of the original. This misconception was found among more two students out of ten (Fig 4).

It's sure thet genes play a huge role in how an organism develops, but environmental factors also play a role and some heritable changes occur without changes in the genome. Many studies showed that gene expression in identical twin changes from environmental factors and suggested that these changes can accumulate over the life of the organism. It is possible that these behaviors have have a genetic component, but they are not governed by genes alone, there is an interaction between genes, environment, and epigenetic factors.

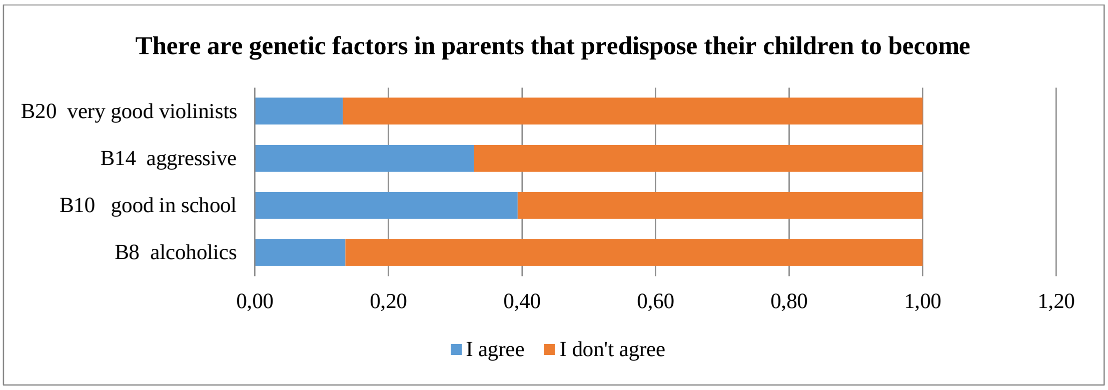

Fig 4 : Students' responses about heredity of some performances

CONCLUSION

Whether cellular or macroscopic phenotype is ultimately based on the properties of synthesized proteins. Now these are the genes which code proteins responsible for the phenotypic characters. so we would think that there is a linear relationship between a gene and a character, the first determining the second. In fact the relationship between genotype and phenotype are often more complex.

This complexity of life can not be reduced to a single genetic determinism. Its study needs to compete with other epigenetic, mechanisms to analyze the construction of phenotypic traits. New models (based on the concepts of self-organization, collective intelligence) contribute significantly to this change in perspective (Petronis 2010).

The analysis of students' responses related to the genetic determinism of human features, behaviour or performances shows a clear innatism in a majority of students' answers. Moreover, this innatism is partly correlated to some sexist and even racist answers. This conclusion is illustrating interactions between the taught science (the scientific knowledge K) and implicit values (V) (Clement 2006).

Epigenetics is still absent from university education programs reflecting an important didactic transposition delay. In the next few years, our understanding of the multiple layers of genomic information is likely to improve significantly. The school must incorporate these scientific innovations quickly enough and especially when they have an important educational dimension and which are related to socially controversial problematics.

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THE HISTORY OF ASTRONOMY IN MUSLIM CIVILISATION, FOR EDUCATING MOROCCAN FUTUR SCIENCE TEACHERS TO SCIENTIFIC THINKING IN HARMONY WITH THEIR CULTURAL IDENTITY

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INTRODUCTION

Developping scientific literacy of students, reconciling them with their cultural identity through the discovery of the technical and theoretical scientific achievements of Muslim civilization and of the manner that the rationality has been developed inside the cult science are all reasons that support the need for the introduction of the history of astronomy in the Arab-Muslim civilization in science training programs at University in Morocco. They are the goals of a training entity that we have developed for the benefit of students of a master of philosophy and a master specialized in the teaching of science at the Cadi Ayyad University, Marrakech, Morocco.

In this paper we describe those goals and the content we teach to acheave them. In the training entity here described We try to show how it is possible to support the appeal that religion has on young people nowadays in our country to root them in scientific thought, and also to highlight the way in which it has been possible for Muslims to live their faith and in the same time to appropriate and develop scientific heritage of previous civilizations.

1. Moroccan and science: needs, fascination and alienation

Morocco is a developing country that is working hard on many fronts to emerge on the world level. First in politics by adopting a bold new constitution in 2011 and engaging in a process of democratization considered enough positive within the country and abroad. In Economy by engaging in large projects such as the Green Morocco for the development of agriculture, Halieutis Morocco to value fishery resources, Azur 2020 program for the promotion of tourism and the Central Solar Noor, one the largest factories in the world of power generation from solar energy. He also conducted a social policy to improve life in precarious rural areas and urban poor districts through the National Initiative for Human Development. The country relies heavily on its education system to train human resources capable of carrying out its emergence objectives on the international economic scene. Unfortunately this system is not satisfactory enough.

Indeed the country has a big need of doctors, engineers and skilled technicians. He is also engaged to have an honorable production in scientific research as stipulate one of the levers of the Strategic Vision of the Reform of the Education System. Morocco has made training in science and technology the way to respond to those needs. Quantitatively we are very close to achieve the target rate of 66% of high school students in scientific and technical fields. These sectors have a good audience among young people, probably because they are deemed opening on best professional prospects. The best students look to join the great schools of engineering or medicine. On an other hand Researchers in Morocco in universities and research centers produce and communicate and publish books and articles in scientific journals. The average Moroccan uses many new technologies. So the number of mobile subscribers exceeds half the number of the country's population and Internet penetration rate reached 41% in 2015. There's respect and fascination towards science and technology products.

However Moroccan people have a sort of alienation towards science and technology. Maybe because of the fact that for Moroccan scientific researchers the issues of their work are domiciled in Western labs and for the average Moroccans technology products are made elsewhere away from home.

On the other hand when we analyze Moroccan sciences programs in the university we note that the contents are sufficiently rigorous and similar to those taught worldwide. Only the subjects taught are decontextualized and isolated from any historical or epistemological lighting. That could maintain or create in students minds a sense of alienation with respect to scientific thought.
During our experience of teacher and actor in an amateur asotronomy association, We have found that young Moroccans even those who have advanced degrees in science blame an indisputable lack of knowledge of astronomy. However the Moroccan sky is relatively less affected by stray light and is suitable for reading sky and doing astronomical observation. The problem may be in the low presence of astronomy in primary and secondary school programs or in the belief that to make it is necessary to have means equipment, telescopes and telescopes that one can’t easily offer.

On the other hand, it there is an obvious return to religion in Moroccan society that is manifest in politics and in everyday and intellectual life. The political forces that rely on Islamic ideological repository are so active and popular that its a party of this obedience which leads the current government. The return to religion is also evident in the intense attendance to muskets and the way that many of both men and women are dressed (beards for men and scarves for women). The reference to religion is also present in the discourse of people and discussions shared by even the most highly trained in science among them. There is a tradition considered scientific by its supporters called "scientific miracles of the Quran" which try to find the origins of the latest scientific discoveries in verses of the Koran. It is popular among youngs and adults, even and specially those who graduates in science.

In our opinion, this "pseudo-science" shows a dogmatism and a withdrawal and pernicious intellectual laziness that is contrary to the requirement of effort and creativity that goes with scientific thought which is a kind of thinking which takes into account contemporary theoretical productions and the action on the reality for producing the knowledge and not the opposite.

2. Our problematic

Faced to those multiple challenges and those phenomena at least disturbing several questions arise related to training in science in our country:

- How to train in science and to avoid that the fascination that she could create in young Moroccan mind dose not turn into a feeling of strangeness and alienation?
- How to train in science while showing that it remains an universal production which has a history and which scalable?
- How to train in science and to show that it is a type of thought distinct of the religious one?

We believe that for our students the history of science, that of science in Muslim civilization in that case, presents relevant answers to those questions. This is at least what we stand for years and that we use in the training of future teachers of physics and future researchers in philosophy. We describe in this text the objectives of the training unit and the teaching content.

3. Arab-Muslim history astronomy training unit

a. Presentation of the unit

It is a course of six hours which is part of the course of physics Education for the Master of Teaching Physics and Chemistry. A course that analyzes:

- the learning difficulties,
- the learning acquisition process of these school subject,
- the operations undergone by the scientific knowledge to be transformed into taught knowledge
- and the teachings operations and actions.

For the masters of philosophy, this course is part of a unit called "History of Mathematics and Arabic sciences". It lasts the same time but is slightly simplified because those students do not have a great prerequisite in terms of scientific knowledge.

b. Targeted goals

The objectives of this training unit are manifold:

Epistemological objectives

(1) Showing that science is a universal building
(2) Showing that its truth is relative

Psychological goals

(1) Fightig against the feeling of alienation toward science by highlighting the Arab-Muslim scientific heritage
(2) Enjoyig the attractiveness that the achievements of Muslim civilization has on young people of the countries of this civilization
(3) Helping Moroccan young people to build confidence in the genius of the Arab and Muslim peoples and their ability to produce science
(4) Reconciling young people with the history of their civilization and be aware that they dont stay its prisoners

Cultural goals

(1) helping students to distinguish between scientific and religious thinking
(2) showing how science had helped to solve problems and on the other hand that is not the sacred text that helps to solve scientific problems
(3) showing how the scholars of Islamic civilization lived their faith regardless of their scientific production
(4) showing how science was an intellectual production that served the practice of religion
(5) introducing students to astronomy and make them love it
(6) supporting the attractiveness of science
(7) developing the spirit of intellectual openness

c. The content taught

1) The first theme is an introduction to traditional astronomy in the Arabian Peninsula before the advent of Islam. A first objective of this course is epistemological ; showing that even before emerging on the world scene, the Arab people had, as did those of other countries, a handy and paracticle astronomical scientific tradition. The second is psychological; is to show our students that there are fifteen centuries their ancestors had best knowledge that their in this science. What we hope here is that fact lead them to be interested in this science. Indeed before Islam, Arabs had built a traditional astronomical around observations of constellations, the movement and the phases of the moon to meet :
- Aesthetic and artistic motivations (to revel in the beauty of the moonlight in the clear desert nights)
- Guidance needs
- Weather needs to know (recognize) cyclic climate phenomena and the various agricultural seasons. Among others, to know when to plow, transhumance ..etc. They did not knew observing the sun movement like the Greeks or the Syriacs, but they managed to solve the many practicale problems by combining the phase of the moon and its position in its twenty-eight stations in the sky.

This theme ends with the description of the period of translation in Bagdad at the 8th-9th century of the Greek heritage and the Syriac heritage and the Indian heritage in astronomy. We show also the process of the emergence of the astronomy in the muslim civilisation and its transformation into an universal corpus produced in arabic that supports theoretical scientific issues and the political and cultural and social issues that have accompanied this development.

2) The second theme begins with the discussion of religious issues that were among the major causes of the development of astronomy in the Arab-Muslim civilization, namely the designation of the direction of Mecca towards which Muslims pray and the determination of months beginnings, particularly the sacred months Ramadan and Chawal and Dou-Alhijja. These problems have been at the beginning resolved by lawyers who made the interpretation of the founding texts, the Koran and the hadith (sayings and decisions and actions of the Prophet and of his companions). But over time, with the expansion of the Muslim empire and the distance from the center and also with the complexity of political life in various corners of the empire, these solutions had became inadequate and the muslims were forced to use astronomical knowledge to develop a sacred geography. And thereafter to solve these problems mathematically by making use of spherical trigonometry. This need for an epistemological break against cultic thinking of the Muslims in the 10th century.

In the term of the course we invite the students to an initiation in astronomy. Our argument is that they must know at least a little in comparison with the great culture that their ancestors had in this area.

CONCLUSION

Our aim in this paper is to show how we are acting with our students for :

- developping their scientific thinking while trying to avoid that the facination for science their mind a feeling of strangeness and alienation
- showing that it remains an universal production which has a history and which scalable
- showing them that the science it is a type of thought distinct of the religious one
- using their introduction in the history of astronomy in muslim civilisation as a springboard for initiating them to astronomy.

The training unit might seem consistent but the question that arises is that of its efficiency. Hence the need to carry out research to assess its impact.

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ANALYZING AGENT FUNCTION DESIGN TEACHING IN ELECTRICAL ENGINEERING EDUCATION

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ABSTRACT: In this study, the effect of chosen examples in agent function design teaching is aimed to be analyzed. Traditional problem solving method is used at the beginning of agent function design teaching. Then, one workshop has been organized before a quiz. Totally 22 number of students have been divided into two groups. Each group members are randomly chosen. Each group needs to develop an agent function in a specific time. All the participants of the first group, those are expected to find a new example; choose the solved examples in lectures. Some of the students in the other group perfectly develop an agent function for a given new example. Results of the study revealed that students who asked to develop a new example require additional thinking than the ones that have an example. Both groups have been asked the same questions in midterm and final examinations.

Key words: teaching methods, agent function, robot design, robot control

INTRODUCTION

Teaching methods are generally divided into two categories; Teacher Centered Approaches and Student Centered Approaches. Teacher Centered Approaches are widely used teaching methods. The well-known and mostly used teaching strategies can be classified into three. These are namely; expository teaching, discovery teaching and inquiry teaching strategies (Demirel, 2009). Especially, education in engineering faculties' given by an expert teacher is an example of expository teaching method. Expository teaching method can be more effective with discussion and problem solving techniques (Sönmez, 2011).

Robotics is one of the multidiciplinary course in Electrical and Electronic Engineering program in Cyprus International University. This course involves robot design for a specific task and real time robot control. This study is motivated from the students' learning difficulty about agent function design learning which is the first step in robot design topic. This topic requires higher problem analyzing ability and additionally students should have good computer programming skills. Traditional problem solving methods are used at the beginning of the agent function design teaching. After giving the definition of an agent function, a simple vacumm cleaner world problem is introduced to the class. This problem was firstly solved in the class with discussions. After that, the same problem is modified twice with small changes having an increasing complexity. Becasue of the students' difficulties to find an acceptable solution, a new teaching method for agent function design is applied.

Benefits of problem based learning is studied by Yenal, (2003). That research reports that in adult education the problem based learning method might increase students' cognitive competence and higher thinking ability. Another study about student centered learning method is done by Başbay, (2005). The effect of project based on learning approach which is supported by layered curiculum is studied and results of that study shows that students' learning levels are increased. Escpically, students having higher level leraning abilities are positively affected.

TEACHING METHODS

Effective teaching methods should be used to teach today's new technology to the next generations. Psychologists and educationists are working on learning taxonomies and effective teaching methodologies. Widely accepted learning taxonomy is introduced by Benjamin Bloom in 1956 and it is revised by Anderson and Krathwohl in 2001 (Krathwohl, 2002). In the last decade, a Student Centered teaching approach namely Layered Curriculum is introduced by Kathie Nunley (2005). The reason of all these studies is to have improvement in the students' learning levels to desired learning outcomes.

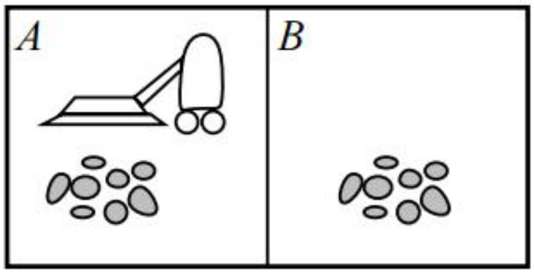
If a teacher uses traditional methods in higher education, the teacher determines course objectives and tasks by her/himself. On the other hand, if the teacher prefers to use interactive teaching method such as problem based learning and cooperative learning students' interest increases. Armstrong observed that the example choice increases the students' interest about what they are taught (Armstrong, 2012).

In this study, discovery teaching strategy is applied for agent function design teaching which is one of the Teacher-Centered Approach. In order to increase student interest in agent function design learning, some of the students are asked to find their examples related with agent function design activities as a workshop and a quiz. The implementation details of this strategy are explained in Agent Function Teaching section.

Agent Function Teaching

Agent function is a well-known problem in artificial intelligence. A simple robot design and control code can be demonstrated with agent function. In an agent function, a robotic system's perceptions and actions are decided and processed. A classical agent function definition and an example are given from Russell (2005).

An agent function concept is explained to the class of students with lecturing method. After this, a simple example as Vacuum-Cleaner world problem is introduced by demonstrating technique together with lecturing as shown in Figure 1.



Percepts: location and contents, e.g., $[A, Dirty]$

Actions: $Left$, $Right$, $Suck$, $NoOp$

Figure 1. Vacuum-Cleaner World Problem (Russell, 2005)

The example is analyzed together with the class about the required percepts and actions.

```
function REFLEX-VACUUM-AGENT( [location,status]) returns an action

  if status = Dirty then return Suck
  else if location = A then return Right
  else if location = B then return Left
```

Figure 2. Vacuum-Cleaner Agent Function (Russell, 2005).

The syntax of agent function is explained and the control algorithm is traced in the class. An optimal agent function solution is shown in Figure 2. After some discussions related with student questions, the vacuum-cleaner world problem is modified with the following questions:

- ***i.*** Modify your agent function for a problem of: "having four numbers of locations in the environment."
- ***ii.*** Modify your agent function for a problem of: "the algorithm must stop when all environments are clean."

The modifications are asked in the given order and they solved in the class one after the other. Firstly, after each question, some time duration is allowed to students to think about the problem. After that, potential solutions are discussed in the class. The second question is asked after the solution of first question. Again, some time is given to students to think about it. Additionally, in order to increase students' interests in learning process a workshop is organized and some of the students let free to choose their example about agent function.

The class is randomly grouped into three. One group includes students that not attended the workshop, second group includes students that attended the workshop and they get a question with a given agent function problem. Lastly, the third group of students that attended the workshop and they ask to give an agent function problem. It is expected to have new agent function problems described by the student. One of the aims for this activity is to increase the students' interest about agent function design and to let the students to find their own example.

There was one ungraded workshop, one quiz, one midterm, one group project and a final examination that are planned as course activities. Each activity is graded by the course instructor. Like in workshop, the same group of students are asked to give an agent function example in the quiz where the others are asked solve a new example.

RESULTS AND FINDINGS

The distribution of three groups in the class is illustrated in Figure 3. Whole class randomly and almost equally divided into three groups and they named as Not Attended, Given Example and Give an Example.

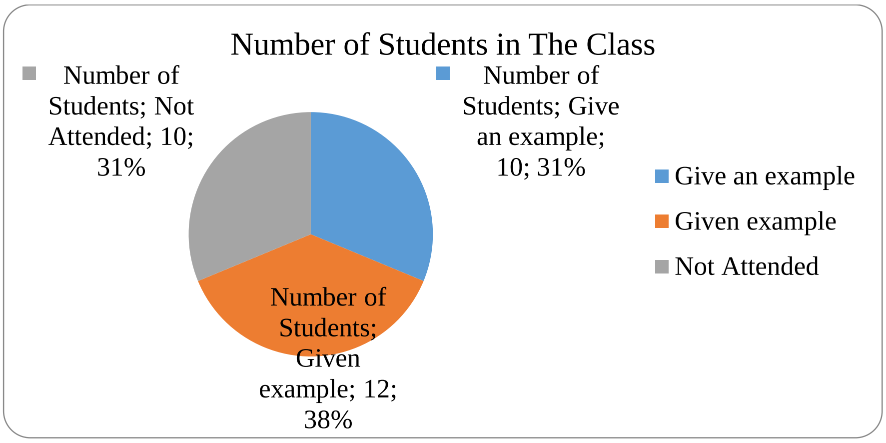


Figure 3. Workshop Attendance Distribution

After the workshop activity a graded quiz is done in the class with a predefined date and content. Like in workshop no new example is given in the quiz by the first group but structure of agent function is correctly used. The quiz examination evaluation was out of 5 and the class averages is given in Figure 4. Significant success is seen with the students that attended the workshop.

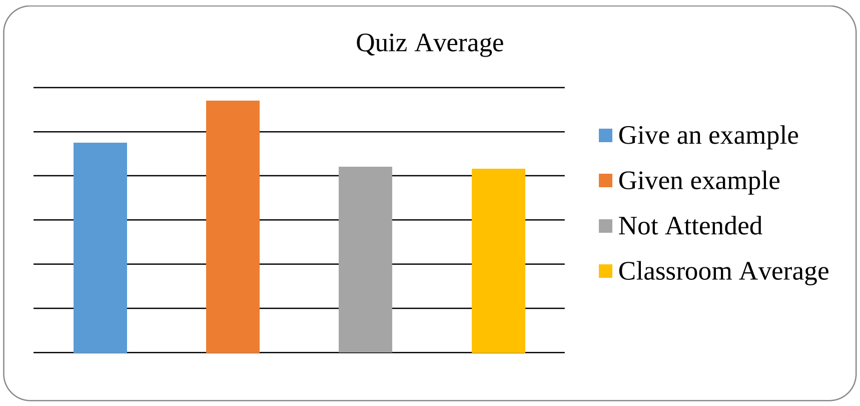


Figure 4. Quiz Average for Agent Function Design Question

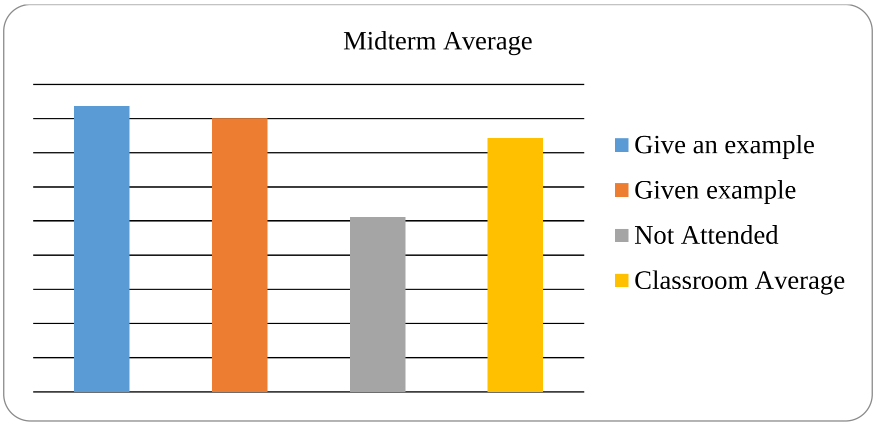


Figure 5. Midterm Average for Agent Function Design Question

An agent function question is asked in the midterm examination. Its evaluation was out of 25 and the class averages is given in Figure 5. Significant success is also seen with the students that attended the workshop.

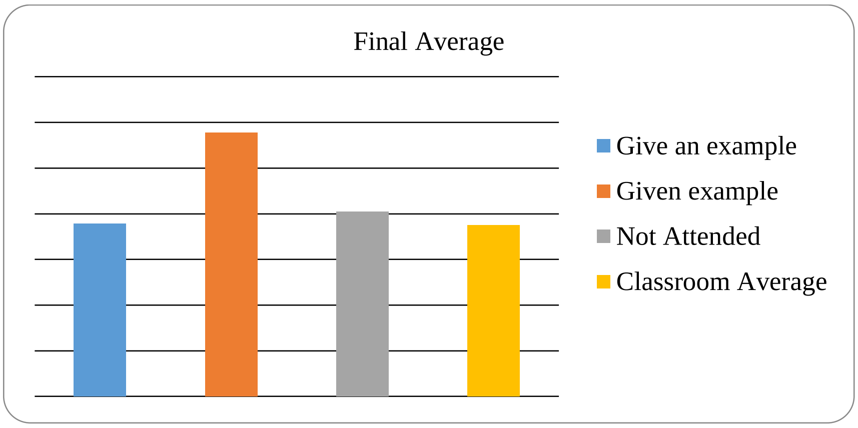


Figure 6. Final Average for Agent Function Design Question

An agent function question is again asked in the final examination. Its evaluation was out of 20 and the class averages is given in Figure 6. The success average of Given Example group is found as the greatest one. This might be because of the students' personal learning abilities. The personal learning ability plays a big role in teaching-learning methods. It is obvious that asking to find new example has no effect on students' learning interest.

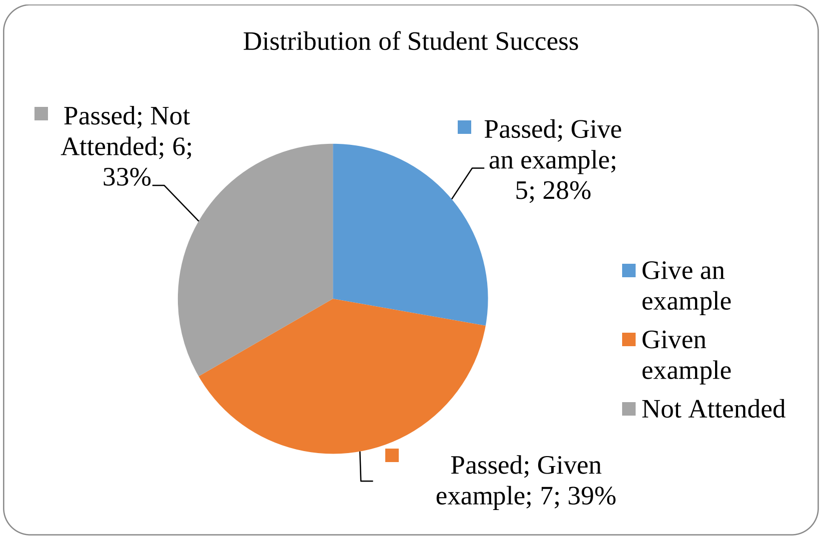


Figure 7. Distribution of Passed Students in the Class

The success rates between these three groups are analyzed in Figure 7. Students that are asked to find an agent function example have the lowest passed ratio regarding the others.

CONCLUSION

This study analyzes the effect of chosen example for agent function design teaching in Electrical and Electronics Engineering students at Cyprus International University in 2015-2016 Fall Semester. Totally 32 students' examination scores are analyzed which are registered at the beginning of the semester.

The students' performances show that a given example by the instructor has significant effect on students' learning levels. This might be because of an experience requirement to find a new example for agent function design problems. It is also observed that with project implementation students' performances from midterm to final examinations are also improved.

It can also be observed that the Layered Curriculum with project based learning might be the most suitable teaching approach for the Robotics course. Furthermore, to see the effect of this approach in the education of engineering faculties further research is required. There are some courses in all engineering faculties where the proposed approach can be easily implemented. Introduction to computer programming, advanced computer programming, logic design and robotics are some examples of those courses.

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SIMPLE AND EFFICIENT BI-COLOR PATH FOLLOWING ROBOT CONTROL ALGORITHM TEACHING IN ELECTRICAL ENGINEERING EDUCATION

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ABSTRACT: In this study, bi-color path following robot control algorithm teaching is presented. Mostly, autonomous robots follow a path on black colored surfaces having white line or vice versa. Courses having different line colors are rarely used because of its difficulty in its implementation. Several algorithms or hardware designs are developed for the autonomous solution of path following robot problem. Two electrical engineering students are taught about robot control algorithm development through inquiry teaching approach. A novel algorithm is developed after this process. This paper investigates the efficient and simple path following robot control algorithm development over two colored lines on same course simultaneously.

Key words: teaching methods, robot design, robot control, line following robot

INTRODUCTION

Nowadays, student-centered teaching approach is seem to be most popular teaching approach in higher education. Active learning, project based learning, problem based learning and inquiry based learning are some of the well known and mostly advised learning approaches in higher education (Aceska 2016; Demirel and Turan 2010; Demirel 2009; Felder and Brent 2009; Gormally et al. 2009; Healey 2005; Sönmez 2011) which are significant methods for student-centered learning.

Science, Thecnology, Engineering and Mathematics (STEM) education became more popular to educate well trained students (Miura 2016). Specially, the positive impact of inquiry based, problem based and project based teaching approaches in engineering education cannot be ignored (Erdem 2002; Furtak 2006; Gençoğlu and Cebeci 1999; Lotter et al. 2007; Mao and Chang 1998). Besides these approaches, the previous knowledge level of learners are also important to use teaching approaches like inquiry based teaching (Kirschner et al. 2006).

Inquiry based teaching approach forces learners to understand the required knowledge in detail. Tearcher guidence helps students to develope skills in learning and critical thinking. Engineering education involves critical thinking in its nature. Path following robot control algorithm development requires critical thinking and therefore inquiry based teaching approach should be aimed to be applied. In this study, inquiry based teaching together with project based teaching approach is implemented with two electrical engineering students.

This paper investigates, efficient and simple line following robot control algorithm development teaching with inquiry teaching approach. The brief introduction of inquiry based teaching approach and the line follower robot problem are given in methods section. The students' performance about line follower robot design and control algorithm development are given in results and findings section. Observations about inquiry teaching approach for line follower robot design and control algorithm developments are discussed in conclusion section.

INQUIRY TEACHING METHOD

Inquiry based teaching is one of the widely used student centered teaching approach in engineering education. This teaching approach aims to increase the motivation and attention of learners in learning process (Erdem 2002; Furtak 2006; Gençoğlu and Cebeci 1999; Lotter et al. 2007; Mao and Chang 1998). The applied inquiry based teaching approach with project based and problem based teaching can be illustrated as shown in Figure 1. Basically, problem based teaching approach involves development of a solution to a given problem. If a novel product or design is developed during the problem solution process, then this teaching approach is called as project based teaching. Both project and problem based teaching approaches are kind of inquiry teaching approach. Learners search and investigate the required solution or knowledge having a guide from an instructor.

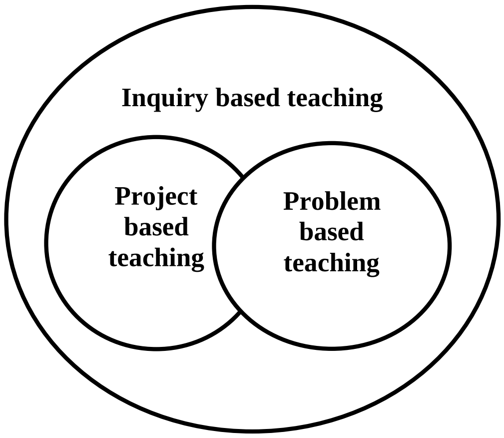

Figure 1. Inquiry teaching approach

Traditional instructional teaching approach cannot be removed from higher education. For an effective learning, students' interest can be increased by using active teaching strategies (Kirschner et al. 2006). Inquiry based teaching might be useful when the learners have enough background about a problem.

An important issue about inquiry teaching approach might be the required time to accomplish a project. This study is accomplished in two semesters. Learners spent around one semester to finalize robot manufacturing and one semester to develop a novel control algorithm. Another important issue is that, students have enough knowledge about used components and programming. The previous knowledge of learners is very important to start investigation.

Line Follower Robot Problem

A mobile robot follows a pre-defined path. Traditional line follower courses include one line on the path. The path may contain screws and the color of line may be black or white as illustrated in Figure 2.

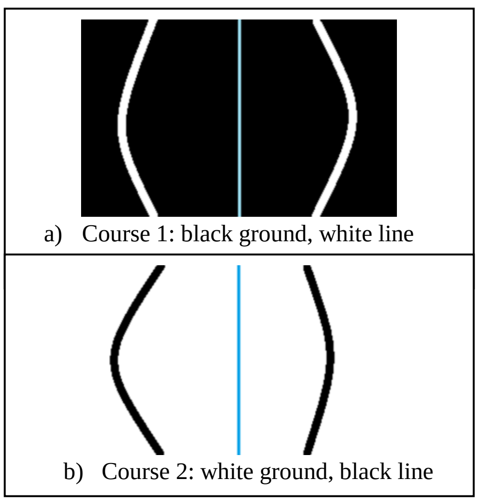

Figure 2. Example of courses having different colors

The control algorithm of a line follower robot in such courses may include contradictions. Sensor perceptions are the reverse cases of each other when the color of line changes. A truth table of sensor array with three sensors summarizes the sensor perception sequence. Assume that logical one represents black color and logical zero represents white color. All possible sensor perceptions are given in Table 1.

Table 1. Table Captions Should Be First letters capitalized

Sensor			Required Action	Description
Left Sensor L	***Center Sensor C***	***Right Sensor R***		
0	0	0	No action	All white color
0	0	1	Turn right	Black line turns right
0	1	0	Forward	Black line on the center
0	1	1	Turn left	White line turns left
1	0	0	Turn left	Black line turns left
1	0	1	Forward	White line on the center
1	1	0	Turn right	White line turns right
1	1	1	No action	All black color

A line follower robot performs only three actions; go forward, turn left and turn right. Based upon the table above, there are eight cases at most having a sensor array with three sensors. Regardless of the line color, same logical expressions are aimed to be used for the robot's control algorithm. Logical expressions of the control algorithm are developed by using data in Table 1. Simplified expressions are given in Table 2 are used only in algorithms 2 and 4. This simplification shows that only three cases are enough to control a line follower robot on bi- color line courses. This algorithm is easy to update when you increase the number of sensors. The only modification is to add a new XOR statements to the corresponding action case with logical AND operation.

Table 2. Logical Expression List

Logical Expression	Action
(L XOR C)AND(C XOR R)	Forward
(L XOR C)AND(R XOR L)	Turn Left
(R XOR C)AND(R XOR L)	Turn Right

These three cases are enough to work on both black and white color lines. Algorithms that are given below are tested with CIURunner. Obstacle sensing routine given below is commonly used in all algorithms. It causes to stop both motors when an obstacle is sensed by the Sharp IR range finder. Algorithm 2 and algorithm 4 is developed in this study.

Obstacle sensing:

- *do*
- *Read IR range finder 3 times and calculate the average distance*
- *If distance <= desired distance*
    - *Stop all motors*
- *While (distance > desired distance)*

Pseudo Code of Algorithm 1:

- *Program initializations*
- *While (true)*
- *Call obstacle sensing algorithm*
- *Read sensor values (L, C, R)*

- *If (C & !L & !R) Then*
  - *Go forward with a fixed speed*
- *If (L & !C & !R) Then*
  - *Turn Left with a fixed speed*
- *If (R & !C & !R) Then*
  - *Turn Right with a fixed speed*
- *End while*

Pseudo Code of Algorithm 2:

- *Program initializations*
- *While (true)*
- *Call obstacle sensing algorithm*
- *Read sensor values (L, C, R)*
  - *If (L XOR C)AND(C XOR R) Then*
    - *Go forward with a fixed speed*
  - *If (L XOR C)AND(R XOR L) Then*
    - *Turn Left with a fixed speed*
  - *If (R XOR C)AND(R XOR L) Then*
    - *Turn Right with a fixed speed*
- *End while*

Pseudo Code of Algorithm 3:

- *Program initializations*
- *While (true)*
- *Call obstacle sensing algorithm*
- *Read sensor values (LM, L, C, R, RM)*
  - *If (C & !L & !R & !LM & !RM) Then*
    - *Go forward with a fixed speed*
  - *If (L & !R & !LM) Then*
    - *Turn Left with a fixed speed*
  - *If (R & !L & !RM) Then*
    - *Turn Right with a fixed speed*
  - *If (LM & !C & !L) Then*
    - *Strong Turn Left with a fixed speed*
  - *If (RM & !C & !R) Then*
    - *Strong Turn Right with a fixed speed*
- *End while*
- *End while*

Pseudo Code of Algorithm 2:

- *Program initializations*
- *While (true)*
- *Call obstacle sensing algorithm*
- *Read sensor values (L, C, R)*

- *If (L XOR C)AND(C XOR R) Then*
    - *Go forward with a fixed speed*
- *If (L XOR C)AND(R XOR L) Then*
    - *Turn Left with a fixed speed*
- *If (R XOR C)AND(R XOR L) Then*
    - *Turn Right with a fixed speed*
- *End while*

Pseudo Code of Algorithm 3:

- *Program initializations*
- *While (true)*
- *Call obstacle sensing algorithm*
- *Read sensor values (LM, L, C, R, RM)*
    - *If (C & !L & !R & !LM & !RM) Then*
        - *Go forward with a fixed speed*
    - *If (L & !R & !LM) Then*
        - *Turn Left with a fixed speed*
    - *If (R & !L & !RM) Then*
        - *Turn Right with a fixed speed*
    - *If (LM & !C & !L) Then*
        - *Strong Turn Left with a fixed speed*
    - *If (RM & !C & !R) Then*
        - *Strong Turn Right with a fixed speed*
- *End while*

Pseudo Code of Algorithm 4:

- *Program initializations*
- *While (true)*
- *Call obstacle sensing algorithm*
- *Read sensor values (LM, L, C, R, RM)*
    - *If (L XOR C) AND (C XOR R) AND (C XOR RM) AND (C XOR LM) Then*
        - *Go forward with a fixed speed*
    - *If (L XOR R) AND (L XOR LM) Then*
        - *Turn Left with a fixed speed*
    - *If (R XOR L) AND (R XOR RM) Then*
        - *Turn Right with a fixed speed*
    - *If (LM XOR L) AND (LM XOR C) Then*
        - *Strong Turn Left with a fixed speed*
    - *If (RM XOR C) AND (RM XOR R) Then*
        - *Strong Turn Right with a fixed speed*
- *End while*

Algorithm 1 and *Algorithm 3* are modified with additional instructions for a black line but CIURunner couldn't follow the line. However, when algorithm 2 and algorithm 4 are tested with CIURunner, it has been observed that they work properly on both courses. Same motor speeds are used in all algorithms. However, motor control speeds differed for each action.

CIURunner is tested in two courses having different line colors. Instead of long straight lines a path with strong screws are preferred to test the algorithm performances as shown in Figure 3.

a) Course 2: Path with black and white line

b) Course 1: Path with white line

Figure 3. Used Line follower courses

The performance of the proposed algorithms (*Algorithm* 2 and *Algorithm 4*) is tested in course 1 and course 2 which have 4.16 meters length. The performance of the proposed algorithm and traditional control algorithm are summarized in Table 3. The proposed algorithm might look similar to the control logic which is given in studies (Hasan and Al Mamun 2012; Hasan et al. 2013). The advantage of the proposed algorithm is, having the ability to follow a path with bi-color. A similar logic circuitry that is presented in (Hasan and Al Mamun 2012) can be constructed for the proposed algorithm as well.

Table 3. CIURunner Control Performance

Courses	**Performances of Algorithms**			
	Algorithm1	***Algorithm2***	***Algorithm3***	***Algorithm4***
Course 1	15,5 sec	15,3 sec	15,4sec	15,3 sec
Course 2	Lost the line	15,3 sec	Lost the line	15,4 sec

The speed of the CIURunner is recorded with different number of sensors and logical expressions. CIURunner speed was 0.4 m/s in ITURO2013. However, then the motor control parameters are increased. Thus, the performance of CIURunner is reached to 0.55 m/s. Dynamic PID control algorithm provides high quality of line following behavior with the speed of 0.2 m/s (Engin and Engin 2012). However, CIURunner does not astray from the line when the speed is 0.4 m/s with the algorithms 2 and 4.

RESULTS AND FINDINGS

In this study, a simple and efficient line follower robot control algorithm is developed for bi-color line course where it detects obstacles in front of it. The robot named as CIURunner is developed for the line follower robot competition of ITURO2013 which is organized by the İstanbul Technical University in every year. CIURunner is designed as a line follower robot as shown in Figure 4. The robot has two DC motors which control two wheels, two free wheel at front and end of it, five light sensors and one IR range finder. Inquiry teaching approach is applied during the development of this robot.

Figure 4. The Line Follower Robot (CIURunner)

The block diagram of the line following robot architecture is illustrated in Figure 5. Since +5V is not sufficient to work with DC motors, a L298N motor driver is integrated to the PIC. In order to perceive accurate IR sensor voltage values, 74HC14 comparator is used in this architecture.

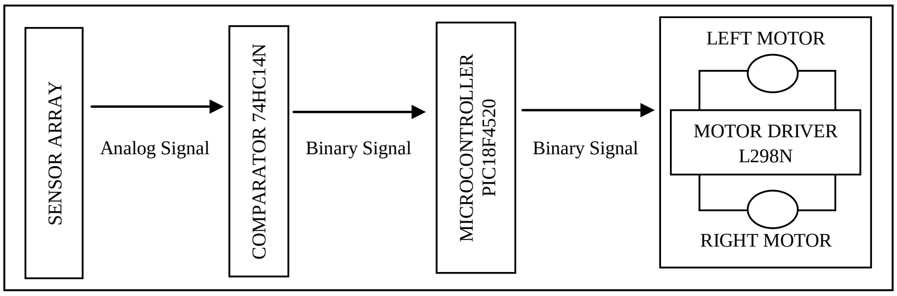

Figure 5. Block Diagram of Line Follower Robot

In order to make CIURunner to turn screws fast, five IR reflective sensors (QRD1114) having 2 cm distances between each is installed on sensor array. The organization of sensor array is shown in Figure 6. Path color information is perceived by IR sensors as an analog voltage between 0V and 5V. These values are converted to binary values as 0 or 1 by 74HC14 comparator. Path colors are represented as sequence of 0s and 1s. Binary sensor information is used by the microcontroller to control the line follower robot.

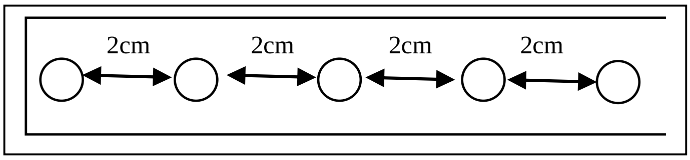

Figure 6. Top view of sensor position

Obstacle avoidance behavior can be implemented by using range finder sensors. Therefore, an IR range finder sensor (Sharp IR range finder) is integrated to the body of the robot as shown in Figure 7. This sensor works with analog signal with the range between 20 cm to 150 cm.

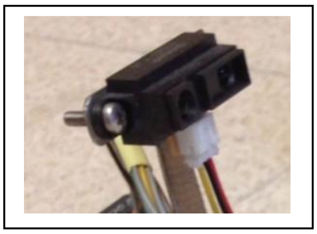

Figure 7. Sharp IR range

CONCLUSION

This study analyzes the effect of inquiry teaching method for mobile line following robot in Electrical and Electronics Engineering students as case study at Cyprus International University. Only 2 students are chosen as a group and the line follower robot problem is given to them. At the beginning, students searched the literature for line follower robot design and the related control algorithms and then they discussed their observations with the instructor.

A novel control algorithm is given to students at the beginning. However, after literature review, students couldn't find similar control algorithm and therefore they decided to implement known algorithms first. The experimental results showed that the known algorithms are not working for bi-colored paths. When the given algorithm is implemented, it is seen that it works perfectly without any modification. Since these students have enough experience about line follower robot the proposed algorithm implementation is done very quickly and easily.

Students have been attended to a well known robot competition organized by İstanbul Technical University. The speed of CIURunner was 0.4 m/s in ITURO2013. After that, the motor control parameters are increased. Thus, the performance of CIURunner is reached to 0.55 m/s. This was the first experience of the students in robot competitions. The students' performances show that the inquiry based teaching approach has significant effect on students' learning levels. This might be because of interactive learning and it followed with exact learning.

It can also be observed that the inquiry teaching method with project based learning be the most suitable teaching approach for courses such as Robotics. Furthermore, to see the effect of this approach in the education of Robotics course further research is required.

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BIODIVERSITY IN MOROCCANS TEXTBOOKS: IMPLICATIONS FOR ACTION-ORIENTED ENVIRONMENTAL EDUCATION

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ABSTRACT: The world environmental situation is likely to be further aggravated by the increasingly rapid extinction of species. This is likely to destabilize various ecosystems. This phenomenon has stimulated citizenship's awareness to the extent that it is acknowledged that its study involves great educational value and should be present at school. Biodiversity teaching quality depends on how it is dealt with in the classroom. Given that textbooks constitute a widely used material, its content should increase the pupils' knowledge about Biodiversity and the consequencies of its loss. The present research explores the contents of school textbooks of Morocco in relation to Biodiversity topic. The research method is content analysis. The findings revealed that the majority of textbooks have integrated a number of issues that could enhance understanding about the significance of biodiversity but only one textbook dealt with consequences of its loss. The textbook analysis revealed a multiplicity of biodiversity definitions, with a strong predominance of the number of species, suggesting that many textbooks were outdated. Majority of analysed textbooks cannot expect concrete action planned and executed against loss of biodiversity. The paper calls for redressing some of the observed limitations through revision of existing content.

Key words: Biodiversity, content analysis, textbooks, environmental education.

INTRODUCTION

Following the earth summit in rio in 1992 and the alarming report on the state of global biodiversity and the speed of its erosion, concern for preservation and conservation of biological resources has become a global issue (anup shah 2015 ; barbault 2004 ; barroca-paccard and al 2015) . This is particularly reflected in the adoption and signature by the states involved in the convention on biological diversity (cbd 1992). It has long been feared that human activity is causing massive extinctions. Despite increased efforts at conservation, it has not been enough and biodiversity losses continue (un www.milleniumessessment.org 03/2005).

Now, the term biodiversity is part of the vocabulary of our educational system in the Life and Earth sciences programs in secondary education. As many researchers have pointed out, this term is not easy to define. However the concept of biodiversity also represents an evolution of representations, more or less implicit, linking the term unless the issue of biodiversity itself to the question of the preservation of nature or to the Register of disaster.

This complexity associated with Biodiversity concept seems to be an opportunity in the context of a disciplinary education which aims to build knowledge and build the students' capacity of discernment. In this sense, the problematization of biodiversity can help to develop a pedagogy of judgment, able to overcome the difficulties related to a fixed view of school knowledge (Fleury & Fabre, 2006).
Some studies have tried to guideposts for how to teach Biodiversity (Barroca-Paccard & col 2015; Lhoste & Voisin, 2013).

Textbooks have a positive role to play and should provide the core elements of learning in the subjects. Textbooks should also be designed to develop students' critical and creative thinking and other generic skills through the information and activities that they provide. Quality textbooks can also assist teachers by providing a source for materials that will help them to plan the scope and sequence of their teaching.

The present research aims to analyze the contents of secondary textbooks of Morocco in relation to Biodiversity topic. Our research question is : In what ways and to what extent have issues related to biodiversity been integrated into secondary Biology textbooks?

METHODS

Corpus

We have analyzed textbooks of scientifc Common Core (level 10) and those of first year and second year of baccalaureat (level 11 and 12) . These levels correspond to different times where biodiversity is treated to all students of science subjects in secondary education (Table 1). The analyzed textbooks are some of the commonly used textbooks and all correspond to Life and Earth sciences' programs currently applied in Morocco.

Grids

For textbooks'analysis, we have used grids developed as part of the European Biohead-Citizen project (Caravita et al 2008). The textbook analysis allow to determine if the dimensions of the New Environmental Paradigm were or were not taken into account. This is to identify whether the cases cited:

- Are only a linear and analytically or are presented in their systemic complexity;
- Are local cases contextualized or general cases leading an overview of the situation, even world;
- Have as a goal to introduce the idea of respect for nature, conservation or rational management;
- Allow an awareness of individual responsibility or social vis-à-vis the environment on the part of each student influencing its current citizens and future behavior.

The textbook analysis had dealt on text and images

RESULTS AND ANALYSIS

In textbooks analyzed, Biodiversity topic was dealt at ecosystem, species and the genetic level, in this order from one grade level to the upper one.

Ecosystemic diversity

A large party of the scientifc Common Core's textbook is devoted to the study of ecosystems and their diversity with examples of different environments (forest, sea, desert, soil ...) (13 pages).There are more illustrations than text.

The descriptive approach is more used than explanatory one. There is description of ecosystem's components and of various types of environmental factors that modulate ecosystems (Temperature, rainfall, physical and chemical composition ...). The environment includes a variety of species, numerous trophic relationships occur in diverse ecosystems. No reference to the capacity of ecosystems to resist to changes induced by human activities.
Ecosystems are described in sufficient detail but the various relationships between ecosystem's components are described in a linear way failing to take account the complexity of these interactions.
The impact of Human on the ecosystems is dealt with numerous exemples: tree cutting and deforestation, excessive pasture, forests fires, excessive use of pesticides, but very few management actions on ecosystems are described (shrub planting to combat the movement of sand in the desert areas).

Diversity of Species

Throughout the scientifc Common Core's textbook, a multitude of species are described whether animal and plants. Species diversity is related with habitat diversity modulated by environmental factors and trophic relationships.

Species extinction is mentioned several times and only related to the negative impact of human activities.
A paragraph is devoted to man's efforts in the protection of nature (tree planting, using biological pesticides, genetic improvement of forets' trees, protected areas, reintroduction of some species in their natural habitat, regulation of hunting and fishing, pasture management in consultation with the local population). the textbook gives as an example the reintroduction of Ostrich in its habitat in southern Morocco.

Species diversity is also studied at the level of reproduction. The manual gives many examples of reproduction modes (sexual and asexual) only in plants. The specific diversity is also shown in the study of plant classification (morphological diversity, life cycle ...).

Economic, social dimensions are discussed but in rare cases :

> « *Faced with the alarming indicators of the deterioration of ecosystems, and in accordance with international recommendations, and in the context of sustainable development, man has taken action to protect the flora and fauna of an integrated way taking into account the economic and social needs of man without tourefois harm the natural balance ».*

Genetic Diversity

This part is treated in the textbook of 2nd year of Baccaleaureat in the chapter of population genetics.
Several photos show diversity within populations of the same species at morphological and biochemical level. The immunological and nucleotide levels are not mentionned.

The manual also deals with the diversity in the human species without mentioning races but by mentioning human groups. This underlies that what differentiates us as human populations is more important than what assembles us. This reductionist approach suggests that these differences have genetic basis and that we constitute different "races". Theses assumptions are dangerous because they were used as pretexts by various dictatorships (nazism ...) to commit crimes and massacres against several people. Hereditarian conceptions have been shown in other research and in various contexts (Agorram 2010).

Ethnic, social dimensions in the Biodiversity topic are not mentioned.

Values in textbooks

The textbooks analysis allow to identify numerous values that can be categorised as follow :

- Ecological: the textbooks dealt with : maintenance of natural systems that require biodiversity; the perceived quality of the environment (local and global); acceptance of constraints for human action, awareness of the planet as a limited pool of resources.
- Aesthetic: Referring to an appreciation of beauty and harmony through our senses; to the pleasure gained by this perception; to the value assigned to beauty relative to other environmental affordances.
- Economic: Referring to the value of resources, to the costs and benefits of human plans of actions.
- Ethical: Referring to taking responsibility as users of resources, to right of future generations to benefit from these resources
–

So, the most mentioned dimensions in textbooks are related to knowledge there is a lack of several dimensions such as

- Existential: Referring to the value assigned to the quality of life, to the person ; to the role assigned to the spiritual dimension (religious, artistic, ideological) in one's own life.
- Cultural: Referring to the maintenance of the attitudes and the practices of social and cultural units (traditions, habits, knowledge); to the image of science.
- Social: Referring to the maintenance of the cohesiveness of the social environment; to attitudes about diversities (gender, sex, age, culture).
- Political: Referring to the ways of managing, ruling and controlling the interactions between individuals and society, humans and environment; the participation of citizens.

Theses values are pertaining to different dimensions of human practical and intellectual activity that are relevant to Environmental Education (caravita 2008 ; Agorram & caravita 2009).

Teaching styles

The Informative style is the dominant one, it is present in all analyzed textbooks. The injunctive and persuasive styles are underdeveloped in these textbooks.

The participative style, which should be used in any content that have an educational dimension is totally absent in all studied textbooks. Authors should emphasize this style that allows persuade, convince more than one ; that encourages students to question, reflect and propose action from their own thinking.

The Environmental Education suppose out of forms of classical education. It should focus on the teaching styles that encourage a more participatory student learning.

But the dominance of informative style in all studied manuals, would not allow learners or participate in the development and construction of their knowledge or to adopt responsible behavior towards themselves and towards the environment. Education that does not allow the adoption of attitudes is doomed to failure (Agorram & Caravita 2009 ; Caravita 2008).

Conception relation of humans respect to nature

The human-nature relationship is presented as conflictual. This conflictual conception is present in textbooks in other topics (Ecosystems, pollution, use of resources).

Textbooks consider that Human activities are largely affect the nature and cause loss of biodiversity. The difficulty of finding a compromise between the protection/preservation of environmental "integrity" and the demands of the development of human economy is stated in terms of a stereotyped complaint about the destructive presence of humans on the Earth.

The textbooks analysis show that the attitudes conveyed by these textbooks might be classified into the following types: fatalistic, blaming ("Man is guilty!"), responsibilizing, objectivizing ("interest of environment are also the interest of the human species"),

In previous research, we have found the same attitudes when we had analyzed textbooks for other topics (ecosystems, pollution, use of resources) (Agorram & caravita 2009).
Thus, the appeal to a generic responsibility of humans substitutes the identification of real cases, the pointing out of specific responsibilities of agents, the highlighting of concrete policies that might be explored at different levels in the organization of a society : economic, social and political.

CONCLUSION

Analyzed Textbooks devote much to the biodiversity topic, but teaching approaches used are often inadequate and should be reviewed.The textbook analysis from these globally highlights a conservative and disciplinary posture. The perception of the action of man is through examples of collections that focus on discourse in practice, action and develops a very functionalist vision where man is presented as manager (Barroca-Paccard & col 2015). This is particularly true for Scientific Core textbooks. Textbooks neatly not show a link between traditional disciplinary issues and socioscientific dimension to the detriment of the latter. In general, it is clear the coexistence of two approaches: on one hand, a very disciplinary vision leading to a progressive vision for biodiversity and the other an anthropized vision largely centered on the concept of ecosystem. This juxtaposition can give the impression of a dichotomy between disciplinary knowledge and applied examples. This approach is however not sustainable, we must "bring biodiversity in social, moral, ethical and thus changing the relationship to nature among the citizens of tomorrow". This proposal remains to be built at the textbooks analyzed in this work.

In higher secondary school textbooks, the role that individuals can take in the preservation of biodiversity is almost disregarded or it is treated in a way, that is ignoring that the students are in a more adult age, have hopefully developed higher competences, have more autonomy of decision and action as consumers, as customers of services, as people who are planning their life as adults. Providing information about the environment and environmental choices remains an important role of environmental education, but it is not the only role.

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DEVELOPMENT OF THE SECONDARY-BIOLOGY CONCEPT INVENTORY (S-BCI)

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ABSTRACT: This project aims to develop a measurement tool for assessing the conceptual understanding of secondary grade-level biology students (ages 11 to 18) that is reliable and valid. The study reported here describes the validity assessment of Secondary Biology Concept Inventory (S-BCI). The validation stage involved an iterative revision and review process to establish sufficient content and construct validity. This stage included (i) student interviews and (ii) multi-expert panel critique. Assessment items proven to be valid where included on the S-BCI.

Key words: biology, secondary education, concept inventory, and alternative conceptions

INTRODUCTION

Concept inventories (CIs) are research-based measurement instruments used for assessing student understanding of concepts (Hestenes et al., 1992). These tests can be useful tools in measuring what students understanding. Several existing CIs target tertiary-level conceptual understanding of specific topics in biology such as natural selection, cell, genetics, and osmosis and diffusion (Anderson et al., 2002; Elrod, 2008; Odom and Barrow, 1995). Additionally, the college-level Biology Concept Inventory (BCI) includes the major concepts covered in a first-year undergraduate biology course. However, the BCI's validation process included college-level students and not secondary-level students (Klymkowsky & Garvin-Doxas, 2008). Although there are several existing CIs related to biology concepts, there is no fully developed CI available that collectively measures the major concepts covered in secondary biology classrooms. Thus, this study aims to develop a measurement tool for assessing the conceptual understanding of secondary grade-level biology students (grades 7 to 12) that is reliable and valid. In this paper, we describe the Secondary-Biology Concept Inventory (S-BCI) and its development and validation.

METHODS

Our goal was to design a concept inventory that would be able to measure the thinking of a large, diverse sample of secondary-level biology students.

S-BCI Constructs and Item Development

The S-BCI was designed to assess secondary-level students' understanding of core concepts (Table 1). These core concepts were identified by surveying a panel of expert biology teachers and college level biology experts about which concepts represent the secondary-level fundamental models in the field of biology.

Table 1. Core Concepts in S-BCI

Core concepts in S-BCI	Total number of questions
CC1. Evolution and diversity	13
CC2. Population interactions	12
CC3. Growth and reproduction	13
CC4. Inheritance	11
CC5. Energy and matter	13
TOTAL	61

An average of 12 single-tiered items were written or adapted from other assessments targeting the core concepts associated with each model (Table 1). A total of 61 selected response items were developed. Each item was comprised of question stem and four to seven possible responses. Many of the distractor responses represented alternative conceptions identified by practitioner observations and empirical research.

Validation

The validation stage of the S-BCI development involved an iterative revision and review process to help establish sufficient S-BCI content and construct validity. This stage included (i) student interviews, (ii) student questionnaires, and (iii) multi-expert panel critique. Based on the responses from the multi-expert panel review, student questionnaires, and student interviews, the S-BCI items were revised.

RESULTS

The first stage of developing content and construct validity included student interviews. From these student interviews, items that were designated as having 'validity concerns' were edited for student questionnaires. Generally, the validity concerns of the assessment items fell under three categories: (1) confusion about the wording and problems with complex terms, (2) a lack of understanding of figures associated with the question, and (3) unanticipated alternative conceptions. This paper will focus on category one: confusion about the wording and problems with complex terms.

Confusion about the wording and problems with complex terms is associated with vocabulary within the question stem that students did not understand. These words were first identified in the undergraduate student interviews by students either asking for clarification of the term or a lack of understanding of the terms' definition after further questioning.

Exemplar: Confusion about Wording

The exemplar assessment item represents an example of a question that was identified as having validity concerns during the expert panel review and student interviews because of lexicon complexity. The original item (Figure 1) was developed for the Dominance Concept Inventory (Abraham, Perez & Price, 2014). This question was incorporated into the S-BCI because the item aligned with the S-BCI's Inheritance Core Concept (Table 1). Furthermore, this task targets common alternative concepts held by some secondary-level students. For example, if a student selects distractor B, then the students may have the alternative conception that within a population, the selective advantage of a particular phenotype is determined by the phenotype's impact on survival and reproduction (Abraham, Perez & Price, 2014).

Figure 1. Original Question (Abraham, Perez & Price, 2014)

A rose population has two alleles of a gene for thorn length. Long thorns help protect the roses from herbivory by deer. Allele H1 codes for long thorns, while allele H2 codes for short thorns. Given this information, please indicate which of the following a biologist would infer about the mode of inheritance for allele H2?

a) It is dominant.
b) It is recessive.
c) It is co-dominant.
d) It is impossible to determine.

The original question (Figure 1) was reviewed by both the College Biology Expert Panel and High School Expert Panel. The expert panel review data suggested that description of the allele variants (i.e. allele H1 codes and allele H2 codes) may cause student confusion. The term 'herbivory' was also identified as a term that may lead to student comprehension issues. Therefore, this question was edited to reduce student confusion (Figure 2).

Figure 2. Edited Question after Expert Panel Review

In a rose population, there are two variants for thorn length, short thorns and long thorns. Long thorns help protect the roses from being eaten by deer. Given this information, please indicate which of the following a biologist would infer about the mode of inheritance for short thorns?

a) It is dominant.
b) It is recessive.
c) It is co-dominant.
d) It is impossible to determine.

The assessment item in Figure 2 was further evaluated during the undergraduate interview stage. Students indicated that the phrase 'mode of inheritance' could be reworded in order to reduce terminology confusion. As a result, the phase 'mode of inheritance' in the original question (Figures 1 and 2) was replaced with the phrase 'the way [thorns] are inherited' (Figure 3). Furthermore, the answer stems were expanded to include descriptions of student reasoning. That is, if a student selects choice A, then that student is likely to have the alternative conception that dominant traits provide an adaptive advantage.

Figure 3. Edited Question after Undergraduate Interviews

In a rose population, there are two variants for thorn length, short thorns and long thorns. Long thorns help protect the roses from being eaten by deer. Given this information, please indicate which of the following a biologist would infer about the way short thorns are inherited?

a) It is a dominant inheritance pattern because short thorns have an adaptive advantage.
b) It is a recessive inheritance pattern because short thorns are more widespread in the population.
c) It is a co-dominant inheritance pattern because both long and short thorns are found in the population.
d) It is impossible to determine.

CONCLUSION

After the expert panels and student interviews, both undergraduate and high school, the refined S-BCI questions totaled 52. Nine of the original 61 questions were considered invalid. The remaining 52 S-BCI questions will be moved forward in large scale quantitative testing. Within the interview stage both undergraduate and high school students understood the questions with a mix of students conceptually targeting, both alternative and accepted conceptions, indicating that the items on the S-BCI vary in difficulty. In the wide scale quantitative study, we will work to determine if the S-BCI is reliable.

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PLANT CLASSIFICATION AND BIODIVERSITY WHAT RELATIONSHIP IN TEXTBOOKS OF MOROCCO

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ABSTRACT: Biodiversity is rapidly declining worldwide. The main cause of the loss of biodiversity can be attributed to the influence of human beings on the world's. To protect biodiversity we need to understand it. An informed understanding of plant diversity and resources has never been more important. Environmental surveys and effective conservation strategies depend upon detailed knowledge of plants. To communicate such knowledge accurately and effectively, training is required in plant taxonomy, the discipline devoted to plant diversity, relationships and nomenclature. In Morocco, plant taxonomy is addressed in different levels of pimary and secondary education. Textbooks, didactical reference tool for pupils and teachers, also address this issue. The purpose of this paper is to present the results of the analysis of pedagogical approaches used by these textbooks. The methodology used is content analysis both in the text and in images. The analyzes show that there is dominance of the functionalist classification and negligence of the utility of species. In textbooks, there is use of ecological criteria, relating to reproductive and vegetative and negligence of genitic and biochemical criteria. The pedagogical styles are often informative and explanatory. The classification of plants is not linking in an explicit way with biodiversity. Results show that pedagogical approaches fail to develop the necessary skills to classify plants include in particular the kinship between species and to classify living species in their taxa. Such pedagogical approaches does not allow the development of critical thinking required in any action of the Environmentel education.

Keywords: Botanical classification, Textbooks, Biodiversity, pedagogical approach

INTRODUCTION

Biodiversity is a term that describes the variety of living beings on earth. It encompasses microorganism, plants, animals and ecosystems. In biodiversity, each species has an important role to play in ecosystem. Various plant and animal species depend on each other for what each offers and these diverse species ensures natural sustainability for all life forms. A healthy and solid biodiversity can recover itself from variety of disasters. The biodiversity is in grave danger, human beings are the most dangerous cause of its destruction.

In the last years, biodiversity has become a major focus in biological research. Its appreciation requires the identification of organisms. Classification and identification are fundamental to most biological sciences. Yet, taxonomic teaching and research have declined to a level where adequate support for the other sciences can no longer be sustained. New teaching initiatives are needed, combined with the provision of suitable resource materials and identification guides.

Textbooks represent one of the pillars of formal education and they influence the content, the approach and the teaching style (caravita 2008). This paper aims to study how plant classification and biodiversity are treated in textbooks.

METHODS

This study is mainly qualitative, our methodology is based on a content analysis of textbooks. The analysis we propose is guided by two questions:

- How Biodiversity and the plant classification are treated and also what are the links between these topics?
- What is the approach taken to address these issues?

In the analysis, we have used a grid designed and validated by the BIOHEAD project consortium (caravita 2008)

Corpus

We have analyzed textbooks of scientifc Common Core (level 10) and those of second year of baccalaureat (level 12) . These levels correspond to different times where biodiversity and plant classification are treated in secondary education. The analyzd textbooks are some of the commonly used textbooks and all correspond to Life and Earth sciences' programs currently applied in Morocco. The textbook analysis had dealt on text and images.

RESULTS

In analyzed textbooks, Biodiversity topic was dealt at ecosystem, species and the genetic level, in this order from one grade level to the upper one. Throughout the scientifc Common Core's textbook, a multitude of species are described whether animal and plants. Species diversity is related with habitat diversity modulated by environmental factors and trophic relationships.

Species diversity is also studied at the level of reproduction. The manual gives many examples of reproduction modes (sexual and asexual) only in plants. The specific diversity is also shown in the study of plant classification (morphological diversity, life cycle ...) (Figure 1).

Chêne vert	Cèdre de l'Atlas	Polypode vulgaire	Funaire hygrométrique	Fucus vésiculeux	
النبـــــــاتات					**Règne** مملكة
نباتات زهرية Spermatophytes (ou Phanérogames)		مستورات الزهر الوعائية Ptéridophytes	حزازيات Bryophytes	طحالب ملوّنة Hétérochontophytes	شعبة **Embranchement**
كاسيات البذور Angiospermes	عاريات البذور Gymnospermes	سرخسيات Fougères	حزازيات Mousses	طحالب سمراء Phéophytes	تحت الشعبة **Sous Embranchement**
Magnolopsida (Dicotylédones)	Coniféropsida (Pinopsidées)	Filicopsida (Filicopsidées)	Funariopsida (Bryopcidées)	Fucopsida (Fucophycées)	**Classe** طائفة
Fagales	Pinales	Polypodiales	Bryales	Fucales	**Ordre** فصيلة
Fagacées	Pinacées	Filicophycées	Briophycées	Phéophycées	**Famille** عائلة
Quercus	Cedrus	Polypodium	Funaria	Fucus	**Genre** جنس
ilex	atlantica	vulgare	hygométrica	vésiculosus	**Espèce** نوع

Figure 1: Plant diversity related to the reproduction mode

Biological diversity is largely addressed by activities related to the classification of living beings. It is very present in textbooks, it is the application of a stereotypical nesting method unrelated to evolutionary concepts. This can lead to focus on the classification as a product using contingent criteria.

All the textbooks analyzed reflect this difficulty since they incorporate evolution through the notion of kinship. They evoke the notion of kinship only in activities "plus the number of common attributes shared by two species is important, more they are close parent " (Figure 2).

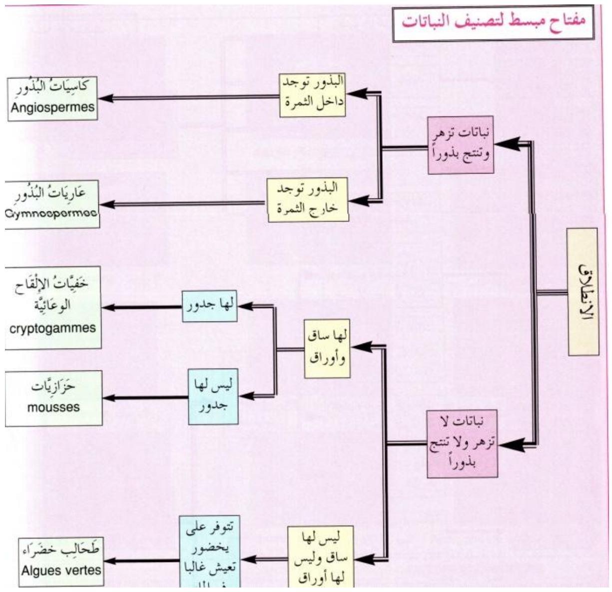

Figure 2 : Plants classified in Taxa, genre and species.

No explicit link between classification activity and the preservation of biodiversity. Students do not understand the usefulness of the classification. The relationship between biodiversity conservation and phylogenetic classification is entirely absent. Generally, textbooks are few links between disciplinary knowledge of biology and biodiversity protection leading to a very functionalist vision.

CONCLUSION

It is therefore important that students through textbooks, can build the knowledge and methods to classify living in a clear conceptual framework: biological evolution. This is all the more necessary it is with rare exceptions of a new knowledge that replaces the old and unstable knowledge.

The treatment of plant classification in textbooks must have a purpose and explicit goals and must be linked to the preservation of biodiversity, if not students do not understand the interest to learn technical jargon (criteria used in the determination keys) to give a name to a plant (Andekrson & al 2014 ; Barman & al 2006).

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CHILDREN CONCEPT ABOUT SURFACE ORIENTATION OF LIQUIDS

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ABSTRACT: In this paper is analysed the process of adopting the concept of horizontal position of the liquid surface by students of the third grade of elementary school. Numerous studies have found that approximately 40% of the adult population behave as if they do not know that liquid remains horizontal, regardless of the orientation of its container. If we asked students about position of the liquid surface, most will answer, in a voice, that liquid surface is always horizontal. However, check a thorough understanding of this seemingly simple and widely known scientific facts pointed to the difficulties. The sample consisted of students from six classes in elementary school "Ivo Lola Ribar" and "Dositej Obradovic" in Sombor (Serbia), and in three of tham are implemented the project "Water is precious", which lasted from March to June 2015. The paper presented the experience and difficulties in adopting corect concept about surface orientation of liquids. Based on the study findings, conclusions were drawn and offered possible solutions. The study has once again confirmed that the one-time doing of experiments, without continuity in observation and experimentation is insufficient to properly and permanently adopted certain scientific notions and concepts.

Key words: Scientific concepts and notions, basic properties of a liquid, science in primary school teaching.

INTRODUCTION

Teaching practice in Serbia is mostly focused on the implementation of the curriculum, innovative methods are rarely used, as well as, correlation between the subjects. Students are not required to predict and present different ideas and arguments, check them and provide evidence (Bošnjak, Branković, Gorjanac Ranitović, 2013; Cvjetićanin, Branković, Petrović, 2014).

Teaching methods based on inquiry-based activities, like project-based learning have proven their effectiveness, in stimulating the interest of students, improving the level of their achievement and developing their functional knowledge and critical thinking (Expert Group of the European Commission, 2007).

Under the project-based learning mean acquiring knowledge during the course of the project, which have to comply with the following elements:selection of topics from real life, challenging leading question, the students' voice and choice, developing skils of 21st century (cooperation, communication, critical thinking and the use of technology), students research, find innovation, conduct self-evaluation and public presentation of their results ((Larmer & Mergendoller, 2010; Chard, 2002 by: Curtis, 2002). In the proces of project-based learning project task has to be in the form of research, research topic combines different scientific areas and involves cooperative learning (David, 2008).

We conduct action research to investigate the practical possibilities of introducing project-based learning in teaching practice in Serbia, through the identification of specific features, problems and difficulties in its implementation and to find possible improvements. The paper presented one part of the study findings related to adoption corect concept about surface orientation of liquids by students of the third grade of elementary school.

For proper understanding of the research problem the developmental abilities of children are important. Child's development is reflected in its specific ways of understanding the world around them, including the space. Before they go to school, children have acquired the implicit and the non-numeric knowledge of shape, position, distance, spatial orientation and directions.

For the understanding of space, and subsequently surface orientation of liquids, it is important to develop the concept of conservation. Conservation is the ability to view that quantitative properties of matter (quantity, mass, weight, length, area, volume) remain unchanged, although it changed its external characteristics (shape, place and order in space). This becomes apparent for child only on the basis of the conclusion which is not derived from the observation, but is the result of intellectual constructions performed by using mental operations. Thus, the conservation of matter and length occurs about 7-8 , the conservation of weight around 9-10, and volume conservation only about 11-12. years of age (Korać, 2012, p. 10).

Proper understanding of the space also depends on the egocentrism of the child, because it is centered on the individual aspects of the space and relations of elements in it, but not on an objective system of relations (spatial coordinates). In the course of cognitive development, originally developed intuitive space, due to the separation of spatial operations, is replaced by formalized (matematical) and experiential (physical) space. (Piaget, 1994, pp. 237-241).

METHODS

The research problem was investigation of the process of adopting the scientific concept of horizontal position of the liquid surface. The choice of research problem derives from the awareness and experience about the difficulties in the acquisition of complex concepts. Result was adoption of unrelated facts by students, not the concept itself, which would be a necessary precondition for the creation of functional knowledge. Project-based teaching has been recognized as a possible solution to overcome these problems by increment students motivation and contribute to a fuller and deeper adoption of scientific concepts.
The aim of this research was to detect difficulties in adopting corect concept about surface orientation of liquids and to find possible ways of improvements.

The study **sample** consisted of 116 third grade students (59 students in the experimental group and 57 students in the control group) from six classes in elementary school "Ivo Lola Ribar" and "Dositej Obradovic" in Sombor (Serbia), and in three of tham are implemented the project "Water is precious", which lasted from March to June 2015.

Piaget and Inhelder invented the water level task (WLT) to study children's progressive understanding of the spatial-coordinate system. Childrens were presented a rectangular-shaped bottle half-filled with water. They were then shown a similar empty bottle tilted by researchers at various angles. For each angle of inclination, the child had to indicate the direction of the water level, under the assumption that this bottle was half-filled with water. Results showed that different patterns of errors were typical of the preoperational and concrete-operational developmental stages (Pascual-Leone & Morra, 1991).

Later research shown that many people (bouth, adult and children) do not know that water remains horizontal, regardless of the orientation of its container. They have problem with water level representation, not because they are lacking the relevant knowledge, but rather because they are attempting to solve a different problem—a problem represented in an object relative, as opposed to an environment-relative coordinate system (McAfee & Proffitt, 1991).

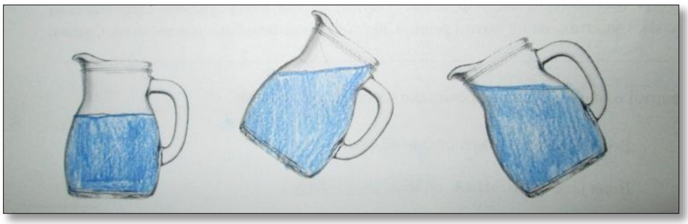
RESULTS

The studentsof the experimental group were asked to do the experiment with a bottle and colored liquid in it. They were supposed to rotate and tilt the bottle and at the same time observe the position of the liquid surface. After the experiment, they should have to conduct a conclusion on whether the position of the liquid surface changes when changing the position of the container, or remains in the same position. During the experiments we observed that many students had difficulties to distinguish change of the shape of liquid surface from change of the position of liquid surface (Figure 1). It was necessary to correct the experiment in a way that a ruler or a piece of paper was leaned in parallel to the surface of the liquid, and then, tilt the bottle to observe whether a piece of paper/ruler remained parallel to the surface. This approach was helpful for some students, but not for all.

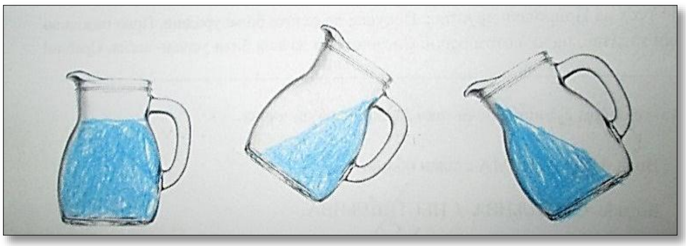
Figure1: Observing position of the liquid surface when changing the position of the container

Check a thorough understanding of this seemingly simple and widely known scientific facts about the horizontal position of the water surface by question where they were supposed to draw the position of the liquid surface in an decanter or bottle represented in several different positions, confirme difficulties noticed during the experiments.

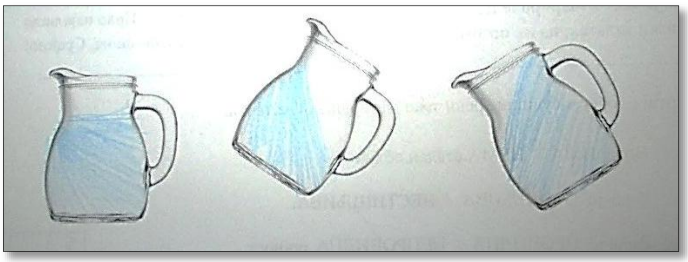
In tasks where they were supposed to draw the position of the liquid surface in an upright decanter or bottle, or, inverted bottle, there were no significant differences between the results achieved in experimental (E) and control (C) group, as well as, at the initial and final test in both group. Percentage of correct answer is between 90% and 100%, which means that vast majority of students have no problem to draw the position of the liquid surface in these cases, regardless of whether they carried out experiments or not.



a) Appropriate inclination and the horizontality of the liquid surface



b) In the tilted decanters inclination of liquid surfice is on right side, but horizontality still missing.



c) In the tilted decanters inclination of liquid surfice is on wrong side and horizontality missing too.

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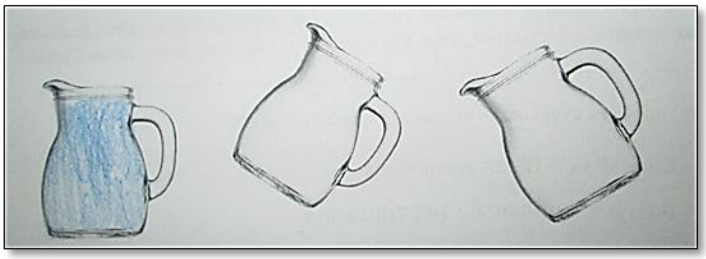
d) In the tilted decanters liquid takes up lengthwise half of the decanter.



e) Liquid **is** not drawn in the tilted decanters.

Figure2: One example of correctly and four examples of incorrectly drawn fluid level in the tilted decanters

If we analised their drawings about position of the liquid surface in a tilted decanter/ bottle, both, experiemntal and control group showed worse results at the initial test. Percentage of correct answers in experimental gorup is: E_R - 28,33% respectively E_L – 31,67%, and in control group is K_R – 44,1% and K_L – 4 7% (index L and R indicate the part of the task where the decanter tilted to the right, respectively, to the left side). In the final test, the percentage of correct answers was higher for 10 - 15% in the both groups regardless of the experimental experience of students of E group. But the result is generally very low, because the percentage of correct answers in group E is 44%, and in the K group 58% . A few examples of solutions for this task at the initial test is shown in Figure 2.

Results indicate that in tasks where they were supposed to draw the position of the liquid surface in an upright decanter or bottle, or, inverted bottle, there were no significant differences between the results achieved at the initial and final test, or between experimental and control group. we can conclude that students have no difficulty with the position of liquids in these position. However, when they were supposed to draw the position of the liquid surface in a tilted decanter/ bottle students showed much worse results at the initial test. In the final test, the percentage of correct answers was slightly higher, but still very low, if we take into account experimental experience acquired in the meantime. Same research suggest that practical experience promotes a functionally relative perspective, in which the orientation of the liquid's surface is evaluated relative to that of its container as opposed to being related directly to the surrounding environment (Hecht & Proffitt, 1995).

CONCLUSION

Results show that almost half of the students even after conducting the experiment has not been able to properly draft the position of the liquid surface in the tilted bottle. This result can be explained in two ways. First, that students of this age (9-10 years), in addition to the development of preconditions have not yet been able to fully adopt the concept of horizontality of the free surface of the liquid, ie, that it tilted container is still confusing. The mistakes that children make when drawing horizontal and vertical lines are the result of concentrating on the relations of those lines that are closest (Bryant, 2009, p. 13). Second, it takes a lot more practical experience in experimentation with focused observation position of surface of the liquid in the tilted containers that problem would be permanently overcome. Size constancy as well as the most typical Euclidean attitude of perceptive character, shall be adopted around the age of nine (Piaget, 1994, p. 162). According to Piaget conservation of length, area, volume and weight is not the result of measurement, but on the contrary, the precondition of each measuring operation.

The results also have shown that single application of project was insufficient to support students' properly and permanently adopted certain scientific terms and concepts. That is why this education program should be applied permanently and as an integral part of the teaching process, not as a supplement to regular teaching activities. On the contrary, continuous application of project teaching would encourage independent research work of pupils, which means that they express their own assumptions, assessments, carry out examinations/experiments, notice and corrects their own mistakes and finally formulate and write down correct conclustions (Pavkov-Hrvojević at all, 2016).

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EFFECTS OF NUMBER TALKS ON NUMBER SENSES OF PRE-SERVICE PRIMARY SCHOOL TEACHERS

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ABSTRACT: The aim of this study is to analyze the effects of the number talks on number senses of pre-service primary school teachers. The participants of the study were 31 third grade pre-service primary teachers at a state university in the 2015-2016 academic year. The study was designed as single group pre-post test research. The data collection tool was the number sense test developed by Kayhan Altay (2010). The findings of the study showed no significant difference in test scores of the participants. However, in regard to solutions of the problems in the test it was found that the number sense scores were significantly and positively significant.

Key words: number sense, number talks

INTRODUCTION

Numbers and operations is widely included in the primary school mathematics program, with regard to number sense (NS) , providing students with skills such as figuring, also mental calculus are among basic objectives of the related program (MEB, 2009). And it's remarkable in the literature that teacher candidates' NSs are quite low. Thus, it'll be possible to contribute to the development of students' NS since teacher candidates understand the importance of NS and how to improve NS (Gülbağcı Dede, 2015; Kayhan Altay and Umay, 2011; Şengül, 2013; Tsao, 2004; Tsao, 2012; Yaman, 2015a; Yang, 2007). Therefore, allowing teacher candidates to experience about how to improve students' NSs and to think on how their classroom activities and teaching plans can be structured will contribute to teacher candidates significantly in terms of improving students' NSs (Şengül, 2013; Tsao and Lin, 2012). And also, number talk is a learning tool that allows teachers to understand how students think, and to listen and observe students' explanations about solution strategies (Flickr and Kuchey, 2015). In the study conducted by Celski (2009) with primary school first grade students relating to the effect of talking applications on students NS, an increase in both students' NSs and their participation to classroom discussions was observed. While there're studies available in the literature in which number talks are introduced to educationists and researchers and that emphasize the importance and necessity of using them in classrooms (Celski, 2009; Johnson and Partlo, 2014), there aren't any studies carried out with teacher candidates. Therefore, the aim of this study is determined as examining the effect of number talks on class teacher candidates' NSs.

METHOD

In this section study group, data collection tool and data analysis method of the research are included.

Research Model

Since the research examines the effect of number talks applied in two classes on teacher candidates' NSs, the research model is in single group pretest-posttest trial method. In this pattern, all groups are treated as a experimental group (Çepni, 2009).

Study Group

Study group of the research constitutes of 31 3rd graders who are attending the primary school education at a state university as of 2015-2016 academic year.

Data Collection Tool

The NST (number sense test) developed by Kayhan Altay (2010) and prepared for middle school students but deemed appropriate in using for teacher candidates by experts was used (Kayhan Altay, 2011; Yaman, 2015). KR-20 internal consistency coefficient obtained as a result of measurements was found as 0.83, and test measurements were considered as reliable.

Analysis of Data
Scoring of NST applied before and after the application is applied in two categories. In the first scoring stage, correct answers are given 1 point, and wrong and null answers are given 0 point. In the second stage, solutions and explanations used by teacher candidates while solving problems are taken into consideration, scoring is made according to candidates' use of NSs.

FINDINGS

In the first sub-problem of the study, an answer to the problem "How do pretest-posttest success point averages achieved from NST by primary teacher candidates applied with number talks differ?" is sought. Descriptive statistics for success scores from NST obtained by teacher candidates are given in Table 1.

Table 1. Descriptive Statistics of NST

Measurement (NST)	N	$\overline{X}$	S	Mode	Median	Coefficient of skewness
Pretest	31	10.32	3.40	7	10	0.007
Posttest	31	10.54	2.93	10	10	0.495

Pretest success point average for NST by teacher candidates is calculated as 10.32 and their posttest success point average as 10.54. Considering the fact that the highest score that can be achieved from NST is 17, it can be observed that score average slightly exceeded the half value. The fact that average, median and mode are equal and coefficient of skewness is within limits of +1 and -1 can be interpreted in a way that scores do not show excessive deviation from normal. Results of t-test conducted to test whether there is a significant difference between teacher candidates' pretest-posttest average success scores are given in Table 2.

Table 2. Results of t-Test for NST

Measurement (NST) Success rate	N	$\overline{X}$	S	sd	t	p
Pretest	31	10.32	3.40	30	0.560	.580
Posttest	31	10.54	2.93			

A significant difference between pretest-posttest average success scores in NST by the group applied with application is not observed, $t(30)=0.56$, $p>.05$. This finding shows the fact that the application does not have a significant impact on the state of correctly answering problems in NST by teacher candidates.

In the second sub-problem of the study, an answer to the problem "How do pretest-posttest NSS averages of primary school teacher candidates applied with number talks differ?" is sought. Regardless of how candidates' performances of NS usage in pretest and posttest differ, descriptive statistics for the total NSS obtained from the test are included (Table 3).

Table 3. Descriptive Statistics of NSS

Measurements (NSS)	N	$\overline{X}$	S	Mode	Median	Coefficient of skewness
Pretest	31	30.06	13.03	26	26	0.26
Posttest	31	38.48	11.60	28	37	0.63

It is seen that, while NSS average does not exceed the half value, in the final test, this average is higher than the half value. The fact that coefficient of skewness is within limits of +1 and -1 can be interpreted as scores do not show excessive deviation from normal. Results of t-test conducted to test whether there is a significant difference between teacher candidates' pretest-posttest NS point averages are given in Table 4.

Table 4. t-Test Results for NSS

Measurement (NST) NSS	N	$\overline{X}$	S	sd	t	p
Pretest	31	30.06	13.03	30	5.34	.000
Posttest	31	38.48	11.60			

After the application, it is seen that there is a significant increase in average scores indicating teacher candidates' state of benefiting from NS, $t(30)=5.34$, $p<.05$. This finding shows that there is a significant increase in average scores for candidates' usage of NS.

CONCLUSIONS and RECOMMENDATIONS

No significant differences have been observed between average scores reflecting teacher candidates' performances before and after the number talks. Reason for the emergence of this result can be explained with the purpose of number talks. After the application, it's seen that there's a significant increase in average scores relating to teacher candidates' use of number sense. This finding of the research is in parallel with studies in the literature (Celski, 2009; Johnson and Partlo, 2014). Since this study cover a duration of almost 3 weeks, maybe a significant difference did not emerge between teacher candidates' scores obtained from NST.

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EXPLORING THE RELATIONSHIP BETWEEN PRE-SERVICE TEACHERS' MATHEMATICAL ORINTED BELIEFS AND THEIR PEDAGOGICAL PRACTICES WITHIN THE REAL CLASSROOM

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ABSTRACT: Over the past few decades, there has been much research on teachers' cognitive and affective variables such as beliefs, emotions, conceptions and knowledge as well as their relationship with teaching practice. This study has been conducted to explore the relationship between future teachers' mathematical beliefs and their initial teaching practice in a classroom setting. A collective case study approach was used, in which future teachers were observed using a variety of procedures to reveal qualitative data about their initial teaching practice during the school-based practicum, and were then requested to complete six open-ended questions form concerning a mathematical beliefs. The preliminary analysis of data revealed that most of the participants hold constructivist-oriented mathematical beliefs. The initial observation and field notes demonstrated that most pre-service teachers who have had a constructivist-oriented belief teach utilizing contemporary approaches in mathematics teaching. However, some pre-service teachers held learner-based pedagogical belief, but did not integrate constructivist ideas into their teaching. The paper presented some implications for teacher education programs and teachers' professional development.

Key words: pre-service teachers, mathematical beliefs, initial teaching experience, school-based practicum

INTRODUCTION

Teacher may design interactive, diverse and innovative learning environments relying on their own beliefs (Wilson and Cooney, 2002), which are frequently formed by previous experiences. In fact, teachers' beliefs are received from their individual experiences as learners in school and later through knowledge they maintain from pre and in service teacher education programs (Lortie, 1975). In the last decade, constructivism became widespread in Turkish educational arena and led the recent mathematics curriculum towards learner-based approaches. The idea behind the new curriculum is that learners are given a central role in learning process, which they can build their own knowledge and develop their own mathematical thinking skills through active participation (Baki, 2008). Reformations based on the innovative approach have been also established for teacher education courses. The aim of this was to replace the traditional-oriented teaching approaches, which is described as a telling and showing of mathematical procedures with new constructivist teaching ideas. This particular study aimed at better understanding of what type of pedagogical beliefs pre-service teachers hold and how they enact these beliefs into their teaching practice.

Beswick (2011) defined mathematical beliefs as what individuals believe to be true about the discipline of mathematics as well as its teaching and learning that shape teaching practice. Ernest (1989) stressed that to design effective and meaningful learning environments, it is important to identify and comprehend individual teaches' beliefs in relation to mathematics teaching and learning. Pedagogical beliefs of teachers including beliefs about what teachers should do to assist pupils learn mathematics. For this study, beliefs about mathematics teaching and learning are categorized as a traditional and constructivist perspective reported in the literature (Chan and Elliot, 2004).

METHODS

A collective case study approach was used, in which future teachers were observed using a variety of procedures to reveal qualitative data about their initial teaching practice during the school-based practicum, and were then requested to complete six open-ended questions form concerning a mathematical beliefs. The sample in this study for qualitative data comprise of nine pre-service teachers from Faculty of Education at the University of Artvin Coruh. It was expected from novel teachers to teach students age of 8 and 10 in classrooms once time a week during one-term school period. The constant comparison method were used so as to ascertain themes relevant to participants.

FINDINGS

Stated beliefs

When directed what pre-service teachers thought about mathematics, it teaching and learning, majority of them responded that mathematics is being useful to individuals for daily-life routines such as counting, marketing, measuring, drawing and so on. The considered mathematics as a vehicle for solving problems within the daily-routine activities, make it easier for his everyday life. Only one teacher characterised mathematics as pure logical thinking and as an instrument for exercising the mind. It can be interpreted that the development of reasoning skills in mathematics was regarded as an important aspect of mathematics. Six participants out of nine back up progressive the ideas and methods of teaching mathematics which stressed that the learners can ascertain, solve problems, share and argue their findings and approaches. It was shared belief that learning abstract mathematical ideas through concrete materials is vital and viewing such connections would assist pupils to make sense of abstract concepts by introducing ideas from simple to complex. It was a belief that concrete and visualisation makes learning effective and permanent due to the immobility of mathematical objects on the white board. The comment is consonant to a constructivist-oriented pedagogical beliefs where the pupil is active during learning process and the teacher's role is guide. Some of them held belief that more practice and more examples may provide better results in understanding of mathematical concepts. It was noted that repetition seemed to be essential element in her learning of mathematics.

Enacted beliefs

The analysis of the classroom observation data and field notes showed that while pre-service teachers were teaching mathematics in classroom, some of them made great efforts to create a progressive learning environment where pupils have an opportunity to work on mathematical task, discover, solve mathematical problems and express their approaches and ideas with the peers.

This teacher's role was mainly as a guide who introduced mathematical tasks and assisting the pupils to find out and explore mathematical ideas embedded in activities by using a variety ways of teaching and learning approaches such as discovery learning, active involvement and informal discussion during her school-based practicum. However, some pre-service teachers utilized some concrete materials to provide more detailed explanations to pupils, to request a selected pupils practice with material and to interrogate their understanding in terms of what they understood. While working on mathematical modelling activities with each other, pupils were given not enough opportunity to contribute to their own mathematical knowledge and talents with their own efforts, teachers providing immediate answer when they tackled with mathematical task rather than experiencing with trial-and error approach.

CONCLUSION

The study made great efforts to observe pre-service teachers' current practice during the one term school period and determine their mathematical beliefs by asking open-ended written questions so as to reveal whether they are consistent each other or not. A collective case study of pre-service teachers illustrated that classrooms can be complex sites of social and cultural effects, and that the candidate teacher's mathematical beliefs were less conventional than their current teaching practice. Candidate teachers' beliefs involved both some elements of traditional and constructivist-oriented pedagogical beliefs about subject-matter. This showed that the early experience in both teacher education program and educational system appeared to affect pre-service teachers' beliefs about mathematics and their pedagogical decision making about mathematics teaching and learning.

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NETWORKING WITH NEW TECHNOLOGIES IN TRAINING OF SCIENCE TEACHERS: A CASE STUDY FROM THE LAYOUT TO THE REFLECTION

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ABSTRACT: The Major Teachers' Training Program (MTTP) implemented at pilot phase in 2009-2011 by the Greek Pedagogical Institute for teachers of Primary and Secondary Education in five regions of Greece, among them was Mytilene. The program was based on the findings of a survey of the teachers' training needs and focused on the development of flexible training models, such as e-learning, mixed in person and remotely communication, synchronous and asynchronous education etc., by involving new technologies in all school objects.

In this paper, the trainer describes the exploitation of New Technologies and Social Networking Web 2.0 in a target based, sustainable and integrative Major Teachers' Training Program (MTTP) at Mytilene. In the training process involved in person and remotely, synchronous and asynchronous encounters of trainees and trainers with Moodle platform for producing Internet-based courses, a blogspot for information, communication and exchange of views and ideas as well as two wikispaces websites for co-formulation of educational material concerning parallel of MTTP activities in local issues "Aristotle and Lesvos" and "Sappho the Educator". Additionally, in the communication contributed emails, skype and telephones.

Networking aimed at managing a large volume and consumption of variety of training materials, applying and practicing of innovative methodology for personal and professional development of teachers with consequent improvement of the education provided to their students. The whole project served the strategic objective of the Greek Ministry of Education "New School", with emphasis on the development of horizontal competences of teachers and students, which run across all school subjects and are required in everyday educational practice.

Key words: Science Teachers' Training, Secondary Science Education, Information and Communications Technologies, Greek Major Teachers' Training Program

INTRODUCTION

Import of computers in school education and teacher training, as innovation, has brought many changes in the educational process, to the role of the teachers and to curricula which redesigned to meet the new needs and trends. Teachers who utilize Information and Communication Technologies (ICTs) become more active and interactive in society and learning (Kapsalis et al, 2010). The educational system no longer can be remain closed to the changes it has brought and augurs web 2.0, we can say that already has launched the Education 2.0.

To meet teachers their new, demanding role need to cultivate skills and gain new capabilities (CEU, 2007). The "New School", as all day, innovative, sustainable, inclusive, digital, designed in 2010 by the Greek PI, aiming to students and teachers with capabilities to learn autonomously and from different sources, with problem-solving skills, to cooperate and develop interpersonal relationships, to foster accountability , sincerity and confidence, be able to plan their personal future and societal belonging (PI, 2011). Because in Greece there is a lack of systematic training and practice in contemporary educational issues related to daily school didactic, pedagogical and administrative practice, GTP was designed to fill this gap (PI, 2011). The whole project served the strategic objective of the Greek Ministry of Education "New School", with emphasis on the development of horizontal competences of teachers and students, which run across all school subjects and are required in everyday educational practice. GTP carried out in 54 hours in person and 146 hours distance training. The Program piloted in 2011 in five regions of Greece, among them was Mytilene, on which is referred this work. Mytilene was eligible convergence geographical area for the Knowledge Society and Innovation in the National Strategic Reference Framework (NSRF) 2007-2015. In this paper, the trainer describes the exploitation of New Technologies and Social Networking Web 2.0 in a target based, sustainable and integrative 'Grand Training Program-3rd section of Science Teachers in Mytilene'. In the present study attempts a critical approach of the application of a digital learning community formed by 19 Science teachers of all specialties of Secondary Education, who, upon selection by the PI, had been the 3rd training section of GTP in Mytilene. In collaboration with their trainer, they applied the GTP as promoted by the PI and developed parallel, beyond the mandatory, educational activities in a digital learning community which is describing in this paper.

METHODS

In this paper there is presented the development of the social networking's framework of the 'Grand Training Program-3rd section of Science Teachers in Mytillene', as developed by the trainer and trainees. It is a reflection case study on the training process applied to Science teachers of Secondary schools with synthesis of personal narrative of trainer, the archival material of the Program and the written reflections of trainees. The discussion aims to highlight those characteristics of the training that made it an integral part of the education simultaneously happening in many schools of Lesbos and others of Greece, as rotated through constant reflections and feedbacks, since it was applying in the same time, in pilot phase, in teachers, their students and their colleagues, in small and large groups of trainers and trainees.

At each stage, trainees completed the training, were writing their reflections, concision in the working groups. For a fuller description of the training and the response of teachers, are presented below, by choice, excerpts of this reflection which were retrieved from the archival material of the training interventions kept by the trainer.

RESULTS AND FINDINGS

1. Networking Supports Teachers Learning

Learning is an adaptive process in which, one who learns organizes the world of his experiences because we do not find out the truth but build viable explanations of our experiences (Wheatley, 1991). Thus, knowledge is not transferred or accepted passively by the learner, but actively it built up (Olssen, 1996).

The research of the project archival material offered data about the training in person and remotely process, synchronous and asynchronous encounters of trainees and trainers with Moodle platform for preparing Internet-based courses supporting parallel the offered by GT. A BlogSpot was used for information, communication and exchange of views and ideas, additionally to the emails, Skype conferences and telephone discussions. Also, two Wikispaces built up for the co-formulation of educational material of the educational activities on local issues "Aristotle and Lesvos" and "Sappho the Educator". Networking aimed to handle a large volume and consumption of variety training materials, applying and practicing innovative methodology for personal and professional development of teachers with consequent improvement of the education provided to their students.

2. Structuring A Network For Knowledge And Information Sharing

Regarding the process of organization of the GTP, the PI followed the procedure: in the beginning posted the proclamation in the homonymous site of the PI, which was specially constructed to serve the communication needs of trainers, trainees and secretary. Were given the opportunity to teachers from all over Greece, at their choice, to join Special Register of Trainers A1 (on particular cognitive objects), A2 (on group cooperation teaching), B (on particular cognitive objects with group cooperation teaching), ICT (in digitization of the educational materials) και Transversal Actions (TA) (on the interdisciplinary approach for the cultivation of the environmentally literate active citizen). Trainers A1, A2, ICT and TA designed educational materials for each teachers' specialty and trained the trainers B who, in their turn, offered training to teachers from schools in five prefectures of the pilot implementation of the Program. The communication of all participants in GTP was done directly with the PI, through the dedicated website and emails. Thus distributed, hierarchically, the announcements and instructions from the project manager to the secretaries, trainers and trainees who, finally, received all the feedback to the retrograde. Teachers, what they learned during their four-month training, they applied slowly to the classes in an organized and consulted manner, going punctual in schools, planning teaching interventions applying in the classrooms and writing the feedback to the trainer. Then, all trainers B summarized the experience and conclusions to the PI from which again come feedback.

In a separate section of the platform Moodle were set two Wikispaces, headed "Aristotle and Lesvos' and" Sappho the Educator ". Wikis are websites that help the co-construction of knowledge by creating and editing a number of related websites, via a web browser such as Internet Explorer and the HTML language.

The Blogspot mpe04mytil.blogspot.com posted on the e-Google blogger website, utilizing ready BlogSpot's creating forms. It operated alongside the Moodle platform to meet the direct communication and understanding needs of trainees, of sharing and annotation of current information of school lives and any educational and informational questioning-answering.

3. Connectivity For The Professional Development Of Teachers

Because modern learning theories attach great importance to social networking for collective learning through collaborative social interaction, the describing asynchronous distance training of the ‘Grand Training Program-3rd section of Science Teachers in Mytillene’ was an important supporter process because it offered the advantage of education regardless of time and place. Teachers generally work alone, they work in their schools as a closed circuit, as system does not exchange enough information on the environment (Vasilou & Haramis, 2005). Many factors have contributed long to restrict the joint work of teachers, such as the traditional syllabus and curriculums, timetables, the suffocating time of teaching hours, split into 45 minutes, the varied and multiple demanding reality of each school community and each class and generally the prevailing mentality in schools. "We need collaboration among team members”, “collaboration and interaction with the instructor offer equal membership", "The evolution of a teacher does not stop with the nomination”. “We must constantly be developed and cultivated with new teaching methods, new school, teamwork, use PCs and interactive whiteboards, new curriculums”.

4. Delivery of Digital Educational Material and Methodologyfor Teaching Sciences

The possibilities that computers offer to modeling, visualization and simulation of physical phenomena and processes help to create powerful learning environments that provide unique opportunities for users to observe phenomena, materials and processes which are often difficult or impossible or even dangerous to observe them actually. They give opportunities to perform virtual experiments and to intervene in the processes in order to control affairs and study of matter changes in both the real and into alternative worlds (Stavridou, 2011).

For the design and implementation requirements of all the materialized teachings during the Program produced huge quantity of great variety and specialization teaching material which combined, on multiple levels, with methods, techniques and ICTs applications in a sophisticated dimension and vision of teaching Science in Secondary Education. Through the created electronic infrastructure circulated the training material of GTP, posted plans and scenarios of Science courses, offered books and internet addresses with helpful educational material of already practitioners, handed out photos, videos, music, texts, educational applications available for use in future, when the need will come. Teachers were informed about the websites that preserve their colleagues trainees of the same group that did not know of their existence or had not paid attention until now: "You never know what dynamics have each your colleague”, "In the beginning (of the training seminars) you say that all the same and the same will be, but in the process often you changes your mind ....".

CONCLUSION

The described training intervention of the ‘Grand Training Program-3rd section of Science Teachers in Mytillene’ simultaneously addressed to teachers and students, giving them the possibility of applying and integration teaching and learning innovations directly from the training seminars to the classroom education. Based on the objectives of the ‘New School’, emphasizing the development of horizontal skills of trainees and their students, that run transversely all school subjects. Teachers participating in virtual and real encounters of synchronous and asynchronous training, without geographic and economic boundaries, with texts, sound and images, used Internet and in person teaching tools, in joint information, sharing and editing teaching materials in Science. All together designed and built the new knowledge in schools that daily change rapidly.

RECOMMENDATIONS

The products of this co-construction of knowledge on modern teaching of school Science objects are uploaded on the websites up mentioned and can be basis for discussion and new partnerships of teachers to scientific and technological progress and cohesion of school communities, they can be used in any educational processes anywhere in Mytilene, near or far.

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THE EXAMPLES OF PHYSICS CONCEPTS FORMATION BY THE USE OF KWL STRATEGY

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ABSTRACT: The goal of teaching should be to assist the students in creating a full understanding of a concept. A student who has formed a concept, knows more than just the definition of a term. Concept formation is deep conceptual learning rather than superficial knowledge of a vocabulary word. The goal of every learning strategy is to enable concept formation. The KWL strategy is initially developed as an instructional learning strategy that is used to guide students through a text; therefore it is rarely applied in teaching physics and science in general. The KWL strategy consists of: (1) accessing previous knowledge, (2) determining what one wants to know and (3) recalling what is learned. This strategy is designed in a form of a KWL chart with three columns as an organizing instrument: (K) *What I **K**now*, (W) *What I **W**ant to know* and (L) *What I **L**earned*? The KWL strategy improves comprehension and helps students in concept formation. It can be very useful in teaching and learning physics, especially when the content should be learned from text. Instruction about implementation of KWL strategy in physics classes and example of its use for formation physics concept *force* is given in this paper.

Keywords: concept formation, KWL strategy, learning strategy, physics

INTRODUCTION

Lately number of students has inadequate reading and study habits (Taslidere & Eryilmaz, 2012), they are uninterested to study physics and have difficulties in understanding it (Hewitt 1990). Students rely upon teachers for constant support instead of being independent learners. Those problems are reflected on the students' physics achievements.

Physics Concepts Formation

Concept formation is process by which a person learns to sort specific experiences into general rules or classes. A concept is a rule that may be applied to decide if a particular object falls into a certain class. Conceptual classification should be distinguished from discrimination learning. In discrimination learning, objects are classified on the basis of directly perceived properties such as physical size or shape. The emphasis on concrete physical features in discrimination learning can be contrasted with the more abstract nature of concept formation.

Physics is a natural science based on experiments, measurements and mathematical analysis with the purpose of finding quantitative physical laws for everything in nature (from the nanoworld of the microcosmos to the planets, solar systems and galaxies that occupy the macrocosmos). It attempts to quantify reality through a precise application of observation coupled with logic and reason. In order to make use of such discipline there is certain foundational information that one must have first, in order to build upon it. Those are basic physics concepts. Concept formation is very important in physics teaching, especially in primary school. According to curriculum in sixth grade of primary school student are become familiar with concept force and different examples of forces. In seventh grade of primary school concepts of mass, inertia, force, equilibrium and acceleration are discussed; these concepts are combined with the Newton's laws of dynamic to provide a convenient means of analyzing an object or system of objects at rest or in motion.

Know-Want-Learn Strategy

The Know-Want-Learn (KWL) reading strategy is an instructional learning strategy. It is an active learning strategy (Bryan, 1998; Jared & Jared, 1997; Ogle, 2009) which supports student-centered learning (Draper, 2002). The KWL is applicable in different school subjects (Brozo & Simpson, 1991). It consists of three basic

stages: accessing previous knowledge, determining what one wants to know and recalling what is learned (Blachowicz & Ogle, 2008).
The KWL strategy is realized in a form of a KWL chart. It helps students to adopt given concepts and also to activate prior knowledge and assess what they have learned (Martorella et al., 2005). KWL chart consists of three columns (Figure 1). The KWL strategy is suitable to be used by a teacher working together with all students in classroom and can easily be transferred into a method for students' independent study (Tok, 2013).

Topic: ____ Before you begin learning list details in the first two columns, after completing it fill in the last column.		
*What I **K**now*	*What I **W**ant to know*	*What I **L**earned*

Figure 1 KWL chart

When KWL charts are implemented for school learning, first students brainstorm about what they already know about a topic and write their responses in the first column of the chart (K). Then student brainstorm what they would like to know about a topic and write their responses in the second column of the chart (W). Next step is learning activities and reading; after what students return to the chart and fill in what they have learned in the third column of the chart (L), with special attention on information that is related to what they wanted to know.

The use of KWL strategy makes learning and remembering easier (Gammill, 2006) and encourages more complete understanding of a topic since students research a specific question that they are interested in (Jared & Jared, 1997). Accordingly, it can be good learning strategy for acquiring physics contents and it helps in physics concepts formation.

THE EXAMPLE OF "FORCE" CONCEPT FORMATION BY THE USE OF KWL STRATEGY

When teaching about Force, teacher can introduce students with that concept and lead them to remember of examples what they already know. Then teacher encourages students to write their one questions – what would they want to learn. After learning students write what did they learn. The whole chart is written on board while all students participated in the discussion. The example of KWL strategy for Force is given at Figure 2.

Topic: __________**Force**__________________________________ Before you begin learning list details in the first two columns, after completing it fill in the last column.		
*What I **K**now*	*What I **W**ant to know*	*What I **L**earned*
Gravity attracts objects. Magnetic force can both, attract and repel objects. Magnetic force does not act on every object. Every object in motion will stop because of friction. Motion is somehow related with force.	What is force? Why magnetic force does not act on every object? Why different objects do not stop after the same distances? Why friction force is weak when we are on ice? Is object in motion because some force is acting on it? Why friction stops objects? Is objects velocity related with force acting upon it?	A force is a push or pull upon an object resulting from the object's interaction with another object. A force is a vector quantity. Whenever there is an interaction between two objects, there is a force upon each of the objects. There are contact forces and forces resulting from action-at-a-distance. Force changes the motion of an object. About gravity, magnetic force, electric force, friction…

Figure 2 KWL chart for concept Force

This is example of the use of KWL chart in formation concept force in sixth grade. As it can be seen in given example, problem with the use of KWL strategy can be that students are interested in knowledge that according to curriculum should be realized in later education. That does not have to be a problem, students can be allowed to choose to learn more and they can be instructed to find some of the answers in later education.

CONCLUSION

Instruction about implementation of KWL strategy in physics classes and examples of its use for formation physics concepts in the field of dynamics are given in this paper. It can be very useful to implement KWL strategy in school practice, since it is good learning strategy but in order to successfully implement described strategy, it is necessary to provide adequate resources and professional development for teachers.

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THE IMPORTANCE OF SYMBOLS AND UNITS IN NATURAL SCIENCE

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ABSTRACT: The science and engineering students are expected to know the basic quantities and to distinguish the derived quantities regardless of their majors. The symbols and units are important to be understood, interpreted, and correlated in natural science. The purpose of this study was to investigate the importance given to the symbols and units by students. The research was conducted with 220 students. Data were collected using an evaluation form designed for examining the students' knowledge about the some symbols and units. The students were asked twelve fundamental quantities. The descriptive statistical analyses of the research data were performed. The results of the research indicated that the students ignored the symbols and units. Detailed results and recommendations based on the findings of the research are presented in the research.

Keywords: higher education, natural science, symbol, unit

INTRODUCTION

Numerous researches were practiced on physics teaching at every level of education. New methods and techniques for active learning were developed in these researches. The aim of these developed methods was to enhance students' learning, understanding, perception, confidence, and motivation epistemologically (Domert, Airey, Linder, & Kung, 2007; Lising & Elby, 2004; May & Etkina, 2002). Some research examined the students' understanding of the symbol and unit (Sherin, 2001). These researches reported that students had problems showing the variables in formulas.

The connections among units and equations have an important role in physics teaching. This teaching could be provided with the correct usage of the scientific language. If they are not taught correctly, the students can encounter with some drawbacks in problem-solving. Therefore many studies will be needed to develop new methods for physics teaching of the symbols and units.

The correct usage of the physics/science language can be provided with using the international standards. The standards concerning quantities' name and symbols which are valid all over the world are expressed as "*Many of the quantities, their recommended names and symbols, and the equations relating them, are listed in the International Standards ISO 31 and IEC 60027 produced by Technical Committee 12 of the International Organization for Standardization, ISO/TC 12, and by Technical Committee 25 of the International Electrotechnical Commission, IEC/TC 25. The ISO 31 and IEC 60027 Standards are at present being revised by the two standardization organizations in collaboration. The revised harmonized standard will be known as ISO/IEC 80000, Quantities and Units, in which it is proposed that the quantities and equations used with the SI will be known as the International System of Quantities" (Taylor & Thompson, 2008, p. 10)*. The aim of this research is to investigate the students' awareness towards learning of some quantities' symbol and unit.

METHOD

The study was conducted on four departments offering two-year programs in Torbali Technical Vocational School of Higher Education at Dokuz Eylul University, Turkey. The research was applied to 220 college students. The present study used survey methodology. The research data was collected with a survey included some physical quantities' symbols and names.

The survey provided the information on participants' usage of symbol and unit. The survey covered 12 items on the symbol and name of the some quantities. The students were conceptually asked for determining the derived quantities. The collected data were calculated and analyzed statistically.

RESULTS AND FINDINGS

Table 1 demonstrates the findings of the descriptive statistics concerning students' awareness on quantities' symbol and unit. When the data were generally evaluated, it could be concluded that many students did not realize physical quantities' symbol and unit while learning physics and/or problem-solving. 78% of the students knew the force concept and 53% of the students answered the velocity and acceleration concepts while fewer than 10% of students responded the angular velocity, impulse and momentum concepts. The range between 100 and 125 students could not give any answer to density, work, and power concepts. The range between 126 students and 150 students could not respond the torque, weight, and impulse concepts. Over 150 students could not answer to density, heat, and angular velocity concepts.

Table 1: The Descriptive Analysis of Some Physical Quantities

Physical Quantities		Correct		No Answer	
Symbol	Unit	N	%	N	%
d	kg/m^3	51	23.2	114	51.8
$\boldsymbol{F}$	N	171	77.7	47	21.4
$\boldsymbol{\tau}$	N.m	47	21.4	146	66.4
$\boldsymbol{W}$	N	61	27.7	128	58.2
$\boldsymbol{v}$	m/s	116	52.7	82	37.3
$\boldsymbol{a}$	m/s^2	120	54.5	90	40.9
$\boldsymbol{w}$	rad/s	16	7.3	183	83.2
W	J	68	30.9	103	46.8
Q	J	47	21.4	157	71.4
P	W	43	19.5	113	51.4
$\boldsymbol{I}$	N.s	20	9.1	145	65.9
$\boldsymbol{p}$	kg.m/s	10	4.5	173	78.6

CONCLUSION

The results reported that many students have great problems showing the quantities' symbol, and unit. These problems could be resulted from the students' motivation, confidence, and anxiety. The other drawbacks could be resulted from the instructors' teaching style. Many instructors do not even notice the symbol of physical quantities, the difference between the vector and scalar quantities in Turkey and besides they do not follow the international standards for presenting the symbols and units of the quantities. As a result of this many students have difficulty in conceptual learning. The students should encounter the difference of the usage of the symbols from the elementary school level to the university level. In the current case, the students do not comprehend the fundamental concepts of the physics and they cannot solve problems based on the principles of the physics.

RECOMMENDATION

Some recommendation based on the findings of the research could be reported as follows: 1) The instructors should use a scientific language in their course from elementary school level to university level. 2) The instructors should consider psychology of the students while teaching physics/science from the lowest to the highest level of the education. They should develop a curriculum plan by thinking psychology of the students in the current situation. 3) The instructors should explain vector and scalar quantities for each concept to help the students to distinguish the fundamental differences in concepts.

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AN EXAMINATION OF 7TH GRADE STUDENTS' MISTAKES IN ALGEBRAIC EXPRESSIONS

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ABSTRACT: The aim of this study is to determine students' achievement rates in algebraic expressions and the mistakes they made. 100 7th grade students from 4 different schools in the center of Burdur attended to the research. The study is a qualitative research, which was carried out in the survey design, and the data was analyzed using descriptive analysis. A test that consisted of 6 open-ended questions about algebraic expressions was used as the measurement tool. During the development of the questions, algebra learning area of the 7th grade was considered as the scope. A 9-question test was developed by consulting expert and teacher opinions in the first place. This test was applied in a 7th grade class and 2 questions were excluded as they were not appropriate in terms of difficulty levels, and also, some questions which caused problems in understanding were revised. The students' achievement rate is 68% in addition operations in the algebraic expressions, 43% in expressing a verbal expression algebraically and 26% in expressing a geometric representation as an algebraic expression. Their overall average is 69%. Looking at the reasons behind the mistakes from a broader perspective, it was determined that the main reasons were failure to attribute a meaning to the unknown and therefore doing the operations by assigning a value to the unknown. In other words, it could be asserted that failure to understand the main idea of algebraic expressions (the concept of variable and the concept of algebraic expression involving variables) as a concept properly is the major reason.

Key words: algebraic expressions, conceptual learning, 7th grade students

INTRODUCTION

Algebra is a branch of mathematics, which focuses on symbolization of general numerical relations and operations on mathematical structures (Kieran, 1992). Usiskin (1988) described four conceptions of algebra as generalized arithmetic, problem solving methods, the relation among quantities and the study of structures. Lacampagne (1995) stated that algebra was the language of mathematics and a prerequisite of advanced mathematics. According to Kaf (2007), algebraic thinking is a way of thinking which includes such skills as reasoning, using representations, understanding variables, explaining the meaning of symbolic representations, working with models to develop mathematical opinions and carrying out transformations among representations.

The reasons why students have difficulty in understanding algebra are as following: "Not being able to simplify algebraic expressions" (Dede, 2005), "Difficulties they experience in transition from arithmetic to algebra" (Dooren-Verschaffel-Ongehena, 2003; Van Ameron, 2003), "Misinterpreting equations" (Real, 1996), "Difficulty in writing algebraic verbal problems as equations" (Dede 2004; Herscovics-Kieran, 1980; MacGregor-Stacey, 1996; Real, 1996; Stacey-MacGregor, 2000), "Perceiving equations as if they were different phenomena from reality" (Pope, 1994).

One of the major causes of incompetency in algebra teaching is the curriculum while another one is the teacher. The teacher is expected to be aware of the facts their students may face while learning algebra. The facts that students may encounter can be examined under six topics as following (Altun, 2007): "A letter represents a single numeric value", "Cases when the letter value has no importance", "A letter is used as an object", "Cases when a letter is used as a special variable", "Cases when a letter represents a number within a range", "Cases when a letter is perceived as a variable".

Bednarz and Janvier (1996) classified school algebra under four conceptions: generalization, problem solving, modelling and functions. In many of the activities that form the concepts in school algebra subjects, algebraic thinking and algebraic symbolizing aspects are involved. Students must definitely gain these two abilities which complement algebraic understanding. Activities to be carried out at schools in order to improve students' algebraic thinking can be supported with those four different study types (NCTM, 2000): Activities to understand patterns, relations and functions (1), Activities to show and analyze mathematical situations and structures using symbols of algebra (2), Activities to use mathematical models to show and understand quantitative relations (3), Activities to analyze changes in different contexts by drawing graphs, and using technology-aided programs or worksheets (4).

METHOD

The aim of this study is to determine students' achievement rates in algebraic expressions and the mistakes they made. 100 7th grade students from 4 different schools in the center of Burdur attended to the research. The study is a qualitative research, which was carried out in the survey design, and the data was analyzed using descriptive analysis. A test that consisted of 6 open ended questions about algebraic expressions was used as the measurement tool. During the development of the questions, algebra learning area of the 7th grade was considered as the scope. A 9-question test was developed by consulting expert and teacher opinions in the first place. This test was applied in a 7th grade class and 2 questions were excluded as they were not appropriate in terms of difficulty levels, and also, some questions which caused problems in understanding were revised.

FINDINGS

This section includes the rates of students' answering the questions correctly and among the factors that cause failure, only those included in algebraic expressions are presented.

Findings Related to the First Problem

The students were asked to write the most simplified equivalent for the algebraic expression of "2x-3+4x-5". 68% of the students answered this question correctly. Incorrect solutions appeared as follows:

- After variables and fixed terms were put in operation separately, equalization of the results. 2x+4x=6x, -3-5=-8, 6x=-8.
- Doing operations just for coefficients ignoring the variable: 2-3+4-5=-2
- Assigning any value to x and finding a solution.

Findings Related to the Second Problem

The students were asked to write "the algebraic expression that shows 3/5 of an x plus 4". 36% of the students answered this question correctly. The causes for mistakes appeared to be as follows:

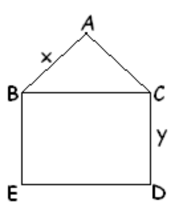
- Taking a number plus 4 as (4x).
- Not using parenthesis.
- Assigning random values to x.
- Writing 4.(3/5) ignoring the unknown variable.

Findings Related to the Third Problem

The students were given the problem "In the algebraic expression –a+2b+3c= 18, what is c while a=1 and b=2?" 78% of the students solved this problem correctly. The causes for mistakes appeared to be as follows:

- Failing to understand the question.
- In 2b expression when b=2, thinking that the expression was 22.
- Considering that c would be 3 if a=1, b=2.

Findings Related to the Fourth Problem



In the figure, as ABC is an equilateral triangle and BCDE is a rectangle, write the algebraic expression that gives the perimeter length of the shape in x and y. 35% of the students answered this question correctly. The causes for mistakes appeared to be as follows:

- In the algebraic expression giving the perimeter, finding a numeric result by assigning random values to the variables
- Finding a perimeter length by assigning values to variables

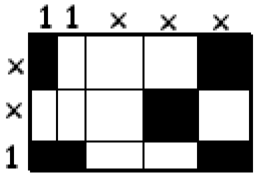
Findings Related to the Fifth Problem

"Selin's age is 3x and Yiğit's age is 4x. How old will Yiğit be when Selin reaches Yiğit's age?"
71% of the students answered this question correctly. The causes for mistakes appeared to be as follows:

- Failing to understand the question.
- Finding a numerical result by assigning a value to x in the algebraic expression they obtained.
- Solving by assigning arbitrary numbers for x.

Findings Related to the Sixth Problem

In this question, the students were asked to find algebraic expression giving the area of the black part. 16% of the students answered this question correctly. The reasons for mistakes were as follows:



- Failing to understand the rectangle whose edge lengths were given as x.
- Making errors in arithmetic operations in the algebraic expressions such as writing $x.x=2x$, $x^2+x^2= x^4$, $x+x=x^2$.
- Finding a numerical result by assigning arbitrary values to x in the algebraic expression they obtained.

Findings Related to the Seventh Problem

The question given to the students was as follows: "3 trees of x meter height are planted in a garden. Each year these trees grow y meter. In this respect, write the total height of the 3 trees after 2 years as an algebraic expression". 32% of the students answered this question correctly. The causes of mistakes appeared as follows:

- Finding a numerical solution by assigning arbitrary values to variables in the expression they obtained.
- Initially by assigning arbitrary values to x and y, doing numerical operations.
- Thinking wrongly such as $2x+3y$, $3.2x=6x$, $3x+2y$, $3x=6y$.
- Errors in arithmetic operations in algebraic expressions such as $y+y=y^2$, $y^2 +y^2+ y^2=3^{y2}$.

DISCUSSION AND CONCLUSION

The students' achievement rate is 68% in addition operations in the algebraic expressions, 43% in expressing a verbal expression algebraically and 26% in expressing a geometric representation as an algebraic expression. Their overall average is 69%. In studies carried out in the USA, Thailand, Japan and Korea, 43%, 46%, 57% and 64% of the students respectively could write a verbally stated expression algebraically (Kaş, 2010).

In the present study, the causes of mistakes within the scope of algebraic expression are as follows:

- Putting variable and fixed terms into operation separately and equalizing the results.
- Doing operations for coefficients only by ignoring the variable. In the study carried out by Küchemann (1981), it was also found that students ignored algebraic letters.
- Getting a solution by assigning a value to the variable.
- Digitizing the algebraic expression by assigning a value to the variable in the solution obtained.
- Failure to pay attention to the use of parenthesis.
- Failure to attribute a meaning to x in a geometrical shape. In Dindyal's (2003) study, it was found that students had various conceptual difficulties in understanding the nature of the concept of variable and forming algebraic expressions while solving geometry problems.
- Errors in arithmetic operations in the algebraic expressions. Bağdat (2013) found that 8th grade students had difficulty using and doing operations with the symbols in algebraic expressions.

Looking at the reasons behind the mistakes from a broader perspective, it was determined that the main reasons were failure to attribute a meaning to the unknown and therefore doing the operations by assigning a value to the unknown. In other words, it could be asserted that failure to understand the main idea of algebraic expressions (the concept of variable and the concept of algebraic expression involving variables) as a concept properly is the major reason. Similarly, in the study carried out by Dede, Yalın and Argün (2002), it was found that 8th grade students could not attribute a meaning to the concept of variable and were incompetent in doing operations with algebraic expressions involving variables. Akgün (2007) stated that students had several difficulties and misconceptions in understanding the concept of variable and distinguishing between different uses of this concept. Moreover, it was determined that students found it difficult to carry out operations with expressions including variables or letters and to build relations between variables and word problems.

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COORDINATION LEVEL AMONG THE CHEMISTRY TEACHING CURRICULUM OF PEDAGOGICAL UNIVERSITY AND SECONDARY EDUCATION IN MOZAMBIQUE

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ABSTRACT: The curriculum as an organized model of the educational program of the school and describing the matter, the method and teaching steps - what, how and when to teach, "is the assessment and analysis in the study: Coordination level among the Chemistry Teaching Curriculum of Pedagogical University and General Secondary Education in Mozambique. The initiated study serves as one of the main ways to curriculum reform and also predominant in the diagnosis of the level of learning and therefore the level of contents of program areas and class approval. It was established as a comparative study because Pedagogical University is the largest higher education institution in the country with the main mission to train education professionals. The main objective of the study is to know the levels of articulation between the teacher training curriculum from UP and General Secondary Education programs in chemistry subject. It focused on analysis of chemistry teaching curriculum of UP and chemistry teaching programs of the 8th to 12th of the national education system, and examination of the 12th from 2000 to 2010. The results prove the existence of gaps in the coordination of programs and major strategic gap between teaching and examination (time and given weight for each content). About research concluded that: 1- there is a lack of coordination between the ESG curricula and training of teachers (UP), thus creating a disparity in treatment considerations and content mode; 2- the introduction of new content or curriculum changes has not strictly followed the steps of the curriculum reform and not proceeded by training of teachers which hinders its implementation, treatment of certain content, providing poor learning, poor dispensing of the contents to examine, consequently the high level of failures. The survey results lead to suggestions for greater coordination in the preparation of curricula, defining priorities and above all avoid discrepancy in dosage of teaching time content with the weight of the exams.

Keywords: Curricula, coordination, training, teaching and learning, exams.

INTRODUCTION

The curriculum as a guiding document of the teaching and learning process has been the subject of several studies and changes. Many studies as Dewey(1904), Bobit (1918), Tyler (1949), Habermas (1971), Schön (1983);Skilbeck (1984), Shulman (1987), etc., and curriculum changes have had a common goal, that's improving the teaching and learning process quality.

This study is explorative and reflexive-philosophical character. Exploratory research is defined as an integral part of the main research as the preliminary study in order to better adapt the measuring instrument to the reality that if you want to know (PIOVESAN & TEMPORINI, 1995, p. 321).

Study on curricula can be the start of many other studies depending on the results, and because according to Santos (2010?):

> *"Exploratory research is "Used to conduct a preliminary study of the main objective of the research that will be conducted, that is, become familiar with the phenomenon being investigated, so that the subsequent search can be designed with a greater understanding and accuracy"*

The research was based on the study of curriculum and fit us in various curriculum theories, teaching and learning and curriculum reform, education policy and its different facets, among others aimed at the study of the teaching-learning process and the different variables influence their quality.

It's under these circumstances of teaching and learning process and other factors, the researcher would like to discuss the coordination of Chemistry Teaching Curriculum at Pedagogical University and High School Education in Mozambique. Therefore, the university must have a good management capacity to accomplish their values and objectives in teaching and learning process. The main purpose of this project is to focus on the current levels of coordination, its consequences, the relationship between different syllables aspects and the results of the teaching- learning process.

In order to carry out the study, it was necessary to concentrate on data gathering procedures or techniques, in this case the researcher used Bibliographical technique and reviewed some current curriculum theories and also analysed the Curriculum Plan and education programs of the High School Education and the Pedagogical University, in terms of its contents.

The work follows the philosophical essay structure proposed by Polonius where we highlight the problem as the starting point for further points and sub-points as well as a logical sequence to achieve the predefined objectives

Questioning

In Mozambique the curricular changes in secondary education has happened relatively often, due to various factors, according to the makers of curricula, among them economic policy ("*PARPA*" for, Five Year Plan and population density) and social aspects (the educational needs of society, etc.). The curricular changes in view of the dynamism that characterizes the teaching-learning process, it is welcome, but this must be accompanied by some changes from teacher training and conditions of its operation.

In the past ten years in Mozambique the secondary school curriculum has gone several changes. The main reasons evocated for these changes is to meet internal (socio-economic and political changes) and external demands (SADC integration and Millennium Development goals for education). On one side, we would like to question the process of curriculum change done by the Ministry of Education: it is happening in relatively short period of time (less than 5 years of implementation of the previous one) and not involving the teacher training institutions that train teachers for secondary school. On the other side the Pedagogical University, guided by the same reasons (internal and external) has undergo several curriculum change that do not meet the demands of secondary school curriculum – where the teachers are trained to work.

In a study is the Curriculum Plan of the Secondary Education in 2007 which came into force in 2008, without however be no change in the teachers training curricula of the Pedagogical University particularly and other institutions such as the Eduardo Mondlane University and Catholic University of Mozambique, Since these are institutions that form the professionals to the secondary education, and according to *PCESG*, "the success of the plan depends on the agents of which the teacher," however, is needed to ask the following question:

Question

What are the levels of articulation between the teacher training curriculum of Pedagogical University and programs of secondary education in the chemistry subject?

Objectives

General Objective

Knowing the levels of articulation between the teacher training curriculum of Pedagogical University and Secondary Education Programs in Chemistry subject

Specific Objectives

- Identify the possible convergences and divergences between the two curriculum and its implications;
- To describe the approach of content levels, in teacher education curriculum and secondary education;
- To evaluate the educational achievement level taking as the basis the level of assimilation and the teaching of content;
- Analyze the strengths and weights of the contents in curricula and tests applied;
- Proposing organizations and model of curriculum reforms.

Topic Relevance

It is common today, many questions about the quality of education in Mozambique. By contrast it has been noted contained in the Secondary Education curriculum change without however be a monitoring of curriculum changes in teacher training to deal with the proposed innovations.

According to PCESG-2007 the curriculum influences the quality of education. The curriculum being a "structured plan of teaching and learning, including learning objectives or results to be achieved, materials or content to teach, processes or learning experiences to promote"; (RIBEIRO-1989 *in* LOPES 2009), we need first to graduate teachers in the context of curriculum change and then introduce the new curriculum.

Changing the contents of the workload, the evaluation methods of students among other changes, should be in line with the changes in teacher training, fit these with reality and even identification with the changes by the teachers, at risk to compromise the objectives of education in general.

The curriculum design should obey some subsystems as:

- Political administrative;
- Participation and control;
- Ordination of the education system;
- Production of learning through
- Scope of cultural creations, scientific, etc;
- Technical teaching: trainers, experts and researchers in education;
- Experts and Innovation;
- Practical-pedagogical. (GIMENO-2000, p. 23)

Failure to follow one of the above steps, the probability of producing a resume disabled, which causes some negative consequences in education.

THEORETICAL FRAMEWORKS

The learning process is a natural human phenomenon which involves a number of factors as: cognitive, emotional, organics, psychosocial and cultural (WORLD EDUCATION). The process Also depend on Several other factors such as educational policies, society, teachers, students, parents and / or guardians, school supplies, school environment, etc.

For the learning process Shulman drew a string of Categories of the Knowledge Base, which are:

- Content knowledge;
- General pedagogical knowledge, with special reference to those broad principles and strategies of classroom management and organization that appear to transcend subject matter;
- Curriculum knowledge, with particular grasp of the materials and programs that serve as “tools of the trade” for teachers;
- Pedagogical content knowledge, that special amalgam of content and pedagogy that is uniquely the province of teachers, their own special form of professional understanding
- Knowledge of learners and their characteristics;
- Knowledge of educational contexts, ranging from workings of the group or classroom, the governance and financing of school districts, to the character of communities and cultures;
- Knowledge of educational ends, purposes, and values, and their philosophical and historical grounds; (SHULMAN, 1987, p. 8)

We recognize that there are various factors and categories that influence in different ways the quality of education and are capable of studies. Based on the combination of all these factors and categories, the study devoted to the analysis of the curriculum document handlebar teaching-learning process based on two categories, namely: Content knowledge e pedagogical content knowledge.

The curriculum presents aspects as:

- Who will teach? (teacher's background)
- What will teach? (objectives / fields of learning);
- How to teach? (strategies);
- Who should be taught? (the target audience).

Among curricular aspects of the more prominent of the process is "who teaches", hence the concern about the level of training, curriculum, skills and particular aspects such as:

- Teacher’s background
- Solid and deep scientific knowledge
- Pedagogical knowledge of the field of education.

Teacher's Background

The solid scientific knowledge is essential for anyone who teaches, for such there is need to be some alignment between the training school curriculum (learned) and broadcast (workplace). According to Novoa (1997, p.33) cited Gaia (2007)

> *(...) There are no two identical teachers and (...) the identity that each of us constructs as an educator is based on a unique balance between personal characteristics and professional paths. And the conclusion that it is possible to unravel the universe of the person through the analysis of their pedagogical action: tell me how to teach, I will tell you who you are.*

For the acquisition of solid content, the teacher's character helps a lot. Linked to individual aspects as a determining factor in the learning process are the 3 principles of Piaget's learning theories advocating:

- Learning by discovery
- Readiness for learning
- Individual difference

Piaget believed that children learned only through its effect on the environment while Vygotsky argues among several implications:

- Active participation of the subject and acceptance of individual differences
- Power Discovery vs. independent discovery (Piaget)

The teacher's background are determinant in both process, we mean, on traditional and constructivism leaning process, although as lower incidence or relatively less decisive on constructivism.

In the teaching-learning process, the teacher should list their individual skills with different facets of the process, such as the use of technology, science, his experience of the day-by-day, and several other aspects that will provide you a good learning and later transmission or mediation.

Content Knowledge

For the process of teaching and learning it is very important that the teacher has solid and deep knowledge of the subject to transmit or facilitate depending on the applied teaching model, traditional or constructivist respectively.

> *While teacher content knowledge is crucially important to the improvement of teaching and learning, attention to its development and study has been uneven. Historically, researchers have focused on many aspects of teaching, but more often than not scant attention has been given to how teachers need to understand the subjects they teach. Further, when researchers, educators and policy makers have turned attention to teacher subject matter knowledge the assumption has often been that advanced study in the subject is what matters. Debates have focused on how much preparation teachers need in the content strands rather than on what type of content they need to learn. (BALL, THAMES, and PHELS, p. 1)*

Content knowledge of an knowledge that aims to train skills, i.e. transformation of the individual progressive form of the categories of knowledge according to the BLOOM taxonomy's, based on the knowledge (cognitive) to know how to be, and be (emotional) to the know-how (psychomotor) must be contextualized and systematic modes that is easy, acquisition and testing of ways to transform the teacher's knowledge accumulated and lived by it.

The adoption of contextual learning experiences and use by teachers as the basis for improvement of teaching points fall on current study Lee S. SHULMAN (1987, p. 1) comes to teaching reform

> *[…] teaching reform on an idea of teaching that emphasizes comprehension and reasoning, transformation and reflection. ...He justified it "by the resoluteness with which research and policy have so blatantly ignored those aspects of teaching in the past." To articulate and justify this conception, Shulman respond to four questions: What are the sources of the knowledge base for teaching? In what terms can these sources be conceptualized? What are the processes of pedagogical reasoning and action? And what are the implications for teaching policy and educational reform?*

In the traditional model of education the teacher must first be accumulated scientific knowledge holder during the period of training for onward transmission to the students and the constructivist model where "the principle goal of education in the schools shouldn't be creating men and women who are capable of doing new things, not simply repeating what other generations have done." (PIAGET), the constructivist model gets added to the teacher's responsibilities as a guiding agent or facilitator rather than mere transmitter of knowledge acquired in the training period.

According to the characteristics of teaching models both traditional and constructivist is evident the importance of knowledge of the contents by the teacher. When knowledge of the contents are solid and deep, this makes the teacher to apply the most appropriate methodology and according to real and concrete conditions in order to ensure meaningful learning, effective, affective and lasting

Pedagogical Content Knowledge

The pedagogical content knowledge is the step that links the knowledge of the content, the ability to acquire the same by the students and the methodology to be applied in order to reach the teaching-learning process objectives.

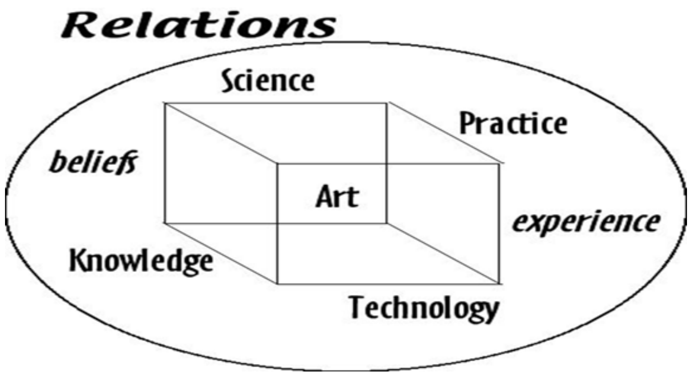
"Those who can, do. Those who understand, teach" (SHULMAN, 1986, p. 14), Teaching is a process of transmission and or mediation of knowledge, so it is necessary to adjust for each content, learning and pedagogical aspects.

Pedagogical Content Knowledge is a type of knowledge that is unique to teachers, and is based on the manner in which teachers relate their pedagogical knowledge (what they know about teaching) to their subject matter knowledge (what they know about what they teach). (COCHRAN, 1997, p. 2)

When teachers got Content Knowledge Their next step is to research the best way to transmit them using various means according to their ability and creativity. These details vary from teacher to teacher, because not everyone can have the same creativity and not the same possibilities.

> *For Shulman (1986) apud Cochran (19997, p. 2) pedagogical content knowledge […] embodies the aspect as contents most germane to its teach ability. Within the category of pedagogical content knowledge I include, for the most regularly taught topic in one's subject area, the most useful forms of representation of those ideas, the most powerful analogies, illustrations, examples, explanations, and demonstrations – in a word, the way of representing and formulating the subject that make it comprehensible to others.*

Pedagogical content knowledge is a knowledge that gives us ability and different ways to teach. According to Shulman (1986, p. 9) "it also include an understanding of what makes the learning of specific concepts easy or difficult; the conception or preconception that student of different ages and background bring with them to learn". So the pedagogical content knowledge becomes an art of teach with the main objective of facilitating the process of teaching and learning.



Curriculum Theories

The curriculum theories from Silva and Pacheco suggest that content must arise from the need for learning society to the government and not imposed by the government to society. Following the correct Society-Government knowledge it can be contextualized the serving of key assumptions for effective learning.

Silva (2003) in their teaching classes, in the academic perspective, "the teacher is trained as a specialist in one or more areas or disciplines, with the main objective to master the content to teach." Based on the proposal of the direction of emergence of the contents to be taught, and the main purpose of teacher education there is need to harmonize the curriculum of teacher training schools and secondary schools in ways to avoid discrepancy between the curriculum.

Theses

Main Thesis

Lack of efficiency in the transmission of content (weak learning and high level of failures)

Secondary Theses

- Introduction of contents that are not taught in teacher training;
- Relativity in their priorities, importance and weight in the dosage and treatment of content *vs* evaluated contents and their weights;
- Teachers who do not identify with the curriculum (lack of motivation).

Reasons for Theses

Lack of efficiency in the transmission of content (weak learning and high level of failures)

The chemical as a curricular discipline, studies the matter and its transformations. In cycles of learning, regardless of system or subsystem, the study of chemistry is guided by so-called general contents. The general contents, by logic should be treated with balanced or approximate consideration (importance and weight) both at the Pedagogical University (teacher training) as in secondary schools. Since the Pedagogical University trains professionals to teaching mainly in secondary education, the levels of content approach levels should be higher, i.e. the contents in the universities should be treated with greater complexity or depth but the following table shows some differences:

Table: General Contents

General contents	Hours scheduled for treatment at the Pedagogical University			Hours scheduled for treatment at Secondary School	
	Basic Chemistry	**General chemistry**	**Other subjects**	**1st Cycle Grade (8-10)**	**2nd Cycle Grade (11-12)**
1. Atomic Structure and Matter,	28	9		22	18
2. Periodic Table of elements				**5**	**9**
3. Chemical bonding		**9**		**7**	**12**
4. Class of Inorganic compounds			IQ – 80	15	20
5. Class of organic compounds	22		OQ – 80	72	*40*
6. Thermochemistry					
7. Chemical Kinetics		**12**	**FQ – 15**		***9***
8. Chemical Equilibrium,					**32**
9. Redox reactions		16	FQ – 20	6	22
10. Electrochemistry					
11. Stoichiometry and solutions	15	18		10	6
12. Reactions and hit equations.	15				
Total	**80**	**64**	**195**	**137**	**168**

Looking at the table above it appears that no content as 2, 3, 6, 8, 10, i.e., half the contents are treated in Pedagogical Universities less thorough manner due to the time available for your study in relation to secondary schools. The findings above are plausible data for the lack of efficiency in the transmission and reception of facts, as they are intricately treated in secondary education (workplace) and not in Pedagogical Universities (training institution).

Content Introduction Not Taught In Teacher Training

The training of professionals of any desktop is the moment when we adopt the tools individuals (scientific knowledge and methodologies) required for its activities as a professional. The introduction of both technologies content as "unknown", the decrease in workload but without altering the contents, the lack of educational facilities, among others, to create so-called teacher feeling “burnout" which according to (CODO, 2002, pg. 374) means "the pain of professional pinned down between what we do and what we can actually do, between heaven and hell possibilities structural limits, between success and frustration". The transformation of professionals in "burnout", induce the commission of several errors in the education sector such as: Teachers trained in a certain area but obliged to teach the other as an alternative to the lack of qualified professionals;

- Teachers teaching content which in turn do not dominate;
- Teachers committed to the completion of the programs and not to the quality of the content learning;
- A Ministry "pusher", concerned with positive results to serve as justifications bases of curriculum changes or other measures taken.

The above points are also born a few antitheses raised about the subject being studied, which in turn has been largely used to pass to the teachers the responsibility of the failures of political and educational process in general and the quality of education in particularly.

Among various antitheses on the subject, the following stand out:

- The teacher should be a simply facilitator and not the knowledge transmitter;
- Training of teachers for the new approach to content or new content approach;
- View and considering the country's financial conditions, it is not imperative to change the curriculum of Pedagogical University but of Secondary Education because of the quality of graduates.

Antitheses

The teacher should be a simply facilitator and not the knowledge transmitter

The intention of changing the model of teacher centered in teaching methods (traditional theory) to the model of student-centered (critical theory), supports the antithesis and also give rise to not conceive the teacher as a holder of knowledge but with the requirement to transmit the methodologies and indicate the sources for the purchase or production of knowledge.

The above arguments clearly admit that touts teachers with methodologies domain and not precisely scientific knowledge, because it is regarded as moderator. The Mozambican reality indicates the reverse, by reason of the lack of educational facilities such as libraries, books, laboratories, flood in classrooms etc. in most schools, mean that the teacher is the only source of transmission of knowledge. Being the teacher the only source of transmission of knowledge is imperative to be equipped with scientific knowledge on the content to be taught.

Training of Teachers for the New Approach to Content or New Content Approach

The training of teachers has been notorious in the schools, but the level and modalities of its implementation leaves much to be desired, and as a result do not guarantee a solid learning, let alone solving the educational problems.

Some comments from citizens lead us to understand that they are apologist for the unilateral change, but the practice goes against this thinking, because even though theoretically emancipated centralization of education in student practice teaching still centered on teacher, due to various factors. However these assumptions require a teacher to be deeply knowledgeable of the contents to be taught. So if the education secondary education results are not satisfactory, and the results indicated the change of the curriculum, will be very important to articulate or even unify the changes between the curricula of teacher training and secondary education.

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[i] *Where the teacher should be an expert in one or more subject areas, with the main objective of training the content area teaching.*

[ii] *The student is an active participant of learning, the teacher is the mediator between knowledge and the student.*

View and considering the country's financial conditions, it is not imperative to change the curriculum of Pedagogical University but to secondary education because of the quality of graduates.

Reflection Points

There is a growing level of failures result of lack of coordination?

The study based on analysis of content and its dosage in examinations (2000-2010), clearly proves that the contents with higher weight (both in question amounts as values), are linked to chemical equilibrium peaking in exams 2005 in the first and second time values 9.8 and 10.9 respectively the following organic chemistry.
Chemical balance is one of the contents studied at the Pedagogical University according to the tabulated data extracted from the program, and one of the most if not the most complex chemistry teaching because it involves deep mathematical calculations, domain other content such as chemical reactions, hit equations , stoichiometric calculations, among others.

In this respect the following contents are automatically bonded "an antagonistic model by Descartes' which instead of breaking to facilitate understanding of the contents, they are bonded. The poor knowledge of the matter by the teacher, consequently no understanding of them by students and overweight exams "paradoxical phenomenon " contributes good percentage in group aspects that increase the level of disapproval.

Were the universities contributed to the development of this curriculum (Secondary Education 2007)?

By differences in priority and treatment of various contents, and partial lack of identification of the universities with the secondary curriculum and a clear distancing regarding the supposed lack of quality of secondary education appears the lack of involvement of universities or a joint review in curriculum revision. Nevertheless there are several countries in which universities participate actively in the development of curricula for upper secondary education, with the bases the assumptions and curriculum models adopted by the government as a result of various curricular researches.

Is not the curriculum design model the main cause of problems in the education sector?

The curriculum development model has been one of the least recommended, as many actors as V. Landsheere & G. De Landsheere (1983: 49) in Pacheco (2001: 52) suggest that "the primacy in education target of choice must go to the analysis of the needs of society ", but in Mozambique the contents rather than comes from the community's educational needs to the government, it comes from the government to the community. Curricular reforms that follow the government to society model is not stanch the problems of basis, this makes the school community (teachers, students, etc.) and society does not identify with the curriculum, creating motivation, lack of interest, not contextualized and consequently weak learning.

CONCLUSION

About examined topic conclude the following:

- There was lack of coordination of the curriculum of secondary education and teacher training (Pedagogical University), thus creating a disparity in treatment considerations and content mode.
- The introduction of new content or curriculum changes has not strictly followed the steps of the curriculum reform and not proceeded by training or training of teachers which hinders its implementation.
- The lack of coordination between the curricula of the Pedagogical University and Secondary Education carries gaps as: the difficulty in treating certain content, poor learning, poor dispensing of the contents to examine hence the pronounced level of failures.
- At the macro level, the lack of coordination between the curricula of the Pedagogical University and Secondary Education is reflected in the poor quality of education.

PROPOSAL

To ensure greater involvement and more effectively the reforms and their implementation, it is proposed that:

- Curricular reforms should take place in cascade and follow direction, Universities-Secondary Schools and not Secondary Schools-Universities, thus ensuring, first to train teachers able to deal with required reforms and policies and then work with these.

- Prioritize joint research with universities (forming education professionals) and other research institution on teaching and learning, curriculum, contents adjusted to the reality of the country, region and world before any reform modes to provide a meaningful learning, lasting and applicable.

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APPENDIX

1. Table of search on weight content in general examination from 2000-2010
2. Lifting table of the number of questions in the 2000-2010 exams

TABLE OF SEARCH ON WEIGHT CONTENT IN GENERAL EXAMINATION FROM 2000-2010

General contents	2000 1ª / 2ª Season		2001 1ª / 2ª Season		2001 2ª Season	2002 1ª / 2ª Season		2003 1ª / 2ª Season		2004 1ª / 2ª Season	2005 1ª / 2ª Season		2006 1ª / 2ª Season		2007 1ª / 2ª Season	2008 Extra	2009 1ª Season	2010 1ª / 2ª Season		2010 Extra
1. Atomic Structure and Matter,	0,8	0,7	0,5	0,5	0,5	0,8	0	0,5	0,5		2	2,2	1,5	3	0,9	1	1	0,5	1	1
2. Periodic Table of elements					0,5			1	0				1,5	1	1		0,5	1	0,5	0,5
3. Chemical bonding	1	0	0,5	0,5	0,5	0	2,8	0,5	1				0,8	0	0,9	1,5	1,5	1,5	1,5	1
4. Class of Inorganic compounds	1	1,6	0,5	1	0,5	3,2	0	0	0,5				0,6	1,8		1,5	0,5	1,5	1	1,5
5. Class of organic compounds	2,6	4,1	3	3,5	3,5	1,6	5,8	2,5	2,5		3,8	3,1	3	3,2	3,8	**4**	**4,5**	**4,5**	**4,5**	**4,5**
6. Thermochemistry	1,2	2						1,9	0,5								0,5	0,5	0,5	0,5
7. Chemical Kinetics	3,2	3,4	3	3	3,1	2,4	1,4	3	3		2	2,5	3,7	3,7	3,5	1,5	2	2	2	2
8. Chemical Equilibrium,	**3,8**	**2,8**	**5,8**	**7,3**	**6,7**	**5,9**	**4**	**6,1**	**5,5**		**9,8**	**10,9**	**5,6**	**4,3**	**6,1**	**7**	**5,5**	**5,5**	**5,5**	**5,5**
9. redox reactions					2,5	2,4	1						3,3	0		0,5	1,5	0,5	1	1
10. Electrochemistry	4,4	3,6	5,7	0	1,7	3,7	3	4,5	4,5		2,4	1,3	0	3	3,7	1	0,5	1	1	1
11. Stoichiometry and solutions	0	1,8	0,5	1,5	0,5											1	2	1,5	1,5	1,5
12. Reactions and hit equations.	2	0	0,5	2,7		0	2	0	2							1				

LIFTING TABLE OF THE NUMBER OF QUESTIONS IN THE 2000-2010 EXAMS

António C. P. Madeira & Djabrú. J. Manuel

General contents	2000		2001		2001	2002		2003		2004	2005		2006		2007	2008	2009	2010		2010	Avar/
	1ª / 2ª		1ª / 2ª		2ª	1ª / 2ª		1ª / 2ª			1ª / 2ª		1ª / 2ª		1ª / 2ª		1ª	1ª / 2ª			%
	Season		Season		Season	Season		Season			Season		Season		Season	Extra	Season	Season		Extra	
1. Atomic Structure and Matter,	1	1	1	1	1	1	0	1	1		4	3	1	3	1	2	2	1	2	2	1,5
2. Periodic Table of elements					1			2	0				1	1	1		1	2	1	1	0,6
3. Chemical bonding	1	0	1	1	1	0	3	1	2				2	0	1	3	3	3	3	2	1,4
4. Class of Inorganic compounds	1	1	1	2	1	1	0	0	1				1	3		3	1	3	2	3	1,3
5. Class of organic compounds	2	4	4	4	4	2	4	5	5		4	3	2	2	4	8	9	9	9	9	4,9
6. Thermochemistry	1	1						2	1									1	1	1	0,47
7. Chemical Kinetics	2	2	3	2	2	1	2	3	3		2	3	3	3	5	3	4	4	4	4	2,84
8. Chemical Equilibrium,	**3**	**2**	**4**	**5**	**5**	**2**	**2**	**5**	**4**		**5**	**5**	**6**	**4**	**5**	**14**	**11**	**11**	**11**	**11**	**6,05**
9. redox reactions					2	2	1						4	0		1	3	1	2	1	0,89
10. Electrochemistry	3	3	3	0	1	2	2	3	3		3	1	0	1	2	2	1	2	2	3	1,9
11. Stoichiometry and solutions	0	2	1	2	1											2	4	3	3	3	1,1
12. Reactions and hit equations.	1	0	1	3		0	2	0	1							2					0,5
Total of questions	**15**	**16**	**19**	**20**	**19**	**11**	**16**	**22**	**21**		**18**	**15**	**20**	**17**	**19**	**40**	**40**	**40**	**40**	**40**	**20V**

TOMATO PRODUCTION IN POWDER: A TOMATO CONSERVATION TECHNOLOGY TO SUPPORT THE COMMUNITIES AND METHODOLOGICAL PROPOSAL FOR CHEMISTRY CONTEXTUALIZED EDUCATION

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ABSTRACT: The tomato is a very produced food in Mozambique in particular in the District of Gorongosa. This product although it is often used in the confession of food, have little time left paradoxically rich in vitamin C, lycopene and also contains the β -carotene. Both belong to the family of carotenoids, terpenoids (pro-vitamin A). In operation of the human body are given rise to a series of chemical reactions where mostly formed free radicals (unstable and reactive) that react rapidly with various compounds and cellular targets, in many of these reactions can damage DNA, proteins lipids, carbohydrates, etc. causing various diseases that affect humans. The tomato has β -carotene and lycopene are carotenoids act as an antioxidant because of their conjugated double bonds susceptible to oxidation under the action of light or oxygen. The study was dedicated to the determination of carotenoids (lycopene and β -carotene) in tomato powder and fresh. The motivation for the study came from research on production of dried tomato funded by the Ministry of Science and Technology powder through the National Research Fund, categorized as a project of Innovation and Technology Transfer, held in 2013, instructing associations Báruè Districts and communities Gorongosa District through a team of teachers, students and accompanied by representatives of the Government and institutions. Because tomatoes have little shelf life and important game against vitamins and natural antioxidants, after successfully obtaining the tomato powder, to be a viable and recommended alternative for communities urged the need to do laboratory analysis of carotenoids in it existing and comparing with the fresh tomato. Analyses for determination of carotenoids were made in different laboratories (UP- Beira and Chimoio – UCM), but all were with the help of the spectrophotometer, differed in laboratory reagents and other materials. As other nutrients such as sugar and vitamin C could somehow influence the activity of the microorganisms etc. was also performed analyzing sugar levels in fresh tomato based refractometer. The survey results show that the extraction of carotenoids is made with use of organic solvents and subsequent identification using various methods such as high performance liquid chromatography (HPLC), calorimeter, thin layer chromatography (TLC) and spectrophotometry. It is also noted that processing of carotenoids caused an increase and decrease in sugar and vitamin C (ascorbic acid). It follows that in 100kg of fresh tomatoes are obtained 6kg of tomato powder and that levels of carotenoids such as lycopene both β-carotene in tomato powder are larger than fresh tomatoes according to the processing mode used. An open set of chemistry content such as mass conservation law, stoichiometry, concept of atom, molecule, dehydration, vaporization, laboratories and experimental lessons etc., May be taught or understood very easily with the aid to processing phase, creating conditions for the long lasting grasping, consequent contextualized meaning as well as effective and affective grasping.

Keywords: *Tomato Powder, fresh tomato, carotenoids, conservation technology, chemistry contextualized education*

INTRODUCTION

Tomato production takes place everywhere in the world, but his short life time, difficulty, lack of handling conditions and conservation technologies especially in producing communities, where most of them have a low family income, Creates the need for search, create, innovate or proposed conservation technologies of this product in accordance with the conditions of each community as a target group.

According to the conditions of the rural communities of the districts of the central area and the whole country in General regarding the lack of cold storage system, associated with this is the resistance of microorganisms at low temperatures compared to high, the presence of water to the metabolism of these, etc., the transformation of fresh tomatoes in tomato powder can be the best alternative for the conservation of tomato.

The tomato is a product of easy access, and in its transformation from fresh to powder, several phenomena as physical, chemical, nutritional aspects can happen. All these phenomena, especially the nutritional aspects may interfere negatively or positively on human health.

Both the transformation of fresh tomato to powder as the changes of the nutrients can be extensively used not only in the transfer of processing technologies to support the community but also as methodologies for teaching various chemical contents of contextualized, effective and affective way.

The tomato is a fruit classified as a legume rich in carotenoids, including lycopene and β-carotene. These carotenoids are responsible for the color of tomatoes and at the same time are antioxidants that act on free radicals.

Free radicals often break unsaturated fatty acids, impairing the ability of the membrane to transport substances into and out of the cell. Free radicals also damage cellular proteins, altering their functions and DNA, disrupting all cells that have inherited this damaged DNA Zeraik and Yariwake (2007).

Lycopene is a carotenoid found primarily in tomatoes (Holden et al., 1999;. Rodriguez-Amaya et al, 2008), where their chemical structure (extended conjugated double bonds) give it a property to provide the red color of tomatoes and a large and important antioxidant properties, which is manifested by the ability to react with free radicals, especially singlet oxygen, formed from the irradiation of the oxygen by ultraviolet (UV) radiation (SCOTTI and Velasco, 2003; SIES and Stahl, 1996 cited Cefali, 2009, P. 19) responsible for lipid peroxidation of cell membranes, damaging them and causing diseases for the human organism.

The β-carotene is a carotenoid found in tomatoes also although in reduced quantities with respect to lycopene, has extended conjugated double bonds provides the yellow color to tomatoes, it has anti-oxidant capacity and pro-vitamin A.

In the high rate of unsaturation both of lycopene as the β-carotene, has been very instrumental in changing their levels in tomato processing, as factors such as heat, light and acids cause isomerization of trans carotenoid, which is the most stable form in nature, to the *cis* form, losing color and pro-vitamin activity.
Carotenoids are also susceptible to enzymatic or non-enzymatic oxidations that depend on the carotenoid structure, availability of oxygen, the presence of enzymes, metals, pro-oxidants and antioxidants, high temperature and exposure to light. (SCHROEDER & JOHNSON, 1995).

Taking as a basis the transfer of technology to communities, the importance of carotenoids and its easy change in processing, the focal point of the study was to determine the levels of carotenoids in tomato powder and fresh and in parallel there was relationship between data in this process all with chemistry teaching content, contextualizing teaching.

The study was conducted in three stages, with the first to the tomato processing that took place in interaction lines between science, technology and society which took place in the district of Gorongosa, place the tomato study origin and the second step was the determination of carotenoids in laboratory tests and the last step was chemistry teaching contents of study that can be taught based on practical examples of processing steps and analyzes the study of tomato.

Topic Study Rationale

The production of tomato powder was simply a curiosity that came from products of agro-processing work carried out in the districts, in a project that combined the GAPI, the first lady's office and the UCM-Faculty of Engineering.
The results of the first project of agro-processing with respect to product shelf life difference processed in relation to unprocessed, diversity processing and its use has led to attention in particular to the study and processing of tomatoes to be one of the main products of the kitchen and with much less life time.

Upon successful production arose concerns about components of tomato that could be changed, and various other aspects such as color, nutritional value, its mode of application, etc.
About fresh tomato that is dried and turned into powder, can be made a number of studies as the amendment of its nutrients are many (e.g. protein, fat, saturated fatty acid, monounsaturated and polyunsaturated, phosphorus, carbohydrates, vitamin A, ascorbic acid, etc.), or interference in the methods and processing conditions, studies of existing microorganisms and changes of the population caused by processing among others. For the study was not so widespread, we are dedicated in the determination of carotenoids in tomato because of its importance both in color and in the prevention of some diseases which are described in the work and later relate the different process steps with the teaching contents of chemical.

The choice of study of the tomato components was motivated by the project designed by the author who was tomato agro-processing "tomato powder" and which was funded by the Ministry of Science and Technology through the National Research Fund in the 4th call. Due to the impact of this project on fieldwork and its dissemination in social networks emerged proposals to continue with analysis of some tomato nutrients.

Since the processing following steps as the selection of tomato, washing, drying and finally grinding, all methods of a or otherwise interfere with the modification of the nutritional value of the tomato, it was found that it was important to study the nutrients that are most likely they could be changed and perhaps creating a huge gap of quantity in tomato powder and fresh.

By changing some nutrients, several products can be converted from food to poisonous products, others still nutritious not nutritious at other times certain changes may lead to dose modification consumption, especially when it is controlled diets for some reason.

Some Similar studies were published in Brazil and Greece but with full difference in processing mode, and in some cases, studies of carotenoid in dry tomato and not necessarily in powder and in case of tomato powder was used for processing machines grinding and drying of tomato and thermal conditions, and entirely different drying conditions.

The study is set in the following areas: chemical and enhancement of natural products, modern instrumental analytical methods, interaction science, technology and society and school chemistry lab.

Characterization and Placement Problem

The tomato is a food rich in vitamin C, lycopene and also contains the β-carotene. The two carotenoids (lycopene and β-carotene) belong to the family of the terpenoids that are pro-vitamin A.

The human body is considered reactor therefore its operation to give rise to a series of chemical reactions. In many of these reactions are formed free radicals (unstable and reactive) that react rapidly with various compounds and cellular targets, may in several of these reactions damaging DNA, proteins, lipids, carbohydrates, etc. causing various diseases that affect humans.

The tomato has β-carotene and lycopene are carotenoids which act as an antioxidant because of their conjugated double bonds susceptible to oxidation under influence of light and oxygen. According Zeraik and Yariwake (2008):

> *Antioxidants are substances capable of reacting with free radicals and neutralizing them, with such beneficial effects slowing the process of atherosclerosis, prevention of obstruction of arteries and reducing the process of cell death in various organs such as the brain, kidneys, lungs and skin.*

Carotenoids are also absorbed in the intestine and transported in the blood associated with plasma lipoproteins. Blood play some important biological functions including the prevention of hypertension. The intake of β-carotene reduces the potential incidence of cancer and production of Vitamin A, while lycopene can be used for controlling diseases such as diabetes, anemia and production of vitamin A in addition to preventing malfunction of kidney function.

The β-carotene and lycopene have a high oxidation capacity which can alter the nutritional value of tomatoes from their collection, processing until ingestion. The production of tomato powder takes several steps, one of which is unusual to cool drying which is where various physical and chemical phenomena occur due to exposure to the sun and atmospheric air, high temperatures, etc. They alter the content of its components such as β-carotene and lycopene which in turn can interfere positively or negatively in the nutritional value of the tomato.
For Della Lucia at al (2008):

> *"[...] It is very important to predict such changes especially in the case of loss and establish preventive measures and criteria that can be adopted to minimize the nutritional damage both at home, and in communities of food services."*

As well as other risks that compromise the quality of food, the loss of nutritional value directly affect the health of consumers and is no less important than the others, although some of its consequences potentially be perceived in the medium and long term.

Carotenoids as colorants may show more or less depending on their exposure to sunlight, temperature, tomato grinding, dehydration, oxidation, among other things that the processing itself has the step and risks.
Associating the reasons and reality, especially the loss of tomato in a short lifetime, ensuring that turns them into powder would have longer life the fact that there are contents of educational programs that require manipulations, there were some issues:

- How to turn fresh tomato modes powder to support communities in the conservation of tomatoes?
- What is the level of carotenoids (lycopene and β-carotene) in tomato powder and fresh?
- What contents of chemistry can be taught during the process of tomato transformation?

Objectives

- Develop individual, collective and institutional capacity for increased creativity and solving specific problems of society;
- Systematize and transfer agricultural processing technologies for the local population, the province and the country;
- Help communities in the conservation of agricultural surpluses, reduction of post-harvest losses and increase the yield and quality of life;
- Creates space for interaction school-community where through transfer of knowledge and technologies to solve these specific problems.

MATERIALS AND METHODS

The study had as its primary basis of research, innovation and technology transfer through teaching. The starting point was the tomato processing mode, the likely changes of nutrients and causes. For purposes resorted to methods that are: literature review, experimental (laboratory tests) and education (imparting knowledge to students and local community).

Tomato processing work on the principles and connecting lines between science, technology and society. The fundamental principle that guided the work was research and innovation tomato processing techniques and subsequent transfer of the techniques / technologies to students and these in turn local communities.

The processing work team was composed by Professors, university students of food engineering course, representatives of the Government, an institution that supports communities (Gorongosa National Park) and grouped populations in villages of Canda and Vinho in Gorongosa District.

Students played a crucial role in the work since served as a vector of transmission of the University knowledge (represented by the author of the work and supervisor) to local communities, a true spirit of teaching based on the model of context "The Salters approach", where these in turn had the mission to spread the neighboring communities serving a responsible agent of the multiplier effect.

The process of transmission of knowledge was the result of study and training for students by the author of the work, followed by testing for the domain and consolidation of content and subsequent transmission of this that was held by teaching local communities under author tutoring and monitoring supervisor.

Laboratory tests were carried out in different laboratories due to the conditions and reagents. The β-carotene analysis was performed at the Laboratory of Pedagogical University – Beira Branch and, for lack of refractometer and not location quartz cuvettes or glass the sugar and lycopene level, were made in the laboratory of UCM-Chimoio.

Tomato Processing

Selection: was selected tomato with good quality considered, leaving the part of the semi-rotten tomatoes and unripe not to influence the level of drying, taste or even at the level of conservation and or putrefaction.

Figure 1. Greenhouse Ready

Washing; Court; Drying:

Figure 2. Cut and Dried Tomato.

Milling**:**

Figure 3. Tomato powder

Laboratory tests
Determination of β-carotene
Materials and reagents:

The materials and reagents used for extraction and determination of β-carotene in the tomato powder and fresh, were of good quality and recommended for this analysis, as shown in the table below:

Table 1. Materials and reagents for extraction and determination of levels of β-carotene

Materials	Reagents
Spectrophotometer UV-Vis (Cintra 20, GBC);	Fresh tomatoes;
Plastic cuvettes;	Tomato powder;
Bath;	- Petroleum ether;
Analytical balance;	- Dichloromethane;
Becquerel 100 to 500ml;	- Distilled water
Blender;	
100ml volumetric flask;	
pipettes;	
simple funnel;	
filter paper;	
Spatula;	
squirt.	

Methods of Analysis

There are different methods of analysis for determining different products. Methods vary according to various aspects (type apparatus, the nature of the reagents, composition of the sample, objectives of the analysis, etc.) As the method of extraction or isolation of substance to analyze also vary

For example, the extract of carotenoids under study can use among various methods, as the open column chromatography according to the study Abreu Braga (2012), with the adsorbent magnesium oxide (Art Lab) and hyflosupercel (Synth) (1: 2, w / w) to the extraction of lycopene.

Can be used the method chromatography in liquid phase to the lycopene extraction, Cefali the second study, with the reactant ethyl acetate, ethanol, methanol, acetonitrile, among others. Some studies used calorimetric as a method for determining the carotenoid in tomato-based instrument called a calorimeter. According to Gondim (2010)

> *Some studies have reported methods of extraction and purification of carotenoids from diverse backgrounds. Liu et al. (1998) reported the use of organic extraction solvents and subsequent quantification by high-performance liquid chromatography (HPLC) retinol and carotenoids present in human milk. Fleischamann et al. (2002) showed a partial purification and kinetic characterization of carotenoids extracted from the quince (Cydonia oblonga). These researchers conducted an exhaustive procedure involving centrifugation, acetone precipitation, ultrafiltration, isoelectric focusing and polyacrylamide gel electrophoresis.*

In general various experiments and studies as (CARDONA, 2006) (SACAMA, 2012), (RODRIGUEZ & AMAYA, 1999, p. 675), (Zeraik And YARIWAKE, 2008), OLIVEIRA, 2010), (Cefali, 2009), among others converge on the use of acetone, hexane, ethanol and distilled water for the extraction of lycopene and using petroleum ether, dichloromethane and distilled water for β-carotene extraction.

Therefore, the extraction of carotenoids for quantification can be performed by chromatography or by simply capturing reagents (complex-forming) of these. Due to the absorption capacity of visible light that carotenoids possess its main methods are calorimetric (calorimeter) and spectrophotometry (spectrophotometer).

We use the analysis method proposed by the League of California Food Processors that is fast spectrophotometer method for lycopene analysis. Note that this method is recommended by the Department of Food Science and Technology-Davis (SACAMA, 2013).

For extraction of β-carotene was used as the reagent petroleum ether, dichloromethane and distilled water as lycopene was possible with hexane, acetone, ethanol and distilled water and finally a sequence described in each step.

Reagent Preparation for extraction and determination of β-carotene

The extraction of β-carotene in tomato is made with petroleum ether and dichloromethane feature where 80 grams of tomato are to 100,0ml oil added phased ether and then dichloromethane in the proportion of 0.2g of extract - 1 liter of dichloromethane. After homogenization, the solution was placed in 3 trials for analysis by UV-Vis spectrophotometer at 453nm.

Determination of Lycopene
Materials and reagents:

Materials and reagents used to extract and determine the level of lycopene in tomato powder and fresh quality and were recommended for this analysis, as shown in the following table:

Table 2. Materials and reagents for the extraction and determination of the levels of lycopene

Materials	Reagents
1. Spectrophotometer UV-Vis (Zuzi);	Fresh tomatoes;
2. Glass cuvettes;	Tomato powder;
3. Analytical balance;	- Hexane;
4. Becquerel 500ml;	- Acetone;
5. 100ml volumetric flask;	- Ethanol;
6. Pipettes;	- Distilled water
7. Simple Funnel;	
8. Spatula;	

9. Squirt;
10. Filter paper;
11. Clock.

Reagent Preparation for extraction and analysis of lycopene

The extraction of lycopene in tomato is made using hexane, ethanol and acetone in a ratio of 2: 1: 1. 0.3 grams of tomato are 12 ml of hexane, 6 ml of ethanol and 6 ml of acetone.

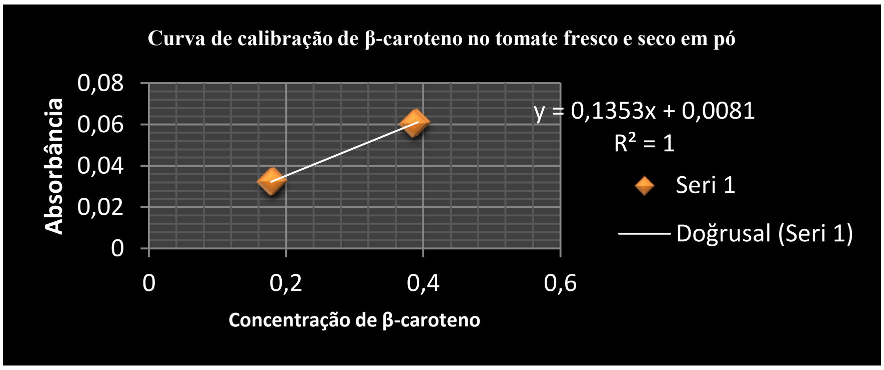
RESULT AND FINDING

β-carotene levels

The mean absorbance of β-carotene from the spectrophotometer (453nm) in fresh tomato (0.0326 Abs), and dried tomato powder (0.0607 Abs) we found a difference of almost double.
After the analysis in 3 trials by UV-Vis spectrophotometer at 453 nm yielded the following tabulated results:
Table 3. Analysis of Results of β-carotene

Spectrophotometer UV-Vis 453 nm			
Fresh tomato		Sun Dried tomato	
Absorbance (X) = Concentration (X mg / L)		Absorbance (X) = Concentration (X mg / L)	
0,0323 = 0,178 0,0325 = 0,180 0,0329 = 0,183	Average = 0,0326 = 0,181	0,0602 = 0, 385 0,0608 = 0,389 0,0612 = 0,392	Average = 0,0607 = 0,388

Using the line equation (Y = 0,1353x + 0.0081), we have:
Fresh tomatoes (Y = abs) then: 0.0326 = 0,1353x + 0.0081; x = 0,181mg / L
Tomato powder (Y = abs) then: 0.0607 = 0,1353x + 0.0081; x = 0,388mg / L



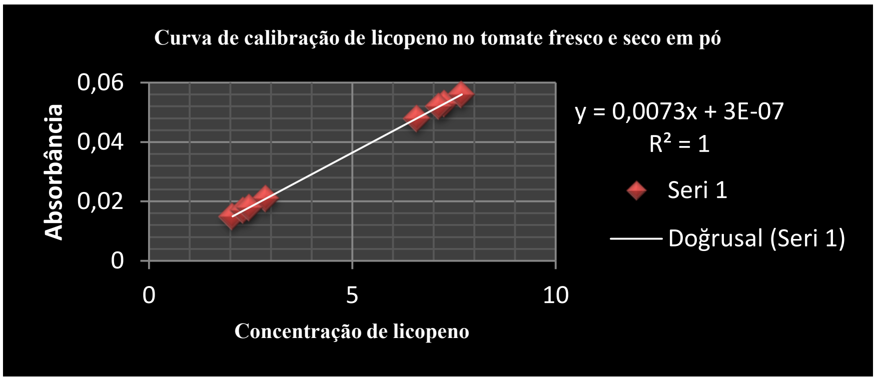
Lycopene levels

The mean absorbance of Lycopene from spectrophotometer (503nm) in fresh tomato (0.018 Abs) and Dried Tomato (0.052 Abs), the difference of the values are close to three times, as shown in the following table.

Table 4. Lycopene analysis results

Spectrophotometer UV-Vis 503 nm			
Fresh tomato		**Sun Dried tomato**	
Absorbance (X) = Concentration (X mg / L)		Absorbance (X) = Concentration (X mg / L)	
0,015 = 2,061 0,017 = 2,336 0,021 = 2,885	Average = 0,018 = 2,473	0,048 = 6,595 0,053 = 7,282 0,056 = 7,694	Average = 0,052 = 7,145

Using the line equation [**C (**mg/kg) = 137.4 x A503], we have:
Fresh tomatoes (0.018 Abs) then: C (mg / kg) 137.4 x = 0.018; C = 2,473
Tomato powder (0.052 Abs) then: C (mg / kg) 137.4 x = 0.052; C = 7,145



Discussion of results carotenoid levels (β-carotene and lycopene)

Any β-carotene and lycopene are in larger quantities in tomato powder compared to fresh. The temperature influences the change of carotenoids. Several studies as Bohm at all, (2003), SACAMA (2012), Souza (2002), etc., show that the temperature rise is directly proportional to the increase in carotenoid in tomatoes and inversely proportional Vitamin C.

> *"The fruit can be sun dried, artificial, or a combination of both methods. Sun drying affects quite the carotene and vitamin C content retention of vitamins in food artificially dehydrated is generally higher than that of dry food in the sun "(GAVA, 1984 apud SOUZA, 2002, p. 39)*

The temperature influences the change of carotenoids. Studies such as Bohm at all, (2003), SACAMA (2012), Souza (2002), etc., show that the temperature rise is directly proportional to the increase in carotenoid in tomatoes and inversely proportional Vitamin C.

The dehydration of the food plays an important role on the microorganisms. According to Souza (2002, p. 39) "[...] the removal of water is a method of controlling microbial growth, since they require water to develop their metabolic activities". Minor microbial growth favors not decreasing the carotenoids by microbial action.

The transformation of fresh tomato dry was held in various t° (t° depended environment). According to the climatic conditions and the mountainous influences these allowed the retention of heat and subsequent diffraction by the plastic contained in the greenhouse at times thus increasing the thermal peak temperature of 76° C.

The thermic process may also decrease the carotenóide, principally of β-carotene, according Cruz (2011, p. 38) "[...] the degradation of carotenóide is the result of isomerization of *trans* to *cis*-carotenóides and this isomerization is promote by thermic treatment which changes the color and biologic activity".

However, the processing way leads also to thermic phase, but the alternate conditions (heating at variable and moderated T°, refreshment at shadow exposition), not allowing the isomerization great quantities of carotenóides, by the contrary, they decrease them.

The observed decreasing of the carotenóides in this analysis is linked to their contact surface due to its great standard cells liberation.

(CRUZ, 2011, p. 39) "The thermic processing breaks cells walls allowing the extraction of lycopene of chloroplasts" and this liberation grows as the heating increases depending on the heating duration too. (HADLY et al., 2002 apud CRUZ, 2011, p. 39).

Having greater amount of tomato carotenoids, especially β-carotene, the greater the production of vitamin A, since this is resulting from breakage and subsequent oxidation of β-carotene molecule by the action of light, heat or oxygen.

The great quantity of lycopene in dry tomato in relation to fresh tomato is the major gain of this type of processing, because it increases the possibility of the use of this anti-oxidant which is important on degenerative diseases such as breast cancer, prostate, lung, skin cancer, and so forth.

The tomato has a smaller amount of β-carotene (responsible for the yellow color) with respect to lycopene (responsible for the red color).

In many of the cases, the tomato processing increases the quantity of carotenoids and this increase may vary depending on the type of processing and external conditions.

CONCLUSIONS

For carotenoid extraction, organic solvents are used and the main and used in the study acetone, hexane, ethanol and distilled water for the extraction of lycopene and using petroleum ether, dichloromethane and distilled water for β-carotene extraction;

For determination of the carotenoids may be used various methods such as high-performance liquid chromatography (HPLC), calorimetry, thin layer chromatography (TLC), spectrophotometry, etc. We analyzed based on spectrophotometry;

Tomato in powder may be the best conservation way for the community;
An open set of chemistry content such as mass conservation law, stoichiometry, concept of atom, molecule, dehydration, vaporization, laboratories and experimental lessons etc.,
May be taught or understood very easily with the aid to processing phase, creating conditions for the long lasting grasping, consequent contextualized meaning as well as effective and affective grasping.

At last it has been understood that the levels of carotenoids either lycopene or β-carotene on tomato in powder are more than in fresh tomato taking in account the processing way used.

Limitations

The presenter could not search about processing and finding of carotenóides of unique specie of tomatoes.

Challenge

Convince people to transform tomatoes from fresh to powder (because from 100kg of fresh we will get only 6kg of powder tomatoes)

Recommendations

To researchers:
It is recommended to search:
Several ways of tomato processing and finding its nutrients;
Other ways of tomato conservation and publish it to the population taking in account the specific life conditions of the target population.

To the public in general

It is recommended that: They should transform the fresh tomato to powder tomato, as a way of taking advantage of this product in difficult seasons gaining simultaneously improving health by increasing carotenoids which are antioxidants with great heeling advantage.

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INFLUENCE OF MORNINGNESS-EVENINGNESS PREFERENCE OF EDUARDO MONDLANE SECONDARY SCHOOL STUDENTS IN CHIMOIO ON SCHOOL PERFORMANCE

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ABSTRACT: The current study aims to diagnose the influence of morningness-eveningness preference of Eduardo Mondlane Secondary School (EMSS) students in Chimoio on school performance. The research involved school students of the grade 10 (N= 88) from Chimoio in Manica which 51 were male and 37 female, with ages ranging from 14-22 years old. For data collection was used Horne and Osterberg questionnaire Portuguese version. This research seeks to answer the following questions i) what is the frequency distribution of early and late chronotypes in the population of the studants? ii) is there any relation between the variation of chronotypes and school achievement? Our results show that 60% of students have morningness preference, 35% intermediate and only 5% have eveningness preference. The study reveals a certain correlation between morningness-eveningness preference and school performance on EMSS students in Chimoio thus 85% morningness preference that have morning schedule approved and only 15% reproved. The night schedule students have 75% of approvals and 25% of disapproval. In conclusion, the morningness students attending the morning shift have better school performance in relation to the morning attending the night shift. The competent authorities, parents and guardians should identify the morningness-eveningness preferences on students as they influence positively or negatively on educational performance in our schools.

Keywords: *morningness-eveningness, schedule, school performance.*

INTRODUCTION

This work is the result of a survey of the students of the 10th grade at the Eduardo Mondlane Secondary School (EMSS), in order to analyze the influence of biological rhythms in biology learning, focusing on the sleep/ wake cycle (SWC).

It should be noted that all living beings have "watches" biological internal controlling and set the time activity of their systems. The science that deals with the study of biological rhythms is called Chronobiology, the branch of science that studies the temporal organization of living organisms and the mechanisms that control the various vital systems and chemical and electrical activities of each body. It appears then, that the temporal organization of life has a huge effect on the structures and dynamics of living beings (LIMA, 2012).

According to MARQUES & MENNA cited by Barreto-Filho, *at all* (2013), these concepts began in the eighteenth century in the international community with issues involving the existence of variations or rhythms in plants, but had not yet occurred disclosure in the scientific community.

With regard to education, the study of Chronobiology seeks to understand and improve the study of the nature of man, can obtain knowledge about the disposition for learning. Educators need to think better about the distribution of the student's activity during the day, to know what the most appropriate time to perform certain activities, which of shifts (morning, afternoon, evening) could be more appropriate, in accordance with the biological rhythm of the student (Finimundi, 2012).

There are people who sleep more and some who sleep less, people who like to sleep earlier and others later. Each individual has his/her preferences for hours of sleeping and waking. In this regard, humans have been classified as: morningness (those who wake up early and sleep early), there are also eveningness (those who wake up late in the morning and go to sleep late), and those who are intermediaries, who are neither morningness and eveningness or so (LOUZADA & MENNA-BARRETO cited FINIMUNDI, 2012).

The brightness is responsible for keeping our speeds by LOUZADA & MENNA-BARRETO cited BARIN (2011), it enters the body through the retina and goes to the hypothalamus, where the biological clocks are, it modifies the expression of biological rhythms through the increased secretion of a hormone called melatonin by the pineal gland at dusk, signaling the darkened body.

At dawn, the adrenal gland secrete a greater quantity of another hormone called cortisol, which prepares the body for alertness, and also is related to the secretion of gastric juice before feeding schedules, (Almondes cited BARIN, 2011) .

For EXPOSITO cited BARIN (2011), the body temperature of the evening is higher than that of the morning when awake. And the temperature of the evening increases, reaching its maximum in the late afternoon, while the morning arrives at most a few hours earlier.

When the temperature of the body is at its maximum, human beings have optimum performance in activities and there is more willingness to them, (MORAES cited BARIN, 2011).

By studying the rhythm of the students and to check the availability of students to study, highlighting the students of the morning and of the EMSS night in biology discipline, we have taken into account that circadian rhythms (which last 24 hours) can happen freely, even when students have knowledge of the time of the day.

The school must take into account elements that go beyond the classroom, enhancing skills and competencies according to the biological time of each student.

With the investigation, it was possible to identify whether the students classified with morning and evening have better or worse school performance, by studying the morning shift or night.

Description and placement of the problem

The student's time is critical to his learning, each having his biological time, his history and the period he remains at school.

Barsan quoted by BARBIERI (2008) also points out that the student can suffer behavioral changes during the day and did not show the same performance at all times of the day, "it is known what to teach, how to teach, but one needs to know when teach. "

The organic cost of a school task is not the same in different hours of the day. For example, one of the stages in adolescence is the delay characteristics of the biological clock, probably determined by the major hormonal changes. The result is that young people have a hard time to go to bed early and wake up early. It is a fact that has a negative impact on school performance when the round is too early or too late.

According to some studies, sleep deprivation or poor sleep may compromise the memorization process and logical reasoning, since information learned are more efficiently memorized after an appropriate period of sleep. Believe, is that part of memory consolidation which occurs during REM sleep stage (from the English (rapid eye movements), (ALMEIDA, 2013).

Even with classes starting not very early (usually 7 o'clock), some students are not able to sleep early, especially if you have television, internet or friends nearby. When the awakening touches, your sleep is disrupted. Teenagers studying in the morning suffer a partial pressure of chronic sleep, and this can have consequences. The first consequence is the excessive daytime sleepiness. Drowsiness in the classroom decreases attention and interest, and may impair school performance, to address this problem rise the question:
How the biological rhythms of the students of the 10th grade at the EMSS interfere in the teaching and learning of biology?

Objective

To analyze the influence of the biological rhythms of the students of the 10th grade at the EMSS in Chimoio in the teaching and learning of Biology.

Question research

i) What is the frequency distribution of early and late chronotypes in the population of the studants?
ii) Is there any relation between the variation of chronotypes and school achievement?

Justification and relevance of the research

It is common to see in the school, the first hours of classes; students yawn, and become lazy and dose on their desks. Perhaps a father or mother would say that they watch television till late, and then complain to wake up early.

According to Mello (2014), it is known that adolescence is a stage of transition, marked by several conflicts and new challenges for the youth. It is also a phase in which the body undergoes a series of changes. This process of organic amendments is given the name of puberty and it seems that puberty modifies the biological rhythms. During puberty it is observed a delay in biological rhythms, the youth, later begins to feel sleep and wake up later also.

"The planning of school activities can and should be seen under a chronobiologic prism. It means organizing activities in order to behold moments of greater or lesser efficiency in school tasks, from the point of view of the students or the teachers "(GOMES, 2014).

For some reasons the teenagers are subjected to night shifts or shift contrary to their biological rhythm, which can compromise their performance. According FINIMUNDI (2013), with respect to these conditions with regard to human social organization, most labor and educational activities takes place between 8 am and 6 pm, in order to impose a certain temporality that favors the best performance of individuals who are synchronized to this time. However, part of the population is biologically synchronized at unusual times and lives in a desynchronized state of social schedules.

Regarding the age group, the most marked change in the SWC occurs in adolescence, probably secondary to hormonal changes caused by puberty. Most children aged up to 10 years presents a morning chronotype, while in puberty, becomes eveningness. Teenagers start to present a delay at bedtime and difficult to wake up early. Thus, when they are in term time, often complain about the daytime sleepiness and difficulty in sleeping early, resulting in a reduction in the number of sleeping hours, which are compensated on weekends, beside the changes in sleeping habits. In the adult stage, the morning period returns as favoring of the achievements of intellectual and sporting activities (Almeida, 2013).

Thus, it is assumed that there are times of day when every student is more willing to do certain tasks, such as schooling. It is necessary, then, after identifying this preference, to evaluate his performance in both periods of the day and know what the student is doing in the reverse shift of their classes, especially in the discipline of Biology. So you can analyze what is the best time for each group of students, whether morningness, intermediate and eveningness are more on the mood to the learning process.

The human biological rhythm, governed by the hypothalamus, is the key to health and the adaptation of man, so, the student to the environment. For all to go well and makes sense to the brain, is necessary to assimilate at the right time, factors such as sleep, words, movements, expressions, emotions, attitudes, interactions, etc. (LOUZADA & MENNA, quoted by BARBIERI 2008) .

It should be also referenced that there were not done studies in Mozambique of the influence of biological rhythms in learning, school performance of students in schools. Teachers need more specific knowledge of their students, as their biological rhythm, for more satisfactory results for the academic achievement.

According to ALMEIDA (2013), these works are very important and should be encouraged in order to draw new plans in education, to adequate teaching to the student's profile and not in contrary as we find today, where students are forced to follow a routine schedule, that for some, can be harmful in view of the different characteristics of chronotypes.

METHODS

A sample of 88 secondary students, 51 male and 37 female, aged from 14 to 22 year old. All participants were tested in groups of 44 students. Sample was taken from a universe of 1057 students. Their participation was voluntary and they were not paid.

The Morningness-Eveningness questionnaire (MEQ), Portuguese version from Horne-Ostberg morningness-everningness scale (Horne and Ostberg, 1976) were used us data collection instrument. The MEQ is the most frequently used self-evaluation instrument (scale). It has been translated into many local languages to make it easily understood by the subjects, all over the world (Achari & Pati, 2007). The basic scores of the questionnaire were used to identify the biological rhythms of the students of the 10th grade at the EMSS in Chimoio.

For relate the academic performance and the school shift to the biological rhythms of the pupils, Grade Point Average was used. It has been calculated in common subjects: Mathematic, Physic, Biology, Chemistry, Portuguese, English, History and Geography. Official grades ranged from 0 (worst) to 20 (best). Most of the other studies are also based on this method (e.g. Díaz-Morales, & Escribano, 2013, Besoluk, Onder & Devenci, 2011, Gray & Watson, 2002, Randler & Frech 2006, 2009).

RESULTS AND FINDINGS

From the questionnaire of Horne and Osterberg applied to 88 students, we identified 53 students *morningness* oriented, 36 students attend school in the morning shift and 17 students attending school on the night shift. The *eveningness* students totalized were 4, all attend school in the morning. We found 31 students that were *intermediate* oriented.

Relating the biological rhythm and school shift, there is a greater number of the *morningness* in the morning shift with 36 students, 21 intermediate students and 4 eveningness students oriented.
On the night shift there are also a greater number (17) of morning-type students, 10 students were intermediate and no evening –type student were found.

The identification of students chronotypes it turns out that there are 60% of the morning-type students, 35% intermediate-type, and only 5% of students are evening-type. The morning-type are mostly male gender and women present a higher degree of eveningness, which leads to the conclusion that men tend to be more morningness regarding women. These results coincide with the study done by BARBIERI (2008), in the Farroupinha Municipality School in Brazil. It is also explained by ROENNBERG, at all, (2004) cited by BUENO & WEY, (2012), which says that the delay in adolescence, reaches a peak around the age of 16 for women and 21 years for men, this could set up a late adolescence marker.

The results of this study show that the morning-type students studying in the morning shift mostly have a higher academic performance with more than 3.0 values the most difference in average relative between other morning-type students studying on the night shift. FINIMUNDI, (2013), says that it may be related to their energy pike (biological rhythm), which is more active for the morning and therefore, are dedicated to schoolwork outside school.

Correlated to some studies done in the afternoon shift students and morning for (Barbieri et al, 2007; BARBIERI, 2008; BARIN 2011, quoted by FINIMUNDI, 2013), at different schools, concluded that the morning –type younger students had higher academic achievement in the morning shift and older have higher academic achievement in the afternoon.

The intermediates-type students have few significant differences with respect to the school day. It leads to the result that morning teenage students from the night shift, are studying in turn contrary to its biological rhythm.
The sample assessed shows significantly an increase in higher disapproval index on the night shift, especially among the morning-type students. The study indicates that if the morning-type students have a bad school performance when placed at evening classes because they have many failures and approvals averaging 10 points which is the minimum to pass. It leads to the point that the students are not on schedule conducive to their biological rhythm. REINBERG quoted by FINIMUNDI, at all (2013) introduces the term "school rhythms," which means that the uses of student time scale of days of the week and some quarters. It reports that there is an ideal time to learn and memorize.

Intermediate-type students no significant difference presented in their school performance.
The research leads to a result which indicates that individuals with the morningness profile have better test scores when do their activities in morning, but reduce the quality of their performance during the course of the day. The individuals with eveningness profile do the opposite way, presenting lower incomes in the morning and gradually improving over day (ALMEIDA, 2013). Similarly the morningness put on the night shift did not perform well as they are not willing to study as defined by their biological rhythm.

CONCLUSION

The morningness students attending the morning shift have better school performance in relation to the morning attending the night shift. The morningness students studying in the morning have good results and fewer failures, while the morning-type studying at night has many failures.

RECOMMENDATIONS

We recommend the Ministry of Education of Mozambique to include as regulation, the identification of students biological rhythm; the directors of the schools to check the turn in which the student is more willing to studies, seeking hence better learning; the parents to have attention on developing healthier sleep habits in their children's lives, starting with the identification of possible sleep deprivation signs, looking for a better school performance.

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PROJECT-BASED LEARNING IN MECHATRONICS ENGINEERING: MODELLING AND DEVELOPMENT OF AN AUTONOMOUS WHEELED MOBILE ROBOT FOR FIREFIGHTING

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ABSTRACT: The mechatronics engineering education has advanced rapidly since the introduction of mechatronics as a new discipline in engineering education. The project-based learning becomes also one of the most effective approaches in teaching mechatronics subjects such as robotics and mechatronics system design. The main objective of this paper is to present the role of project-based learning in the mechatronics engineering education. An autonomous wheeled mobile robot that scans a rectangular area looking for a heat source (simulated by a burning candle) extinguishes it and returns back to its home position is designed. The project was developed successfully and the students got the second position in a robotic competition organized by the university. The design details as well as the performance analysis of the mobile robot will be presented here. Also, the milestones of the project will be discussed and analyzed.

Key words: mobile robot, firefighting, competition, project-based. Mechatronics education

INTRODUCTION

By about 1990, new assessments of college students had shown that the knowledge they acquired in high school remained at a superficial level. Even the best scoring students, those at the top colleges, often had not acquired a deeper conceptual understanding of material – whether in science, literature, or math [Gardner 1991]. Educators still face these critical problems today.

Project-based learning provides opportunities for students, teachers, and members of society to collaborate with one another to investigate questions and ideas. Collaboration helps students build shared understandings of scientific ideas and of the nature of the discipline as they engage in discourse with their classmates and adults outside the lecure hall [Krajcık &Blumenfeld]. A possible solution is the project-based learning where students can integrate their knowledge and appreciate what they have studied when they are able to see what they can achieve from the theoretical background courses as well as the hands-on courses. Project-based learning also builds the students' self-confidence and allows them to think, develop and design new ideas and approaches through their teamwork.

Recently there are many robotics competitions to enhance the student's understanding and present a learning environment for students. Pack et al. [3] presented the experiences of engineering students in fire-fighting mobile robot design at the U. S. Air Force Academy, Trinity College, and Penn. State Abington during a robotics competition. A survey results that support the values of the fire-fighting design and development was included as well. Khoon et al. [4] described the development of an Autonomous Fire Fighting Mobile Platform (AFFMP) that is equipped with the basic fighting equipment that can patrol through the hazardous site via a guiding track with the aim of early detection for fire. The tasks for the AFFMP once it navigates out of the patrolling route include the obstacle avoidance, locating for more precise location of fire source using front flame sensor and extinguish the fire flame. Kiranmai and Kumar [5] presented fire detection and controlling method using robot is proposed. Fire is detected using the fire sensor and immediately SMS is sent to the user by using the GSM module. Then the user can control the robot by using GSM Module from remote location. The robot also detects the obstacles while moving by the obstacle sensor. Setiawan et al. [6] presented an approach in designing a fire fighting robot contested in a robotic student competition. The approach makes use of computer simulation and animation in a virtual reality environment. The efficiency of the algorithms and parameters values employed can be easily evaluated. Tavera et al. [7] investigated on sensor fusion and navigation of a robot with intelligent vision, receiving signals from sensors and specialized control chaotic to reduce human, material and environmental injuries. A real robot moves in spaces with boundaries like walls or surfaces of obstacles. To solve this problem, we consider the motion of the robot in an imaginary space. This imaginary space is obtained by smoothly connecting boundaries of two spaces that have the same shape as the real space.

The main objective of this paper is to share the experiment of designing and development of a wheeled mobile robot for firefighting. This project was a course project for the third year mechatronics engineering student for the mechatronics system design course at Mevlana University, Konya, in Turkey in second semester of the academic year 2013-2014. The main idea behind this project is to allow the students integrate their knowledge in a complete project before going to their senior graduation project. Another reason came to our mind since the university was about to organize a robotic completion and I offered the students to participate in the competition with the course project and if they succeeded to get any of the first three position they will get final mark in the project since project has almost 20% of the marks of the course in addition to 10% for laboratory assignment.

The students were divided in three groups and each group has to present a weekly report on their activities. Although each group will concentrate in their role, but all of them will exchange ideas and proposals for other groups during the laboratory section of the course. The three groups are organized as follows:

1. The Mechanical Design Group: Mushahid Hassan, Shehzan Ali and Vehbi Mesin
2. The Trajectory Planning and Control Strategy Group: Sokhna Diarra, Ahmed Erkoc and Salman Farouk
3. The Trajectory Planning and Programming Group: Jabir Mohammed and Mohamed Ali

There is overlapping between the last two groups since the trajectory planning affects the control strategy and the microcontroller programming at the same time. Dealing with two groups for this topic ensures the better results.

The paper has five sections: section (2) summarizes the problem in a mathematical form and model the mobile manipulator to calculate roughly the motor size while section (3) shows the mechanical design development of the mobile robot as well as the intial water pumping system. Section (4) discusses the control strategy while section (5) explores the performance analysis followed by conclusions and references. This paper contains some tecnical details so the reader will be familiazed with the subject as well.

Problem Formulation

A mobile manipulator consists of a single link which is attached to a cart as shown in Figure (1). The rod can rotate about its pivot and has a length of $2l$ and a mass of m_{rod}. This rod (Hollow tube) was initially designed to direct the water from a reservoir to the heat source using a water pump. The mobile platform has a mass *M* and two wheels each of mass m_w and radius *r* . The position and orientation of the mobile robot can be identified by the cart position $x(t)$ and the rod angle $\theta(t)$. A force input $F(t)$ is applied to the cart through two DC motors that drive the two wheels attached to the same axis. A castor was attached for stable movements of the mobile robot as shown in Figure (1).

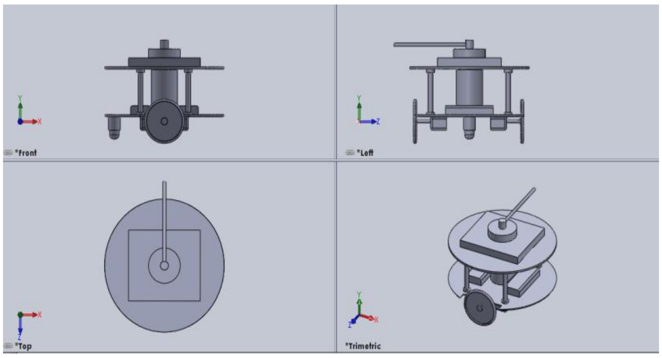


Figure (1) Configuration of the wheeled Mobile Robot

The main objective of this section is to derive a simplified model for the wheeled mobile robot without taking into consideration the non-holonomic constraint of the mobile platform. We need to have a rough estimate of the motor wheels to select the proper motor size.
The equations of motion of the mobile manipulator can be derived using Lagrange equation which states that:

$$\frac{\partial L}{\partial \dot{q}_j} - \frac{\partial L}{\partial q_j} = Q_j \qquad (1)$$

Where *L* is the Lagrangian of the system which is the difference between the kinetic and potential energies, q_j is the generalized coordinate and Q_j is the generalized force associated with the generalized coordinates.
The kinetic energy and the potential energy of the manipulator are given by:

$$K.E. = \frac{1}{2}\left(M + m_{rod} + \frac{3}{2}m_w + m_{tp}\right)\dot{x}^2 + (m_{rod})l\dot{x}\dot{\theta}\cos\theta + \frac{1}{2}(m_{rod})l^2\dot{\theta}^2$$

(2)

$$P.E. = (m_{rod})gl\cos\theta$$

(3)

If we consider the equivalent mass as:

$$M_{EQ.} = \left(M + m_{rod} + \frac{3}{2}m_w\right)$$

(4)

Hence the Lagrangian of the system is given by:

$$L = \frac{1}{2}M_{EQ.}\dot{x}^2 + m_{rod}l\dot{x}\dot{\theta}\cos\theta + \frac{1}{2}m_{rod}\, l^2\dot{\theta}^2 - m_{rod}\, gl\cos\theta$$

(5)

Upon substituting the Lagrangian into Equation (1) and after some algebraic manipulations the equations of motion can be obtained as:

$$F = M_{EQ.}\ddot{x} + m_{rod}\, l\ddot{\theta}\cos\theta - m_{rod}l\dot{\theta}^2\sin\theta$$

(6)

$$\tau = M_1\ddot{x}\cos\theta + m_{rod}l^2\ddot{\theta} - m_{rod}\, lg\sin\theta$$

(7)

From Equations (8 and 9) the linear and angular accelerations
are given by:

$$\ddot{x} = \frac{1}{M_{EQ.}}\left[F - m_{rod}\, l\,\ddot{\theta}\cos\theta + m_{rod}\, l\dot{\theta}^2\sin\theta\right]$$

(8)

$$\ddot{\theta} = \frac{1}{M_2 l^2}\left[\tau - m_{rod}\ddot{x}\cos\theta + m_{rod}\, l\, g\sin\theta\right]$$

(9)

Equations (6 and 7) can be used to estimate the motor torque needed to drive the wheel as well as required motor torque to rotate the water tube.

There is another way to roughly estimate the motor size by calculating the total weight of the robot and assuming the coefficient of friction between the wheels and the ground and calculate the torque as:

$$\tau = \mu_k Nr \qquad (10)$$

Where r is the wheel radius which can be calculated from the assumed linear velocity of the robot as well as the angular velocity of the motor as:

$$V = \omega r \qquad (11)$$

The initial mass of the robot is assumed to be 3 kg and the rod and wheels masses as 0.3 kg and 0.5 kg respectively. A fifth order polynomial trajectory is assigned for the linear motion of the platform as well as the rotation of the rod and these trajectories are shown in Figures 2 and 3 repectively. For simulation purposes, The platform is assumed to move forward 8 m and return back as it achieves the boundary of the field .The rod is assumed to move upward an angle of 90 degres during the same period.

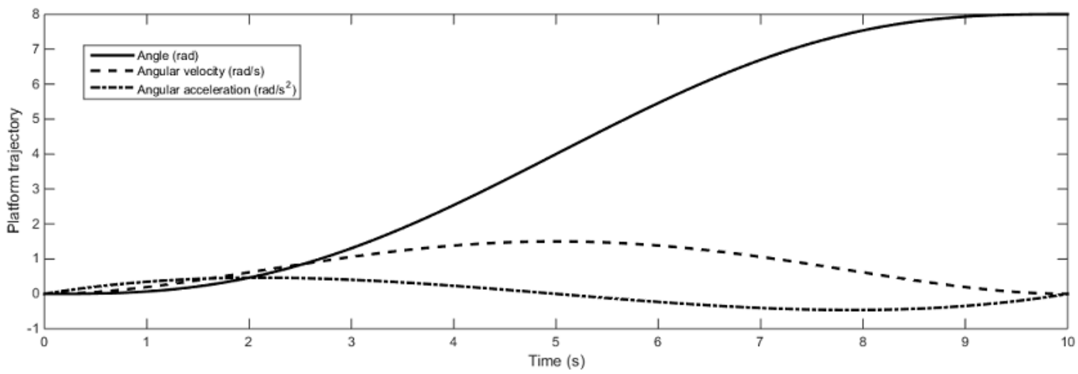


Figure (2) Platform Trajectory

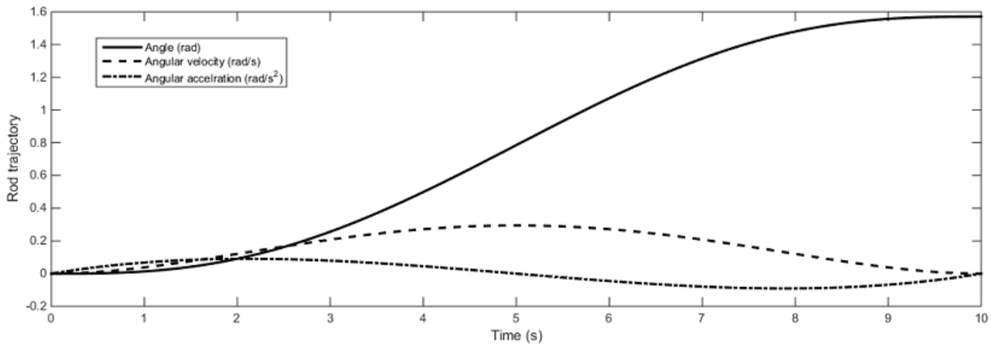


Figure (3) Rotating Rod Trajectory

Upon substituting theses trajectories into equations 6 and 7, the traction force as well as the torque for the rotating rod can be simulated as shown in Figure (4)

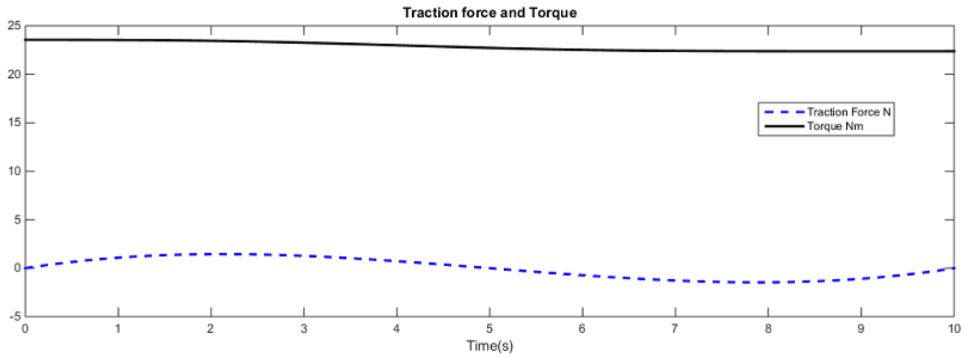


Figure (4) Traction Force and Torque for the Rod

Mechanical Design

The mechanical design was the first and important task since it affects the motion and the trajectory design for the mobile robot. The differential derive with two wheels driven by DC motors and castor for balancing was selected for the locomotion system and the platform was designed as a two-level circular shape with two grooves for wheel fixation. The circular body shape minimizes the possibility of collision with objects inside the course of motion and allows ultrasonic sensors to work accurately without signal interference. The two similar motors were attached at the bottom of the first level and the space between the two levels is reserved for the controller, the battery and the circuit boards as shown in Figure (1).
In the initial design, a water pump and a reservoir were proposed to splash water at the heat source (simulated by a burning candle). But due to time constraint and unavailability of light weight water pump, a fan-based system was used instead. A single fan was used and then after performance analysis another fan was added to produce strong flow of air. A 12 V light weight rechargeable battery to reduce the weight of the robot and hence the motor rates and weights.

CONTROL STRATEGY AND TRAJECTORY PLANNING

Since the main objective of this robot is to locate the heat source and extinguish it, two main problems arise in this regard:

1. The first challenge is the proper selection of the heat or flame sensor that is able to sense the heat source from a suitable distance and send a signal to the microcontroller to start the extinguishing process timely and accurately.
2. The second challenge is to design the robot trajectory properly to cover the inspected area and accurately moves the robot towards the heat source as soon as it detects the flame. This trajectory is the main issue here since the heat sensor can detect the flame at a reasonable distance not a big one and if the sensor fails to detect the heat source the whole process collapse.

To solve the first problem, the students searched the internet and explored the previous literature review until they came up with a good sensor that can accurately detect the flame from a distance of 20 cm and gives a 5 V signal to the microcontroller to take action. The picture of the flame sensor is shown in Figure (5).

Figure (5) Flame Sensor

The second problem was a little bit difficult and needed a lot of trials to design the effective trajectory. First the flame sensor was mounted on a rotating base that can scan 180 degrees. The mobile robot moves in a straight line starting from the home position and moves forward until it reaches the boundary of the selected area. Ultrasound sensors fixed at the front side of the mobile robot will detect the presence of a boundary or any obstacle and the robot will make U-Turn andreturn back to cover the whole area. During that time, the flame sensor with its rotating base is searching for the heat source. As soon as the flame sensor detects the heat source, the base stops rotating and the mobile platform moves towards the source. When the robot is about 15 cm from the heat source it stops and the two fans start working to extinguish the flame. After finishing the task, the robot returns back to its home position again to start another search. Figure (6) shows the assembly of the mobile robot.

The Arduino microcontroller was used to control the mobile robot since the programming team is familiar with its programming language. The team started programming the motion of the robot as well as the flame sensor and the fans after the mobile robot was assembled. The team spent a lot of time adjusting the robot and refining the code until the robot works properly. The flowchart of the project procedure is shown in Figure (7) while the controller details are illustrated in Figure (8) .

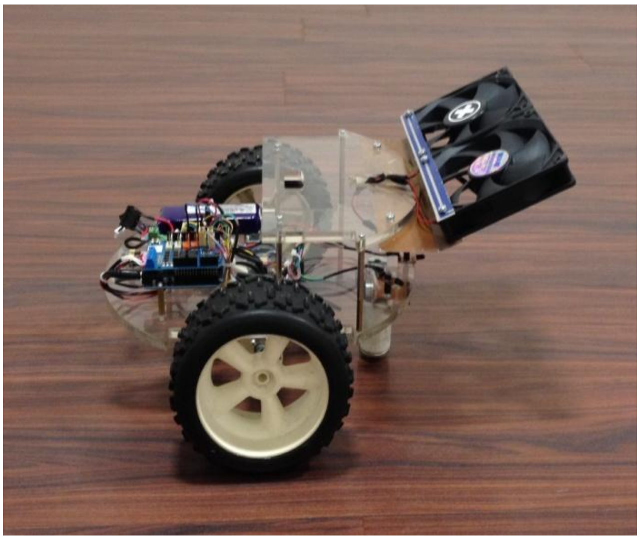
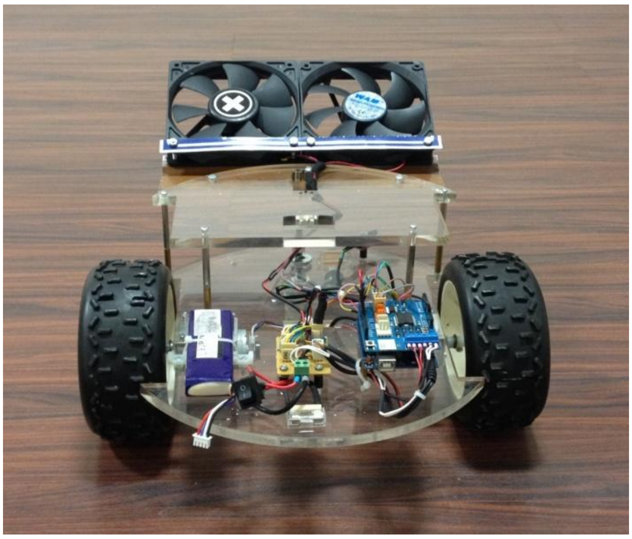


Figure (6-a) Side View of the Wheeled Mobile Robot

The floor of the laboratory has a moderate coefficient of friction and the students made many tests during the performance analysis stage to check the maneuverability of the wheels and the suitability to work in similar grounds. During the competition the floor was different and the students asked to move to another near place with better coefficient of friction similar to the laboratory floor because they are afraid of wheel slippage.



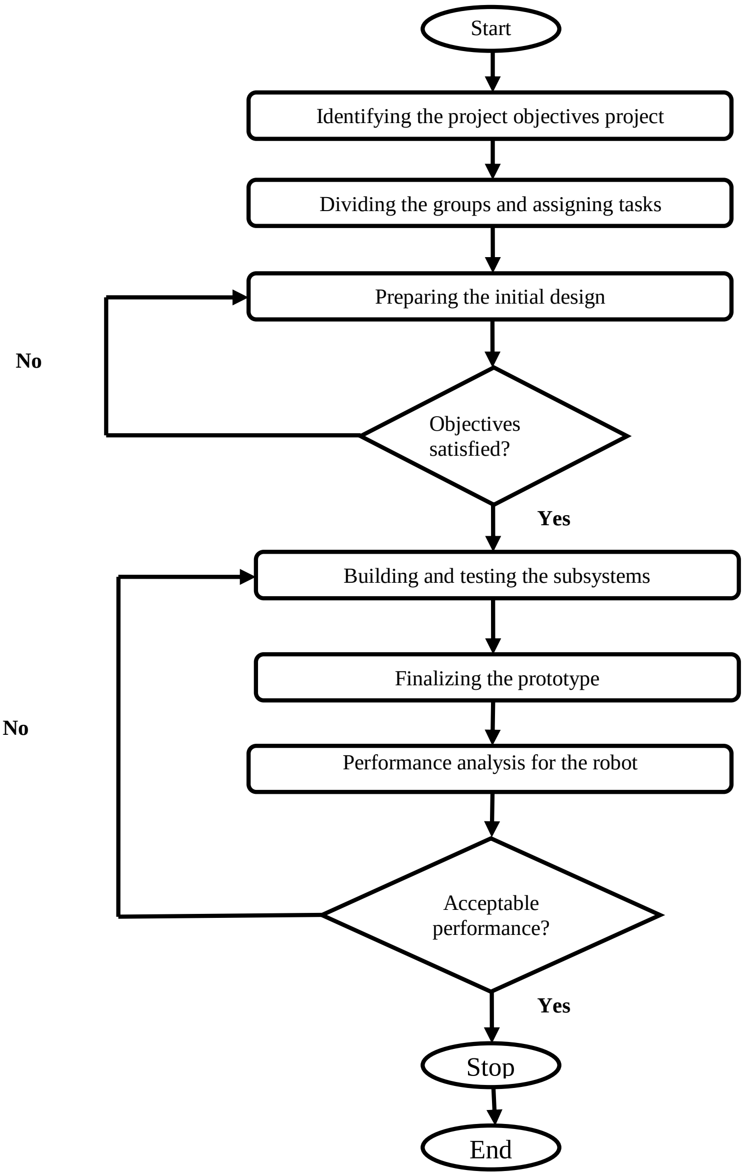


Figure (7) Flowchart of the Development Procedure

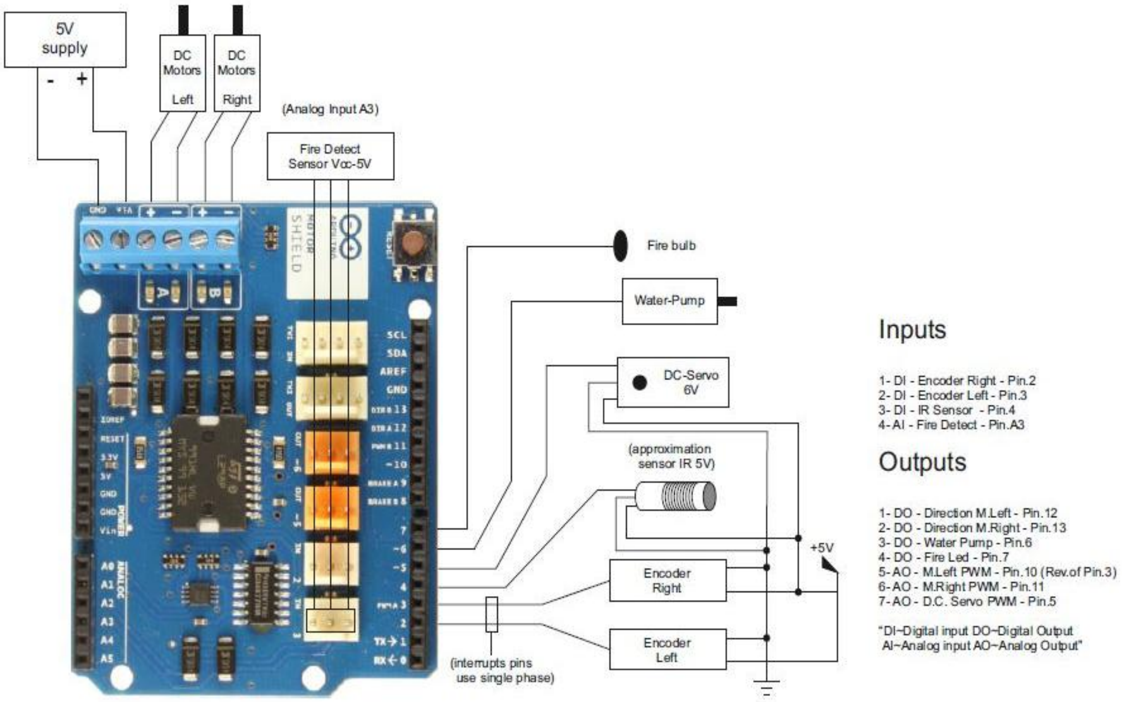


Figure (8) The Arduino Microcontroller and Circuit Analysis

DISCUSSION AND CONCLUSIONS

Before the competition day the students spent a lot of time adjusting the code so the flame sensor can detect the heat source easily. They tried many trajectories and they ended with straight line trajectory starting from the home position in the middle of the area moving forward and the robot should make a U-Turn and the end of the course and repeat it until it covers the whole designated area. The students started by putting the heat source randomly at the right of the mobile robot and the robot started from its home position. The robot was able to reach the heat source and extinguish it. One referee changed the position of the heat source to the far left of the proposed inspected area and asked them to repeat the experiment. The mobile robot did not recognize the heat source in the first time but it was able to detect it and extinguish the flame when they repeat the experiment starting from the home position of the robot. They got the certificate for the second position since the prize was reserved only for the first position winner.

It is worth mentioning that the students learnt from this course and their performance was very good compared to other courses. I taught six mechatronics courses to this group except the Electrical student and I knew their level. I discovered that some of them are not good in theoretical aspects courses but they have very good hands on experience which I watched during the different phases of the project. They were very enthusiastic to finish the project on time specially when we approached the competition. As a whole, I believe the experience was successful and this kind of teaching approach is appropriate for mechatronics education because of its multidisciplinary nature.

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STRUCTURAL MODEL OF BELIEFS, CONCEPTUAL KNOWLEDGE AND EXPERIENCE AMONG TRAINEE MATHEMATICS TEACHERS

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ABSTRACT: Beliefs, conceptual knowledge and experience play important roles in enhancing the quality and effectiveness of the teaching and learning of mathematics. As such, this study is conducted with the aim of profiling three main constructs, namely beliefs, conceptual knowledge and experience among trainee mathematics teachers. The study is also intended to produce a measurement model of these constructs and subsequently a structural model that incorporates all the hidden and observed variables. 317 trainee teachers from six Higher Education Institutions (HEIs) (public universities) were randomly selected to participate in this study. Beliefs, conceptual knowledge and experience are measured using mathematical beliefs questionnaire (MBQ), mathematical experience questionnaire (MEQ) and a test of conceptual knowledge (TCK), focusing on the topic of fractions. The structural model shows that there is a weak correlation between mathematical beliefs and mathematical experience; a very weak correlation between conceptual knowledge and mathematical beliefs; and a very weak correlation between conceptual knowledge and mathematical experience. In addition, SEM analysis shows that there is a significant contribution of the four variables on the mathematics beliefs of the trainee teachers. Furthermore, regression coefficient of mathematics content knowledge experience of the respondents is the highest among regression coefficients of the predictor variables.

Key words*:* beliefs, conceptual knowledge, experience, trainee mathematics teachers

INTRODUCTION

Mathematical beliefs refer to what is true about mathematics, and generally, it is based on an individual's experience as a student of mathematics (Liljedahl, 2005). According to Beijaard et al. (2004), beliefs, on the other hand, are the main component of a teacher's identity. Thus, understanding pre-service teachers' beliefs is pivotal in mathematics education. This understanding would ensure effective teachers' education programmes are developed and executed (Barlow & Reddish, 2006).

Other than mathematical beliefs, pre-service teachers' conceptual knowledge of mathematics is also an important element to be studied. Conceptual knowledge refers to a teacher's ability to connect one mathematical idea to another and to the network of other mathematical ideas, and provide examples. Therefore, a teacher's conceptual knowledge needs to be established and improved upon, so that it would correspond with the aims and objectives of the school curriculum. One of the objectives of the curriculum is to enable students to explain mathematical problems using accurate mathematical terms (Curriculum Development Centre, 2004). To achieve this objective, emphasis on both understanding of concepts and development of skills must be balanced (Noraini, 2005).

Mathematical experience refers to what has been experienced by individuals during their course of studying mathematics, both at school and tertiary levels. Generally, when they have become teachers, they would apply the knowledge and experiences which they have acquired into their teaching and learning processes in the classroom. In this sense, all the approaches and techniques are the same as the ones practiced by their own former teachers. Thus, duplicating of experience takes place, and if this continues, creativity and innovation is hampered in the education system, and specifically, in mathematics education.

STRUCTURAL EQUATION MODELING (SEM)

Structural Equation Modeling (SEM) is specifically designed to model the relationship between multiple dependent and independent constructs simultaneously (Zulkifley & Kamarulzaman, 2009). Thus, SEM is selected for the study to connect existing theoretical relationships between the variables simultaneously. SEM is preferred to path analysis because it produces measurements with better validity and reliability (Chua, 2009). Besides that, it can also be used to test the hypothesis of a study (Zainudin, 2010).

To analyze the measurement model, confirmatory factor analysis (CFA) is utilized in this study. CFA is used to determine whether or not a hypothesis fits certain set of data (Byrne, 2010; Hair *et al.,* 2010). Several values are obtained, which are factor loadings, variance and modification indices (MI) in order to get the best model fit. In determining the model fit, a few values are used. Kline (2005) suggested at least four tests be used: Chi-square (χ^2), Goodness of Fit Index (GFI), Normed Fit Index (NFI) or Comparative Fit Index (CFI), Non-Normed Fit Index (NNFI) and Root Mean Square Residual (RMSR). In this study, six fit indices are employed, which are GFI, Absolute Fit Measure (AGFI), NFI, Tucker Lewis Index (TLI), Incremental Fit Index (IFI) and CFI (Byrne, 2010; Hair *et al*., 2006; Hair *et al*., 2010). The values of these indices range between 0 and 1.00, with values 0.90 and above considered as a good model fit (Byrne 2010; Hair *et al*. 2006; Hair *et al*. 2010). However, for Parsimonious Fit Measure (CMIN/df), some researchers allow up to value 5.00 as a good model fit. There are also some researchers who use values 2.00 or less. Nonetheless, the value of CMIN/df used in this study is less than 3 (< 3), corresponding with Kline (2005).

METHODOLOGY

The respondents selected in this study are pre-service teachers in their third and forth years from education faculties of six HEIs which offer mathematics education programmes. During the 2007/2008 academic session, the total number of pre-service teachers in their third and forth years who are enrolled in mathematics education programmes is 494. Out of the 494 pre-service teachers, 371 (60 males and 257 females) are selected as respondents of the study.

The respondents are selected using two levels of stratified random sampling. The first level is clustered random sampling, which involves selecting six out of eight public higher education institutions that offer mathematics education programmes, which are UM (24), USM (26), UPSI (185), UKM (33), UPM (29) and UTM (20). The second level is purposive random sampling which is based on the years of study (third and forth years).

RESEARCH FINDINGS

Structural Model of Study

In this study, the structural model consists of two dimensions of mathematical beliefs, three dimensions of mathematical experience and one dimension of conceptual knowledge. The mean values of mathematical beliefs, mathematical experience and conceptual knowledge constructs are used to represent each construct. The first structural model of the study is constructed to include all three variables, which are mathematical beliefs, mathematical experience and conceptual knowledge of the pre-service teachers. Analysis of SEM indicates that there is a significant relationship between those variables in this study.

The results of the SEM analysis show that each of the variables has a significant relationship with another; between conceptual knowledge (CK) and mathematical experience (ME) (β =0.13, $p < 0.05$), between mathematical beliefs (MB) and mathematical experience (ME) ($\beta = 0.39$, $p < 0.05$), and between mathematical beliefs (MB) and conceptual knowledge (CK) ($\beta = 0.11$, $p < 0.05$). The study finds that there is a weak correlation between mathematical beliefs and mathematical experience ($\beta = 0.39$). Even weaker correlations are found between conceptual knowledge and mathematical beliefs ($\beta = 0.11$), and between conceptual knowledge and mathematical experience ($\beta = 0.13$). However, based on the fit index values, the model is found to be ill-fitting and not the best model fit of the study. Out of six fit index values used in determining the best model fit of the study, only GFI meets the requirement, with value > 0.90. The value of RMSEA = 0.105, greater than the fixed value of 0.08; and the value of CMIN/DF = 4.481 (>3) is quite high. Therefore, the first structural model of the study needs to be modified to obtain the best model fit which fits the data of the study.

The modifications are based on a suggestion by the modification index (MI), which suggested inserting a connection between error e2 and error e4. Further analysis shows that all fit indices meet the requirement of the study. The analysis of SEM shows that there is a significant relationship between the variables; between mathematical beliefs (MB) and mathematical experience (ME) ($\beta = 0.38$, $p < 0.05$), and between mathematical beliefs (MB) and conceptual knowledge (CK) ($\beta = 0.11$, $p < 0.05$). The relationship between conceptual knowledge (CK) and mathematical experience (ME) is also significant ($\beta = 0.13$, $p < 0.05$). However, weak correlations still exist between mathematical beliefs (MB) and mathematical experience (ME) ($\beta = 0.38$), between conceptual knowledge (CK) and mathematical beliefs (MB) (β = 0.11), and between conceptual knowledge (CK) and mathematical experience (ME) (β = 0.13).

The analysis of SEM indicates that there is a significant relationship between beliefs and experience of the pre-service mathematics teachers. While there are weak correlations between the predictor variables in the study, the structural model is accepted as the structural model of the study. No improvement can be made on the model since it has met all requirements as model fit. Besides, improvements would result in the correlation values between predictor variables and criterion variables to become weaker.

The Contribution of Beliefs on Conceptual Knowledge and Experience of Pre-service Mathematics Teachers

A regression test is conducted on the variables of the study to see whether or not the independent variables have any significant contribution on the dependent variables. Since mathematical experience, which includes respondents' experience of the mathematics content knowledge, the pedagogical experience of their mathematics teachers as perceived by them, their experience as students of mathematics and their conceptual knowledge has a significant contribution on the pre-service teacher's beliefs, further analysis determines how those predictor variables could explain the variance of mathematical beliefs. This is conducted based on the values of multiple correlation squared or R^2.

The value of R^2 for mathematical beliefs is 0.56, which means that 56.0% of variance of mathematical beliefs could be determined by regression equation for mathematical experience, which are respondents' experience of the mathematics content knowledge, the pedagogical experience of their mathematics teachers as perceived by them, their experience as students of mathematics and their conceptual knowledge, as the predictor variables. From the perspective of effect size as suggested by Cohen (1983), the value of the contribution is medium.

The analysis also shows that the regression coefficient of mathematical experience, which is respondents' experience of mathematics content knowledge is β=0.70; the regression coefficient of pedagogical experience of the respondents' mathematics teachers as perceived by them is β=0.21; the regression coefficient of the respondents' experience as students of mathematics is β=0.14; and the regression coefficient of conceptual knowledge is β=-0.01. Clearly, the regression coefficient of mathematics content knowledge experience is the highest at β=0.70, compared with the regression coefficient of other predictor variables. This implies that the respondents' experience of the mathematics content knowledge contributes the most to their mathematical beliefs.

DISCUSSION AND CONCLUSION

Structural Model of Study

The findings of the study agree with the study by Quillen (2004) who also found that there is a significant relationship between mathematical beliefs, knowledge of contents and mathematical experience. His study showed that respondents who have good knowledge of contents have positive emotions towards mathematics compared with those who do not. They are also more inclined towards the use of teaching aids if their former teachers had also used them. Additionally, another study by White *et al*. (2006) found that there is a significant relationship between attitudes, beliefs and mathematics achievements in the teacher-trainees of a primary school at University of Western Sydney.

The findings also are consistent with the findings by Anne and Michael (2006) who stated that mathematical beliefs of the pre-service teachers are mostly gained from their experience and interpretation of their former mathematics teachers. A study by Marchionda (2006) also found that there is a positive relationship between mathematical beliefs and conceptual knowledge, whereby if one's conceptual knowledge is high, his mathematical beliefs are also affected. In addition, Ernest (1989) stated that beliefs are the main safeguard in professional behavior of teachers in the mathematics classroom. His findings demonstrated that beliefs influence and guide teachers in making decisions, carrying out teaching strategies (Van Zoest et al., 1998) and practicing what is learnt in the mathematics classroom (Wilson & Cooney, 2002). A study by Teo (1997, in Golafshani 2004) yielded similar findings as well. Hongying (2009) also found that pre-service teachers' beliefs are influenced by their learning experience. Such experience can have either a positive or negative effect on their beliefs. However, the findings of this study disagree with the findings by Willcox-Herzog (2002) and Villena-Diaz (2005) who stated that there is no significant relationship between beliefs and teaching practice in the mathematics classroom. Siti Mistima (2011) also found that mathematical beliefs do not have a significant relationship with pedagogical knowledge of contents.

This study and previous studies have shown that there are discrepancies in the findings when it comes to mathematical beliefs. Some studies indicate a significant relationship (Anne & Michael, 2006; Marchionda, 2006; Quillen, 2004) between variables of mathematical beliefs and other variables, while other studies indicate no significant relationship (Siti Mistima & Effandi, 2010; Villena-Diaz, 2004) between those variables. Such discrepancies could be the result of several factors, such as the selected respondents, scope of study and demography, such as genders or learning experiences. Thus, there are conflicting findings in the studies about the relationship between mathematical beliefs and other variables. In addition, these conflicting findings could exist because the pre-service teachers' core beliefs do not correspond with the information on the beliefs that they relay. Besides, the environment of the universities where they receive their education also influences their mathematical beliefs (Aida Suraya et al., 2008). Moreover, the relationship between the pre-service teachers' learning experience and the knowledge they acquired is not optimized. This is supported by Lilia (2009) who claimed that pre-service teachers' acquired knowledge still needs to be improved upon, especially acquired knowledge based on experience.

The Contribution of Beliefs on Conceptual Knowledge and Experience of Pre-service Mathematics Teachers

The analysis of multiple correlations squared or R^2 shows that value R^2 of beliefs is 0.56. This means that 56% of variance of beliefs could be explained by the regression equation for experience, which is respondents' experience of the contents of mathematics, the pedagogical experience of their mathematics teachers as perceived by them, their experience as students of mathematics and their conceptual knowledge, as the predictor variables. The results of analysis also show that the regression coefficient of respondents' experience of the contents of mathematics is higher compared with the regression coefficient of the pedagogical experience of the respondents' mathematics teachers as perceived by them, the regression coefficient of their experience as students of mathematics, and the regression coefficient of their conceptual knowledge. This indicates that the respondents' experience of the contents of mathematics plays a very important role in shaping their beliefs. Experience related to the contents of mathematics influences the evaluation and selection of teaching strategies by the teachers (Lloyd, 2002). Besides that, the teachers' knowledge of the contents of mathematics is relevant to what their students would be learning (Hill et al., 2005).

Teachers who lack adequate knowledge of the contents of mathematics would not be able to associate the students' existing knowledge to the new knowledge that they are acquiring. In addition, such teachers also have a tendency to focus only on algorithm (process of calculation), and not the underlying mathematical concepts (Cai, 2005; Llinares, 2000). On the other hand, teachers who are knowledgeable would prefer students' mathematical questions, and to solve them together with the students, as opposed to merely providing answers to their questions.

The findings of the study are different from a study by Siti Mistima (2011) who found that mathematical beliefs, teaching practice, teaching experience and education level contribute very little or in a small percentage to the variance of pedagogical knowledge of contents. Clearly, there are discrepancies in the findings of this study and previous studies on mathematical beliefs. This is could be due to the different variables or respondents in the studies. Moreover, it could also be caused by external factors, such as the respondents' age and genders.

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GENDER DIFFERENCES IN CONSTRUCTIVIST APPROACH TO HIGH SCHOOL LEARNERS' COMPREHENSION OF ELECTROCHEMISTRY CONCEPTS

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ABSTRACT: This study reports on research findings on the effect of collaboration combined with text manipulation on male and female learners' comprehension of electrochemistry concepts in the Ximhungwe circuit of the Bohlabela district in the Mpumalanga province of South Africa. The theoretical frame work of this study is rooted in Posner et al's Accommodation of a Scientific Conception: Toward a Theory of Conceptual Change. This theory strongly proves that learning is a social process and communication facilitates learning. An intact sample of 47 12th grade physical sciences learners from two public schools in the circuit participated in the study. One of the schools was a high achieving school (HAS) and the other a low achieving school (LAS) as was classified by the Department of Education. Learners were given electrochemistry concept test (ECT) and Chemistry Classroom Environment Questionnaire (CCEQ) as pretest and post-test. After the treatment using a self-designed conceptual change teaching strategy of collaboration combined with conceptual change texts, ANCOVA conducted on posttest scores of the learners showed that there was no significant mean difference between male and female learners in their comprehension of electrochemistry concepts. Similarly, there was no significant interaction effect between gender and treatment. However, Pearson Product-Moment Correlation revealed that there was positive relationship between achievement and learners' perception of their chemistry classroom environment. It was concluded that collaboration combined with text manipulation was equally effective for both males and females.

Key words: collaboration, conceptual change texts, electrochemistry, gender, social constructivism

INTRODUCTION

Researches for the past three decades on gender and achievement have revealed mixed results regarding gender differences in science achievement. Whereas some argue that there are instances where females perform equally well as their male counterparts others found that there are differences in achievement between males and females from lower grades through high school to college, especially when measured by standardised tests (Ingels and Dalton, 2008). Halpern, (2012) has indicated that much research has focused on gender differences in various areas of intellectual achievement. Else-Quest, Hyde and Linn, (2010) and Penner, (2003) reported that gender differences in mathematics and science achievement were typically in favour of males but it is insignificant, however, Hyde, Lindberg, Linn, Ellis and Williams (2008) and Lindberg et al. (2010), suggest that the gap is closing up and even disappearing in these fields. Some researchers have argued that these findings have essentially become part of the stereotypical view of men and women (Lindberg et al., 2010; Nosek et al., 2009). In contrast, achievement test results over the years have continuously shown an ever increasing gap in the performances of boys and girls in chemistry at senior secondary school level (Onekutu, 2002). Gafoor and Shilnar (2014) found that nearly 15 per cent variation in performance in organic chemistry was accountable to test format which was in favour of the girls when multiple choice items were used. Similarly, a research conducted by Voyer, and Voyer (2014) showed that gender differences in school achievement favoured females in all fields of study. These variable research findings indicate that research in this area is still inconclusive. Accordingly, Dhindsa and Emran, (2011) contend that extant constructivist approaches that influence classroom environment help cognitive development in both male and female learners, which consequently reduces gender differences in their academic achievement in all areas including science subjects.

Theoretical Framework

The underlying concept of this study is conceptual change interpreted as what actual knowledge a group collectively produces and agrees upon as a final take. The conceptual change theory proposed by Posner et al. (1982) strongly indicates that learning is a social process based on social constructivism in which learner dialogue supersedes teacher`s talks in the classroom thereby facilitating learning. This conceptual change theory influenced the emergence of an active social interaction in the classroom like collaboration. Cognitive level and knowledge restructuring of individual is facilitated by an appropriate instructional setting that enhances learners' curiosity, creativity and development of higher–order thinking skills that are characteristics of a meaningful learning. Learning is a natural process pursued personally by the learner in an active meaningful way. The learner tends to seek and create meaningful, coherent representations of knowledge stored in the short- and long-term memories once exposed to the learning process. Scott, Asoko and Leach, (2007) opined that conceptual change is examined by emphasizing the social construction of knowledge and discursive interactions in the classroom. Current research on intentional conceptual change points to the need for designing learning environments that encourage learners to employ goal-directed, reflective strategies, explanatory frameworks and to develop meta-conceptual awareness (Lederman, Lederman and Antink, 2013). Understandably, socio-cognitive discourse plays a key role in facilitating conceptual change as well as enhancing problem solving skills (Chan, Lam and Leung, 2012; Heng, Surif and Seng, 2014).

From a Vygotskian social-constructivism perspective, a major role of schooling is to create social contexts for learning such that individuals master the use of cultural tools (Smagorinsky and O'Donnell-Allen, 2000). Vygotsky's theories stress the fundamental role of social interaction in the development of cognition (Vygotsky, 1978; Wertsch, 1985). Collaboration, an aspect of social constructivism, can be described as interactions in which participants mutually discover solutions and create knowledge together (Kittleson and Southerland, 2004). Collaborative learning experiences, then, provide a social context within which learners can jointly build understanding. When collaborating, learners work together to solve a given problem. According to Galloway (2001) two of the main principles of Vygotsky's work linked to collaboration are the More Knowledgeable Other (MKO) and the Zone of Proximal Development (ZPD). The MKO refers to someone who has a better understanding or a higher ability level than the learner, with respect to a particular task, process, or concept. the MKO and the ZPD form the basis of the scaffolding component of the cognitive apprenticeship model of instruction. Vygotsky (1978) defines the ZPD as the distance between the "actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers" (p. 86). Vygotsky believed that when a student is at the ZPD for a particular task, providing the appropriate assistance (scaffolding) will give the student enough of a "boost" to achieve the task.

Gee (2005) describes the ability to combine language with behaviours to enact a socially recognizable identity as a discourse. Gee indicates that science discourse is a specialized way of talking and acting that reflects the values and identities associated with members of the social group known as scientists. This would imply, then, that replicating features of the activities of the scientific community in the classroom provides learners the opportunity to take part in and practice science discourse. A collaborative group confronted with a challenging problem is reflective of a scientific community working together to find possible solution to a given problem. Members of the scientific community establish the norms and expectations for their group. For example, scientists place a heavy emphasis on the importance of evidence in backing their claims. Thus, members' individual concepts are pooled and the discourse that ensues may lead to a consensus concept representing potential conceptual change and the co-construction of science knowledge. Learners presented with the opportunity to engage in problem-solving collaboration group are in other words exposed to a situation similar to the scientific community.

Much remains to be understood about the nature of the interaction between members of a collaborative group (Kittleson and Southerland, 2004). Describing and examining learner discourse generated during the normal course of classwork can uncover the goals, agenda, and premises that influence what conceptual understanding is shaped by the group and the way this understanding develops (Kittleson and Southerland, 2004). Since discourse is language in use, examination of discourse includes what happens before, during, and after a discourse event. It reveals shift in reasoning within the group as well as the strategies used and social procedures enacted while developing the group constructs. Describing and examining the discourse will reveal the socially constructed nature of science knowledge (that is, how members organize, retrieve, present, and manipulate their conceptual understandings). This type of research can help make sense of the interaction patterns within a group by describing the ways of thinking, action, and interaction common to the group. It is these patterns that constrain and shape the meaning members will construct as a group (Gee, 2005).

Statement of the Problem

Research has shown that South Africa has shortages in scarce skill areas like science and technology in spite of the various interventions the government has continuously put in place. This is evidenced by the poor performance of learners in science and mathematics at the high school level. The problem that formed the focus of this study is that high school learners in South Africa have been performing poorly in chemistry topics including electrochemistry since 2009 (Department of Education Mpumalanga Province (DEMP) 2015). This has been attributed to conceptual difficulties experienced by learners as a result of the way knowledge is acquired in the classroom, as well as problem solving difficulties they experience. Research in chemistry education has shown that learners often have difficulty in understanding chemistry concepts due to their abstract nature and many attempts have been made by researchers to assist learners' learning by identifying misconceptions, the difficulties experienced by learners and possible solutions to overcome such problems (Sanger and Greenbowe, 1997a and 1997b; Niaz, 2002; Niaz and Chacon, 2003; O'grady-Morris, 2008; Ozkaya et al., 2006). As a result, the Department has put various programmes such as winter schools, spring schools and camps in place to help improve learners' performance, yet majority of learners continue to perform poorly in the National Senior Certificate (NSC) examinations. Essentially, teachers talk and learners listen, and it was against this background that this study was undertaken.

Purpose of the Study

Based on the problems highlighted above, the study designed a conceptual change teaching strategy, specifically collaboration combined with conceptual change texts to enhance learners' comprehension of electrochemistry. It was also to investigate the changes in science conceptual comprehension between males and females when they have the opportunity to collaborate, define, discuss and determine possible solutions to extended science problems assigned by the classroom teacher.

Hypotheses

Three null hypotheses (Ho) were formulated for the study as follows: that
1. Ho_1: there is no significant difference between posttest and pretest mean scores of male and female learners with respect to their comprehension of electrochemistry.
2. Ho_2: there is no significant interaction effect between gender and conceptual change teaching strategy with respect to learners' comprehension of electrochemistry concepts.
3. Ho_3: there is no significant relationship between males and females in perception of their chemistry classroom environment and their achievement in electrochemistry concepts.

Significance

First this study will illuminate the sources of learners' misconception, miscomprehension and difficulties in electrochemistry. It will promote comprehensive discourse in the problem areas among male and female learners in order to generate positive cognitive conflicts that will enhance conceptual comprehension. This study will also provide useful information as to the processes that learners go through in solving a particular problem through collaboration.

Scope and delimitation of the Study

This study confined itself to the Ximhungwe circuit because it is one of the low-performing circuits in the Bohlabela district in the Mpumalanga province. The study covered grade 12 physical sciences learners because the researchers observed that they have had some three years physical sciences education in the high school. So, they should have had some experience needed to respond to the statements in the questionnaire and also answer the ECT questions effectively.

METHODS

The study is a descriptive study and utilized a pretest and posttest non-equivalent control group quasi-experimental research design. According to Gliner, Morgan and Leech (2011), a quasi-experimental design is appropriate for a study such as this because it was not possible to randomly assign individual learners to particular classes or groups. In other words, in the research schools, learners were not randomly assigned as individuals to experimental groups and control groups. Therefore, all learners within any particular classroom were randomly assigned as an intact group to serve as an experimental group (EG) or control group (CG). A four-week special teaching programme using conceptual change teaching strategy of collaboration combined with conceptual change texts for the two participating schools was carried out on the topic of electrochemistry with one chemistry teacher purposefully trained for this study. The changes in achievement males and females were determined using the pre-intervention and post-intervention diagnostic tests.

Sample and Sampling Technique

The sample consisted of grade 12 physical sciences learners in their intact classes in two high schools, one high achieving school (HAS) and the other, low achieving school (LAS) in the Ximhungwe circuit. These two schools were randomly selected from 10 high schools, using the table of random numbers. In addition, the schools were categorized as HAS or LAS by the department of education in the Mpumalanga province (DEMP, 2015). The sample consisted of 47 grade 12 physical sciences learners. There were 28 grade 12 physical science learners from HAS and 19 from LAS. The 47 intact class learners was made up of 28 females (17 are from HAS and 11 are from LAS) and 19 males (11 are from HAS and 8 are from LAS).

Instrumentation

Two instruments were used to collect data in this study. The instruments are Electrochemistry Concept Test (ECT) and Chemistry Classroom Environment Questionnaire (CCEQ). The researchers developed the ECT by consulting the various literatures, textbooks and previous examination papers. They were then validated by some experienced physical sciences teachers and supervisors. The ECT showed a reliability value of .79 as determined using Kuder-Richardson formula 20 and the CCEQ had a reliability ratio of .82 with the Crombach`s alpha calculation. The CCEQ was adapted from literature with modifications to be applicable to this study, which took place in a rural setting.

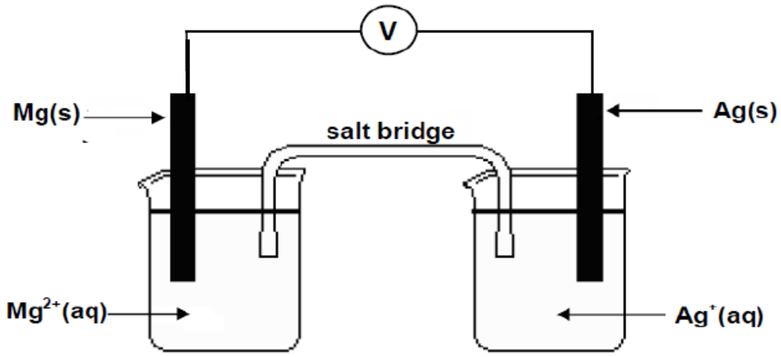
Method of Data Collection

A conceptual change teaching strategy (collaboration combined with conceptual change texts) was used to collect data. These texts were developed by the researchers to support the collaboration. Three texts on galvanic, electrode potential and electrolytic cells were produced for the study. The conceptual change texts were developed according to the Conceptual Change approach introduced by Posner et al. (1982) that is based on the conditions of dissatisfaction, intelligibility, plausibility and fruitfulness. The following is a sample of the texts. These conceptual change texts are proven for their effectiveness (Ozkan and Sezgin Selcuk, 2013) and complimented collaboration to enhance learner participation and comprehension and to reduce discursive teaching and interaction among group members. The conceptual change texts designed is made up of five parts and has been planned in accordance with the conditions of dissatisfaction, intelligibility, plausibility and fruitfulness in the conceptual change approach developed by (Posner et al, 1982). It was recommended that students be given the five parts separately to prevent them from reading the answers in the next part and change their answers accordingly.

The two teachers used in this study started the teaching-learning process by handing out worksheets to each group member that include the first step of the conceptual change texts. The students were told to follow the instructions carefully. Since the purpose of this exercise is to diagnose and overcome the misconceptions the students have, and especially to see the effect of the group process on learner achievement, the teacher directed the students to study in groups of five within a specified time frame and provide their answers as requested. After distributing the texts, the teacher asked each group to select a volunteer to read the text to the hearing of all their group members. Each group member was allowed sometime to independently solve the problem. After this, the students discussed the subject matter with their group members, giving them the opportunity to correct their friends' mistakes if any are made and come up with a pooled answer. Throughout this period, the teacher was a facilitator or guide. The teacher did not correct students' mistakes directly, but encouraged them to discover the reasons for their mistakes by offering clues (Vygotsky, 1978).

The first part of the texts aimed to identify any possible misconceptions students may have and to create an inconsistency that is, dissatisfaction. This allows a teacher to understand how a student's comprehension is influenced within the group.

Use the following information to answer the next two questions.



Numerical Response

1-1. Identify the anode and cathode, and explain how they were identified.
1-2. Explain the concept of the charges on the anode and cathode.
1-3. Discuss the movement of electrons and ions through the cell. In your discussion, name the direction in which the electrons and ions move.

Figure 1. First part of the text

During the implementation stage, the teacher allowed group members to discuss the issues raised thoroughly to enable students grasp the problem situation better. The second part features common misconceptions and answers that are scientifically wrong.

1-1. The most frequent answer about this is "The identity of the anode and cathode depends on the physical placement of the half-cells" misconception. What about you? What do you think? Now, read the next text very carefully.
1-2. The most frequent answer about this is "The anode is negatively charged and because of this it attracts cations. The cathode is positively charged and because of that it attracts anions" misconception. What about you? What do you think? Now, read the next text very carefully.
1-3. The most frequent answer about this is "Electrons enter the electrolyte at the cathode, move through the electrolyte, and emerge at the anode" misconception. What about you? What do you think? Now, read the next text very carefully.

Figure 2. Second part of the text

After the students have given the problem a second thought, the scientific conceptions concerning the subject are explained. That explanation must be very clear and intelligible. In this section, Posner et al.'s intelligibility and plausibility principle are taken into consideration. The students are allowed to discuss the subject matter with their group members as they compare their previous answers with the explanation provided by the conceptual change texts. Supporting collaboration with conceptual change texts gives direction to group members and reduces boredom and monotony and improves learner comprehension and achievement.

Let's see if your answer is correct

- Electrodes are electrical conductors that are placed in an electrolyte to provide a surface for oxidation or reduction half-reactions. The nature of the electrodes and the electrolyte determine the oxidation and reduction reactions which occur. Inert electrodes, such as graphite and platinum, are made from substances which conduct electricity and are not chemically altered in cell reactions. The labelling of the electrodes as anode or cathode depends on the site of the oxidation and reduction half-reaction and not their positions in the half-cells. The electrodes at which oxidation occurs is called the anode while the electrode at which reduction occurs is called the cathode. The anode is labelled (-) because oxidation takes place there to produce electrons while the cathode is labelled (+) because electrons from the external circuit enter the electrolyte here.
- If the anode is oxidised, electrons move directly from the anode to the cathode through the external circuit and positive ions are released into solution around the anode as it dissolves. At the cathode the substances being reduced accept electrons from the external circuit. If the anode does not react,

electrons are transferred directly from the oxidised substance onto the anode and then through the external circuit to the cathode. At the cathode the substance being reduced accept electrons. An electrolyte conducts electricity within a cell by the movement of dissolved positively and negatively charged ions. The movement of ions completes the circuit and maintains electrical neutrality. Anions move through the electrolyte to the anode and cations move to the cathode. A salt bridge contains ions in solution and provides a continuous path for the movement of ions between separate half-cells.

Figure 3. Third part of the text

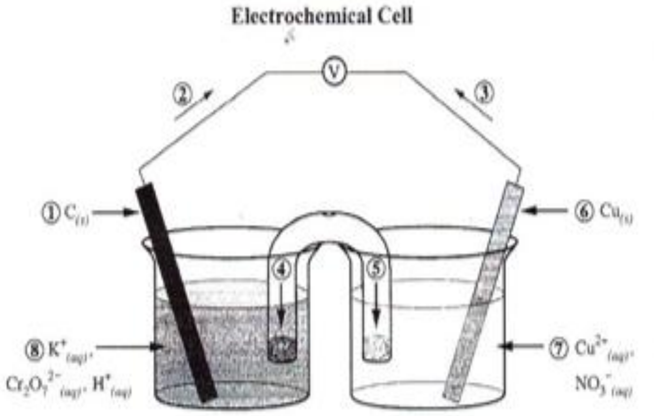
In the fourth part, when students perceive the difference between misconceptions and scientific explanations, they are asked to express their own opinions. The aim in this part is to measure how much awareness has been created among students and see if they still have misconceptions.

Did you change your mind after reading the text? If you did, please express your views once again by considering the text, and give an example.

Figure 4. Forth part of the text

In the last part, the purpose is to understand whether or not the students have grasped the text well. In this section, Posner et al's fruitfulness principles is applied to a new problem situation to see if learners can transfer knowledge acquired to a new problems situation.

Now, let's answer the following questions:
Use the following information to answer the next two questions.



1-1 Identify the anode and cathode in the electrochemical cell above and explain your choice
1-2 How is electrical neutrality ensured?

Figure 5. Fifth part of the text

Two physical sciences teachers were trained by the researchers and used in the study. At the commencement of the study a pretest was administered on chemistry classroom environment questionnaire (CCEQ) and electrochemistry concept test (ECT) to all the grade 12 learners in the two schools, who agreed to participate in the research. The teaching was for 3 hours a week and was taught for the four weeks of treatment after normal school hours. At the end of the treatment, a posttest on the same instruments was conducted. ECT and CCEQ were administered as pretest in the third week of July 2015 before the instruction begun in the fourth week of July 2015. Posttest was administered after the treatment, precisely in the fourth week of August 2015. The ECT involved pencil and paper test.

Data Analysis

Hypotheses one and two were analysed using analysis of covariance (ANCOVA). Hypothesis three was analyzed using Pearson Product-Moment Correlation to check the relationship between CCEQ and ECT posttest mean scores.

RESULTS AND FINDINGS

Electrochemistry Concept Test Results

Ho_1: there is no significant mean difference between posttest and pretest mean scores of male and female learners with respect to their comprehension of electrochemistry. The results are presented in Table 1.

Table 1: ANCOVA Summary on Comprehension based on Gender

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1019.049[a]	4	254.762	4.242	.006	.288
Intercept	2419.899	1	2419.899	40.293	.000	.490
pre	171.476	1	171.476	2.855	.098	.064
Gender	16.280	1	16.280	.271	.605	.006
Gender*Pre	.496	1	.496	.008	.928	.000
Error	2522.441	42	60.058			
Total	119050.000	47				
Corrected Total	3541.489	46				

a. R Squared = .288 (Adjusted R Squared = .220)

The Analysis of covariance results above shows that there was no significant mean difference between male and female learners in terms of comprehension of electrochemistry concepts ($F(1,42) = .271$, $p = .605$, partial $\eta^2 = .006$). The strength of the relationship between gender difference and comprehension of electrochemistry concepts was very weak. Gender difference accounted for only 0.6% of the variance of the dependent variable with the pretest scores as covariates. Analysis from descriptive statistics indicated that the posttest ECT mean score of (48.68 ± 8.64) for males was not statistically significantly different from posttest ECT mean score (50.18 ± 8.97) for the females. Similarly, an analysis of the result indicated that there was homogeneity of variances, as assessed by Levene's test of homogeneity of variance ($p = .799$). This suggests that the variance within each of the groups is equal. Post hoc analysis performed with a Bonferroni adjustment as shown in Table 2, indicated that there was no statistically significant difference between males and females on the posttest scores ($p = .264$), indicating that they all benefited equally from the intervention.

Table 2: Pairwise comparison between Males and Females

Teaching method		Mean Difference	Std Error	Sig.
Male	Female	-1.976	1.757	.264
Female	Male	1.976	1.757	.264

Ho_2: there is no significant interaction effect between gender and research experimental teaching method with respect to learners' comprehension of electrochemistry concepts. This was statistically tested by determining whether there is a statistically significant interaction term, gender *pretest. In order to do this, a general linear model univariate analysis was conducted. The results revealed that there was no significant interaction effect between gender and treatment (see Table 1) on learners' comprehension of electrochemistry concepts, $F(1,42) = .008$, $p = .928$. In other words, there was homogeneity of regression slopes as the interaction term was not statistically significant.

It was assumed that the pretest is linearly related to the posttest, for all groups of the independent variable, gender. A scatterplot of posttest against pretest grouped on gender was plotted as shown in Figure 1.

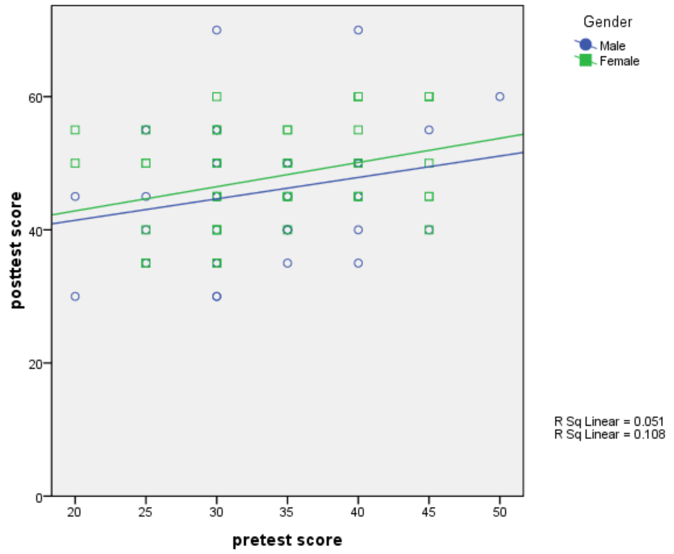


Figure 1: Scatterplot of posttest against pretest grouped on gender

Figure 1 shows that there is a linear relationship between pretest and posttest scores for each intervention type for gender, as assessed by visual inspection of the scatterplot. Similarly, an assessment by Levene's test of homogeneity of variance (p = .799) showed that there was homogeneity of variances.

Ho_3: there is no significant relationship between males and females on their perception of their chemistry classroom environment and their achievement in electrochemistry concepts. The results of the analysis are presented in Table 3.

Table 3: Correlation between CCEQ and ECT Scores of Gender

Variable	N	Correlation Coefficient	p-values
CCEQ	47	0.256	0.04
ECT	47		

Pearson Product-Moment Correlation was used to check correlation between CCEQ and ECT posttest mean scores for males and females. The results revealed that there was relationship between achievement and learners' perception of their chemistry classroom environment ($p < 0.05$). This therefore means that, as learners' perception of their chemistry classroom increases, it results in an increase in their performance on the ECT equally. This suggests that collaboration combined with text manipulation generated a positive classroom environment that resulted in improved performance for both males and females.

CONCLUSION

In conclusion, collaboration combined with text manipulations was equally effective for both males and females. In other words, males and females benefited equally when this self-designed teaching strategy was used. Hence, the designed teaching strategy has a promising potential to be used as a tool in the South African physical sciences classrooms in order to improve learners' conceptual comprehension in electrochemistry concepts in particular and chemistry in general. It was also found out in this study that there were no interaction effect between treatment teaching method and gender, indicating that the teaching strategy equally improves gender achievement. Finally, collaboration combined with text manipulation generated a positive classroom environment that resulted in improved performance for both males and females. This article contributes to the area of research on gender differences as it proves that collaboration combined with conceptual change texts as a conceptual change teaching strategy is equally effective for both males and females with a consequent improvement in achievement. However, more research is still required to determine factors related to gender differences in school science achievement, if any, as well as their possible causes. The findings of the study were limited to grade 12 physical sciences learners as well as variables investigated. Also, only rural high schools were used in the study and it is possible that the findings could have been different if urban high schools were used. Thus future researchers should make efforts to extend the study's scope to urban high schools and possibly increase the number of participating learners.

RECOMMENDATIONS AND IMPLICATIONS

It is recommended to conduct a study with larger sample size (n>47) because research has shown that with larger sample size, statistical power will increase to get better statistical results (Ellis, 2010). Research on development of teacher training programmes about preparing and implementing collaboration combined with conceptual change texts (CCTs) in classrooms and effectiveness of this programme can be conducted. Although there was no interaction between the method and gender in this study, it is suggested that in further studies possible interaction of treatment and gender could be investigated. More research is needed to conclude that this method is equally effective for both males and females.

Implications: One of the strategies that teachers could use to eliminate misconceptions is collaboration and conceptual change texts based on conceptual change model of Posner et al. (1982). Several studies mentioned in this article have shown that constructivism minimises or eradicates gender differences in Science achievement (Balci, 2006; Dhindsa and Emran, 2011; Loofa, 2001; Önder, 2006) and help learners' gain proper comprehension of scientific concepts. This implies that both males and females could benefit equally from collaboration combined with CCTs. Teachers should design their lessons in such a way as to make learners have high and positive perceptions of their chemistry classroom environment to improve performance. The teacher must create a conducive environment during the instruction and must also provide equal chance of involvement for each learner during the instruction.

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IMPACT OF A CONSTRUCTIVIST APPROACH TO LEARNING ON HIGH ACHIEVING STUDENTS' COMPREHENSION OF ELECTROCHEMISTRY CONCEPTS

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ABSTRACT: This paper is part of a larger study to investigate 'The impact of a constructivist approach to learning on physical sciences students' comprehension of electrochemistry concepts' in the Ximhungwe circuit of the Bohlabela district in the Mpumalanga province of South Africa. The study explored the impact of using a constructivist type of teaching intervention – collaboration combined with conceptual change texts, otherwise called conceptual change teaching strategy (CCTS) on students in high achieving schools (HAS) in their comprehension of electrochemistry concepts. The study utilized non-equivalent pretest and posttest control group quasi-experimental research design. The theoretical framework for this study was based on Vygotsky's social constructivism theory, which he defines as a sociological theory of knowledge that applies the general philosophy of constructivism into social settings. A sample of 51 12^{th} grade physical sciences students from two high achieving public schools in the circuit was randomly selected using a table of random numbers to participate in the study. Students were given electrochemistry concept test (ECT) Chemistry Classroom Environment Questionnaire (CCEQ) as pretest and posttest. One-way between group analysis of covariance (ANCOVA) and post hoc analysis with a Bonferroni adjustment conducted on ECT showed that students taught with the CCTS had significantly better acquisition of scientific conceptions related to electrochemistry than students taught with the traditional teaching method (TTM). Pearson Product-Moment Correlation also revealed that there was significant relationship between achievement and students' perception of their chemistry classroom environment. The study provides statistical evidence on the importance of meaningful learning combined with social process to improve students' understanding of electrochemistry.

Key words: collaboration, electrochemistry, high achieving schools, social constructivism, traditional teaching method

INTRODUCTION

When considering the construction of science knowledge it is important to consider the social context within which that knowledge is constructed and accepted (Kittleson & Southerland, 2004). Science involves construction of theories and explanations for observed events, and all proposed explanations are open to challenges. What comes to be acceptable as science evolves only after conflicts and challenges to design, methodologies, analyses, and conclusions have occurred. Scientific communities have established social mechanisms for validating claims and providing opportunities for its members to question evidence and explanations; unfortunately, opportunities like these rarely occur in science classrooms (Vellom, Anderson & Palinscar, 1993). This is a common concern shared by science educators all over the world.

In view of the above, it is now widely accepted that science learning can be facilitated when students articulate their prior ideas and explain their comprehension to each other. This approach consequently brings about change in conception. Accordingly, Scott, Asoko and Leach, (2007) opined that conceptual change is examined by emphasizing the social construction of knowledge and discursive interactions in the classroom. Furthermore, researchers of late question conceptual change as a sudden change or replacement of misconceptions with scientific ones through externally-driven conceptual conflict (Chan, Burtis & Bereiter, 1997). According to them, conceptual change involves a gradual and complex process – the gradual revision of students' initial conceptual structures being mediated by students' intentional learning strategies (Sinatra & Pintrich, 2003).

Current research on intentional conceptual change emphasizes the role of students' metacognitive strategies, epistemic beliefs and agency in knowledge restructuring (Sinatra & Pintrich, 2003). It also points to the need to designing learning environments that encourage students to employ goal-directed, reflective strategies and to develop meta-conceptual awareness. Researchers have argued that conceptual change involves not only changes in concepts; there needs to be changes in students' epistemic cognition and views about the nature of science (Duit & Treagust, 2003). Cognitive research has shown that students' epistemic beliefs can constrain or facilitate their thinking, reasoning, and science learning. For example, Stathopoulou & Vosniadou (2007) examined the relationship between chemistry-related epistemic beliefs and chemistry conceptual comprehension among 10th grade students; Conley, Pintrich, Vekiri and Harrison (2004) also attempted to investigate the changes in 5th grade students' epistemic beliefs in science, and findings indicated that students became more sophisticated in their beliefs about source and certainty of knowledge.

Vosniadou (2008) noted that conceptual change involves meta-conceptual awareness where students will be able to learn science concepts and principles only if they are aware of their prior comprehension and the shift of their initial views toward scientific explanations. Therefore, it is necessary to design learning environments that enable students to become aware of their existing internal explanatory frameworks and beliefs. Increasingly the emphasis is to examine conceptual change that includes not only individual cognitive development but also social and collective aspects. Understandably, socio-cognitive discourse plays a key role in facilitating conceptual change as well as enhancing problem solving skills.

Having students work together to solve a challenging problem can facilitate such a communication shift. Peer collaboration, otherwise called collaboration provides students with opportunities to practice their emerging science communication skills. This is a situation that is reflective of the scientific community, which requires its members to communicate their ideas in much defined ways. For instance, scientists place a great emphasis on the importance of evidence in backing up claims made by its members. So, a collaborative group in a science classroom negotiates its conceptual comprehensions and establishes its cultural norms—that is, what the group considers valid science knowledge (Kelly & Green, 1998).

Through their collaboration efforts, students' individual concepts are pooled and the discourse that ensues may lead to a mutual comprehension of the concepts involved. This represents an opportunity for conceptual development and/or change for group members. The conceptual comprehensions each member of the group takes away from the experience is potentially different from the comprehension level the member entered the experience with, and this change is at least partly due to the social interaction that occurs within the group. Thus conceptual change theory describes learning as coming to comprehend and accept ideas because they are seen as intelligible and rational (Posner, Strike, Hewson & Gertzog, 1982). Conceptual change refers to the idea that students come to any new learning experience with a host of prior experiences and beliefs for which they have constructed explanations that work for them, but may or may not be congruent with what the teacher intended and may not stand up to rigorous scientific analysis. The conceptual constructs students hold or develop in the classroom may be naïve, premature, or actually incorrect in relation to accepted science (Duit, 2003). This implies that teaching for conceptual change would mean engaging students in developing new comprehensions of science phenomena (Dykstra, 2005). This would involve helping students to correct their miscomprehensions; facilitate the reorganization of their naïve concepts into useable, integrated comprehensions; and develop intellectual tools useful to them in a variety of contexts (Suping, 2003). Science education, as part of the cultural institution of school, is charged with transmission of the scientific knowledge created by scientists and deemed important by society and is therefore the agent for conceptual change (Kelly & Green, 1998). Also, conceptual change can be thought of as a "journey toward literacy within a domain" (Alexander, 1998, p. 56) and a collaborative group is a potent source for generating this change. Posner et al (1982), contend that conceptual change will only occur if a learner encounters an event for which his or her existing comprehension provides an unsatisfactory or incomplete explanation. As members of a collaborating group express their differing renditions of the problem they are confronting, discrepancies will inevitably result. This discrepancy may provide the kind of disequilibrating event that provokes the dissatisfaction described by Posner et al (1982). What follows among the group members is a negotiation of these discrepancies.

The importance of the role played by existing concepts, including erroneous concepts, has been identified in constructivist and generative learning theories (Osborne and Wittrock 1983, Wittrock 1974). Of further importance is the recognition of social influences on the construction of students' understanding of science that have been thoughtfully explicated by Solomon (1987). Many studies of students' understandings of science are based on constructivist learning theories and the notion that existing concepts influence learning outcomes because learners link new information with prior knowledge. Novak (2002) stated that group learning facilitates meaningful learning and new knowledge construction. This study used the collaboration approach, a type of group learning that is expected to facilitate and encourage meaningful learning. Collaboration approach is a student-centered method of teaching. It allows students to work independently in performing the activities, then working in small groups to discuss answers to questions, exercises and problems. Group outputs are reported in class by followed deliberation of correct answers to questions, exercises and problems. The teacher is a facilitator to ensure that students stay on task. If meaningful learning will be achieved, then correct knowledge structuring will be enhanced; as a result, misconceptions will be minimised if not entirely eliminated.

The study of misconceptions and difficulties in chemistry (Bojczuk, 1982) ranked electrochemistry as one of the most difficult topics in chemistry. In fact, numerous literature have widely reported electrochemistry as being one of the most difficult topics in chemistry because it contains many ambiguous and abstract terms and has an apparent lack of consistency and logic in its representation (Sanger & Greenbowe, 1997a & 1997b; Ozmen, 2004; Ozkaya et al., 2006; Schmidt et al., 2007).

Chemical equilibrium is a prerequisite knowledge in understanding concepts in electrochemistry. Naturally if students find electrochemistry difficult, then it is imperative that students also experience difficulty in understanding concepts in chemical equilibrium. Several studies have reported misconceptions about electrochemistry (Garnett & Treagust, 1992a, 1992b; Ogude & Bradley, 1994; Sanger & Greenbow, 1997a, 1997b). Of particular note is a research study conducted in South Africa by Ogude and Bradley (1994) which indicated that many students can solve quantitative electrochemical problems in examinations, few are able to answer qualitative questions requiring a deeper conceptual knowledge of electrochemistry. Traditional method of instruction appears to be one of the causes that foster difficulty. Hanson and Wolfskill (1998) relate that many of their faculty perceive that traditional teaching methods have become less effective at the tertiary level. They also believe that more and more students have difficulty in applying concepts when solving problems.

Theoretical Framework

The underlying concept of this study is conceptual change interpreted as what actual knowledge the group collectively produces and agrees upon. The theoretical frame work of this study is rooted in Posner et al's Accommodation of a Scientific Conception: Toward a Theory of Conceptual Change. The conceptual change theory of Posner et al (1982), strongly proves that learning is a social process and communication facilitates learning. This conceptual change theory influenced the emergence of an active social interaction in the classroom like the process workshop. Cognitive level and knowledge restructuring of individual is facilitated by an appropriate instructional setting enhancing learners' curiosity, creativity and development of high–order thinking skills that are characteristics of a meaningful learning. Learning is a natural process pursued personally by the learner in an active meaningful way. The learner tends to seek and create meaningful, coherent representations of knowledge stored in his/her short- and long-term memory, once exposed to the learning process.

Vygotsky (1962, 1978) defined social constructivism as a sociological theory of knowledge that applies the general philosophy of constructivism into social settings. He indicated that social constructivism has three components: (a) knowledge and knowing originate in social interaction; (b) learning proceeds from the interpsychological plane (between individuals) to the intrapsychological (within an individual) plane with the assistance of knowledgeable members of the culture; and (c) language mediates experience, transforming mental processes. Additionally, Mercer (2002) emphasizes that science teachers should understand the importance of constructivism especially in terms of the discourse that happens. Treagust and Duit (2008) maintain that conceptual change recognizes the importance of dialogue. However, Scott (1998) has posited that teachers' talk focused on everyday concepts and scientific perspectives is critical to helping students learn science concepts. Discursive teaching is supported by Vygotsky's (1978) view of socially mediated learning.

Vygotsky has indicated that social contexts facilitate meaning and learning. When students first hear outward descriptions, they then turn these words inward, thus leading to modifications or transformations of their knowledge base. Gutherie and Wigfield (2000) indicated that cognitive engagement is enhanced when students are actively involved in social spaces where they discuss, debate, or critique each other's idea. Similarly, Wells (2000) has stated that an individual learns by interacting with a competent person. This means that lecturing can play a critical role in students' meaning making and conceptual development (Scott, 1998). A teacher's encouragement for exploration of scientific ideas through discourse can help students understand concepts. Extended and elaborate teacher discourse helps students to shift their conceptual understanding. From a social-constructivist position, classroom discourse provides opportunities for students to test the validity of their ideas and develop meaning of higher complexity (Aufschnaiter & Aufschnaiter, 2007). Discourse within a group provides potential for a clash of ideas. Student-to-student and student-to-teacher discourse is important in a science classroom. Discourse provides students with the tools and culture of the scientific community (Vosniadou, 2008). Thus, discourse provides a platform for students to be socially engaged in a meaningful learning process.

Statement of the Problem

The problem that formed the focus of this study is that high school students in South Africa have been performing poorly in electrochemistry since 2009, when the National Senior Certificate (NSC) was introduced (Department of Education Mpumalanga Province (DEMP), 2015). This has been attributed to conceptual difficulties experienced by students as a result of the way knowledge is acquired in the classroom as well as problem solving difficulties they experience. Research in chemistry education has shown that students often have difficulty in understanding chemistry concepts due to their abstract nature and many attempts have been made by researchers to assist students' learning by identifying the difficulties experienced by students and possible solutions to overcome such problems (Sanger & Greenbowe, 1997a and 1997b; Niaz, 2002; Ozmen, 2004; Ozkaya et al., 2006). Essentially, teachers talk and students listen, and lengthy, on-subject discourse in classrooms is a rare event. This appears to be the norm in the South African science classroom since teachers have to virtually struggle to complete overloaded curriculum and therefore do not tolerate any lengthy classroom discourse. Practical investigation with hands-on experiences is virtually nonexistent in most rural schools. Students have to be taught the same topic over and over again with the same teacher or different teachers who are presumed to be experts in some of the challenging areas in the physical sciences and electrochemistry is no exception. In spite of this, majority of the learners perform poorly to the extent that it becomes so difficult to get 30% and above in the NSC examinations.

Purpose of the Study

Based on the problems highlighted, the study designed a conceptual change teaching strategy, specifically collaboration combined with conceptual change texts to enhance students' comprehension of electrochemistry. It was also to investigate the changes in science conceptual comprehension that takes place when students have the opportunity to collaborate on solutions to extended science problems assigned by the classroom teacher. The study focused on the outcome of students' discourse during collaboration because it is the way students make their conceptual comprehension apparent, and it is the primary tool the students use to negotiate their conceptual comprehensions when faced with other students' potentially different comprehensions. This study analyzed the collaborative discourse as a teaching strategy in order to understand the group process and its effects on conceptual comprehension and thereby possibly enhance students' comprehension and improve performance by using both experimental and control groups.

Hypotheses

Two null hypotheses (Ho) were formulated for the study as follows: that

1. There is no significant mean difference between posttest and pretest mean scores of students taught electrochemistry concepts with conceptual change teaching strategy and students taught with traditional teaching method in the high achieving schools (HAS).
2. There is no significant relationship between high achieving physical sciences students' posttest mean scores on their perception of their chemistry classroom environment and their achievement in electrochemistry concepts.

Significance

First this study illuminated the sources of students' misconception, miscomprehension and difficulties of electrochemistry. It promoted comprehensive discourse in the problem areas among students in order to generate positive cognitive conflicts that enhanced conceptual comprehension, conceptual change, problem solving capabilities and resultant improvement of students' performance. Secondly, the study unearthed and documented practices and situations in both the control and the experimental groups, which might give some insight into the factors contributing to the low performance of students in electrochemistry. Finally, this study will have significance for future policy formulators in South Africa on the use of specific teaching strategies to enhanced students' comprehension and consequent performance in challenging high school chemistry topics such as electrochemistry.

Scope and delimitation of the Study

There are sixteen circuits in the Bohlabela district in the Mpumalanga province. However, the study confined itself to the Ximhungwe circuit because of its proximity to the researchers and the fact that it is one of the low-performing circuits. The study also restricted itself to only physical sciences students in high achieving schools because the researchers wanted to look at the effect of the chemistry classroom environment on performance.

Only grade 12 students were used as respondents because they have had some three years physical sciences education and would have had some experience needed to respond to the statements in the questionnaire.

METHODS

The study utilized a quasi-experimental research design. A quasi-experimental design was appropriate for this study because it was not possible to randomly assign students to a particular class sessions, so convenience sampling technique was used (Leedy and Ormerod, 2010). Even though the two schools were randomly selected, students were not individually randomly assigned to a particular group. The sample of the study consisted of fifty one grade 12 physical sciences students in 2 high achieving schools in the Ximhungwe circuit. These two schools were randomly selected using the table of random numbers from five high achieving schools in the circuit. The experimental group consisted of 28 students and followed the designed teaching sequence called the collaboration and a baseline class of 23 students served as a comparison group and followed a similar curriculum but normal classroom teaching termed traditional teaching method. In addition the schools were selected based on their performance in the NSC examinations. This is to ensure that the findings from this study were solely based on the differences in the teaching methods used.

For each electrochemistry topic, the control group was the traditional teaching method classroom, while the experimental group was the conceptual change teaching strategy (collaborative) classroom, which involved collaboration combined with conceptual change texts. Changes in the knowledge level were determined by comparing their pre-intervention cognitive test and post-intervention cognitive test. The changes in achievement were determined using the pre-intervention and post-intervention diagnostic tests.

Instrumentation

Two instruments were used to collect data in the main study. The instruments were Electrochemistry Concept Test (ECT) and Chemistry Classroom Environment questionnaire (CCEQ). Some parts of the ECT were developed by the researchers and others adapted by comparing with various literatures and validated by three experienced physical science teachers and research supervisors. The 40 items on the CCEQ were assigned values on a five-point Likert-type scale format. The CCEQ had five sub-scales or dimensions with each subscale comprising eight items. In the ECT a two-tiered, ten-question test was constructed based on the format developed by Treagust (1988). The first tier of each pair of questions was based on procedural knowledge and the second tier was based on conceptual knowledge, with the respondent choosing a reason for his/her choice in the first tier. This type of questioning has the potential to distinguish between procedural knowledge and conceptual knowledge when examining student`s work (Treagust, 1988). Most electrochemistry questions in the grade 12 National Senior Certificate (NSC) examinations have sub-questions in this format and in most cases students score the first tier but not the second. The CCEQ was adopted from literature, but only five of the seven scales were applicable to this study, which took place in a rural setting.

Method of Data Collection

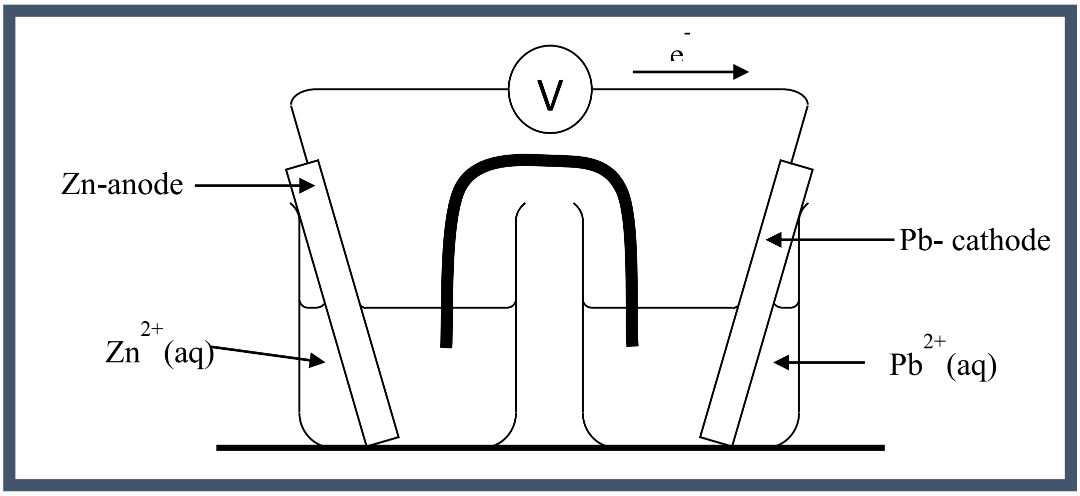
Of the two schools selected for the research, one school represented the control group and the other school represented the experimental group. The latter was taught using collaboration combined with CCTs, and the former with the traditional method that the classroom teacher is familiar with. The ECT and CCEQ were administered as pretest in the fourth week of July 2015, before instruction began in the fifth week of July 2015. The posttest was administered after treatment, precisely in the fourth week of August 2015. The ECT involved a pencil and paper test on electrochemistry concepts for the post-test. Two physical sciences teachers were trained by the researcher for the study. According to the syllabus for grade 12 physical sciences, teachers should use 8 hours to teach electrochemistry in two weeks, four hours per week and one hour per class period. Instead, the teachers used three hours per week, one and half hours per class period for the four weeks of treatment. The experimental group was taught by one of the teachers and the control group by the other teacher. These teachers have been teaching physical sciences for 7 years and were the best teachers in physical sciences for 2011, 2012 and 2013 academic years in the Ximhungwe circuit and Agincourt circuit respectively as judged by the Department of Education.

The texts were developed by the researchers to support the collaborative group. Three texts on galvanic, electrode potential and electrolytic cells were produced for the study. The conceptual change texts were developed according to the Conceptual Change Approach introduced by Posner et al. (1982) that is based on the conditions of dissatisfaction, intelligibility, plausibility and fruitfulness. The following is a sample of the texts. The conceptual change texts used in this study are proven for their effectiveness (Ozkan and Sezgin Selcuk,

2013) and complimented collaboration to enhance learner participation and comprehension. The conceptual change texts designed is made up of five parts and has been planned in accordance with the conditions of dissatisfaction, intelligibility, plausibility and fruitfulness in the conceptual change approach developed by (Posner et al, 1982). It was recommended that students be given the five parts separately to prevent them from reading the answers in the next part and change their answers accordingly.

The teacher in the collaboration class started the teaching-learning process by handing out worksheets to each group member that include the first step of the conceptual change texts. The students were told to follow the instructions carefully. Since the purpose of this exercise is to diagnose and overcome the misconceptions the students have, and especially to see the effect of the group process on learner achievement, the teacher directed the students to study in groups of five within a specified time frame and provide their answers as requested. After distributing the texts, the teacher asked each group to select a volunteer to read the text to the hearing of all their group members. Each group member was allowed sometime to independently solve the problem. After this, the students discussed the subject matter with their group members, giving them the opportunity to correct their friends' mistakes if any are made and come up with a pooled answer. Throughout this period, the teacher was a facilitator or guide. The teacher did not correct students' mistakes directly, but encouraged them to discover the reasons for their mistakes by offering clues (Vygotsky, 1978). The first part of the texts aimed to identify any possible misconceptions students may have and to create an inconsistency that is, dissatisfaction. This allows a teacher to understand how a student's comprehension is influenced within the group.

Use the following information to answer the next three questions.



1. Numerical Response

1-1. Describe the direction of the electric current.
1-2. Why is there a need for standard half-cell?
1-3. How is the cell potential obtained? Calculate it.

Figure 1. First part of the text

During the implementation, a discussion environment is created in the classroom within each group to enable students grasp the problem better. The second part features common misconceptions and answers that are scientifically wrong.

1-1. The most frequent answer about this is "Conventional current is the flow of positive charges" misconception. What about you? What do you think? Now, read the next text very carefully.
1-2. The most frequent answer about this is "The designation of the E° for the H_2 (1M/H^+) standard half-cell is based on the chemistry of H^+ and H_2" misconception. What about you? What do you think? Now, read the next text very carefully.
1-3. The most frequent answer about this is "cell potentials are derived by adding individual reduction potentials" misconception. What about you? What do you think? Now, read the next text very carefully.

Figure 2. Second part of the text

After the students have given the problem a second thought, the scientific conceptions concerning the subject are explained. That explanation must be very clear and intelligible. In this section, arrangement should be made as taking into consideration Posner et al.'s intelligibility and plausibility principle. The students are allowed to discuss the subject matter with their group members as they compare their previous answers with the explanation provided by the conceptual change texts. Supporting collaboration with conceptual change texts gives direction to group members and reduces boredom and monotony and improves learner comprehension and achievement.

Let's see if your answer is correct

In a voltaic cell:

- There is a spontaneous chemical reaction which converts stored chemical energy into electrical energy. The oxidation-reduction reaction which takes place is controlled and the oxidation and reduction half-reactions usually occur in separate compartments called half-cells. A cell potential is spontaneously produced and an electric current results, where electrons move from the anode to the cathode through the external circuit. The relative tendencies of the reactants to be oxidized or reduced determine the resulting oxidation-reduction reaction. The cell potential generated depends on the nature of half-cell reactions. The cell potential generated indicates the capacity of the cell to do electrical work. The cell potential of the cell is measured in volts.

Half cells:

- Half cells are compartments in which separate oxidation and reduction half-reactions occur. Consist of an electrode immersed in an electrolyte. They are linked by a salt bridge which allows the transfer of ions in the internal circuit. Cations from the salt bridge move into the electrolyte in the cathodic compartment to replace cations from the electrolyte that were reduced at the cathode whereas anions from the salt bridge move into the electrolyte in the anodic compartment to neutralize the cations produced as a result of the oxidation that occurred in the anode. Half-cells enable the transfer of electrons from one reactant to another to take place through an external circuit or metallic conductor which links the electrodes.

Reduction potential, standard reduction potentials and standard reduction potential tables:

- Reduction potential indicates the relative tendency of substances to be reduced and on reduction potential table, are listed by half-reaction equations in order of decreasing tendency to be reduced (decreasing strength as oxidizing agent) or increasing tendency to be oxidized (increasing strength as reducing agent). Standard reduction potentials are determined in relation to the $2H^+(aq) + 2e^- \rightarrow H_2(g)$ half-cell reaction which is assigned an arbitrary E^o value of *0V*. Substances more readily reduced than hydrogen ions are listed above hydrogen and have positive E^o values while those which are more difficult to reduce are listed below and have negative E^o values (Refer to Table 4A). Standard reduction potentials assume conditions of 1.0 mol/L or 1.0 mol/dm^3 concentration, 101.3 kPa pressure and usually 25°C temperature. Standard reduction potential can be read as standard oxidation potentials if the sign of the E^o is changed and the equation is read in the reverse direction (from right to left). Standard reduction potential tables list oxidizing agents (oxidants, oxidizers or oxidisers) in decreasing strength from the top to the bottom on the left side of the table and reducing agents (reductants or reducers) in decreasing strength from the bottom to the top of the right side of the table (refer to 4A). Standard reduction potential tables can be used to predict whether or not oxidation-reduction reactions are likely to occur, either in a cell or by the direct mixing of reagents. Standard reduction potential tables can be used to predict the oxidation and reduction half-reactions that may occur at the anode and cathode, and the equation for the half-reaction can be combined to determine the net cell reaction and equation. The half reaction with the highest reduction potential value will be the reduction half reaction. For example, For the half reaction pairs, $Mg \rightarrow Mg^{2+} + 2e^-$; $Pb^{2+} + 2e^- \rightarrow Pb$, state:

i Which metals will be used as anode and cathode?

ii Name suitable electrolytes for each half cell as well as the salt bridge.

iii Give the cell notation.

iv Calculate the cell potential.

Solution

i Anode: Mg Cathode: Pb

ii Electrolyte in beakers - any soluble metal salt solution. (Just make sure that no precipitation reaction will occur because of exchange in metal ions. Chlorides or sulphates will precipitate with lead; nitrates are safe to use because all nitrates are soluble. Salt bridge - $NaNO_3$).

iii Mg(s) I Mg2+(aq) II Pb2+(aq) I Pb(s)

iv Eocell = Eo cathode – Eo anode

= Eo(Pb) - Eo(Mg)

= -0,13 - (-2,36)

= 2,23 V

Standard reduction potential tables can be used to predict the site of the anode and cathode in an electrochemical cell. Standard reduction potential tables can be used to predict the cell potential of a voltaic cell. (Predictions should be interpreted with caution since they provide no information about the rate of the reaction, the concentration of the reaction species or another factor which affect reduction potentials). The strongest oxidizing agent (has the greatest tendency to be reduced) i.e. it undergoes reduction easily, which means it is the weakest reducing agent and has the least tendency to be oxidized. It has the highest reduction potential or the least oxidation potential. The strongest reducing agent (has the greatest tendency to be oxidised) i.e. it undergoes oxidation easily, which means it is the weakest oxidising agent and has the least tendency to be reduced. It has the least reduction potential or the highest oxidation potential.

Figure 3. Third part of the text

In the fourth part, when students perceive the difference between misconceptions and scientifically true explanations, they are asked to express their own opinions. The aim in this part is to measure how much awareness has been raised among students and see if they still have some question marks in their minds or not.

Did you change your mind after reading the text? If you did, please express your views once again by considering the text, and give an example.

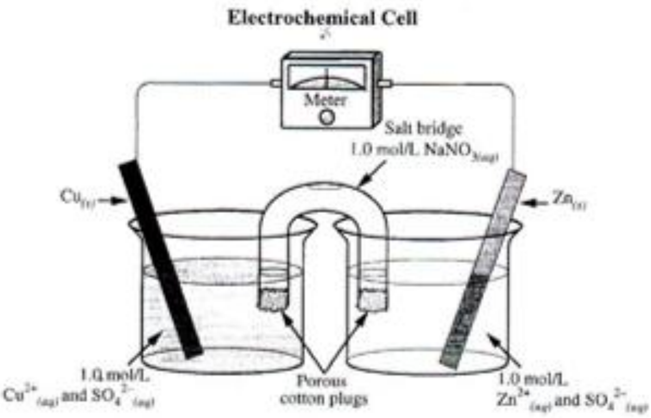
Figure 4. Forth part of the text

In the last part, the purpose is to understand whether or not the students have grasped the text well. In this section, Posner et al's fruitfulness principles is applied to a new problem situation to see if learners can transfer knowledge acquired to a new problems situation.

Now, let's answer the following questions:

Use the following information to answer the next two questions.

Use the following information to answer the next two questions.



Numerical Response

4-1. A student attempted to replicate a traditional Daniell cell by setting the electrochemical cell shown above. Under standard conditions, the electrical potential of the cell should be -/+ ________V.

(Record your **three-digit answer** in the numerical-response section on the answer sheet.)

4-2. In the electrochemical cell above, electrons move through the

A. electrolyte because they are attracted to the positive ions in the solution
B. electrolyte in one direction and protons move through the electrolyte in the opposite direction
C. wire from the electrode with the lower reduction potential to the electrode with the higher reduction potential
D. wire from the electrode with the higher concentration of electrons to the electrode with the low concentration of electrons

Use the following information to answer the next two question.

Common household bleach is an aqueous solution that contains approximately 5% sodium hypochlorite. The equilibrium involved in the production of bleach from chlorine can be represented by the reaction equation:

$Cl_{2(g)} + 2\ OH^-_{(aq)} \rightarrow C1O^-_{(aq)} + C1^-_{(aq)} + H_2O_{(1)}$

1-1. In the production of bleach, write down the oxidation and reduction half-reactions.

1-2. Write the overall cell reaction.

Figure 5. Fifth part of the text

RESULTS AND FINDINGS

Ho1: there is no significant mean difference between posttest and pretest mean scores of students taught electrochemistry concepts with conceptual change teaching strategy and students taught with traditional teaching method in the high achieving schools (HAS). A one-way analysis of covariance was conducted to determine the effect of the two different teaching methods on posttest scores for HAS. Before the ANCOVA was ran, it was assumed that the pretest is linearly related to the posttest, for all groups of the independent variable, teaching method in HAS. A scatterplot of posttest against pretest groups on teaching method is plotted as shown in Figure 1.

Figure 1: Scatterplot of posttest against pretest grouped on teaching method for HAS

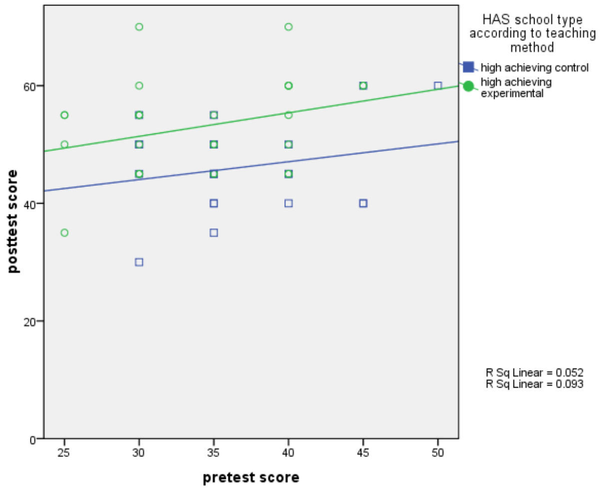


Figure 1 clearly shows that there is a linear relationship between pretest and posttest scores for each intervention type for HAS, as is confirmed by a visual inspection of the scatterplot. It was also assumed that there is no interaction between the pretest and the teaching method for HAS. This was statistically tested by determining whether there is a statistically significant interaction term, teaching method*pre-test. In order to do this, a general linear model univariate analysis was conducted. The result indicated that there was homogeneity of regression slopes as the interaction term was not statistically significant, $F(1,47) = .066$, $p = .799$. When the Explore procedure was ran, it emerged that posttest scores were normally distributed for both HAS control (p=.342) and HAS experimental (p=.094), as assessed by Shapiro-Wilk's test ($p > .05$). Similarly, there was homogeneity of variances, as assessed by Levene's test of homogeneity of variance ($p = .825$). ANCOVA was ran for only HAS. The results of ANCOVA analysis are presented in Table 1. From Table 1, it is observed that there is a statistically significant difference in posttest scores between HAS control and HAS experimental, $F(1,48) = 13.335$, $p = .001$, partial $\eta^2 = .217$. The strength of the relationship between instruction method and comprehension of electrochemistry concepts was strong. Instruction method accounted for 21.7% of the variance of the dependent variable when the pretest is controlled as a covariate.

Table 1: **ANCOVA Summary on Comprehension for HAS**

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	828.928a	2	414.464	7.380	.002	.235
Intercept	1767.350	1	1767.350	31.471	.000	.396
pre	219.208	1	219.208	3.903	.054	.075
SchtypteachHAS	748.881	1	748.881	13.335	.001	.217
Error	2695.582	48	56.158			
Total	130525.000	51				
Corrected Total	3524.510	50				

a. R Squared = .235 (Adjusted R Squared = .203)

When post hoc analysis was performed with a Bonferroni adjustment, the experimental group for HAS had the highest posttest scores, which were statistically significantly higher than the posttest scores of the control group ($p = .001$). The results are presented in Table 2.

Table 2: Pairwise comparison between HAS experimental and control groups

Teaching method		Mean Difference	Std Error	Sig.
HAS Control	HAS Experimental	-7.899*	2.163	.001
HAS Experimental	HAS Control	7.899*	2.163	.001

The ANCOVA results presented in Table 1 showed that there was a significant difference between the posttest mean scores of students taught with the traditional teaching method and those taught with the conceptual change teaching strategy with respect to comprehension of electrochemistry concepts in the High Achieving Schools. To confirm this, analyse and compare means procedure was run. Table 3 presents the posttest means and standard deviations of the control and experimental groups. The results from the table indicate that mean posttest ECT score (53.04 ± 7.97) for the experimental group was higher than mean posttest ECT score (46.06 ± 7.38) for the control group.

Table 3: Mean and Standard deviation for HAS

Teaching Method	Mean	Standard deviation	N
High achieving Control	46.06	7.379	23
High achieving Experimental	53.04	7.974	28
Total	46.83	8.883	51

The results suggest that the students taught with CCTS had a better understanding and hence higher comprehension level of electrochemistry concepts after the intervention. Even though the experimental group had a higher overall mean score than the control group, there were some items for which the experimental group scores decreased compared to the control group.

Ho2: there is no significant relationship between high achieving physical sciences students' posttest mean scores on their perception of their chemistry classroom environment and their achievement in electrochemistry concepts. The results of the analysis are presented in Table 4.

Table 4: Correlation between CCEQ and ECT Scores of EG Students

Variable	N	Correlation Coefficient	p-values
CCEQ	51	0.217	0.02
ECT	51		

Pearson Product-Moment Correlation was used to check correlation between CCEQ and ECT posttest mean scores with respect to students` perceptions of their chemistry classroom environment. The results revealed that there was a significant relationship between achievement and students' perceptions of their chemistry classroom environment ($p < 0.05$). This suggests that as students' perceptions of their chemistry classroom increase, it results in an increase in their performance on the ECT.

CONCLUSION

The Constructivist approach to instruction used in this study caused an improved level of understanding of electrochemistry concepts compared to traditional method of instruction. Gain scores of experimental group were significantly higher than those of control group. The results of the ANCOVA analysis show the differences between the experimental and control groups' performance on ECT. The students in the experimental class provided better structured and more precise answers in the fill-in questions, showing that they had higher level of scientific comprehension and were more confident in writing their responses than the control group, whose answers were shorter and lacked some key features of the scientific explanations. Consequently, this study has provided evidence that Collaboration combined with conceptual change text teaching strategy enhances students` level of comprehension of electrochemistry concepts in particular and Chemistry in general.

Thus, there must be some aspects of the collaboration combined with conceptual change texts that contributed to these differences in the achievement of these groups. The findings in this study have provided some empirical evidence that many students developed conceptual difficulties in this learning area and the results do not support any assumption that normal classroom teaching has provided essential support for students to generate detailed, factual explanations about the chemical phenomena. This calls for concern and needs to be tackled in the classroom teaching and learning regarding a specific, difficult area in chemistry. Also, the findings suggest that the typical classroom teaching and learning strategy characterized by lecture or talk and chalk or telling method of teaching is incongruous for improving students' conceptual understanding. Drawing from this, the

effectiveness of the collaboration combined with conceptual change texts can be determined according to whether or not students in the experimental group had developed a better conceptual understanding after teaching in comparison to the controlled group.
The results also indicated that there was a positively significant correlation between achievement and classroom environment (encompassing students` cohesiveness, teacher`s support, student involvement, students` cooperation without competition and equity) in favour of the experimental group. This suggests that the higher the students' perception level of their chemistry classroom, the higher is their achievement on the ECT.In conclusion, some aspects of the collaboration combined with conceptual change texts may have achieved some particular teaching and learning aims.

RECOMMENDATIONS

The designed teaching strategy of this study has a promising potential to be used as a tool in the South African classroom in order to improve students' conceptual understanding of electrochemistry concepts for higher achievement as is shown in the report. It is therefore recommended that the Chemistry teacher should endeavour to determine necessary concepts in the chemistry syllabus and acquire the appropriate knowledge and applicability of relevant instructional strategies such as collaboration combined with conceptual change text for improved achievement of students. This will further increase the efficiency and effectiveness of the teacher.

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TEACHING STRATEGIES MEDIATED BY TECHNOLOGIES IN THE EDULAB MODEL: THE CASE OF MATHEMATICS AND NATURAL SCIENCES

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ABSTRACT: The EduLab model is a new educational model that integrates technologies in educational contexts comprising full equipped classrooms with attractive and easy-to-use technological resources. This model tries to promote a dynamic and more effective teaching and learning process, boosting the digital inclusion of everyone involved. For this purpose, the model provides teachers training and monitoring in order to encourage innovative pedagogical and acting formats, such as collaborative work, flipped classroom and research-based learning (Pombo, Carlos, & Loureiro, 2015). In the "EduLabs", every classroom is equipped with computer, projector and interactive whiteboard. Additionally, both students and teachers have tablets, digital schoolbooks and educational resources, as well as a classroom management software.

The current article intends to characterize and analyse the developed teaching strategies with the use of the available technologies, carried out in the subjects of Mathematics and Natural Sciences in a fifth grade class in the Gafanha da Nazaré School Grouping (Aveiro, Portugal). With this purpose, classes observations from the considered subjects took place, where observation grids were filled in, as well as the researcher book note. In addition, data were collected through the survey technique (by interview) to the teacher of the class.

In the Natural Sciences subject, technologies were used, particularly, to support the resolution of work proposals. The research-based learning and collaborative work were implemented as a way to develop skills and "acquiring" knowledge by the students. In some Natural Sciences lessons, flipped classroom method was implemented with significant gains for students' learning. In the Mathematics lessons, technologies were used, especially to support the resolution of work proposals and oral exposition by teacher. There was also a diversification of strategies; however, attending to the specificity of the subject, the curriculum extension and the need to prepare students for external evaluation, the implementation of innovative strategies was uncommon.

Key words: EduLab model, technologies, teaching strategies, innovation, Mathematics and Science Education.

INTRODUCTION

The current paper is part of the doctoral project in Multimedia in Education (University of Aveiro, Portugal) of the first author, being the second author her supervisor. This project aims to evaluate the impact of the EduLab model on basic education and is integrated in the AGIRE project (Apoio à Gestão Integrada da Rede Escolar - Support for School Network Integrated Management), a partnership between the University of Aveiro (Portugal), the Consortium E-Xample (which gathers 26 companies in the areas of education and/or technology) and the Gafanha da Nazaré School Grouping (Aveiro, Portugal) (AEGN).

The AGIRE project was created to support the implementation of the EduLabs project in AEGN. The EduLabs project intends to lead on, as a new model of technologies integration in education, through not only the availability of various technological resources, but also, teachers' training and monitoring the integration of technologies in classrooms as well as resources optimization. It is a pilot project that, in the academic year 2014/2015, was implemented in ten groups of Portuguese schools, among them the AEGN. In this academic year, twelve AEGN teachers were involved as well as five courses of three education cycles, totalizing around 100 students.

This paper aims to characterize and analyze the teaching strategies implemented using technologies, in Mathematics and Natural Sciences' subjects, in a fifth grade class of the AEGN EduLab. In order to achieve this aim, data were collected through the techniques of survey (by interview) and observation (grids and researcher book note).

This chapter begins by presenting the theoretical foundation related to the above mentioned thematic, which focuses essentially on the principles of the EduLab model' innovative teaching strategies and the use of technologies in Mathematics and Natural Sciences subjects. In the following chapter, some methodological considerations in terms of data collection techniques and instruments will be presented, as well as the respective treatment techniques and analysis. Then, the results regarding the frequency of use of available technological resources in the AEGN EduLab and the objectives associated with its use will be presented. In chapter "Results" there are some considerations about the implemented teaching strategies with the use of technologies in the Mathematics and Natural Sciences subjects and their impact on the teaching and learning process. Finally, the main conclusions and recommendations for future work will be presented.

EduLab Model

The recognition of the potential of technology in an educational context, have lead that, in recent years, Portuguese schools have been implementing various initiatives and programs to support the integration of technology in the teaching and learning process. It is possible to highlight, for example, the Minerva project, Nónio-Século XXI program, "Equipa de Missão Computadores, Redes e Internet na Escola" (Mission Team Computers, Networks and Internet at School) and "Plano Tecnológico da Educação" (Technological Plan of Education), among others.

The Minerva project, which took place between 1985 and 1994, was the first major initiative to promote the use of technologies in educational context in Portugal. This project had as main goals the inclusion of ICT (Information and Communication Technologies) subject in the curriculum, the use of ICT as an auxiliary tool for teaching other subjects and the training of trainers and teachers (Ponte, 1994).

In 1996, the Nónio-Século XXI program continued the Minerva project and intended to promote the continuous training of teachers, the production of educational software and the encouragement to collaborative network. On the other hand, Nónio-Século XXI program sought to support the development of school projects in partnership with higher education institutions and training centres, designated "Competence Centres". These centres acted as promoters for reflection and research on integration of the ICT in education and supported the preparation and implementation of projects presented by schools (Rego, Gomes, & Andrade, 2000; Order number 232/ME/96, October 29).

In 2005, the Portuguese Ministry of Education established the "Equipa de Missão Computadores, Redes e Internet na Escola" which had as purpose to "design, develop, implement and evaluate mobilizing and integrative initiatives in the use of computers, networks and Internet in schools and in the teaching and learning processes" (Order number 16 793/2005, August 3, p. 11099).

In 2007, the "Plano Tecnológico de Educação" was implemented whose basic goals were: to ensure the technological equipment of schools, to support the development of digital content, to focus on teachers training in ICT and to enhance the dissemination of good practices (Resolution of the Council of Ministers number 137/2007, September 18).

Currently, it is being developed a new educational model that, by the use of technology, seeks to respond to the needs and interests of future generations, the EduLab model.

The EduLab model, whose name comes from the combination of the words "education" and "laboratory", intends to guide a new model for technologies integration in educational contexts. In addition to providing technological resources, this model predicts teachers' training and accompaniment, in order to ensure that the use of technologies is made of a pedagogical and motivational way, with advantages for the teaching and learning process.

The EduLabs constitute experimental teaching and learning ecosystems, equipped with technological resources to be used in a pedagogical way, seeking to promote innovation in the following topics: *i)* development of digital literacy of those involved in the project; *ii)* teachers' training and monitoring the integration of technologies in education process; *iii)* implementing innovative education practices; *iv)* educational community's involvement in the project; and *v)* the development of digital contents (Pombo, Carlos, & Loureiro, 2015) (Figure 1).

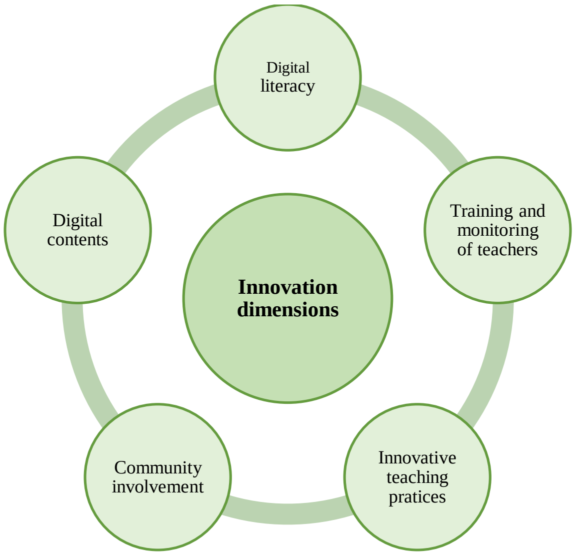

Figure 1. Dimensions of intervention and innovation of the EduLabs project.

Classrooms used in the EduLabs project context are equipped with computer, interactive whiteboard and projector. Both students as teachers involved in the project have a laptop/tablet with integrated textbooks (in digital format), having access to an Open Educational Resources platform (OER), e-learning software/classroom management (Mythware) and Internet (see Figure 2).

Figure 2. Available resources in the EduLab model (adapted from E-Xample, 2014).

In AEGN EduLab, first level students, particularly of primary education (6-10 years), use a laptop, while higher levels of education use the tablet as a device to support teaching and learning. In both cases, the use of resources is based on a "one to one" relationship: a computer/tablet for each student.

Of the various available devices, tablet is the one that, according to Dixon and Tierney (2012), best suits the philosophy "1-to-1 learning" and, consequently, the BYOD (Bring Your Own Device). The tablet allows people to create content, collaborate and communicate. When equipped with a pen, the tablet is totally appropriated for learning because it offers a wide range of educational opportunities, such as converting small notes to texts and writing chemical and mathematical formulae. Dixon and Tierney (2012) argue that the purpose of the "1-to-1 learning" is to create more autonomous learners, confident and with ability to learn throughout life.

The BYOD philosophy increases the opportunities of learning and facilitates the development of 21st century technical skills, as well as soft skills, such as communication, collaboration and creativity (European Schoolnet, 2015). "BYOD" turns learning more active and engaging and promotes the development of creative, intellectual, conceptual and analytical thinking, as well as understanding and connection ideas, new forms ability (Dixon & Tierney, 2012). The European Schoolnet (2015) also argues that the implementation of BYOD improves the teaching quality since it allows teachers to provide differentiated learning experiences that meet students' specific needs and learning styles.

On the assumption that digital content use and access to applications and teaching platforms promote an interactive and motivating learning environment, the EduLab model recommends technologies to be associated with teaching formats and appropriate actions in order to provide a more efficient and dynamic teaching and learning process. With the EduLabs project it is intended to develop a work of continuous improvement in the "pedagogy-technology" relationship, by frequently assessing their impact. Thus it seeks to optimize, whenever appropriate, resources and pedagogical practices.

Verdú and Lorenzo (2010) underline that the learning styles of students, the kind of skills and competences to be developed, the content and the available resources are factors that may determine the success of teaching and learning implementation strategies. The authors point out that the use of diverse strategies is advantageous and that technologies can facilitate the implementation of these strategies.

In order to ensure that the technology has a positive impact in the teaching and learning process, the EduLab model provides, for teachers involved in the project, training in a b-learning system, in two phases: initially, a 15 hours training course with technological nature that focuses on the use and the potential of available technologies; and, subsequently, a 64 hours training workshop with pedagogical character, where teachers discuss relevant strategies for teaching in the project context (Carlos, Pombo, & Loureiro, 2014).

As Prensky affirms (2005), even if access to technology in the classroom is guaranteed, this is not a sufficient condition for teachers to incorporate into their teaching practice. It is necessary that teachers are predisposed to do so, putting technologies at the service of a higher quality educational process, which implies a change in the school practices and the adoption of innovative teaching practices. In this sense, teachers training referred to the EduLab model is based on two main objectives: *i)* to promote the integration of technology in the classroom, creating learning enhancers environments; and *ii)* monitoring activities implementation using technologies in the classroom with students (Carlos, Pombo, & Loureiro, 2014). Thus, teachers training and monitoring emerges as a way of encouraging the implementation of innovative education practices, namely, flipped classroom, collaborative work and research-based learning (Pombo, Carlos, & Loureiro, 2015).

Innovative teaching strategies mediated by technologies

There are several studies and authors that set out the potential of using technologies in educational contexts, reason why, in recent years, it has been encouraged their integration into the teaching and learning process. The positive impact on a motivational level and the support of 21st century skills development, such as communication, collaboration, critical thinking, problem solving and creativity, are some of the benefits which have been recognized (Balanskat, Blamire, & Kefala, 2006; Jonassen, 2007; Schrum & Levin, 2009).

European Commission communication *Opening Up Education: Innovative teaching and learning for all through new Technologies and Open Educational Resources* (2013), highlights the fact that technologies allow to extend the learning contexts beyond the classroom: "open technologies allow All individuals to learn, Anywhere, Anytime, through Any device, with the support of Anyone "(p. 3). In addition, Casa Nova (2014) claims that the technology-mediated learning is a student-centered learning that promotes the development of essential skills to academic and/or professional path, which could not be developed without technologies use. The author suggests a diagram (Figure 3) that reflects the state of maturity of the use of technology in an educational context, where it highlights the focus on learning rather than technology.

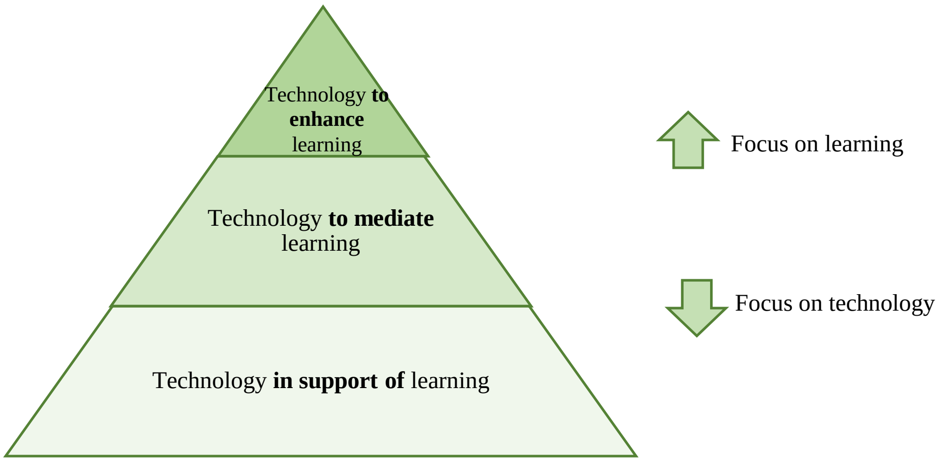

Figure 3. State of maturity of the use of technology (adapted from Casa Nova, 2014).

Thomas and Knezek (2008) state that the implementation of educational practices that promote the integration of technologies depends, on one hand, on the access to technological resources and, on the other, the skills that the teacher has to facilitate students' learning through the use of these resources. The British Educational Communications and Technology Agency (BECTA, 2009) adds that the teacher professional development is the key for teachers to use technology effectively and that the appropriate use of technologies can enable "spare" time.

Ruivo and Mesquita (2013) state that an "aseptic and brainless use" of technologies in the classroom, "without any pedagogic-didactic contextualization", is a "waste of investment" (p. 12). In this context, it makes sense that, as in the EduLab model, teachers are trained and supervised in the process of integration of technologies in their classrooms, promoting, whenever possible, the adoption of innovative teaching practices. The flipped classroom methodology, the collaborative work and the research-based learning are some of the methodologies that may be highlighted hare and that will be briefly exposed afterwards.

The flipped classroom methodology, as its name suggests, is based on the inversion of the tasks that are usually made at home and school. Thus, the tasks that are usually made in the classroom, such as topic exposure, for example, are made at home, independently by the student using a learning resource, for example, a video, suggested by the teacher. On the other hand, the tasks that normally are performed at home, as the consolidation of a theme and the resolution of exercises, for example, are to be held in the classroom (Bergmann, Overmyer, & Willie, 2011). So, in the classroom, it is favored students' interaction, collaborative work, questions, debates and problems solving related to those contents "studied" at home. The implementation of this teaching strategy raises a change in teacher and students' role. The teacher stops being assumed as a knowledge transmitter and starts to guide the students in a process in which they are held accountable for their learning, assuming a more active role (Bergmann, Overmyer, & Willie, 2011; Bergmann & Sams, 2012; Tucker, 2012).

The collaboration turns learning into a social activity (Maier & Warren, 2002), which is characterized by the involvement and active participation of the students in achieving a common goal (Seabra, 2013). According to Verdú and Lorenzo (2010), collaborative learning allows students to create synergies among themselves that may result in a better performance of all, as well as lead to better learning outcomes. In addition, the friction between students is reduced and there is a higher motivation. The authors synthesize a set of benefits of implementing collaborative learning. For example, they highlight that the students have more favorable attitudes for learning and the cognitive conflicts that emerge from the group work can enrich the comprehension. In this sense, the collaborative and collective construction of knowledge can be reflected in a cognitive level, with gains in learning, but also in an affective level, which may result in increasing motivation and feelings of satisfaction (Pombo, Loureiro, & Moreira, 2010; Pombo & Talaia, 2012).

Verdú and Lorenzo (2010) underline that any imbalance in the distribution of tasks may be a disadvantage for the implementation of collaborative learning. Based on studies of other authors, Verdú and Lorenzo (2010) point out other factors that might constitute disadvantages in collaboration, in particular, the fact that this work can result only in a mere cooperation or some members of the group in order to persuade the others to carry out tasks in their own way. In addition, the authors state that without proper guidance by the teacher, sharing answers and tasks within the groups can be reduced, by minimizing the advantages of collaborative work.

The research-based learning seeks concepts, attitudes and values construction, where teacher promotes learning situations in which the student participates actively in the construction of their knowledge (Cachapuz, Praia, & Jorge, 2002). The perspective of research-based learning values the students' previous ideas and error situations and argues that the methodological and pedagogical resources strategies must provide students the integration of concepts, as well as the analysis and reflection of their own methods of work (Lucas & Vasconcelos, 2005).

Cachapuz, Praia and Jorge (2002) point out four principles of the research-based learning perspective: *i)* the inter and transdisciplinarity in order to understand the world in its entirety and complexity; *ii)* approach to daily problem situations, that could allow to reflect on the processes of science and technology and their relationships with society and the environment, promoting informed and responsible decision-making, as well as attitudes and values development; *iii)* methodological pluralism, at the work strategies level; and *iv)* educational assessment, which is intended to be regulatory and guiding.

The research-based learning strategy assumes major importance in the context of the science education and seeks to ensure that lessons are useful in students' personal and social development, future citizens of a, democratic, technologically developed and open society (Cachapuz, Praia, & Jorge, 2002).

The technologies in Mathematics and Natural Sciences' subjects

The document "Organização Curricular e Programas" (Curriculum Organization and Programs) (Ministry of Education, n. d.), set for fifth and sixth grades Natural Sciences discipline, acknowledges that the scientific and technological character of current society requires an adequate response from the school. In this sense, school must provide students with scientific and technical knowledge and attitudes to ensure that they will apply this knowledge in the future. Thus, Natural Sciences subject should allow students development and their understanding of themselves and the world around them; the development of concepts, skills and attitudes that promote taste for knowledge and discovery; and the development of understanding science as a means to solve real-life problems, including the technological character.

Costa, Rodriguez, Cruz and Fradão (2012) stress that the use of technologies to mediate methodologies, which respond to science education specificities, promotes the development of scientific expertise at the knowledge, skills and attitudes levels.

With regard to Mathematics, Costa et al. (2012) refer that research underlines the importance of integrating the technologies in teaching the subject, whose benefits are reflected in the development of autonomy, curiosity and "cognitive contact" with Mathematics; in the improvement of the patterns identification, as well as the connection between mathematical ideas; in increasing opportunities for real data exploration; and access to visual representations to mathematical ideas. The authors state that, currently, there is a wide range of technologies that can be seen as mediating tools of Mathematics' teaching and learning processes, leading to the development of skills, knowledge and mathematical skills. They highlight, for example, Internet, dynamic geometry software, the spreadsheet and the programs based or inspired in the programming language LO GO.

PISA 2012 report from the Organization for Economic Co-operation and Development (OECD, 2014) points out that, in general, students who often use the technologies in the Mathematics classroom believe that their teachers implement more effective strategies, including structuring practices, student-oriented practices, formative assessment and cognitive activation. This report stresses that teachers who are well prepared to implement student-oriented teaching practices (including individualized learning, group work and collaborative project work), are more willing to integrate the technologies in their classes, whenever the necessary resources are available.

METHODS

The doctoral project that is the basis of the presented paper is a mixed nature case study, which aims to assess the impact of the EduLab model in the educational process in basic education. Particularly in this paper, it is intended to characterize and analyze the teaching strategies implemented in the context of the AEGN EduLab, in the fifth grade class and in Mathematics and Natural Sciences subjects.

The class comprises twenty students, twelve (60%) males and eight (40%) females, whose ages, at the beginning of the academic year, were between nine and twelve years old. In this class there are included two special educational needs pupils. There are also two students with retentions in the fifth grade, the previous academic year, and a student with retention in the second grade.

In order to characterize and analyze the teaching strategies implemented in this class, in Mathematics and Natural Sciences' subjects, data was collected through the techniques of observation and survey.

The researcher observed sixteen Mathematics and twelve Natural Sciences lessons, throughout the academic year 2014/2015, in a fifth grade class. When defining the methodological procedures, it was opted for the non-participant observation, since it is not expected to have interaction with the study object at the time of the observation (Carmo & Ferreira, 2008; Sousa, 2009). However, during the investigation, it was considered appropriate to choose a participant observation in order to understand, with more detail, how the strategies were implemented and how was the impact among students, ensuring, however, the same rigor, objectivity and impartiality in the investigation. From the observation grids filling and class registration resulted from an *online* form (https://docs.google.com/forms/d/1H_iRn2w-0hSI8vyBTdSJDlfx8vDdzGyPp8x8GeTluSQ/viewform), common to all years of schooling and subjects in which the EduLabs project in AEGN was implemented. This form intended to identify the resources used, implemented strategies and objectives associated with the implementation of these strategies. On the other hand, the form allowed assessing the impact of the use of technological resources (and respective strategies) in the teacher, students, class management and learning. In addition to the lessons registration grids, the observation, also reflected in the researcher book note, assumed both descriptive and reflective character.

The data collected through the technique of observation were complemented with an interview to the Mathematics and Natural Sciences teacher, who teaches the two subjects in the involved class. The survey interview allows the investigator to interact with the respondent in order to collect descriptive data and additional information in his/her own language, allowing the investigator to intuitively develop a conception of how the person interprets the situation (Bogdan & Biklen, 1994; Coutinho, 2013). The main objective of this interview was to characterize the teaching strategies using the technologies implemented in Mathematics and Natural Sciences subjects in AEGN EduLab and the teacher's perspective on the teaching and learning process respective impact. In this sense, the interview was divided into 6 thematic blocks, shown in Table 1.

Table 1. Thematic and specific objectives of the interview.

Thematic blocks	Specific objectives
A. Professional characterization of the interviewee	• To characterize the academic career of the interviewee; • To characterize the professional experience of the interviewee; • To know the training course of the interviewee in the field of technology.
B. Integration in the EduLabs project	• To know the motivations of the interviewee to integrate the EduLabs project.
C. Teaching strategies that use technologies implemented in the classroom	• To know the technological resources used by the interviewee in her classes before and after joining the project; • To characterize the implemented teaching strategies using technologies in the classroom; • To identify the changes in teaching practice caused by the integration in the project.
D. Impact of the use of technologies in the teaching process	• To know the interviewee perspective of the impact of technologies in the teaching process; • To know the interviewee perspective on the contribution of technologies to the implementation of innovative teaching strategies.
E. Impact of the use of technologies in students and learning	• To know the perspective of the interviewee about benefits and disadvantages of the use of technology to students and the learning process.
F. Barriers to the use of technologies and to the implementation of innovative strategies in the classroom	• To identify barriers to the use of technology in the classroom; • To identify barriers to the implementation of innovative education strategies.

The teacher interviewed is graduated in Math and Sciences of Nature Teachers on Basic Education. She teaches for about twenty years, always in the fifth and sixth year, and, in the academic year 2014/2015, she was the Mathematics and Natural Sciences teacher of the observed lessons. The teacher believes that the integration of technology in education has several potential, both for teaching and learning, reason why she proved to be available to integrate the project in the AEGN EduLab. Throughout her career she made several training in educational technologies area, especially related to Mathematics.

The data collected through the lessons registration grids, given their majority quantitative nature, were statistically target. On the other hand, the data collected through the researcher book note and by interview conducted with the Mathematics and Natural Sciences teacher, by their nature, were treated using qualitative content analysis.

Table 2 summarizes the techniques, instruments, registration forms and data collection sources considered in this paper, as well as data analysis techniques adopted.

Table 2. Data collection and analysis.

Data collection techniques	Data collection instruments	Registration forms	Data collection sources	Data analysis techniques
Observation	Researcher book note	Written notes by researcher	16 Mathematics' lessons	Content analysis
	Registration grids	Online form	12 Natural Sciences' lessons	Statistical treatment
Survey	Interview guide	Audio recording and transcription	Interview to Mathematics and Natural Sciences' Teacher	Content analysis

The results are presented in the next chapter.

RESULTS

This chapter presents the results regarding the frequency of use of available technological resources in the AEGN EduLab and the objectives associated with its use. There are also some considerations about the teaching strategies implemented with the use of technologies in the Mathematics and Natural Sciences subjects and their impact on the teaching and learning process. This description is accompanied by a reflection that takes into account the data collected in the researcher book note and the interview to the Mathematics and Natural Sciences teacher.

It should be noted that due to rounding, the sum of the relative frequencies of some parameters of the graphs presented in figures 13, 14, 15 and 16 apparently do not make 100%, it can have a maximum deviation of 1%.

One of the basis of the EduLab model is equipping classrooms with technological resources, to be used in motivating and pedagogical way. As previously mentioned, AEGN classrooms of the EduLabs project are equipped with computer, projector and interactive whiteboard. In addition, the teacher and the students in the class have a tablet with integrated digital books and access to Open Educational Resources (OER) of Leya Platform and e-learning software/classroom management (Mythware). In the following paragraphs, the results related to the use of the available resources frequency will be presented.

In Mathematics, it is shown a very frequent use of computer, tablet and projector in 88% of the observed lessons (value that corresponds to 14 of the 16 observed lessons). Less frequent is the use of digital books (50%, 8 lessons), the interactive whiteboard (38%, 6 lessons), OER and Mythware software (25%, 4 lessons) (Figure 4).

In Natural Sciences, there is a very frequent use of tablet in 92% of the lessons (value that corresponds to 11 of the 12 observed lessons) and computer and Mythware software in 75% of the lessons (9 lessons). Less frequent is the use of the projector (58%, 7 lessons) and the OER and the digital book (33%, 4 lessons). In Natural Sciences subject, the interactive whiteboard was used in an interactive way in only one lesson. (Figure 4).

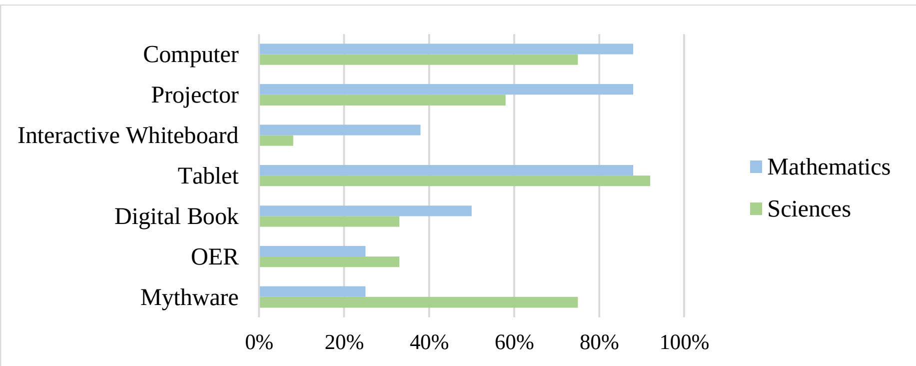

Figure 4. Technological resources used in Mathematics and Natural Sciences.

The Mathematics and Natural Sciences teacher highlights the tablet importance in this project, since in a single resource, teachers and students can access various applications (programs, games, digital books, among others). In addition the tablet is a part of the available material in all lessons (which may be used where appropriate), each student has a tablet for himself and they can enjoy the tablet outside school too. This factor is, in the opinion of interviewed teacher, an advantage for students' learning, since it facilitates the revision and consolidation of knowledge, "in many ways, as many times as they wish, anywhere and at any time".

Tablets have the books integrated in digital format and allow access to a platform of educational resources and Mythware software.

There are various advantages of educational resources used by the fifth grade class, whose impact on the teaching and learning process was considered positive by the teacher interviewed. It offers a wide range of interactive activities, such as review tests and consolidation of knowledge, to carry out an automatic correction and the immediate feedback to students. This platform also includes a diverse set of resources that can be used to address and explore content, such as videos that support the implementation of the flipped classroom methodology. In addition to the resources being presented in a visually appealing way, the platform encourages communication between students and between them and the teacher, through a forum where materials and information are available (Figure 5).

Figure 5. Platform of Open Educational Resources (Leya®), used in the fifth grade.

Along the observed lessons, the Mythware software (Figure 6) revealed many advantages at the level of file sharing, assessment and classroom management. It also allows control and monitor the students activities, such as sending/receiving files of any tablet which is "connected" and the creation of questionnaires, among many others possibilities. These questionnaires, which can assume assessment character, for example, allow the inclusion of different types of questions: single, multiple, alternative answer, true or false, gaps and open response. The software allows automatic correction of questionnaires and the immediate feedback for students and teachers. According to the Mathematics and Natural Sciences teacher, this feature constitutes an advantage for the teacher and higher motivation to students.

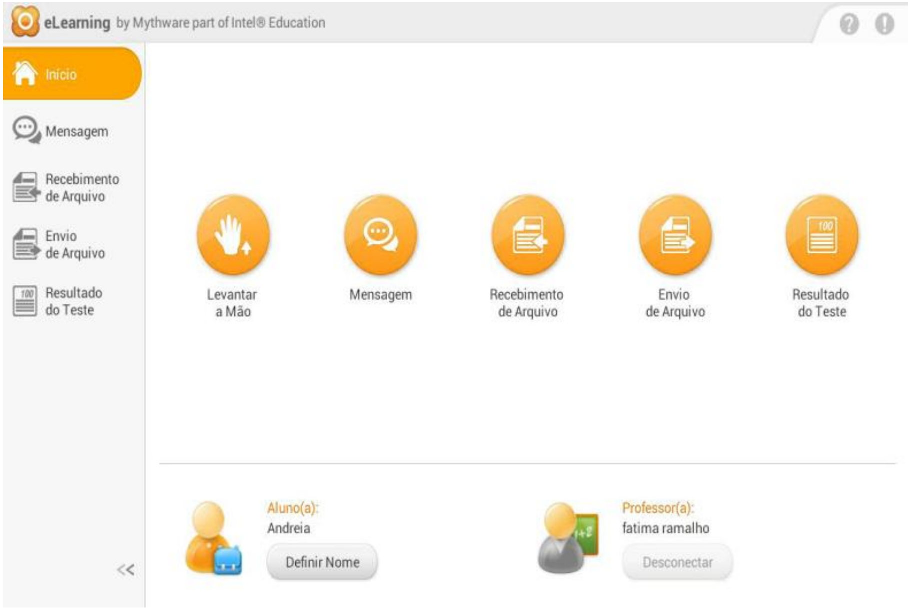

Figure 6. E-learning software and classroom management, Mythware.

In addition to the resources presented in Figure 4, in Mathematics there were used presentations created by the teacher to explore content, in 44% of the lessons (7), scripts of work in digital form in 19% of the lessons (3) and worksheets in digital form in 13% of lessons (2). In 38% of the observed lessons (6) was still used the dynamic geometry software, GeoGebra (Figure 7).

In Natural Sciences, there were used working scripts in digital form and videos in 33% of the observed lessons (4), worksheets in digital form in 17% of lessons (2) and presentations created by teacher in 8% of lessons (1). The students resorted to the Internet in 25% of lessons (3) (Figure 7).

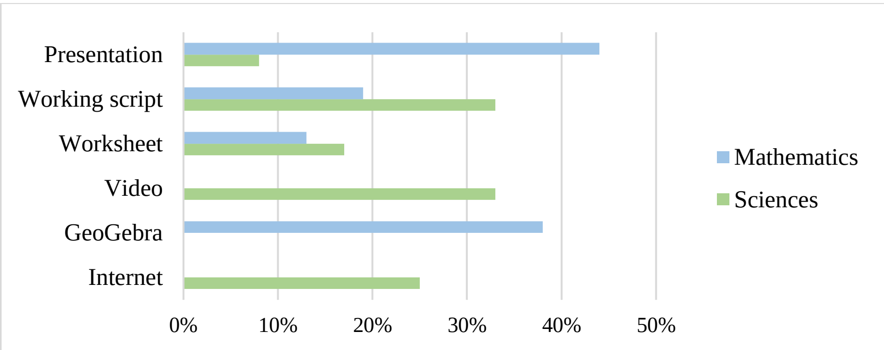

Figure 7. Resources used in Mathematics and Natural Sciences.

As evidenced in Figure 7, the software GeoGebra (Figure 8) was used in 38% of the Mathematics observed lessons. Initially, only the teacher, in exhibition or demonstration lessons, used this dynamic geometry software, for example, to differentiate lines, half-lines and lines segments. However, it is noted that in 25% of the lessons, students, using a script, searched the properties of parallelograms and triangles and formulated the triangular inequality, using this software. It was found that, in the first lesson, students showed some difficulties in the implementation of the steps suggested in the script of exploitation; however, progressively they showed higher level of autonomy and satisfaction in its use. For the teacher, the use of this software brought advantages because it allowed the preparation, in advance, the geometric constructions to exhibit to students along the lessons, saving time providing dynamics in class. However, the teacher also emphasized the importance of the use of drawing material, characteristic of geometry, in particular, ruler, set square, compass and protractor, articulating, frequently, two skills: digital and manual.

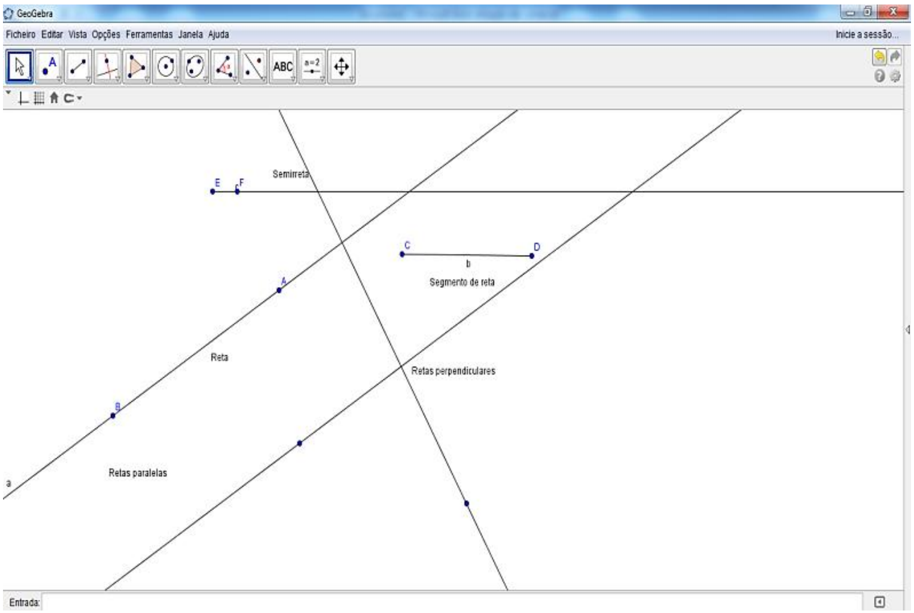

Figure 8. Dynamic geometry software, GeoGebra.

In general, both in Mathematics as in Natural Sciences, the resources were considered adequate to the objectives of the lessons. It was highlighted only a Math lesson (6%) in which the resources were considered unsuitable (Figure 9). That lesson was related to the thematic unit "Organization and data processing" by performing small statistical studies within the class. After establishing joint reflection between the teacher and the researcher, the resources were not considered fully suitable to the lesson' goals, because the potential of some available technologies was not appreciated in this context. For example, in the statistical study, instead of using "papers" it could be used the Mythware software. The teacher sent the question under study, with the four hypotheses, and the students answered using the software, which made it easier to count the students' answers. On the other hand, frequency tables, instead of being made in the blackboard, could be made on a worksheet, for example, that allowed students to reach a first graph's draft. However, despite not using technologies, students were equally motivated and involved in carrying out the tasks.

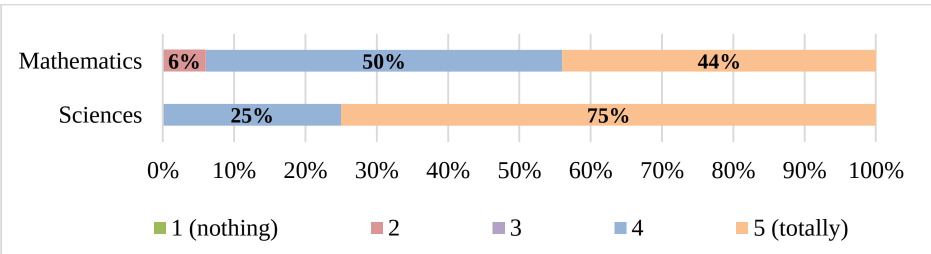

Figure 9. Suitability of technological resources to the goals of the lessons.

The EduLab model proposes that the objectives associated with the use of technologies should be translated into the benefits of teaching and learning process. In the following paragraphs, the goals associated with the use of technology in Mathematics and Natural Sciences will be presented.

In Mathematics, the use of technologies was mainly related with the work proposals resolution (75%, 12 lessons) and oral exposition of content by the teacher (50%, 8 lessons). There was still content production in 19% of the lessons (3), observation in 13% of lessons (2) and the revision of content in 6% of lessons (1) (Figure 10).

In Natural Sciences, the teaching strategies associated with the use of the technologies were more diverse. As in Mathematics, the technologies were mainly used to solve work proposals (50%, 6 lessons). However, there is research-based learning in 33% of lessons (4) and oral exposition by teacher, communication and evaluation in 25% of lessons (4). There was also the presentation of content by students in 17% of lessons (2) and observation and revision in 8% of lessons (1) (Figure 10).

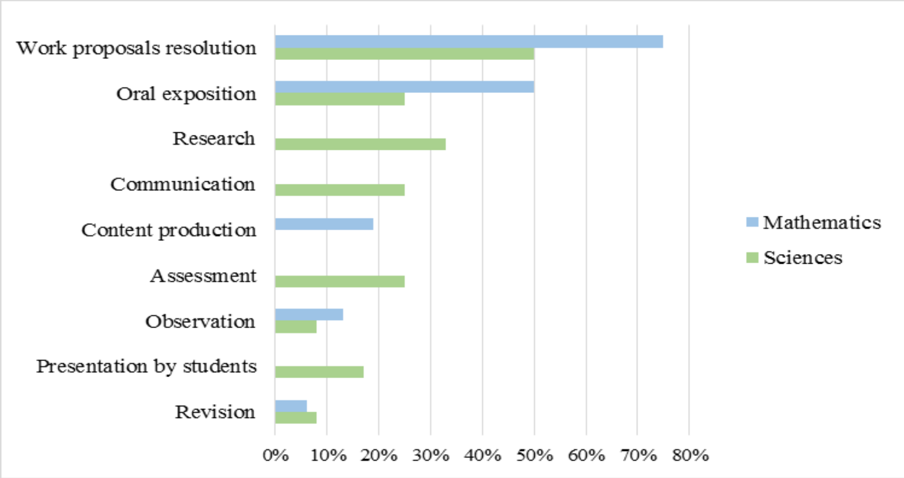

Figure 10. Objectives of technologies use.

The EduLab model seeks to promote innovation through the teachers' encouragement to implement innovative teaching practices with the use of technologies, such as the flipped classroom methodology, the collaborative work and research-based learning (Pombo, Carlos, & Loureiro, 2015). The results on the frequency of implementation of these teaching strategies will be presented afterwards.

In Mathematics, there has not been implemented the flipped classroom methodology and research-based learning. The collaborative work was promoted in 25% of lessons (4), however, there is a higher percentage of observed lessons where individual work was promoted (75%, 12 lessons) (Figure 11).

In Natural Sciences, all teaching strategies advocated by the EduLab model were implemented: flipped classroom in 25% of the lessons (3); collaborative work in 50% of lessons (6); and research-based learning in 33% of lessons (4) (Figure 11).

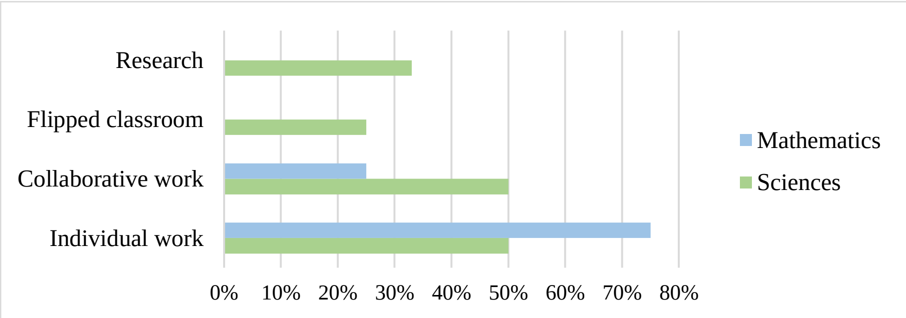

Figure 11. Teaching strategies implemented.

The teacher interviewed believes that the research-based learning strategy fits better to Natural Sciences, due to the nature of the subject content, and recognizes that she doesn't know how to apply this strategy in Mathematics. Some Natural Sciences lessons had, as main goal, the exploration of content upon proposal of a research activity. However, the fact that students have the tablet with internet access, allowed that research was also used as a strategy for questions and curiosities that arose in the course of the lessons. The teacher says that the research-based learning makes learning more interesting and allows students to develop skills for the future. In class, the students were very excited and motivated to carry out search activities. These activities were, in some lessons, a quick and effective way to "extend" the content in the videos suggested by the flipped classroom methodology.

Also the flipped classroom methodology has not been implemented in the math lessons. The teacher says that, in her opinion, the flipped classroom methodology has a lot of capabilities and can be implemented in all subjects, with the exception of Mathematics. In this subject case, the teacher believes that students need to have the "teacher to explain first, repeatedly and in different ways". However, the teacher points out that the implementation of the flipped classroom methodology makes students have a more active role in their learning, so that they learn better.

The flipped classroom methodology was implemented in 25% of observed Natural Sciences lessons. It was found that in the first lesson in which the strategy was implemented, some students previously have viewed the videos or have viewed them entertaining, not paying attention to details, factor that affected the management and the dynamics of the class. Progressively, and with greater awareness and guidance by the teacher, by sending out questionnaires or scripts, it was found that the implementation of the strategy of flipped classroom promoted autonomous learning and the development of skills.

The collaborative work was proposed in 25% of the observed Mathematics lessons and 50% of Natural Sciences lessons. However, the teacher believes that in some lessons collaborative work was not effectively carried out since there was no involvement of all students. The teacher adds that the disposition of the students in the classroom is an important aspect in the implementation of this work methodology. In Mathematics, students are pair sited and forming groups involves reorganization of the disposal of the students, what causes some" lost" time in lesson. For this reason, in some Math's lessons students worked with their pair. The teacher believes that this kind of work has a positive impact on learning since students share ideas and reasoning. In the case of Natural Sciences, the implementation of collaborative work is facilitated by the fact that the students are always arranged in groups of four elements, causing, systematically, to interact and help each other, creating progressively work routines. The Mathematics and Natural Sciences teacher believes that sometimes the individual work leads to a large commitment of students.

The strategies implemented have been considered appropriate to the lessons goals. It is highlighted only a math lesson (6%) in which the teaching strategies were considered less suitable (Figure 12). This lesson was intended to carry out small statistical studies on class, and teaching strategies as well as the used resources were not suitable (see analysis of Figure 9), because the potential of technologies in this context had not been considered.

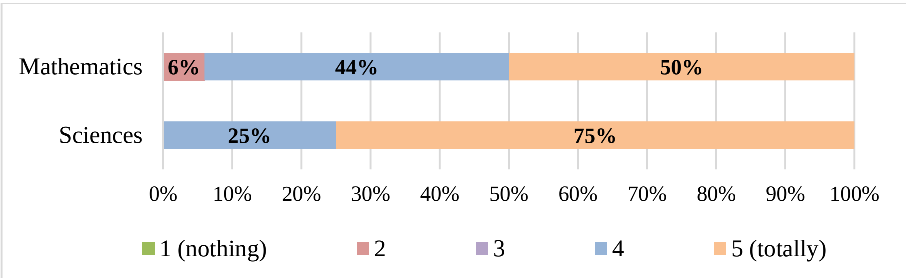

Figure 12. Suitability of strategies implemented to the lessons goals.

In most of the lessons observed in Mathematics (Figure 13) and Natural Sciences (Figure 14) it was considered that the use of technologies and the implementation of strategies for teaching and learning mediated by technologies had a positive impact in terms of motivation, engagement, autonomy and participation of students in both subjects.

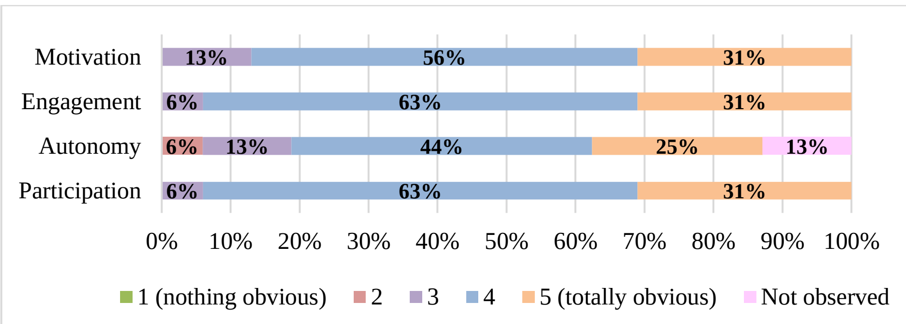

Figure 13. Impact of the use of technologies in the attitudes of students - Mathematics.

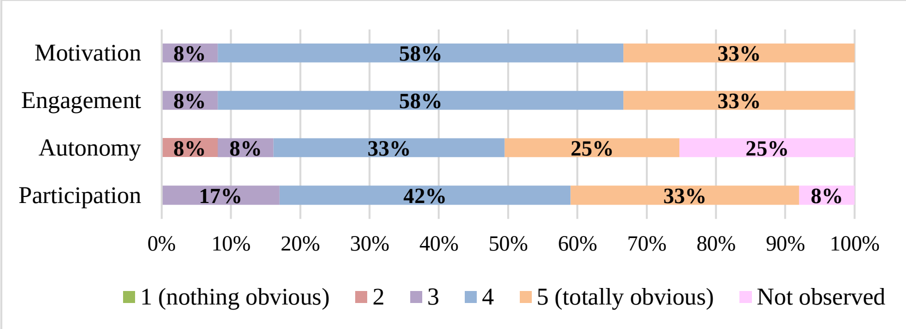

Figure 14. Impact of the use of technologies in the attitudes of students - Natural Sciences.

Mathematics and Natural Sciences teacher claims that, in most of the lessons, students are enthusiastic, motivated and involved. However, the teacher stresses that technology by itself, may not be motivating and that it is necessary to combine the technology with motivating and challenging tasks.

The teacher believes that, at an early stage in using the technologies, lessons may not be as dynamic, and there are various situations that compromise the rhythm of the lessons, as the digital skills demonstrated by different students. According to the teacher, and according to the observation made by implementing strategies that often resort to technologies, students demonstrate progressively greater autonomy and dexterity in the use of resources, making it a more dynamic and productive lesson.

In the specific case of Mathematics, a subject in which it is common that students have difficulties, the teacher considers that using technology can help to overcome some difficulties since students are more motivated, more alert, interested and involved. It was found that the use of technologies and the implementation of technology-mediated strategies clearly contributed to the development of students' skills, in particular, digital skills in 75% of the lessons (12), specific disciplinary skills 100% school (16) and problem solving skills in 63% of the lessons (10). Less clear was the development of communication skills, evident in only 25% of the lessons (4), and critical thinking, evident in 19% of the lessons (3). The goals of 50% of the lessons observed did not predict the development of creativity and in the others it was not evident that technologies had contributed to its development (Figure 15).

The fact that, in most Math lessons, it was not very evident the development of communication skills, critical thinking and creativity, that can be related with the teaching strategies implemented in this subject. According to the figure 10, the use of technologies in this subject was mainly associated with the resolution of proposals and teacher’s oral exposure. In addition, as shown in Figure 11, it was not implemented research-based learning and flipped classroom, whose potential suggests promoting the development of these skills.

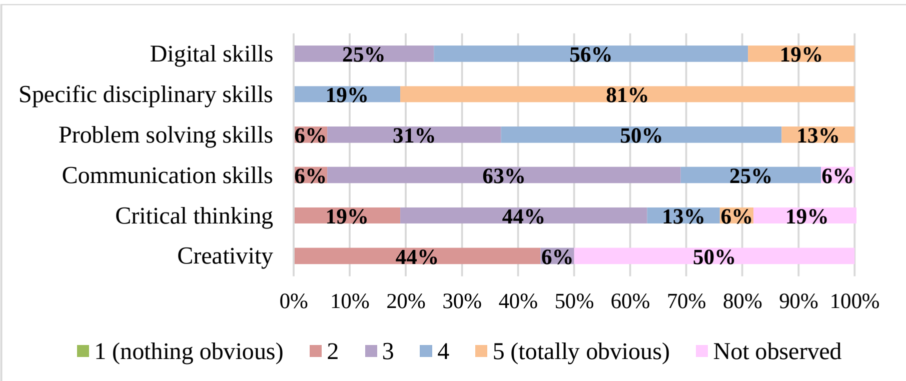

Figure 15. Contribution of technologies for the development of skills - Mathematics.

In the Natural Sciences it was considered that the implementation of technology-mediated strategies clearly contributed to the development of students' skills, in particular, digital skills in 84% of the lessons (10), specific disciplinary skills in 91% of the observed lessons (11), communication skills in 67% of lessons (8) and problem solving skills in 50% of lessons (6). Less clear was the development of critical thinking, evident in only 19% of the lessons (3). 58% of lessons (7 lessons) did not promote the development of creativity and, on the other lessons, as happened in Mathematics, it was not evident that technologies have contributed to development of creativity (Figure 16).

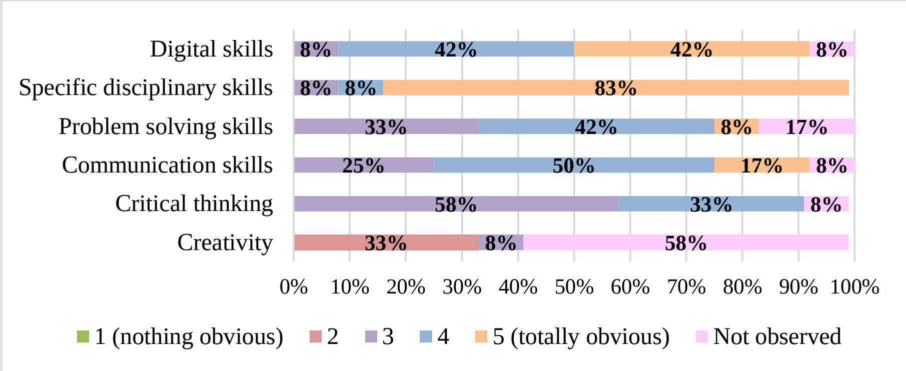

Figure 16. Contribution of technologies for the development of skills – Natural Sciences.

The teacher points out that one of their concerns in the preparation of school goes through planning activities to ensure that students have an active role in their learning, so that they learn best. She also considers that the technologies will give an important contribution to this end and says:

> "I don't know if the technologies encourage them to work more, however it seems that they lead to a more active role in students. […] I have no doubt that having an active role makes learning better because if the student produce, demand, search, conducts, try, definitely learns more and better. It may not be easy for them (students), but they will understand better, their learning is more significant and they retain better the information."

Despite the recognition of strategies that use technology potential, the teacher mentions some obstacles to its implementation, in particular the exams (in the case of Mathematics), the extension of the syllabus, learning goals' requirement and teachers' workload. Moreover, the fear that the strategies do not result (in terms of teaching and learning benefits), the fact that the technologies can make the lessons more hectic and noisy and the fear of not controlling what students are doing individually, constitute, in the opinion of the teachers, factors that can lead to uncommon implementation of these strategies.

The teacher also says that technologies trigger changes in the practice of teachers, which allows a diversification of strategies, which enriches the learning process to the extent that make it possible to explore different learning styles. On the other hand, the fact of being able to get an answer at any time in any place values and facilitates teaching and learning processes, in the opinion of teachers. The teacher further indicates that the existence of technologies may not make a strategy to be innovative but acknowledges that technologies facilitate innovation in education, since they can be used to improve the quality of teaching and learning.

CONCLUSION

By providing technological resources, training and coaching to teachers, the EduLab model aims to turn the teaching and learning process dynamic, efficient and motivating. In this paper, teaching strategies implemented in Mathematics and Natural Sciences class of fifth year involved in the EduLabs project were characterized.

Concerning the use of the available technologies in the context of the EduLabs project, both in Mathematics and in Natural Sciences, it is very frequent to use the tablet and computer and less frequent the digital books and OER.

The frequency use of the tablet reflects the importance assigned by the teacher to this resource in the context of the EduLabs project. The fact that each student has his/her own tablet, allowing him/her to use it at school and at home, has translated into benefits for the teaching and learning process and, according to the teacher, allowed "All individuals to learn, Anywhere, Anytime, [...], with the support of Anyone", as stated by the European Commission (2013).

In Mathematics, the use of technologies is mainly associated with the work proposal resolution and teachers' oral exposition. It should be noted that, whenever relevant, the teacher used also the geometry software, GeoGebra, one of recommendations of Costa et al. (2012). The fact that it combines the use of digital tools, as drawing tools and measurement instruments will also meet the propose of the document "Programas e Metas Curriculares de Matemática no Ensino Básico" (Programme and Curriculum Goals of Mathematics on Basic

Education" (Bivar, Grosso, Oliveira, & Timóteo, 2013). In this context, this document states that teachers should provide learning experiences that promote dexterity in the execution of strict geometric constructions and recognize mathematical results behind the different procedures.

In Natural Sciences, the goals associated with the use of the technologies were more diverse; however, for the most part, the technologies were used to solve work proposals. Diverse strategies might have a positive impact on teaching and learning and technologies may effectively facilitate this diversification (Verdú & Lorenzo, 2010).

With regard to the implementation of innovative education strategies suggested by Pombo, Carlos and Loureiro (2015), the results suggest significant differences in the subjects observed at the level of implementation and its frequency of implementation. In Mathematics there has not been implemented the methodology of flipped classroom or research-based learning. The collaborative work has been promoted in some lessons, whereas individual work has been promoted with a higher percentage. In Natural Sciences, all teaching strategies advocated by the EduLab model were implemented. In this subject, there have been a higher percentage of implementation of collaborative work when compared to Mathematics lessons. The teacher refers that she does not consider the implementation of the flipped classroom methodology and the search strategy in mathematics, regarding the subject content and the fact that students are more dependent on the teacher to learn. In part, this conclusion is in accordance to Verdú and Lorenzo (2010) who mentioned that the learning styles, the kind of skills and competencies to develop and the contents of a subject, are factors that should not be neglected in the teaching strategies to adopt.

Despite not having been implemented in Mathematics, teacher recognizes the potential of flipped classroom methodology, including a more effective and active learning, which reinforces what has been documented in the literature Nevertheless, the collaborative work was implemented in both subjects. In view of the difficulty in promoting a collaborative work effectively when students are arranged in groups, the teacher chose to propose pair's collaboration. The teacher believes that pair work has a positive impact on learning, since students share ideas and reasoning. The research-based learning was implemented only in Natural Sciences, in some planned lessons, while in others, this strategy was implemented in an unplanned way determined by the conducted activities. Cachapuz, Praia and Jorge (2002) stated that the teaching strategy for research assumes major importance in the context of science education and seeks to ensure that the lessons are useful in students' personal and social development. Students are very enthusiastic and motivated when implementing this strategy.

In both subjects, it was considered that the implementation of strategies for teaching and learning mediated by technologies had a positive impact in terms of motivation, engagement, autonomy and participation of the students. In addition, it was considered that the use of the technologies contributed to the development of skills, in particular specific disciplinary skills, digital skills and problem-solving skills.

Along the lessons observed in Mathematics and Natural Sciences, it was considered less clear the contribution of the use of technologies for the development of communication (evident only in some Natural Science lessons), critical thinking and creativity.

The fact that, in most Math lessons, it was not been very evident the development of communication skills, critical thinking and creativity, that can be related with the teaching strategies implemented in this subject. In mathematics, the use of the technologies has been essentially associated with the work proposals resolution and teacher's oral exposition, not registering the implementation of teaching strategies for search and flipped classroom, whose potential suggests promoting the development of these skills.

Thus, the analysis of the results allows us to point out that, despite a significant number of lessons and strategies have been implemented using technologies, it was not clear that these strategies were very evident in most lessons, for the development of the 21st century skills, as suggested by Schrum and Levin (2009). The authors include critical thinking, creativity, communication and collaboration. This situation may be due, in part, to the fact that these data correspond to the year of implementation of the pilot project, in which teachers and students are still appropriating technologies. Maybe, with the continuity of the project, more learning experiences might be promoted, in which the technologies can be used to further develop the 21st century skills.

Despite the recognition of the potential of strategies using technologies, there were identified some barriers to its implementation, in particular the exams (in the case of Mathematics), the extension of syllabus, learning goals' requirement and workload of teachers. Moreover, in the opinion of interviewed teacher, there are other factors that can lead to infrequent implementation of strategies mediated by technologies, such as the fear that the strategies do not have the expected results and the fear of no controlling students, as well as the fact that technologies can make the lessons more hectic and noisy. This last aspect, to be verified, meets PISA 2012, namely that the disciplinary climate is considered significantly worse when students report increased use of computers.

The developed investigation suggests that the integration of technologies must be associated with appropriate teaching strategies, innovative if possible, as well as the motivating and challenging tasks, avoiding an "aseptic and brainless use" of technologies in the classroom, "without any pedagogical-didactic contextualization" (Ruivo & Mesquita, 2013, p. 12).

RECOMMENDATIONS

In terms of future work, it is suggested the development of similar research in other subjects and in other levels of schooling. It would also be interesting to verify that if there is a more frequent implementation of innovative teaching strategies advocated in the EduLab model, when surpassed the phase of appropriation of technologies (pilot year).

It would also be interesting to implement the EduLab model with other schools and take the project off the Portuguese context, testing it in other countries.

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METHODS OF GROUPING IN A FLIPPED CLASSROOM MODEL: EFFECTS ON STUDENTS' ACHIEVEMENT IN DIFFERENTIAL CALCULUS

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ABSTRACT: This study aimed to raise the achievement level of students in Differential Calculus using Direct Instruction with Salazar's Grouping Method in a flipped classroom and Small Group Method. The quasi-experimental method of research was used. The study also employed qualitative and quantitative analysis relative to data generated by the Achievement Test and Math journal with follow-up interview. Within the framework of the limitations of the study, both methods of grouping revealed a significant increase on the gain scores within each group but no significant difference was obtained between groups (control and experimental). However, a slight difference of mean gain scores in the Achievement Test was revealed in favor to the experimental group. Moreover, qualitative assessments showed that both grouping methods develops self-confidence, encourages effective communication and facilitates exchange of ideas towards a common goal. The students from both groups were in favor with the sequence of the presentation of the lesson, especially with the incentives given.

Key words: Salazar's Grouping Method; Flipped Classroom; Small Group Method

INTRODUCTION

In a classroom lecture, students tried to capture at an instant what the teacher says and reflect what is being said and they may miss significant points because they are trying to transcribe the teacher's words. By contrast, the use of prerecorded lectures (video) puts lecture under the control of the students: they can watch, rewind, and fast-forward as needed. Lectures can be viewed more than once and also help for those whom English is not their first language. Thus, the idea of flipping the classroom should be applied.

The flipped classroom is a pedagogical model in which they typical lecture and homework elements of the course are reversed. Short video lectures are viewed by students at home before the class session, while in-class time is devoted to exercises (www.*educause.edu/ir/library/pdf/ELI7081*.pdf.).

Davidson (1970) developed at the University of Washington a teaching method called Small Group Discovery Method. That is, the class is divided into small groups with three to four members in each group. Each group discusses the problems and solve it cooperatively as a group effort during the class.

Students tend to learn more if they are in small group (3 members). Small- group cooperative learning can be used to foster effective mathematical communication, problem solving, logical reasoning and the making of mathematical connections. Cooperative learning is a classroom technique in which students work on a learning activity in small groups and received rewards or recognition based on their group performance (Dela Cruz, 2001). Moreover, Salazar's (2014) enhanced the 3- members grouping into 1-2-3 member's method of grouping, named as Salazar's Method of Grouping. Results of the study revealed a significant increase on the gain scores between the two groups but no significant difference was obtained within and between groups (control and experimental). Further, qualitative assessments showed that the Salazar's Method of grouping develops self-confidence, encourages effective communication and facilitates exchange of ideas towards a common goal. He recommended a replication of his study using other teaching-learning models in different settings compared to other method of groupings. This study explored the possible effects of small group method and the Salazar's Method of grouping in a flipped classroom model in terms of students' achievement level in Differential Calculus.

Statement of the Problem

This study used the Direct Instruction with small grouping method and Salazar's Method of Grouping in a flipped classroom to determine the effects on student's achievement level in Differential Calculus.

Specifically, this study answered the following questions;

1. What is the students 'achievement level in Differential Calculus?

2. Is there a difference in the achievement level of the students after exposing them to small groups and Salazar's Grouping Method in a flipped classroom?
3. What are the gain scores of the student's achievement level in Differential Calculus?
4. Is there a difference in the gain scores in the achievement test of students after exposing them to small groups and Salazar's method of grouping in a flipped classroom?
5. What insights are drawn from the students' journal?

Research Hypothesis

1. There is a significant difference in the mean scores in the achievement test of students exposed to small grouping and Salazar's method of grouping in a flipped classroom.
2. There is a significant difference in the mean gain scores in the achievement test of students exposed to small grouping and Salazar's Method of grouping in a flipped classroom.

Significance of the Study

The main purpose of the study is to explore the possible effects of Salazars Method of grouping in a flipped classroom model in raising the achievement level of students in Differential Calculus
Results of this study will encourage Differential Calculus teachers to use Salazar's method of grouping in teaching calculus and other subjects, if found effective. This study is beneficial to students who valued sharing and helping others, exchange of ideas and effective communication among their classmates and in turn become fruitful citizens in this country. Insights drawn from this study will guide mathematics teachers in teaching Differential Calculus and inspire them to conduct researches on strategies in teaching mathematics. This study will also encourage administrators to recommend to his teachers the possibility of using Salazar's grouping method in or out a flipped classroom model.

Scope and Limitations of the Study

This study used the Direct Instruction with small group in the seatwork stage (control group) and flipped classroom model in the Salazar's grouping method to raise the students' achievement level in Differential Calculus. A validated Achievement Test in Differential Calculus and Math Journal were used in this study.
This study was conducted at an International University- Bahrain, third trimester, AY 2013-2014. The subjects of the study were the two (2) existing section of engineering students who were officially enrolled in Math 406 (Differential Calculus with Analytic Geometry). The experiment focused on the differentiation of algebraic and transcendental functions, midterm period for four (4) meetings, a total of ten (10) hours. The researcher himself handled the experiment.

Definition of Terms

The following important terms are operationally and/or conceptually defined as to be used in this study.
Achievement in Differential Calculus - refers to the performance of the student respondents in the Achievement Test in Differential Calculus.
Achievement Level- this is the interpretations of the student scores and gain scores based on the University grading system (Student Handbook)
Achievement Test – A validated achievement test in Differential Calculus lifted from the instructional materials of the researcher.
Control group – the group of students that were exposed to Direct Instruction with small group (3 members) on the seatwork stage.
Direct Instruction- the method of teaching used by the researcher to both groups (experimental and control groups)
Experimental group – the group that was exposed to Salazar's method of grouping in a flipped classroom model
Flipped classroom –inverts the traditional teaching method, delivering instruction online outside of class and moving "homework" into the classroom (http://www.knewton.com/flipped-classroom) . In this study, the lecture part used in the control group was videotaped and was used in the experimental group.
Gain Scores – it refers to the increase in score of the control and experimental groups from pretest to post test.
Math Journals - refers to the written impressions, comments and suggestions of the students in regards to the method of teaching, grouping method and incentives given as used in this study. The same also serve as the guide questions for the interview.
Informatics/Computer Science students - refers to the students officially enrolled in Math 406 (Differential Calculus with Analytic Geometry) third trimester, SY 2013-2014.

Salazar's Grouping Method in a flipped classroom .This method of grouping was used in the seatwork stage. The first stage was the individual learning, that is, the students solve the assigned problems/exercises individually. As soon as the student successfully defended his solution in class and earned the teacher signature which was counted as additional points for the students' problem sets. The student who got the correct answer was informed to select a group member of his choice and moved to the next problem. Whenever, the same group (with two members) was able to defend their solution in class successfully, each group member earned the teachers' signature. Then they selected another group member of their choice and moved to the next problem. Solving the problem was a group effort .If again, the group with three (3) members successfully defended their solution, and each group member earned the teachers' signature, and returned to stage one. This cycle continues until the end of the semester. However, membership of groups must not be the same on the next groupings. When all the students has belong to a group of two or three, the said group returned to stage one (Salazar, 2012).

This method was exposed in a flipped class room model. Selected video lectures from You Tube suited to the topics were shared thru the face book, and watched at home or outside the classroom by the students. The students were required to watch the video before attending the class. The seatwork stage was conducted in class with a short review based on the video watched.

Small Group Method–this is a variant of the Small Discovery Method applied in a different setting. On the seatwork stage, the students were grouped into three (3) members based on student choice in a regular lecture using direct instruction. Each group worked as a team. They solved an assigned problem/exercise as a group; the first two groups to solve correctly the assigned problem, each of the members earned the teacher signatures which were counted as additional points in their problem sets. The same group members worked on the next exercise/problem and throughout the whole class session.This group was the control group

METHODS

This chapter describes the research design, the subjects of the study, instrument that were used in data collection procedures and data analysis of the study

Research Method

The research design of this study was the quasi-experimental method. In particular, nonequivalent control groups design. This study is a qualitative and quantitative experimental research.

The research design of this study is shown in the diagram next page:

$$\begin{array}{lll} \textbf{E} & : & O_{11} \text{ - - - - - - - } \mathbf{X} \text{ - - - - - - - } O_{21} \\ \textbf{C} & : & O_{11} \text{ - - - - - - - - - - - - - - - - } O_{21} \end{array}$$

Figure1. The Research Design

In figure 1, E and C are the experimental and control groups, respectively. The two groups were given a pretest and a posttest. The symbol X represents the experimental treatment that was given to group E.

The symbol O_{11} represents the pretest (Achievement Test in Differential Calculus) which was administered to the two groups prior to the intervention, while the symbols O_{21} represent the posttest that was given after the intervention.

Subjects of the Study

This study utilized two (2) existing classes-section CE- 12:00-2:30 p m., MW (11 students) and section CF- 7:00-9:30 pm. MW (18 students), third trimester, AY 2013-2014 in Math 406 (Differential Calculus with Analytic Geometry).

The overall group mean was computed to ensure the comparability of the control and experimental groups at the start of the experiment.

Instrument Used

Qualitative and quantitative data were gathered using the following instruments:

*Achievement Test in Differential Calculus***.** A validated Achievement Test (teacher-made test) lifted from The Calculus 7 (Leithold, 1996). An item in the test represents each topic, which includes differentiation of algebraic and transcendental functions, implicit differentiation and higher derivatives. The test consisted of ten (10) problems, two (2) marks each with twenty (20) as the highest possible score.

Furthermore, the said instrument was subjected to a dry-run to the lone section in Math 501- Integral Calculus with Differential Equations and the same instrument was validated by the instructor of the said subject and the concurrent head of the mathematics and science department of the University.

The researcher made a scoring rubric written on the Achievement Test and answer key with corresponding marks before marking. The test was checked and graded by the researcher using the University Grading System. The same was re-checked by the internal moderator of the said subject.

Table 1: Achievement Test Scores Descriptions

University Grading System*			
Score	**Grade Ratings**	**Grade Range**	**Achievement Level Interpretations**
20	96-100	1.00	Excellent
18- 19	86-95	1.25-1.50	Very Good
14- 17	69-85	1.75-2.25	Good
10- 13	50-68	2.50 -3.00	Fair
Below 10	0-49	5.0	Failed

*University Student Handbook SY 2011-2012

With respect to the working description of the gain scores on the achievement test scores, the following correspondence was used.

Table 2: ***Gain Scores Descriptions***

Gain Scores	**Achievement Level Increase Descriptions**
17-20	Very High Increase
13- 16	High Increase
9 - 12	Average Increase
5 - 8	Low Increase
1 - 4	Very Low Increase

Math Journals – this instrument is adapted from Salazar (2014) , which is the source of qualitative data to determine insights in regards to the method of teaching used by the researcher. Prompts focused on the method of teaching specifically on the grouping method used and the incentives given. The students were encouraged to answer the questions in paragraph or outline form in English. This served to validate the results of the quantitative assessments.

Interviews. The interview was used to validate the results of the quantitative assessment of the students. This also served as a source of qualitative data on the students. The interview was conducted informally by groups to increase the rapport in the discussion and minimize shyness among the interviewees. The interview questions focused on the method of teaching, grouping method and incentives given with follow-up questions. The Math journal served as the guide questions to confirm their answers.

Data Collection

Two (2) existing classes in Math 406 (Differential Calculus with Analytic Geometry) as regular load of the researcher was the source of data collected. However, matching was done to ensure comparability in terms of the mathematical ability of the students based on the result of the pretest. By lottery, the control group and the experimental group was determined.

As soon as the treatments were assigned, the researcher conducted an orientation on the processes of the study. Then, the pretest was conducted after the orientation. The researcher himself taught the two classes.

Prior to the conduct of the experiment, a try-out was done for one(1) meeting, to familiarize and as much as possible make the students feel at ease with the new method. The Math journal was given after the posttest. To motivate them to answer the questions on the journal, the researcher give an incentive of additional marks if they answered all the questions. The posttest was considered as a problem set.

To control other factors that might influence the outcomes of the study, the amount of time for conducting the two classes were two and one-half hours. Both groups were provided with course specifications and instructional materials thru the e-learning (moodle), and PowerPoint presentations. The methods of grouping and the method of instruction differ.

The Intervention

Direct Method of Instruction was used in both groups. Moreover, a flipped classroom setting was used in the experimental group. They were requested watched the You Tube videos before they report to class. The videos were shared by the researcher thru the face book. On the seatwork stage the Salazar's method of groupings was used in the experimental group while small grouping (3 members) was used in the control group.

The sequence of activities for both groups is outlined below:
I. *Introduction/Review* –setting the stage for learning.
II. *Development* – explaining/deriving the formula and giving illustrative examples
III. *Guided* Practice- solving a problem with the student on the board, the teacher just acted as a secretary.
IV. *Closure*- making a summary on the lesson emphasizing the important points.
V. *Seatwork* –a set of problems were given to the control and experimental group.

Salazar's Grouping Method. The first stage is the Individual Learning. As soon as the student successfully defended his solution in class and earned a signature, he was told to select a group member of his choice and preceded to the next problem. Whenever, the same group (with two members) was able to defend their solution in class successfully, each group member earned a signature. Then they must select another group member of their choice and moved to the next problem. Solving the problem was a group effort .If again, the group with three (3) members successfully defended their solution, and each group member earned a signature, and then returns to stage one. This cycle continued until the end of the semester. However, membership of groups must not be the same on the next groupings. When all the students have belong to a group of two or three, the said group returned to stage one. The accumulated signatures were counted as additional points to the students' scores in the problem sets (assignments).

Small Group Method. In the seatwork stage, the students were group into three (3) members according to their own choice. This served as their permanent grouping throughout the study, except when some of the group members are absent. Thus, re-grouping was done.

The posttest was administered after the experiment. The math journal was given a day before the posttest. As soon as the students submitted their Math journal, follow-questions were asked (interview) to the subjects of the study.

Data Analysis

Both quantitative and qualitative analyses were done to determine the achievement level of the respondents who were exposed to the two groups. The quantitative data were derived from the math journals and follow-up interview results.

The pretest scores of the two groups were used to determine the comparability of the subjects. Wicoxon Sign Rank Test and Mann-Whitney Test, both non-parametric test was used to test the significance difference between and within groups pretest, posttest, and gain scores in the pretest and posttest.

The Vassar Stats: Website for Statistical Computations (http://vasssarstat.net was used in the statistical computations. Hypothesis was tested using 0.05 level of significance.

RESULTS AND FINDINGS

The following discussion presents the results of the analysis of the student scores in the achievement test in Differential Calculus. It describes the effects of the Grouping Methods on the student's achievement level. This result is supported by the qualitative data gathered from the math journal and follow-up interview.

Achievement Level

It can be gleaned from the table in the below, that both groups (control and experimental) has a mean score in the pretest and posttest of 0.42 and 1.1 respectively with a grade equivalent of 5.0, a failure grade. 100% of the students in the control and experimental group failed, in fact only one student got a score of five (5) out of twenty (20), the rest zero in the control group.. While in the experimental group, two (2) students got a score of five (5) and six (6) and the rest zero. Therefore, the two groups are comparable at the very start of the study.

Further, the posttest in the control group obtained a passing mark of (2.75) with a mean score of 12 and the experimental group obtained a passing grade (2.5– interpreted as fair) with a mean score of 12.9. A gain score of 11.58 (interpreted as average increase) was obtained by the control group while the experimental group achieved also an average increase of 11.8 marks. Similar results was obtained inSalazar's study (2014), although the respondents and subject area were different.Table 3 below presents the results of the pretest and posttest of the two groups.

Table 3
Comparison of Raw Scores in the Achievement Test

Raw Scores	PRETEST						POSTTEST					
	Control Group			Experimental Group			Control Group			Experimental Group		
	f	%	ITP	f	%	ITP	f	%	ITP	f	%	ITP
20										2	20	E
18-19										0	0	VG
14-17							4	33	G	2	20	G
10-13							5	42	F	3	30	F
Below 10	12	100	FL	10	100	FL	3	25	FL	3	30	FL
Total (Mean)	**12**	**100**	**FL (0.42)**	**10**	**100**	**FL (1.1)**	**12**	**100**	**F (12)**	**10**	**100**	**F (12.9)**
Grade Equivalent			**5.0**			**5.0**			**2.75**			**2.5**

Legend: **ITP** – Interpretation-**E**- Excellent:**VG**- Very Good ;**G** – Good ; **F**-Fair; : **FL**- Failed

Student's math journal revealed some reasons on their performance on the achievement test followed by their answers during the interview.

A student in the control group commented: *"It's very good method to interact with students to understand the lesson".*

When this student was asked to explain about this remark: *He said" Dr. we can share our ideas to our group member, and helping them".*

On the other hand, a student in the experimental group remarked: *" The grouping method is a good idea for math subjects because it gives to share other people those who are slow no understand , so its give them opportunity to improve".*

This was also observed by another student, that there exist language barriers which hinder them to understand the lesson. He remarked:*"Many students lack English language skills".*

That's why, in class, they have a choice to explain their solutions in Arabic or English. But most of them preferred to explain their solutions in Arabic.

One student commented: "*The You Tube videos are very helpful, because it can be replayed many times until we understand. But, it would be better if personalized videos were recorded, rather than videos of other lecturers from nowhere"*.

These observations confirm the advantages of using videos in a flipped classroom environment (http://www.knewton.com/flipped-classroom).

Difference in Scores in the Achievement Test

Table 4 below, revealed that there is a significant difference on the student scores in the achievement test before and after exposing them to Enhanced Group Moore Method of Grouping and Small Group Method. However, results of the posttest between groups revealed that there is no significant difference of the scores in the achievement test. This results shows that both grouping methods are effective in raising students scores in the achievement test in Differential Calculus. Similar studies (Salazar, 2014; Ali,2011) confirms that these methods of groupings are effective in raising students' achievement in Mathematics

Table 4: Difference of the Scores in the Achievement Test

<table>
<tr><th colspan="2">Group and Test Compared</th><th>n</th><th>Sum of Ranks</th><th>Test Used</th><th>Z–critical value</th><th>z-observed value</th><th>Decision</th></tr>
<tr><td rowspan="2">Within Groups</td><td>Pretest vs Posttest (control group)</td><td>12</td><td>W=-78</td><td rowspan="2">Wilcoxon Sign Rank Test</td><td>-3.04</td><td>0.0024</td><td>*significant</td></tr>
<tr><td>Pretest vs Posttest (experimental)</td><td>10</td><td>W=-55</td><td>-2.78</td><td>0.0054</td><td>*Significant</td></tr>
<tr><td>Between Groups</td><td>Posttest(control) vs Posttest (experimental)</td><td>12 vs 10</td><td>U_A =61.5</td><td>Mann-Whitney Test</td><td>-0.07</td><td>0.9994</td><td>Not Significant</td></tr>
</table>

** Significant at 0.05 level of significance*

Gain Scores within Groups

Table 5 below,exhibited an increase of scores in the Achievement test in both group after exposing them to Salazar"s Method of Grouping and Small Group Method

Table 5: Gain Scores within Groups

Gain Scores Range	Control Group			Experimental Group		
	f	%	ITP	f	%	ITP
17-20	0	0	VH	0	0	VH
13-16	5	42	H	5	50	H
9-12	6	50	A	5	50	A
5-8	1	8	L	0	0	L
1-4	0	0	VL	0	0	VL
Total (Mean)	**12**	**100**	**A (11.58)**	**10**	**100**	**A (11.8)**

Legend: ITP – Interpretation ; VH – very high increase ; H – high increase A - average increase ; L – low increase ;

As seen in table 5 above, both groups (control and experimental) obtained an average mean increase of 11.58 and 11.8 respectively

Only 42 % (5 out of 10) obtained an increase within the range of 13-16 and 50% (6 out of 12) obtained an increase within the range of 9-12 in the control group, while in the experimental 50% (5 out of 10) got a high increase (score range 13-16) and average increase (score range of 9-12). This result indicates that involvement in cooperative learning is a strong predictor of student's academic performance as revealed in Ali's study (2011).

Comparison of Gain Scores

Results of the Mann-Whitney Test (Table 6) revealed that there is no significant difference in the gain scores in the achievement test of students exposed to Salazar's Method of Grouping in a flipped classroom environment and Small Group Method. However, a slight difference in the mean gain score (Table 5) was observed in the experimental group, credited to flipped classroom. These advantages of flipped classroom were stressed in Hamdan study (2013) which was revealed in the present study.

Table 6: Comparison of Gain Scores

Group and Test Compared	n	Sum of Ranks	Test Used	z-critical value	z-observed value	Decision
Control Group Gain Scores vs	12	$U_A = 62.5$	Mann-Whitney Test	-0.13	Z=0.8969	Not Significant
Experimental Group Gain Scores	10					

** significant at 0.05 level of significance*

Insights Drawn from Students Math Journal and Interview

The following are insights drawn from students Math Journal and interview in terms of the researcher method of teaching, method of grouping and incentives given.

Method of Teaching Used

The students from the two groups (control and experimental) had written the following impressions and comments.

A student from the control group had written on his journal: *"The grouping method is good because we can discuss our solutions in Arabic and can move around to other groups for help, especially our intelligent classmates belong".*

However, a student commented: *Permanent grouping of three members is unfair, because I for one belong to a group in which all of us does not know – maybe rotation of group members must be considered".*

While from the experimental group, a student said in his math journal:*The grouping method is excellent; we have the chances to be group with other classmates and to help them. Also, the turnout of grouping is fast which means more signatures for us. The videos in the face book were very helpful as review materials for us".*

Moreover, a student cited some disadvantages of the method of grouping:*I don't like to be grouped with them (arabs).* When asked why? *Because we are amazing.* Maybe because of cultural differences. Nevertheless, they were encouraged to belong to a group.

Some students commented on the incentives given:*"The incentives given is a good idea, however, some of the students are just copying the solutions and answers in order to get the incentives".*

This was controlled by the teacher by asking question before giving the incentives or asking them to explain their solutions in class.

One student was thankful of the incentives given:*"Am very thankful because we can add more points in our problem set. I will be very happy if this points will be added to our long exam score"*

The incentives given served as a motivating factor to students to participate in class.

Most of the students considered the subject difficult, and one student said: *"The teachers expects us to be good in our algebra, absorbs all what he explained in his presentations. He gives limited examples and the rest as seat works".*
The students are expected to download the notes in the moodle and print it as much as possible which serves as their instructional guide. They were also requested to ask questions or clarifications in regards to pre-requisites skills, especially on algebra.

This was also found out in Salazar's study (2012,2014,2015) that students had poor background in algebra. According to him, it is not that the student does not learn, it's because the students are not ready to learn.

Furthermore, here are some of the general comments:*"I believe that Dr. Douglas is trying his best to help us understand the lesson. He is very accommodating when a student asked a question or help on how and why? Most of my classmates do not attend the class regularly and some just affixed their signature and go. I always heard him saying, you are old enough and you are responsible of what you are doing".*

And lastly, *"Two hours and a half class is too long teacher for a math subject! Too much teacher!!!."*

The student responses to the Math Journal and Interview disclosed that they have tried their best to at least earn the incentives.. They have developed the value of sharing and helping others. It promoted effective communication and exchange of ideas towards a common goal. The incentives made the seatwork enjoyable. This students comments were also revealed by the Salazar (2012,2014,2015) series of studies.

The findings of this study are presented below following the sequence of the research questions in the statement of the problem.

1. The pretest results of the two groups in the Achievement test showed mean scores of 0.42 and 1.1 for the control group and experimental groups, respectively. Both mean scores fall in the category of FAILURE. That is, they totally don't have any idea on how to differentiate functions even if the formulas are given except for three (3 out 22) students.

However, the Achievement Test mean score in the control group improved from 0.42 to 12. That is from 5.0 to 2.75, a passing grade. However, in the experimental group, the achievement test mean score improved from 1.1 to 12.9, that is from 5.0 to 2.5, a passing grade.

2. Comparing the test scores within groups (experimental and control groups) revealed that there is a significant difference between pretest scores and posttest scores in both groups. But, no significant difference was obtained in comparing the posttest scores between the control and experimental group.

3. In the gain scores obtained within groups, the control group obtained a mean gain score of 11.58 interpreted as average increase while the experimental group revealed 11.8 mean gain score which is interpreted as a average increase.

4. A no significant difference of the gain scores between the two groups was revealed by the Mann-Whitney Test.

5. The following insights were drawn from the students' math journal and follow-up interview:

They felt that Differential Calculus is difficult even before the prelim period. .They had poor background in the prerequisite subjects (algebra, trigonometry). Both groups were in favor of the sequence of presentation of the lesson used in this study especially on the incentives given. But on the shared you tube videos; they experimental groups suggested personalized recorded videos of their professor.

The Salazar's grouping method encouraged them to solve problems by themselves, share and help others in the next stages. The incentives served as a driving force to solve the problems on the seatwork stage.While in the control group, cooperative learning took place. They have to solve the problem as a group effort. The incentives served also as their motivation to solve the problems assigned to them.

CONCLUSION

It is therefore possible to raise the achievement level of the students in Differential Calculus using any grouping method used in this study.

Although, the result revealed a failure mark on the pretest but a significant increase of the gain scores was achieved in the posttest. Specifically, an average increase was gained by both groups which obtained a passing mark of 2.75 and 2.5 (control and experimental group, respectively). Insights drawn from the students' journal that can contribute more in raising students achievement in Differential Calculus deserves an attention.That is using flipped classroom model in which the students can put the teacher lecture in control.

RECOMMENDATIONS

On Poor Preparation in Differential Calculus. It is recommended that there must be a strong foundations on students pre-requisite skills, specifically on algebra. College Algebra must be five (5) units' subjects. Engineering and Computer science students must not be combined with business students in College Algebra. Remedial Math for engineering and computer science must be different with the business students. Strict implementation on the policy of accepting new students must be considered.

On Future Researches. For future researches, the following could be considered;Use of homogeneous or heterogeneous small grouping according to ability levels, gender type, reverse order of grouping used in this study, or other types of grouping.

Use of large samples (two sections with 40 students for each group).

Implementation of Salazar's Method of Grouping or Small Groupings in other basic mathematics courses must be considered.

Replication of the present study using video captured lecture in a regular or flipped classroom model.

Calculus is viewed by the students as the most difficult mathematics subjects most students. Unless a strong foundation on its pre-requisite skills is achieved, the students' performance in Differential Calculus will still be low. The students are interested to learn, but they are NOT ready to learn.

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THE WORD "EDUCATION" IN SOCIAL MEDIA

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ABSTRACT: The word education, which can be expressed as a systematic way of giving the knowledge and skills to the individuals, is mentioned frequently in social media. The fastest-growing network twitter is also the optimal platform to get information from the usage of the "education" word by social communities. From this point of view, utilizing from twitter, this study aimed to investigate how the word "education" is used in social media. The usage frequency of the word "education", the most frequently used terms together with the word "education" and also the location information of education tweets were acquired to evaluate the comments of the individuals on the word. The followings and followers numbers of the people who make education sharing are also stated to see the popularity of these people in social media.

Key words: *Education, Social Media, Twitter, Term Frequency*

INTRODUCTION

Social media where billions of data entered on a daily basis has become to an information dissemination and conservation channel with its two billion users worldwide (Daume, 2016). Among the social media services, twitter has gained so much popularity especially with teens and young adults by providing easy connection with friends, family members and strangers (Brenner, 2013; De Cristofaro et al., 2012). The twitter platform provides users sharing their thoughts, information, news, and jokes by using maximum 140 characters of text. Cheap and measurable global communication is possible with twitter and if the user's profile is not private, anyone in the world can see the writings of users which are named as tweets (Derczynski et al., 2015; O'Dea et al., 2015; Tamburrini et al., 2015; Vidal et al., 2016; Cavazos-Rehg, 2016). Hence it can also be assessed as free social micro-blogging service which allows getting information about the data used in this platform (Parra et al., 2016). 500 million tweets are generated every day by nearly 300 million monthly users to share their opinions and emotions all over the world. This generated data density can also be used to inform people on useful issues such as the government's decisions, the stock exchange, natural disasters, political polarization in the public (Abel et al., 2012; Bollen et al., 2011; Conover et al., 2011; Tumasjan et al., 2011). According to a study carried out on the use of twitter, one in eight of messages posted on twitter represents it as a prime source for public access and naturally occurring communication on twitter makes it a perfect place to study the social identity statement (Java et al., 2007; Danescu-Niculescu-Mizil et al., 2011).

Apart from these researchs, the reflections of various terms and their specific sub-terms on twitter related with the fundamental issues that shape our lives such as education, nutrition, health, transportation, and politics have been investigated in recent years. Among these terms, "education" should be kept in the forefront by its meaning as the process of acquiring general knowledge, developing the powers of reasoning and judgment and preparing oneself or others intellectually for mature life (Education, 2016a) People often confuse education with schooling but education is a social process and can also be expressed as a process of living (Education, 2016b). Therefore the diversity of the term education usage forms in social media emerges as an interesting topic.

We focus on the usage of the word education by the twitter users in this study. We investigate some basic parameters related with the word "education" (the word "eğitim" in Turkish language). The first two of these parameters are its usage frequency (word frequency) and the most frequently used terms with the word "education" which were obtained to find the usage rate of the word and the correlation of this word with the other words respectively. The location information of the tweets including the word "education" are obtained to indicate how the use of the word changes regionally. The popularity of the users who tweeted about education are obtained with the followers and followings numbers of these users in social media. Consequently, the data we gathered provide us convenience to assess the individual's comments on the word "education".

METHODOLOGY

In our experiments, we obtained 23,056 tweets gathered between the dates 20-28th January, 2016. To get data from Twitter services, we used a php based application presented by Adam Green (2013). This framework provides a listening to Twitter's streaming API by entering some key words to filter the whole available data stream (that corresponds to the 1% of entire Twitter entries). As keywords to focus our study, we entered the words "eğitim", "egitim", "Eğitim", "Egitim" and "EĞİTİM" as the most frequent variations of this word in Twitter.

In the preprocessing step, we transformed the entries to lowercase versions to provide a simpler word processing. We also converted the Turkish alphabet letters as "ı", "ç", "İ" to their English pairs as "i", "c", "I" etc for removing the varieties of words driven by different keyboard usage preferences. We also removed the hashtags (#topics), mentions (@users), http links, non-alpha numeric characters and stop-words that do not express meaningful aspects. Although a filtering array is applied for listening the Twitter Streaming API related with the word education, some irrelevant tweets are also included in our raw dataset. The deletion of these irrelevant tweets is also performed in preprocessing. After the preprocessing step, the number of Tweets were reduced to 19,479, ready for word processing.

We processed the words and evaluated the usage statistics by a software we developed in C# language, accessing the database rendered by the 140.dev application in MySQL format. Although the most suitable environment for MySQL database is php coding, we preferred C# to empower the word processing by its powerful regex features.

RESULTS AND DISCUSSION

Social media users write words in different ways for some reasons. These variations are generally driven by the keyboard restrictions, need for shortening words for giving fast response, obeying the allowed character number (140 characters for twitter), saving time and reflecting the user's own writing style. Especially, the typing variations in mobile media are generally affected by the keyboard configurations that restrict the users to some common character sets. As mentioned above, we investigated the usage of the word "education" in social media, twitter, in Turkey. The word "education" corresponds to "eğitim" in Turkish and the words at the table below used for the same purpose but represent the different ways of using this word.

Table 1. The Most Frequent Ways of Using the Word "Education" in Turkish Language, in Twitter.

"egitim"
"eğitim"
"Eğitim"
"Egitim"
"EĞİTİM"

Since the raw data are infected by some facts we mentioned in the previous section, we employed a preprocessing procedure to clarify the dataset and simplify data processing. The details of this procedure are also mentioned in the Methodology section. After preprocessing, our database was shrinked to 19,479 tweets by the deletion of 3,577 irrelevant tweets as shown in Table 2.

Table 2. The Usage Number of Tweets on the Word "Education"

Total Tweets	23,056
Tweets after preprocessing	19,479
Tweets filtered in preprocessing	3,577

The Twitter Streaming API also provides the basic user data relative with the tweet stream. By the way we can evaluate the user statistics that are the sources of the tweets gathered. The provided data are the user location, followings (friends) and followers counts. We first evaluated the average following and followers numbers of the twitter users that tweet "education" in Turkish. This data states the popularity of the users as incoming and outgoing links to the entire Twitter users community. To give a comparison with the entire Twitter users follow profiles, we also gathered the average followings and followers counts from an irrelevant database of 10,000 tweets that are collected with no keywords but only in Turkish language. The resulting data is presented in Table 3 below.

Table 3. The Popularity of the Twitter Users Who Tweeted on Education

Number of users tweeted on education: 18460			
The average numbers for the users tweeted on education		The average numbers for the whole Turkish users tweet about anything on twitter	
Followings	Followers	Followings	Followers
1611.34	4800.97	2617.87	6143.94

As seen from Table 3, the number of users tweeted about education has lower average number of followers and followings when compared with the whole users average. This may be an indicator that the popular or trending users in Twitter are less likely to tweet about education than the users having moderate popularity. The occurrence frequency of the education tweets was also calculated as % 0.365 when 10,000 samples of tweets observed in twitter with no keywords but Turkish language. The most frequently used 60 associable words together with "eğitim" are shown in Table 4. The repetition numbers are also stated with these words. The count of whole words engaged with education is 17,833.

Table 4. The Repetition Number of the Words Used With Education

Word	**Frequency**	**Word**	**Frequency**	**Word**	**Frequency**
egitim	19678	*tekin*	528	*saniyede*	385
sistemi(miz)(nin)	2102	*gerekiyor*	455	*ajanlari*	372
milli	1687	*karne*	451	*ulkene*	372
turkiye	1204	*muduru*	444	*bozgunculuk*	371
hakki(ni)	1113	*alman*	439	*diyarbakir*	371
verip(elim)	1101	*ygs*	433	*topraklarimizda*	371
ana(okulu)	997	*iyi*	430	*cikartiyor*	370
meb	990	*hayatim*	427	*gelinlikli*	367
pkk	932	*sinavina*	420	*istanbul*	361
basin	790	*girse*	414	*futbol*	357
akp	702	*dini*	413	*cocuk*	352
egitimecan	692	*ilk*	413	*gun*	347
dilin	682	*kastamonu*	412	*teror*	339
yozlasmamasi	681	*ziyaret*	407	*ozel*	331
bakani	677	*aristo*	406	*ocak*	308
sinifcilarakadro	659	*kazanir*	406	*smiley**	293
arastirma	639	*felsefeyi*	404	*merkezi*	291
okul	621	*sahip*	398	*temel*	291
ogretim	606	*gunu*	395	*kurumu*	286
il	596	*hastanesi*	391	*sinif*	286

* Smiley stands for all smiley characters like :), :-], :(((etc.

The most used words together with "eğitim" can give us idea about the general thoughts, political ideas, emotions, suggestions, expectations and complaints of the twitter users in Turkey. Expectedly, the word "sistem" is the most frequent word paired with "eğitim", expressing the arguments about the national education system that are going on for several decades. Another standing out word is the synonym for the most known terror association in Turkey, that caused the abortion of education in the south-east of Turkey in January this year. Another frequent word "sinifcilarakadro" indicates the demands for employment in first-grade education, as a reality of inactive teachers' community in Turkey. The realities underlying the remaining words are left to the readers attention.

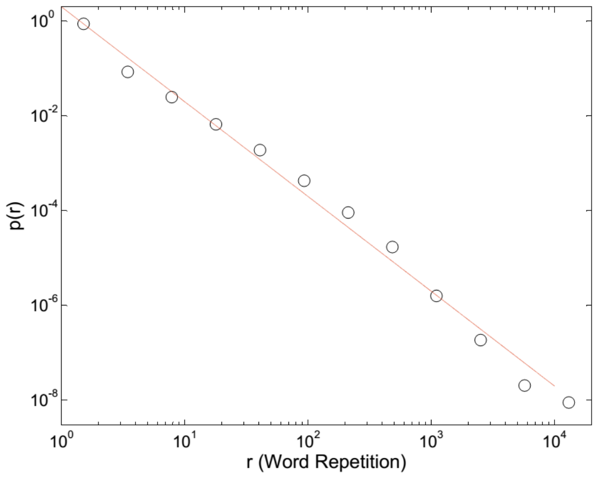

Fig.1. The distribution graph for the word repetition that are used with the Word "eğitim".

The distribution graph of the repetition of these words is also presented in Fig.1. This graph is generated with the data collection including 17,833 words with several repetition counts. Every repetition counts are grouped and cumulated to generate the distribution graph. As seen in the log-log scale, the distribution is consistent with a perfect power-law decay, indicating that the universal laws of complexity is also evident in the weight distribution of a word as a node neighbor with the other words in a sentence (Petersen et.al, 2012). The average repetition counts for the whole words is 13.42.

The regional representation of the tweet words used with the word education on a provinces basis is given in Table 5. The data provided insight about the regional usage intensity of the words used with education by twitter users in Turkey. The data also show us the interest ratio of the Twitter users to the word education in regional basis. This regionally usage ratio may be caused by some reasons as modes of living, economic conditions, etc.

A limiting factor in this dataset is that the location data of the users are rarely generated by their mobile devices automatically but generally the users prefer entering their location manually. This fact leads a large variation of location notifications for a particular location, i.e. "Beşiktaş, İst", "Kadıköy", "Taksim, İstanbul", "İslambol", "Konstantinapolis" etc. for "İstanbul". To remove this variety, we detected all the variations for a certain location and fix them in one name like "İstanbul", by a hand driven procedure. By the end of this procedure, our dataset is limited to 5,387 users having a valid location declared. The resulting data is presented in Table 5 below.

Table 5. The Tweet Counts Used With the Word Education and Population Ratios by Provinces.

Provinces	Total Population*	Repetition	Repetition / Population (million)
Tunceli	86,076	23	267,2
Bayburt	78,55	10	127,3
İstanbul	14.657.434	1778	121,3
İzmir	4.168.415	477	114,4
Ankara	5.270.575	518	98,3
Elazığ	574,304	56	97,5
Rize	328,979	32	97,3
Uşak	353,048	33	93,5
Gümüşhane	151,449	14	92,4
Trabzon	768,417	70	91,1
Sakarya	953,181	82	86
Eskişehir	826,716	71	85,9
Ordu	728,949	62	85,1
Karabük	236,978	20	84,4
Edirne	402,537	33	82

Kocaeli	1.780.055	143	80,3
Samsun	1.279.884	96	75
Yalova	233,009	17	73
Antalya	2.288.456	166	72,5
Muğla	908,877	63	69,3
Bolu	291,095	20	68,7
Bartın	190,708	12	62,9
Denizli	993,442	62	62,4
Giresun	426,686	26	60,9
Aksaray	386,514	23	59,5
Artvin	168,37	10	59,4
Çanakkale	513,341	30	58,4
Şanlıurfa	1.892.320	103	54,4
Adana	2.183.167	118	54
Nevşehir	286,767	15	52,3
İçel	1.745.221	90	51,6
Bursa	2.842.547	140	49,3
Manisa	1.380.366	67	48,5
Malatya	772,904	37	47,9
Karaman	242,196	11	45,4
Isparta	421,766	19	45
Adıyaman	602,774	27	44,8
Batman	566,633	25	44,1
Siirt	320,351	14	43,7
Erzurum	762,321	32	42
Zonguldak	595,907	25	42
Tekirdağ	937,91	38	40,5
Aydın	1.053.506	41	38,9
Çankırı	180,945	7	38,7
Diyarbakır	1.654.196	63	38,1
Niğde	346,114	13	37,6
Sivas	618,617	22	35,6
Konya	2.130.544	73	34,3
Sinop	204,133	7	34,3
Amasya	322,167	11	34,1
Bingöl	267,184	9	33,7
Gaziantep	1.931.836	65	33,6
Kütahya	571,463	19	33,2
Bilecik	212,361	7	33
Kırklareli	346,973	11	31,7
Balıkesir	1.186.688	37	31,2
Iğdır	192,435	6	31,2
Burdur	258,339	8	31
Tokat	593,99	17	28,6
Ağrı	547,21	15	27,4
Kırşehir	225,562	6	26,6
Yozgat	419,44	11	26,2
Kırıkkale	270,271	7	25,9
Kayseri	1.341.056	34	25,4
Çorum	525,18	13	24,8

Kastamonu	372,633	9	24,2
Afyonkarahisar	709,015	17	24
Kahramanmaraş	1.096.610	26	23,7
Van	1.096.397	26	23,7
Osmaniye	512,873	12	23,4
Kilis	130,655	3	23
Erzincan	222,918	5	22,4
Hatay	1.533.507	32	20,9
Şırnak	490,184	10	20,4
Muş	408,728	8	19,6
Düzce	360,388	7	19,4
Mardin	796,591	14	17,6
Bitlis	340,449	5	14,7
Ardahan	99,265	1	10,1
Hakkari	278,775	1	3,6
Kars	292,66	1	3,4

* Total population numbers are referenced in (Nüfus, 2016)

CONCLUSION

The usage of the word "education" on twitter was investigated by the data collected from the users in Turkey. The collected data include the number of users tweeted on education, the average number of their followings and followers and the whole user's average followings and follower numbers. Comparing with the whole users averages, it is determined that the number of users tweeted on education has lower average number of followers and followings. The most used words together with "eğitim", their repetition numbers and the distribution of the repetition are also stated to give an idea about the general thoughts, behaviors, political ideas, suggestions, expectations and complaints of the twitter users lives in Turkey. The regionally usage intensity of these most used words together with "eğitim", is also examined on a provinces basis in Turkey. The numerical results for the regionally usage ratio may be attributed to the modes of living, economic conditions and other living conditions at this region of Turkey.

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THE FUNCTION AND IMPORTANCE OF AMGEN PROJECT IN SCIENCE EDUCATION SUPPORTED BY EUROPEAN UNION

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ABSTRACT: EU has often prepared various projects in last years to provide for each student a qualified science education. These projects which are about science education have been prepared by European Schoolnet. Amgen Teach Project is one of these projects. The purpose of this research is to provide information about Amgen Teach Project devoloped by EU and to specify the importance of process in learning and teaching science. This project has been realized by collaboration with European Schoolnet and Amgen organisation. The main target of this project is to contribute science teacher's professional progress in secondary school and increasing student's interest in science with *"Inquiry-Based Science Education"* approach. Amgen Teach Project is being carried on throughout the ten European countries after having implemented its practices for two years in four European countries. In this context, it has been organised workshops in Brussels to be benefited as possible as for more teachers. In these workshops, it has been worked out on new approachs in science education and it is carried out some events and practices toward the function and importance of technology in science education. It is explained the context of Amgen Teach Project, effective using of "Inquiry Based Science Education" approach and the function and importance of tecnology in science education to the teachers who come from different European countries. Through this project, teachers who belong to the different education culture can share their knowledges by sharing their experiences. At the end of this research there have been reached some propositions on science education.

Key words: : Amgen Teach Project, European Union, Science Education.

INTRODUCTION

The purpose of this research, is to give information about the AMGEN project which is developed by European Union and to declare the importance of learning and teaching science. By this project it is intended to support science teachers in secondary schools for their professional progress and to raise students concern on science through ''Inquiry Based Science Education-IBSE''. This project is being realized by 10 EU countries after having two years of pilot practices in four countries. Workshops are organizied in Brussels periodically for as many teachers as possible to join. In these workshops the contect of AMGEN project has been presented, the effective use of (IBSE), the function of technology in science education. Through this project teachers from different countries explain and share their experiences in science education. At the end of the researches, it is concluded some proposals on science education.

AMGEN Teach Project

It is managed by Eupean Schoolnet which is a part of Amgen Foundation. European Schoolnet is a NGO, which is supported by ministries of education in 30 European countries, based in Brussel. In this project, in IBSE approach, educations are provided in two different level of expertise. It is organised as face to face educations for the science teachers in secondary schools regarding their background of IBSE trainings, at basic level or high level of science education. In the framework of this project, there have been organised local and international competitions. This project is organised by ANISN.

ANISN

It is an union founded in Italy in 1979 which has 2000 members as science teachers on 26 different subjects. By this union, science education has been organized trainings which includes language and science education together and it has organised competitions as well. For example, Science on Stage, Darwin Day, DNA Day and Caesar Bonacini Prize are some of the competitions organised by ANISN. Every year teacher trainings in science education have been organized in summer schools. For 14 years science olympics have been organized, international world science olympics (IESO). Also science experiment games have been organised in Italy since 2010 (www.anisn.it). Students can reach these competitions and projects in e-twinning link in ANISN website.

AMGEN TEACH PROJECT

The purpose of AMGEN Teach Project

The purpose of AMGEN project is to contribute to the teachers for their professional progress and to raise students concern on science through IBSE approach. By AMGEN Project it has been intended to reach more teachers as possible by organizing workshops. It continues to offer education opportunities online by webinars.Thus, it contribute to teachers achieving for them high self-efficiency and to raise their professional progress. Researches made on this subject shows that teachers who have self-efficiency can provide informations and datas with its meaningful context and thus they try to practice in a student-based approach.

The relation between self-efficiency and inquiry based science education

The term of self-efficiency is used first by Bandura(Ekici 2005). Bandura define ‘’self-efficiency’’ term as a qualificiation which has influences on shaping behaviours and self assesment of a person for himself about achieving necessary activities towards a certain performance level *(Ekici 2005 quoted from Bandura, 1997; Kear, 2000; Zimmerman,1995)*. It is determined that reliance of teachers about self efficiency is related to their talent of managing class activities, the choices of teaching methods, techniques and performance towards students success *(İnaltekin&Akçay 2012 quoted from Gürol and oth.,2010)*. Many researches show that science teachers have low self-efficiency level on teaching in education envoirements *(İnaltekin&Akçay 2012 quoted from Savran&Çakıroğlu, 2003; SchriverandCzerniak, 1999; Vural&Hamurcu, 2008)*. To motivate a teacher to teach science (high self-efficiency level) and as a teacher to avoid science education (low self-efficiency level) plays a vital role. Reliance on self-efficiency in science education is closely related to the teachers reliance on science education and their activities in classrooms. Teachers who have high level of reliance on self-efficiency tend to use student-based approaches, to spare more time for science education, to educate through inquiry based education and they are very successfull at doing all of these things.*(İnaltekin&Akçay 2012 quoted from Harurluoğlu &Kaya,2009)*. Teachers who are high-motivated in their classrooms offer their students opportunities to use their mind in a more creative way. Thus, students who can make inquiries without memorising, using their own words instead of certain words in books, make group activities, have experienced their own performance in their classrooms. A student who experiences in their classroom environment and who makes inquiry in a subject which he wonders and then who makes research on those subjects reaches results about them and makes plans to present these results in a best way, is a student that reached high level of self-efficiency and has a successful experience. In IBSE approach the main target group is students, but for teachers, who generate this system, self-efficiency is important in this process. In this reason AMGEN project has been reached both by teachers and students.

The main purpose of inquiry based science education

The main purpose of inquiry based education, is to improve students mental otonomy . In a traditional class environment, students see their teachers as the experts who give right answers. In contrast, in an inquiry based education environment students learn to create their own approach and take on responsibilities to create their own knowledge base. In this process the role of teacher as an expert is to make students learning easier by taking the lead. *(İnaltekin&Akçay 2012 quoted from Collins,1998).* This tendency towards this process in science education is seen after 2000, especially by reforms in teacher training programmes, it is based on training teachers who can inquire and teach inquiring *(İnaltekin&Akçay 2012 quoted from NRC, 2000).*
Now, *inquiry based education* is seen as the most necessary part of devoloping programs in many countries. Various researches show that inquiry approach in education includes giving opportunities to the students to find questions in which they can create informations in their learning process, regulate the research process expose the result and share the results obtained with others *(İnaltekin&Akçay 2012 quoted from Lın Turan, 2005).* Researches on science education show that a well planned education programme is based on inquiry approach on learning of students in a structural learning context (*İnaltekin&Akçay 2012)*.While *AMGEN Teach Project* provides teachers to adapt to‘’IBSE’’, it provides students to reach informations on their own instead of memorising certain informations.

In the workshops organized in AMGEN Teach Project framework

These education methods were presented in some events through the IBSE approach. If we explain one of the experiments briefly; a torch, a carton box, a scissor, an aluminium folio were used in this experiment. We placed aliminium folio at the bottom of the carton box , the sides of box were left as carton. We put carton box closer to wall and we turned on torch. When we set light at the bottom of carton box and reflect it from there, there was no light on the wall. Whereas when we turned the sides of the box and put them closer to the wall and set light from this point, the light was seen on the wall.

The reasons of this experiment were discussed among the teachers.There was no light on the wall. Because aliminium folio is not permeable. The purpose of this experiment is to identify whether the materials are permeable or not.

Evaluation of an experiment

Starting the subject with an experiment in order to find whether the materials are permeable or not, before studying that subject with certain informations in the books helped us to examine the subject quickly and it helped us to do the same experiment by a metal, wood and water. Thus we could classify the materials permeable or non permeable. When we teach our students just by taking notes as “these are the materials permeable and these ones are non permeable” and without doing any experiments they will easily forget.

Workshops

We made some example of science experiments an also we presented multifunctional smart boards which will be used in science education in the future. These experiments which were made in front of smart boards were demonstrated on the huge bilboards. In the meantime students could both watch experiments on their tablets and they could find the results of experiments by using different test materials through small animations. Nowadays, it is clear that it is necessary to use smart boards efficiently for us, as teachers, since children and youths use technology very well.

CONCLUSION

In the workshops organized in the framework of AMGEN Teach Project, which many teachers from all around the world attended and discussed, it appeared that the consistent knowledge is affected by the enviroment in which students can express theselves. A student who makes research on a subject in lab environments and find its results, he reaches in a high level of self-efficiency in his lessons and he has a successful experience. Interest of a student, who learns new concepts concerning in an eucaryotic cell by animations and plays, becomes more successful in their lessons. One of the influential factors for the individuals to realize an activity is their self-efficiency levels about their capabilities of doing it. In science lessons, it is an expected result that students who have high level of self-efficiency will be successful. It is necessary to offer secure environment by teachers for students in order to express themselves, to understand science lessons well, to use the science concepts and processes and to get self confidence by providing them lab opportunities in which they can have successful experiences.

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AN INVESTIGATION OF THE EFFECT OF FAMILY BACKGROUND VARIABLES ON INNOVATION PERCEPTIONS OF ENGINEER AND TEACHER CANDIDATES

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ABSTRACT: The aim of this study is to investigate the innovation perceptions of teacher candidates in the areas of mathematics, science and social sciences. The data collection tools are the Turkish versions of the Individual Innovativeness Scale (IIS) and Big5 Scale for personality characteristics. Multivariate linear regression is the main data analysis technique. Results indicate that 47% of the variation in the IIS is explained by the independent variables.

Keywords: Teacher education, Innovativeness perception, Personality characteristics

INTRODUCTION

Mathematics and science education carry a vital role in the development of the 21st century skills and positive attitudes towards innovation in the next generation. Developing innovation/entrepreneurship skills is important for the Turkey's vision for its integration to the technologically developed international community. Preservice training of future science and mathematics teachers is especially important since the highly qualified technology workforce is the outcome of high quality education at the pre-university level.

The industrial revolution started with using the water and steam power to mechanize the production. This was followed by the technological revolution initiated by the discovery of electricity that started at the post 1800s. Electronical age is the third phase in which is known for the automatization of production. Now the world is at the brink of the fourth industrial revolution which is different from its preceding developments in its speed, scope and approach (Schwab, 2015). The occurring change is at an exponential rate rather than being linear (ibid, 2015). To survive in this new world the keyword is innovation. Technological innovation and entrepreneurship are major forces in economic growth (Acs and Audretsch 2003; Audretsch and Keilbach, 2003; Rosenberg, 2004)

Innovation and creativity are among the major components along with critical thinking, problem solving, creativity and collaboration in the 21st century skills framework developed by the US based P21 partnership NGO (Fadel, 2008). These skills are pre-requisites in many different industries, and teacher training programs are crucial in the education of the teacher force that will be responsible for education the youth (Çorlu & Corlu, 2012; Erdogan, Corlu, & Capraro, 2013; Çorlu & Aydin, 2016).

It is stated in the Strategy Document published by the Scientific and Technological Research Council of Turkey 2003-2023 (TÜBİTAK, 2004) that the Turkey aims to develop technologically competent individuals who can develop new technologies. On the other hand, it is indicated in the World Economic Forum's (2015) 144-nation Global Competitiveness Index, Turkey ranked between 55 and 131 in terms of the index's educational components. It is unfortunate that Turkey has lagged well behind even its own standards for teacher education development, which were established two decades earlier by the National Education Development Project.

Studies on attitudes and performance related to innovation are generally are available in the areas of business and engineering education (e.g. Wang, & Lin, 2012; Stajkovic & Luthans, 1998) but there are less work in the area of education (e.g. Mathisen & Bronnick, 2009). There is evidence that innovation perception is related to personality variables (James & Mazerolle, 2002; Sung & Choi, 2009; Aydin & Çorlu, 2016). There is, however, less concern on other variables that can shape personality as possible predictors of innovation perception and/or performance. Family attitude towards the student is one such variable for which the distinction is generally made between protective, oppressive or democratic attitudes. Geographical background and family type are other two variables of such kind that might have an influence of some degree.

Aim of the Study

The aim of the present study is to investigate the influence of some domestic factors other than personality characteristic on innovation perceptions of student teachers (mathematics, science and social science). and engineering candidates. These factors are family attitude, family type and geographical background.

METHOD

A quantitative research design was selected for this research study. The study collects data from a state university in Istanbul. The sample comprises of 189 second year students in the science teaching (n=69), mathematics teaching (n=62) and social sciences teaching (n=58) departments. These departments are in the first three in the rankings of the university entrance examination so these students are among the country's very successful teacher candidates. The data collection tools are the Turkish versions of the Individual Innovativeness Scale (IIS) (Kılıçer & Odabaşı, 2010) and the domestic factors inventory which is comprised of three fully structured questions: (1) How do you describe your family attitude towards yourself?, (2) What type of location were you raised in? and (3) What is your family type? (Table 1).

Table 1. Options in the domestic factors inventory

Family Attitude	**Geographical Background**	**Family Type**
Protective	Village-Small town	Big family
Democratic	Big city	Nuclear family
Oppressive	City	Other
Inconsistent behavior		

For the current study, survey design was used. The three factor ANOVA is the main technique for data analysis. The influence of the three independent variables on a single outcome variable (dependent) was investigated by a single statistical model (Creswell, 2003). In this study, we investigated the influence on the IIS (the single dependent variable) of the three independent variables listed above (Table 1). The calculated reliability score for the IIS is 0.77 (Aydın & Çorlu, 2016).

FINDINGS

We adopted a three factor ANOVA model to study the influence of the three independent variables on the innovation perception variable. We get a lot more information from the three-way design than using a three separate one-way ANOVAs. We also eliminated the danger of the increase of making a Type I error. For example, for a variable with n levels (with n >2), conducting n T-tests instead of a one one-way ANOVA, increases the probability of making a Type I error as a result of doing an experiment with many groups and analyzing the data with n factoral comparisons. In the case of using a three-way ANOVA, this danger is much greater because this time number of groups and number of comparisons extensively higher (Pagano, p.385). Prior analyses indicates that the three assumptions for using a three-way ANOVA. Independence of observations, equality of variances and normal distribution of the scores of the independent variables (Büyüköztürk, 2011, p.55) were satisfied. Effect size values were also calculated using the eta-squared (η^2) value calculated by the ratio of $SS_{between}$ to SS_{total} (=SSB/SST). F values and effect sizes in the three way model we used were summarized in Table 2.

Table 2. Tests of Between-Subjects Effects (Dependent Variable: Innovativeness Perception)

Source	Sum of Squares	df	Mean Square	F	Partial η^2
Corrected Model	1878.67(a)	19	98.88	1.49	0.11
Intercept	156799.09	1	156799.09	2355.34 (*)	0.91
Family attitude	537.32	3	179.11	2.69 (*)	0.03
Family Type	66.98	2	33.49	0.50	0.00
Geographical Background	220.59	2	110.30	1.66	0.01
Family Attitude * Family Type	63.00	3	21.00	0.32	0.00
Family Attitude * Geographical Background	476.98	6	79.50	1.19	0.03
Family Type * Geographical Background	270.75	2	135.38	2.03	0.02
Family Attitude * Family Type * Geographical Background	17.86	1	17.86	0.27	0.00
Error	14978.64	225	66.57		

Total	1295592.00	245			
Corrected Total	16857.31	244			

Results of the analysis indicated that the only statistically significant effect on innovativeness perception comes from of family attitude variable (F=2.69) The eta-squared value. (η^2= 0.03) suggests a small effect of the independent variable.

Afterwards, we run the Sheffe test to make post-hoc comparisons to understand from which level(s) of the family attitude variable the significant F value resulted. The results indicated that (Table 3) there is a statistically significant difference between the innovativeness scores of the protective and democratic families in favor of the democratic families (M2-M1=4.76, p<0.01).

Table 3. Sheffe test: Dependent Variable: Innovativeness

(I) Family attitude	(J) Family attitude	Mean Difference (I-J)	Std. Error	Sig.
Protective	Democratic	-4.76(*)	1.39	0.01
	Oppressive	0.26	1.98	1.00
	Inconsistent	-2.02	2.03	0.80

*. The mean difference is significant at the 0.05 level.

DISCUSSION AND CONCLUSIONS

Aydın & Çorlu (2016) studied the relationship of a set of personality characteristics to innovation perceptions and reached a regression equation that explained 47% of variation in the dependent variable. This study investigated the influence of three domestic variables attitude, geographical background and the type of the family in which the student was raised that might, in some way, be related to innovativeness perception using not a correlational model but ANOVA statistics. Nevertheless, the study did not yield significant result. The only factor that has an influence emerged as the family attitude. Findings indicated that children with parents that have more democratic attitudes towards themselves tended to have statistically significantly more positive attitudes innovativeness than those having oppressive attitudes in their childhood years. More research is needed to find a model to more fully explain the factors that is responsible for high innovativeness perception.

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AN INVESTIGATION OF THE FACTORS AFFECTING INNOVATION PERCEPTIONS OF MATHEMATICS, SCIENCE AND SOCIAL SCIENCES TEACHER CANDIDATES

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ABSTRACT: The aim of this study is to investigate the innovation perceptions of engineering and teacher candidates. The data collection tools are the Turkish version of the Individual Innovativeness Scale (IIS), and the Domestic Factors Inventory. Three factor ANOVA is the main data analysis technique. Results indicate that family attitude has a statistically significantly influence on innovativeness perceptions.

Keywords: Engineering education, Teacher education, Innovativeness perception,

INTRODUCTION

Creativity is defined as the capability or act of conceiving something original or unusual, while innovation is the implementation or creation of something new that has realized value to others (Hunter, 2013). Innovativeness, according to Hunter's distinction is being one step ahead of being creative as a result of the added value dimension. It is clear that there is a distinction between creativity and innovativeness, nevertheless in practice these words frequently are used interchangeably. There is evidence that creativity relates to organizational innovation and effectiveness (Amiable, 1996; Scott & Bruce, 1994). Studies on innovative/creative perception/self efficacy are generally are available in the areas of business and engineering education (e.g. Wang, & Lin, 2012; Sung & Choi, 2009; Stajkovic & Luthans, 1998; Scott & Bruce, 1994) but there is less concern on teachers' perceptions (e.g. Mathisen & Bronnick, 2009).

Because of the increasing interest in investigating creativity and innovation, in recent studies various predictors of creativity and individual innovativeness have been examined (Choi, 2007; George & Zhou, 2001; Lim & Choi, 2009; Tierney, Farmer, & Graen, 1999). Personality traits as a factor for innovation perception is a relatively new area of inquiry (Sung & Choi, 2009). To investigate the influence of personality variables on innovative/ creative performance the Big Five model of personality was a popular instrument which defines personality as consisting of five dimensions as the name implies (i.e. extraversion, agreeableness, conscientiousness, emotional stability, and openness to experience) (e.g. James & Mazerolle, 2002; McCrae & Costa, 1997; George & Zhou, 2001; Sung & Choi, 2009).

There is growing evidence that students' information processing is different than past in the present time. Managing complex and diverse nature of today's problems needs flexible people who have innovative ideas. Teachers, therefore, need to have innovative teaching skills to make ideas and content more interesting for teaching the 21st century skills as well as for designing their pedagogy to encourage their students to think creatively and innovatively. In other words, teachers are required to 'teach creatively' and 'teach creativity' at the same time (Azzam, 2009).

Aim of the Study

The aim of the present study is to investigate student teachers' perceptions about innovation in the general sense, not particularly limited to teaching. These descriptions of innovation perceptions will also be made with respect to area of teaching (mathematics, science and social science). We also wish to explore the degree of relationship between personality characteristics and innovation perceptions.

METHOD

A quantitative research design was selected for this research study. The study collects data from a state university in Istanbul. The sample comprises of 189 second year students in the science teaching (n=69), mathematics teaching (n=62) and social sciences teaching (n=58) departments. These departments are in the first three in the rankings of the university entrance examination so these students are among the country's very successful teacher candidates. The data collection tools are the Turkish versions of the Individual

Innovativeness Scale (IIS) (Kılıçer & Odabaşı, 2010) and the Big Five Personality Scale (Big5) (Morsümbül, 2004).

For the current study, correlational research design was used. The multiple linear regression (Frankel, Wallen, & Hyun, 2012) is the main technique for data analysis. The relationship between a single outcome variable (dependent) and at least two or more predictor variables (independent) are generally examined by a multiple linear regression approach (Creswell, 2003). In this study, we investigated between the relationships between the IIS (the single dependent variable) and five independent variables: the five subscales (extraversion vs. introversion, agreeableness vs. antagonism, conscientiousness vs. lack of direction, emotional stability vs. neuroticism, openness vs. closedness to experience) of the big5 personality inventory. The calculated reliability scores for the big5 subscales varies between 0.73 and 0.84 (Morsümbül, 2004), and it is 0.77 for the IIS (Table 1).

Table 1. Descriptive statistics and the reliability scores of IS and big5. (N=202)

	Scales	RS	Mean	SD
BF1	Agreeableness	0.747	23.96 /30.00	8.57
BF2	Extraversion	0.839	25.31 /30.00	3.52
BF3	Contentiousness	0.832	21.43 /30.00	4.20
BF4	Openness	0.805	22.13 /30.00	4.75
BF5	Emotional Stability	0.737	20.11 /30.00	4.00
Big5	Total	0.823		
IIS	Innovativeness	0,772	72.27 /100.00	4.27

FINDINGS

Descriptive statistics

Means and standard deviations of the big5 scale and IIS were calculated (Table 1) and the results indicated that highest score is in the extraversion (M=25.31) and the lowest is in the emotional stability subscales. The value of 72.27 in the IIS indicates an "early adapters" level (one level before the "innovators" level) (Kılıçer & Odabaşı, 2010) for the teacher candidates in general. Means and standard deviations were also calculated with respect to the subject area of teaching (Table 2) which yielded no noteworthy differences.

Table 2. Descriptive statistics with respect to the subject area of teaching

	Science Teaching		Mathematics Teaching		Social Sciences Teaching	
	M	SD	M	SD	M	SD
Agreeableness	24,70	3,18	23,90	2,81	23,06	4,68
Extraversion	19,21	4,89	18,71	4,82	18,74	5,04
Contentiousness	21,70	4,72	21,76	4,51	20,78	5,15
Emotional Stability	20,66	4,21	20,05	4,52	19,26	4,07
Openness	22,24	3,60	21,60	4,44	22,43	4,28
Innovativeness	72,51	8,38	71,14	7,86	70,43	9,99

Correlational analyses

The correlation coefficients were calculated to describe the isolated relationship between the dependent (IIS) and several independent variables (Huck 2011). The results of the calculations of the Pearson Product moment correlations indicated low to mediocre statistically significant relationships between innovativeness perception and all five personality traits.

Model fit with respect to innovation perception scores

The result of regression is a generalization, which represent the best prediction of dependent variable from several continuous independent variables (Thompson, 2008). We used, in the present study, a multiple linear regression model. Our dependent variable is the innovativeness perception (IIS) and we wished to investigate whether or not & if so, the degree to which the dependent variable is predictable from the independent variables, namely, the big5 personality traits, the family attitude, family size, the geographical origin and the department of the teacher candidate. We preferred to use the standard technique and put all the variables to the model initially and excluded the variables that did not fit to the model until reaching the equation that can optimally predict the dependent variable. Data were checked, before the analysis, for the regression's assumptions; i.e, normality of residuals, and multicollinearity threat.

Table 3. Pearson Correlation Coefficients between IIS and big5

		Extraversion	Agreeableness	Contientiousness	Openness	Emotional Stability	Innovativeness
Extraversion	Pearson R	1	0,094	0,020	,247(**)	,233(**)	,305(**)
	Sig. (2-tailed)		0,185	0,774	0,000	0,001	0,000
Agreeableness	Pearson R		1	,287(**)	,426(**)	,261(**)	,487(**)
	Sig. (2-tailed)			0,000	0,000	0,000	0,000
Contentiousness	Pearson R			1	0,135	0,024	,209(**)
	Sig. (2-tailed)				0,056	0,735	0,004
Openness	Pearson R				1	0,099	,612(**)
	Sig. (2-tailed)					0,163	0,000
E. Stability	Pearson R					1	,240(**)
	Sig. (2-tailed)						0,001
Innovativeness	Pearson R						1
	Sig. (2-tailed)						

We first found out that 47% of the variation in the dependent variable is explained by the independent variable. Moreover as the Durbin-Watson value of 1.832 is in between 1.5 and 2.5, we concluded that there is no autocorrelation in the residuals (Durbin & Watson, 1951) (Table 4). Moreover, the statistically significant F value of 32.78 in the IIS analysis of variance (ANOVA) table indicates that the model was statistically significant (Table 5).

Table 4: Model Summary (A)

R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
				Sig. F Change	R Square Change	F Change	df1	df2	
,686(a)	0,471	0,457	6,31910	0,471	32,777	5	184	0,000	1,832

Table 5. ANOVA results for in novation perception scores (A)

	Sum of Squares	Df	Mean Square	F	Sig.
Regression	6544,10	5,00	1308,82	32,78	,000
Residual	7347,30	184,00	39,93		
Total	13891,39	189,00			

Variance inclusion factor and tolerance values are considered as important criteria for the selection of the predictor variables to be included in the model: the maximum acceptable VIF value is 10 and minimum acceptable tolerance value is 0.1 (Cohen, Cohen, West, & Aiken (2003) (Table 6). As a result of the coefficient analysis, contentiousness variable from the big5 scale, and the last three demographic variables (family size, geographical background and subject area) were excluded from the model.

Table 6. Coefficient analysis (A)

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations		
	B	Std. Error	Beta			Part	Tolerance	VIF
(Constant)	17,25	4,32		4,00	0,00			
Extraversion	0,29	0,12	0,14	2,53	0,01	0,31	0,18	0,14
Agreeableness	0,54	0,15	0,23	3,51	0,00	0,49	0,25	0,19
Contientiousness	0,14	0,10	0,08	1,34	0,18	0,21	0,10	0,07
Openness	0,97	0,13	0,46	7,42	0,00	0,61	0,48	0,40
Emotional Stability	0,18	0,11	0,09	1,59	0,11	0,24	0,12	0,09

As the b (unstandardized) weights and β (standardized) weights and structure coefficients for each predictor variable of the IIS score indicated, the resulting regression equations will appear as:

- *IIS = 17.25 + (0.29)*(Extraversion) + (0.54)* (Agreeableness) + (0.14)*(Contentiousness) + (0.97)*(Openness) + (0.18)*(Emotional Stability)*
- *Z_{IIS} = (0.14)*(Extraversion) + (0.23)* (Agreeableness) + (0.08)*(Contentiousness) + (0.46)*(Openness) + (0.09)*(Emotional Stability)*

DISCUSSION AND CONCLUSION

Although the statistical model emerged as a result of the analysis of the predictor variables is not a powerful one and are unable to explain 53% of the variance in the individual innovativeness perception, it still provides useful information on the relationship between the innovativeness perception and the personality variables. It does indicate that the personality characteristics (if effectively measured) can be used to identify people with high attitudes towards innovation.

The relationship between perception and performance is not always straightforward as the general literature indicates (Johnston & Heineke, 1998) that we cannot claim that those with high attitudes are those with high performance. There is, nevertheless, evidence that innovation perception is a strong predictor of innovation performance (Kiliçer & Odabaşı, 2010). As the scores of IIS indicate, teacher candidates in general are in level 4 which corresponds to the "early adapters" level. It was thought that the epistemological differences among areas of teaching would make a difference in the IIS scores. It did not. No noteworthy difference was observed among areas of teaching as the IIS scores were in the 70,43-72,51 interval with a slight difference in favor of science teacher candidates (Social STC < Mathematics TC < Science TC).

Openness to experience emerged to be the most important personality factor among others. The result of the regression model shows that among the five personality variables, the one with the highest regression coefficient is the *openness to experience* (B=0.97) (Table 6). *extraversion, agreeableness, contentiousness* and *emotional stability* had lower coefficient values.

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ENGAGING UNIVERSITIES WITH LOCAL EMPLOYERS

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ABSTRACT: There is a growing demand on universities to produce graduates who can make immediate contribution to employments. Work Based Learning should make contribution to this demand and should be incorporated in a modern course curriculum. Employers should be engaged in the curriculum design, content, organization and in some cases delivery and assessments.

This paper will deal with the current higher education challenges. It will consider issues and benefits relating to engaging universities with local employers. These will include general processes the universities may explore in order to improve the way in which they engage employers, understanding employer needs, communication mechanism, methods of engagement, course developments, Universities' income generation from employer engagement and the importance of engaging employers.

The paper will also deal with the current higher education teaching and learning issues and challenges. It will also consider other issues relating to various methods of learning including face to face learning, work-based learning, distance learning and blended learning which are important for engineering and technology courses. Universities may explore these learnings in order to improve their students' success.

Keywords: Universities, education challenge, Learning, Employers engagement

INTRODUCTION

Universities can provide education to more people through engaging employers. They have the ability to deliver their course programme to a greater target audience to their benefit should they choose to provide for employers. They can get the most from this benefit by developing a relationship with employers, and then building this relationship from engaging employers within the internal mechanisms of the university.

Universities have an important role in developing relationships with employers, who in turn benefit from such a relationship. Universities have a responsibility to maintaining this relationship for this mutual benefit. The business side of the university is becoming increasingly more important, as is the need to engage employers and manage business relationships to reach objectives on a larger scale.

University Objectives

Universities work with employers to achieve a number of objectives. Key objectives of the employer engagement are to:

- Improve the employment prospects of those who work for the organisation and wish to progress themselves through learning
- Generate income for the university from a business relationship with the employer which can then be reinvested into the university and its future
- Contribute to the economic development of the local area, through provision of employable skills and increased revenue

In order to meet such objectives, the university should place much of the emphasis on the employer. An employer that is satisfied with the level of service from the university is likely to invest in a mutually beneficial continued relationship therefore meeting the objectives of the university and needs of the organisation.
Two methods this may be achieved would be for the university to:

- Focus on employer satisfaction with the training provided and skill levels of the employees graduating from university course programmes
- Have a greater emphasis on becoming more responsive to employers, and to give greater priority to relationships with employers

Guidelines for Universities

There are some general processes which universities should consider in order to engage employers. These are some general guidelines which should form the basis of their understanding and thought processes in engaging local employers within their universities.

The universities should:

- Achieve and maintain regular and consistent communication between the university and partner employers
- Make the employer aware of and encourage adoption of the university regulations and procedures to ensure compatibility between the organisations
- Continually inform the employer of revised policies, or changes in procedures as and when they happen within the university
- Provide advice and guidance to the course team on how they may deliver university programmes in partnership with employers
- Closely liaise with employers when developing and considering admission requirements and their implementation
- Involve the employer in the development of the student induction process, so that it is compatible with their employees
- Provide the employer with the student handbook for review, to ensure it is sufficient for their needs prior to the commencement of the programme
- Manage and set assessments with the involvement of employers, so that the assessment is appropriate to how they want to assess their employees
- Inform the employers of the outcomes from meetings of the course or award committee, so that they are informed of all developments
- Inform the employers of the outcomes of the examination board, so they can monitor the progress of the employees
- Inform the employers of amendments of the course programme, such as module approval or amendment, as well as withdrawal to ensure they are informed of changes in the programme
- Ensure that employers are informed of the staff members teaching on the programme, and the points of contact for their employees
- Encourage the employer to participate in the collection and analysis of employee feedback of the module so that improvements to the programme can be made

Understanding Employer Needs

In order for a university to engage with employers it must understand them. With this mind, the university should learn and understand the needs of the employers. Within education there is a growing need to be able to respond to the needs of employers.

Should a university take this on board, employers are likely to become willing and participating business partners now and in the future. Universities should therefore realise:

- They must take on the roles of both *consultants* and *sales people*, in that they are there to inform employers of course programmes as well as selling the course to them
- Employer's needs are unique to each employer, with each employer wanting something that meets their own individual needs
- A generic strategy for every employer may not be appropriate in that each employer will have greatly differing needs based on the type of their organization

Communication Mechanisms

Ongoing communication with employers is crucial to the relationship between the university and the employer. Mechanisms in which the university may communicate with the employer include establishing on going platforms for contact with employers and to maintain an open channel of communication.

Within this channel, active and passive methods of communication can be used, and include:

a) Active methods of communication

- Direct and formal meetings with employers at strategic events such as boards and consultations
- Contact in the sphere of work based learning such as in work placements for students and employees

b) Passive methods of communication

- Materials regularly sent directly to employers such as informative publications and print media
- Continual contact with employers maintained over both forms, with discussions of issues relating to the employer

Methods of Engagement

A university can engage employers and enhance their existing employer engagement practices, should they take note of the following guidelines:

- Employers will want to be engaged when the university shows that they understand their business issues, such as the need for educated employees involved in continual learning
- Should a university provide value to the company by taking note of these needs and develop a method of resolving those needs through provision of learning, the employers are likely to be responsive
- For the university to gain an understanding, an effective engagement process would be a structured and thorough consultation to both build the relationship and understand the learning needs of the organisation
- A consultative approach should therefore be taken, so that the employer may explore the needs, perhaps presenting further needs that may not have been realised beforehand
- An employer must believe they are receiving a return on their investment, in the form of knowledge and an academic skill base for their employees that participate in the course programme

Fundamental Factors

Universities should realise two fundamental factors in successful engagement of employers. Research has found that universities and employers closely engage with each other when:

- Employers recruit people directly from universities
- Employers use universities as suppliers of education and training for existing employees

With this mind, universities should realise that employers are more likely to be involved and engaged, in instances of direct recruitment and provision of learning for existing employees.

Importance of Engaging Employers

- The effectiveness of the university at the process of employer engagement can be determined in part by the importance of employer engagement at the higher levels within the university
- Universities that see employer engagement as marginal will focus on mainstream provision and a generic strategy for employers
- Universities that want to have more success will have employer engagement as a central core to the mission of the university
- These universities will have an open mind to expand beyond generic provision from a belief in the importance of employer engagement

Policy on Income

Universities must take into consideration income generation from employer engagement, as this is one of the main reasons for and benefits from engaging with employers.

Issues on this subject include:

- Reviewing of the market rate for provision, and whether the university falls in line with this rate and is competitive
- Advising employers on how learning can be funded, and ways in which they can participate in the learning programme
- Responding to employers that request learning who cannot meet the required funds for learning provision
- Attracting employers who have yet to pay for training in order to achieve greater market penetration
- Using price of training as a competitive advantage in the marketplace of work based learning

Course Development

For a university to meet the broad range of employer needs in the workplace, the employer will have to

- Develop new learning programmes and modes of delivery, and expand their operations
- Engage employers in ways that make them strategic partners to the university, and stakeholders as well as customers receiving learning programmes

Work Based Learning

Work Based Learning (WBL) is a way of creating Higher Education level learning in the workplace. Its special work-linked features enable learning to be centred and take place throughout the working environment [1].

WBL involves universities, students and employers working in partnership to provide high-quality learning for students. This includes a wide range of practice, ranging from fully-integrated WBL programmes, through work placements and practice-based learning, to the accreditation of employer provision by the universities [2].

WBL can help **employees** in making career decisions, developing job skills relevant to future employment, achieving a recognised academic qualification, enhancing their academic knowledge, achieving a recognised academic qualification and improving their personal and professional development [3].

WBL can help **employers** in identifying employees to fill specialist roles, becoming a learning organisation able adapt to changes in the market place, retaining employees and reducing the costs of recruitment [3].

As the university builds relationships with employers, they must then transfer the appropriate information through materials. These materials represent the knowledge the university holds that must be given to the students on the programme and employers themselves. With this knowledge employers can develop an understanding of the programme of content that will be given to their employees. The employees themselves will be able to have this foundation of understanding and then use the teaching materials to learn the programme of content and fully understand the subject in which they wish to build and develop their knowledge.

Distance Learning

Distance Learning is a modern way of studying for an undergraduate, Master or PhD degree courses without actually being on site at the students chosen universities by using new technology in the delivery of subjects associated with these courses, including the use the VLE through the Internet [4]. Instead of attending lectures, students study online, attending ‘virtual’ tutorials and submit their assignments over the Internet.

Distance learning does not always meet the requirements of courses such as Engineering and Technology related courses where the physical classroom attendance is mandatory to complete the course. In this case a blended learning may be required [4].

Blended Learning

Blended Learning is a combination of face-to-face learning, online assessment and feedback, mediated instruction (E-Learning) and traditional study methods, as illustrated in Figure 1 [5].

Because of the face-to-face learning sessions, blended learning can be applied to engineering and technology related degree courses which require a significant amount of laboratory based work in order to satisfy the accreditation requirements by professional bodies.

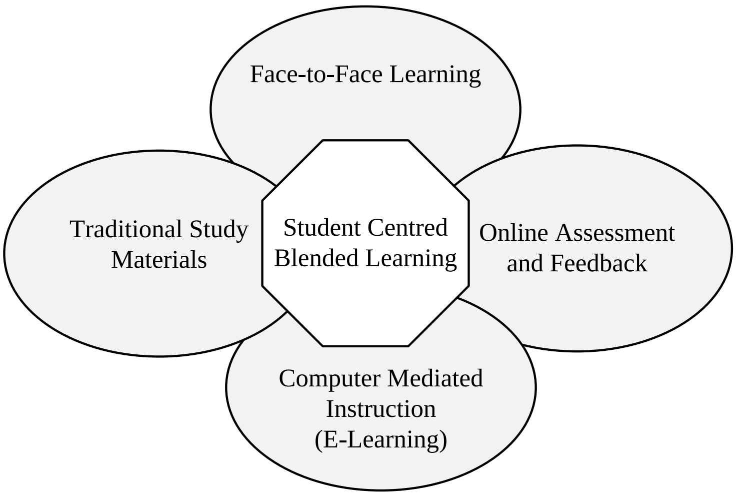

Figure 3: Blended Learning Model

CONCLUSION

This paper has considered issues and benefits relating to engaging universities with local employers and has also dealt with the current higher education teaching and learning issues and challenges.

The paper presented methods and the importance of engaging universities with local employers, guidelines, understanding the employer needs, effective and useful methods of communication with employers, income generation from employer engagement and procedures for teaching and learning in Higher Education.

Employer's satisfaction is an important element. An employer that is satisfied with the level of service from the university is likely to invest in a mutually beneficial continued relationship.

Work-based learning is important for some courses which require the delivery of some materials within the workplace. For industry-based part-time students, this is feasible to implement, however it has proven difficult to find a work placements for full-time students to carry out their work-based learning materials.

It must be noted that, students on each course are different, and this must be reflected in the range and diversity in the materials provided. Teaching and learning must be supported depending on the course studied, with the level of materials equal to the level of the course. Materials developed and delivered must take into account that courses will undoubtedly place a great emphasis on all types of learning and the materials should take this into consideration.

When the universities deliver courses by distance learning they need to make sure this type of learning may not always meet all the teaching and learning needs and blended learning may be required.

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CITIZEN SCIENCE PROJECT "NUCLEAR E-COLOGY": PHYSICAL RESULTS AND THE EDUCATIONAL IMPACT

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ABSTRACT: We created citizen science project called "nuclear e-cology", and proposed it to high school teachers. Its main purpose was, in particular, to introduce the modern physics and science, in general, to afterhours school activities and eventually to modify high school curricula. We also put a special attention to the teamwork and the general scientific methods. Groups of students initially started the serious scientific work and some of them finished the study in the 2014/15 school year and we found results of their activity of the real physical value. We shortly present some of them here. We discuss here also some educational aspects of the project based on interviews and opinions of teacher involved in the project. We believe that the further work could be fruitful and successful from the point of view of students and teachers.

Key words: citizen science, physics education, heavy metal contamination, X-ray spectra

INTRODUCTION

The road transportation activity, a primal component of economic development and human welfare, has been highlighted as a significant source of the emission of heavy metals (e.g., cadmium, copper, iron, lead, zinc, or nickel), which impacts the ecological environment on the roadsides and the vicinity of the roads: farmlands, pastures, rivers, residences etc. The heavy metals may enter the food chain as a results of the up-taking of edible plants or may directly contact to people and, with the accessive levels, they can cause serious health risk (Krzyzanowski et al. 2005) and of ecological problems (Bolin et al. 1986). The observation/monitoring the pollution to understand the problems, and to control the effects is discussed extensively in the literature (e.g., Lagerwerff and Specht 1970, Hamilton and Harrison 1991, Degobert 1992). The study about road pollution will be never out-of-date. The demand of the vehicle use throughout the world has never been decreased since 1960 (Dargay et al. 2007). Furthermore, the repetition of the future study conducted at the same road will allow one to monitor the changes of the heavy metal pollution distributing on the roadside.

Many pages were written about the importance of the physical education of the next generation. People trained in physics are essential for the continuing research in particular field, and for maintaining technically sophisticated workforce. Students at the graduate education level in experimental and theoretical physics have opportunity to experience and solve complex problems. Their trainings involve design, build, and test of instrumentations, they learn teamwork, management, and communication skills in addition to gain new technical knowledge and expertise. Their skills are readily applied to a wide range of technological problems of their nations: in medicine, industry, environment, business, management, and government. Future technologies will be steered by these people, but before the undergraduate degree in physics should provide the solid foundations. The undergraduate students should have the opportunity to acquire deep conceptual understanding of fundamental physics and gain important skills also for experimentation in physics. It is known that in the earlier education young students are fascinated by natural phenomena, and it is known that their interest in science starts erosion around the ages of 14 (Murphy and Beggs 2005; Pell and Jarvis 2001; Hadden and Johnsone 1983). Consequently, the students who could potentially follow a science-related career are rejecting this option by the time they reach high school (Smithers and Robinson 1988; Trumper 2006). A way to lead them to educational path in physics is to reinforce them early and maintain their interest – the power of inspiring healthful of curiosity, in the educational process.

It is hard to find the field interesting, important, 'modern' and possible everywhere. However, we have found the one and we have established the respective citizen science project. We called our project "nuclear e-cology". It is multidisciplinary research project interested eventually on the man-made heavy metal pollution, involving the environmental studies of the surrounding nature based on the atomic structure of the world, and further the structure of the atom and atomic nuclei, using the X-radiation, applying the knowledge of its origin and detection and methods of the X-ray spectroscopy and probably many more detailed subjects which could be touch by the students engaged in the project.

The general question of study the contents of things by the X-ray spectroscopy method is very wide. To make it possible for high school student we narrowed it to the research on the examination of heavy metal pollution in the roadside plants.

The detail description of the project is given elsewhere (Dam-o, 2015, Wibig & Dam-o, 2016, Dam-o et al., 2016). Here we would like to present briefly the idea and results

THE METHOD

The research is focused on the examination of the abundance and their distribution with respect to the distance from the road axis for eight heavy metals: iron (Fe), nickel (Ni), copper (Cu), zinc (Zn), lead (Pb), bromine (Br), rubidium (Rb), and strontium (Sr) in the plant species growing on roadside in Poland and Thailand.

The processes of collecting and preparing samples, analyzing X-ray spectra was carried out by the groups of the school students (at the age from 11 to 18), under supervision of the scientists of the "nuclear e-cology" project, in an remote laboratory fashion.

In principle, each group was expected to collect 18 biological samples on a roadside with distances from the road axis of "0", 25, and 50 meters (within the ±2 meter `accuracy' depending on availability of the plants and features of the research site). For each sample leaves of selected plant species should be collected evenly from the plants over the area of about one square meter around. The process of sample preparation consist of:

- cleaning – remove unwanted parts from plant and thoroughly rinse with distilled water;
- drying – dry the plant samples in free dust and ventilated room for 20 days or dry with drying oven at 60° C for 7 days;
- grinding – grind the dried plants into fine powder (non-fibrous) with ceramic mortar;
- packing – pack 5 g of a powder sample in a clean polyethylene bag, seal it and label the bag.

All listed items are to be done by school students. When completed, they have to send the samples to the "nuclear e-cology" central lab in Łódź (in person or via conventional mail). At the laboratory, we were responsible to further prepare the targets for the measurement and perform the measurement in the Laboratory of X-ray Methods of Jan Kochanowski University in Kielce.

In the present study, to determine the concentration of elements in the samples, the TXRF method (Klockenkämper, 1997) was used. This method is a modification of the X-ray fluorescence method (XRF) (Van Grieken R., Markowicz A. (eds), 1993) with special experimental geometry. The main idea of the XRF technique is excitation in analyzed sample, irradiated by X-rays generated in the X-ray tube, the characteristic X-rays. Emitted by sample X-rays are registered as a X-ray spectrum on which the lines of the characteristic X-rays are observed. The position of the line maximum identifies the energy of X-ray, and consequently, the element from which the characteristic X-rays were emitted. The intensity of the line is proportional to the element concentration. The total reflection X-ray measurements were performed with the S2 Picofox Bruker spectrometer (User Manual S2 PICOFOX, 2012). Typical TXRF analysis needs the sample in the liquid form. The plant ample was prepared by adding to about 0,1 g of sample 4 ml of HNO_3, 2 ml of H_2O_2 and 0,2 ml of Ga (100 μg/g) as an internal standard. Plant solution was placed in a microwave oven for the 20 s (10 s two times). Next, about 5-10 μl of solution was deposited on silicon sample carrier and dried in temperature of 40°C. This dried residuum was analyzed in TXRF spectrometer for 1000 s.

PICOFOX S2 spectrometer measures and calculates the elements concentration automatically. In presented project, we would like, however, to make this elaborated measurement process educational (more `human') to show the physic behind it. We took the raw spectrum data from the PICOFOX S2 spectrometer and used them as an input for special fitting program made by us just for purposes of our "nuclear e-cology" project.

The skill of fitting data is one of the more important abilities of the experimentalists. The mathematical models of the minimization of errors or computer programs which `fit' the data with presupposed curves do not give the students the feeing of the real power of the measurement and the uncertainty of the obtained, fitted result. If the student can move lines with the computer mouse and see what is the effect of the change of the line width or the peak position, his/her general physics education increases substantially. The fitting procedure is not easy, anyway. We found that the very important and hard problem is to understand what the background is and how to take it into account. We have prepared the test which each student has to pass before he can start to work with the real data. He/she have to show, that he/she can adjust the Gaussian curves to the three special cases which we selected as a problems for testing.

When students were able to reasonably work with data, the files with their raw spectrum data obtained from all samples they delivered were added to the available database of the project and students can downloaded them to the Java applet available at the project web page and start the real work. They were asked to make the best estimation of the profile line parameters and to get areas under each peaks in the spectrum from each sample. There are about 150 (18 times 8) relative abundancies each described by three free parameters. This shows the scale of the project! Students were asked to put all the numbers to specially prepared Excel spreadsheet which draw the respective graphs showing the results of the measurement is a clear and consistent way. The experimental group spreadsheets were sent to us and stands for the base of the project 'global report'.

The comparison of results obtained with the professional software of the PICOFOX S2 spectrometer of Kielce lab and our project software using the method of fitting `by eye' is presented in Fig. 1. As we can see the agreement is quite good.

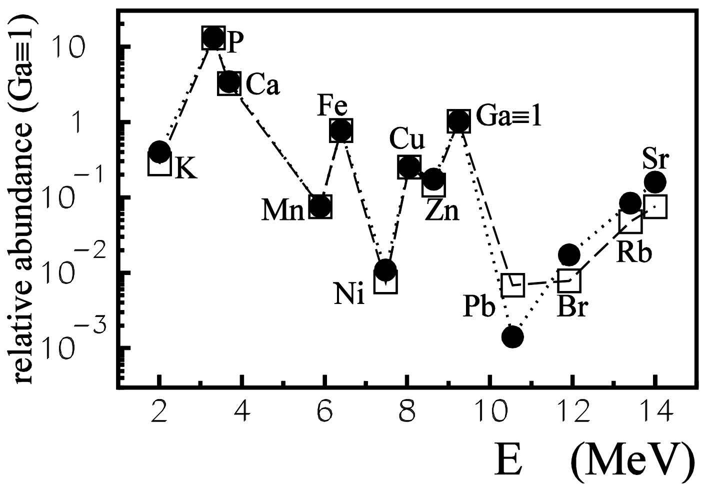

Figure 1: Net area (with respect to gallium) of analyzed element peaks analyzed using our software (solid circles) compared with the Kielce PICOFOX S2 spectrometer program (empty squares).

Results obtained from all students group were sent do our laboratory in form of individual reports. Each group finalize its experimental activity at the final web conference, where they presented findings discussed results and proposed eventual conclusions and remarks. The data from all groups were available to all the participant and some 'global analysis' are , in principle allowed. To conclude first run of the project we combined the students results and, surprisingly, we have found that they have some scientific, not only educational, value.

RESULTS

Physical results

Physical results of the "nuclear e-cology" project consists of two important findings. The first is the confirmation and even more, the quantitatively estimated character of the dependence of the heavy metal pollution as a function of the distance from the road axis. Below we present our results compared with other measurements.

The other experiments shown in Fig. 2 are based on different techniques and sometimes used different samplings, and different species, of course. Alov et al. (2007) presented results of heavy metal pollution in soil samples collected from ground surface. The results shed by Usman and Gaya (2013) are the relative concentration of iron with respect to the copper at distances very close to road edge obtained the plant species *Hyptis suaveolens* (L.). They measured trace metal concentration using atomic absorption spectroscopy. The same technique was used by Lagerwerff and Specht (1970) to measure the pollution in roadside soil and grass in US. The experiment by Zhao et al. (2010) shows the distribution of heavy metal in plants (e.g. *Gramineae*, *Cymbopogon caesius*, *Oryza stiva* L., etc.) along the sloping roadside on Mangshi–Ruili and Dali–Baoshan highways in mountaineous areas of Yunnan province, China.

Lead, considered as the most toxic among heavy metals emitted from automobiles, was studied by many research groups. In the comparison shown in Fig. 2d we compared our result to the results of Lagerwerff and Specht (1997) , Zhao et al. (2010), and also Viard at el. (2004) who the samples of atmospheric deposits were studied and Othman et al. (1997) who measure average lead levels in eggplant and parseley from agricultural lands on vicinity of two roads in Damacus city, Syria with the anodic stripping voltametric method.

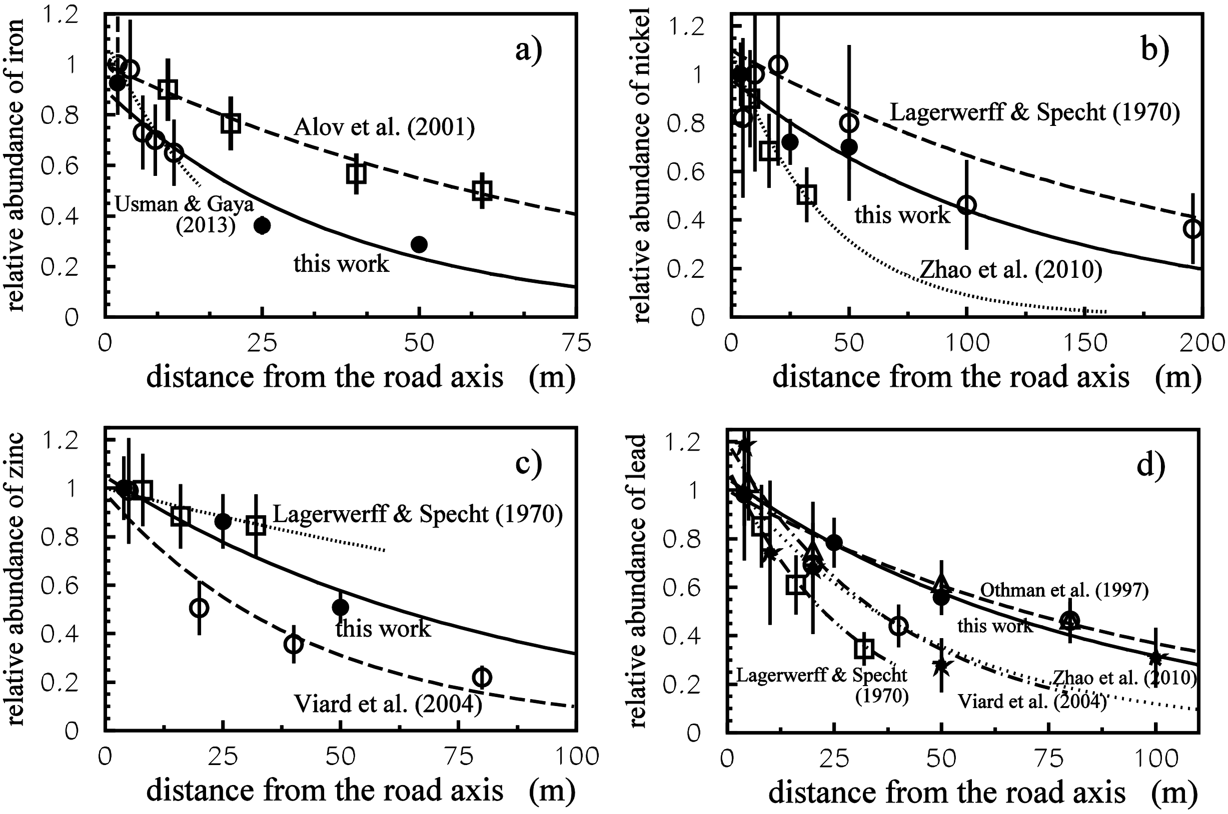

Figure 2: Relative abundances from our study (black circles) compared with other experiment results for four elements: iron (a) (Alov et al, 2001) - squares, (Usman & Gaya, 2013) – empty circles, nickel (b) (Lagerwerff and Specht, 1970) - empty circles, (Zhao et al. 2010), zinc (c) (Lagerwerff and Specht, 1970) – squares, (Viard et al., 2004) - empty circles and lead (d) (Lagerwerff and Specht, 1970) - squares, (Othman et al.,1997) – empty circles, (Viard et al., 2004) – triangles and (Zhao et al., 2010) stars. The lines shows exponential decreases adjusted to each data set. According to small statistics they should be taken with care.

No experimental results concerning the distribution of the bromine aside the road no experimental results have been published yet. Our measurement shows that the characteristic decrease length of relative abundance of bromine is of order of 50 m. It is well within the range of decrease rates of other heavy metals shown in Fig.3.

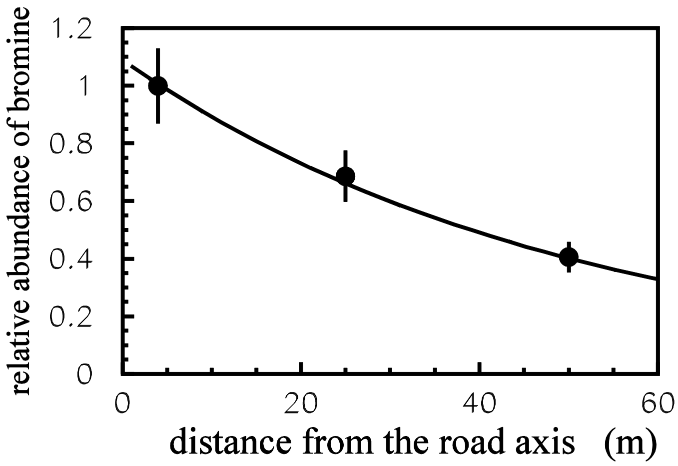

Figure 3. Comparison of decreasing relative abundances of bromine of combined data of the four research sites from our study to the studies.

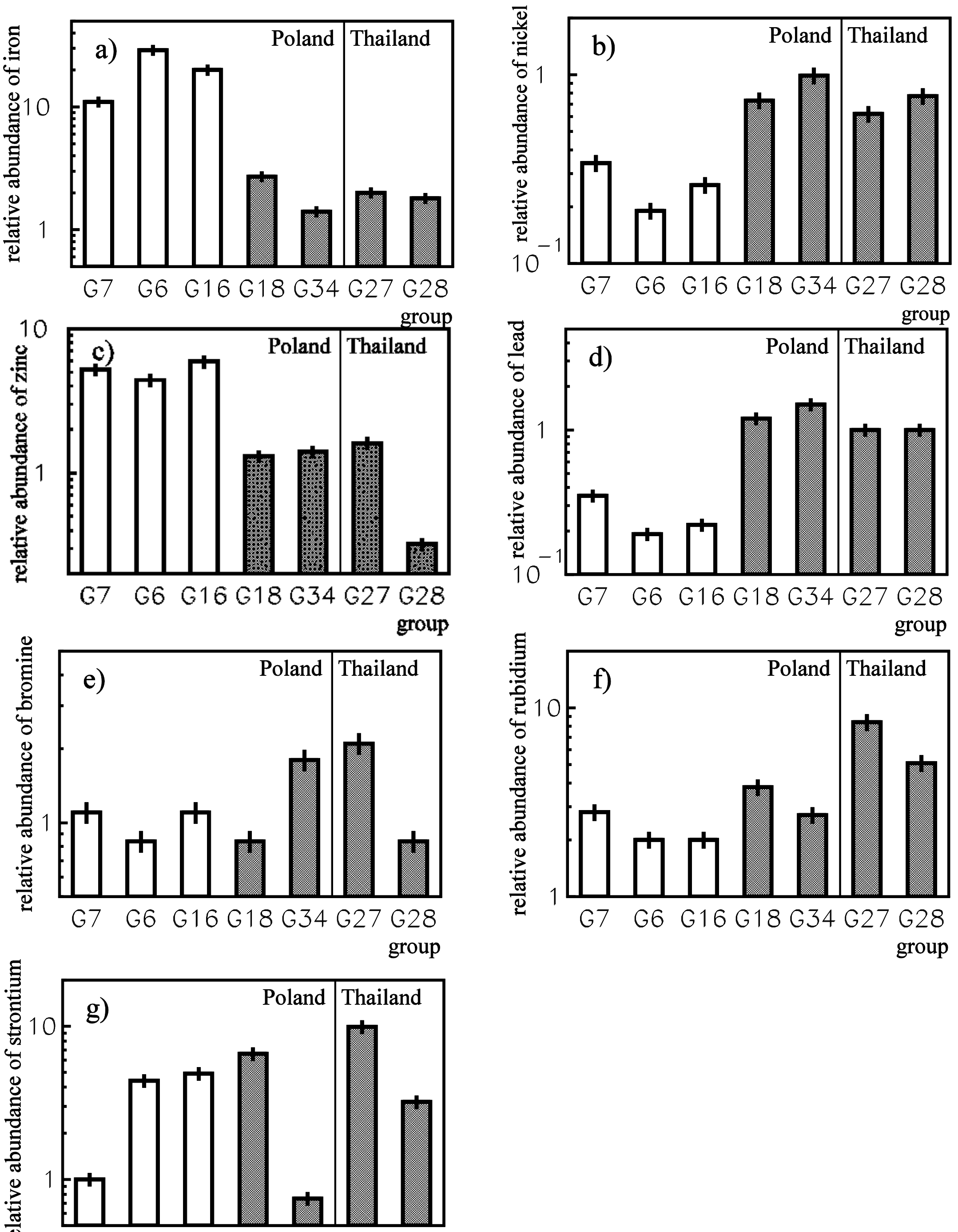

Figure 4. The average relative abundance of iron (a) and nickel (b), zinc (c), lead (d), bromine (e), rubidium (f) and strontium (g) in roadside plants of different research sites in Poland and in Thailand.

Detailed studies made by us gives the accuracy or all measured points is of order of 10%. This part of the work could not be performed by students of one group because of two reasons: first is that it needs rather deep understanding of the uncertainty theory, and the second, it used data collected by all group to estimate the spread of individual measurements.

Another finding, quite unexpected, also needs the comparison of results obtained by different groups. To conclude the first stage of the project measurements we made the comparison of the average abundancies measured by all groups and we noticed intriguing systematic discrepancy. It is shown in Fig. 4. Results of first three group (G7 - Wartkowice, G6 and G16 – Rawa Mazowiecka I and II) are systematically higher than the rest four (G18 – Łowicz, G34 – Łódź, G27 and G28 – Nakhon Si Thammarat I and II) for the iron (Fig. 4a) and lower for the nickel (Fig. 4b) relative abundances. For other elements in Fig.4: the lead behaves similar to nickel while zinc to the iron. For the bromine, strontium and rubidium the evidences of the existence of the effect are weak and rather inconclusive. Trying to understand this we ask students for additional information about their research site which could be helpful and eventually we have found that the first three groups studied sites which were effected by the roads which were build relatively not long time ago, while the other four were in the vicinity of the old roads. We set the boundary at 10 years: the first roads are younger than 10 years while the next are older. This effect was observed for the first time, and we have to say that students participating in the "nuclear e-cology" project could be proud of this discovery. They experienced, in a sense, the excitement of being the trailblazer – a kind of strong stimulus for further scientific activity.

Non-physical results

The involvement of nonprofessional scientists in "real" scientific research (known as "crowd science", "citizen science", or "network science") has become increasingly important in conservation science (conservation biology, environmental science). The open collaborative fashion in citizen science helps scientists with the large collection of data which would be impossible to examine extensively by traditional field research models because of limitations of time and resources. In the field of physics almost all citizen science projects are related to astronomy. Generally, participants are involved in inspection and classification of images of galaxies and stars (Tulloch et al. 2013a and 2013b; Franzoni and Sauermann 2014). So far, there is no project where the participants play the important role in physical experiments and which is designed to conform to physics the curricula at school level as we are going to do.

Teachers

The teachers share with us their opinions and comments about the experimental lesson. They were not only enthusiastic but gave us also important suggestions for further improvement of the project.

The positive attitude of the school teachers, who participated the project, towards the experimental lesson on X-ray spectroscopy was expressed through their suggestion to the new students to take part in the lesson. There is a case of a school, Princess Chulabhorn's College Nakhon Si Thammarat, in Thailand, where the teacher, who participated the project, is a teacher of physics teaching high school students. He has been teaching in the topic of atomic physics and nuclear physics for years. After activities in the project in the year 2013/2014, the teacher suggested students of the next academic year in atomic and nuclear physics class to take part in the experimental lesson of the "nuclear e-cology" project, as the lesson can fulfil student's knowledge of X-rays and the application of spectroscopy. In Poland the most of participants and teachers of the year 2013-14 were in secondary school level. The atomic and nuclear physics are not taught intensively at this level, so, the experimental lesson of the project was suggested as the general science activity which not rely on atomic physics and nuclear physics class.

The participation of school teachers in the project is beneficial to the project. They observe students' activities and thus they gain more information about the experiment and the project as a whole. The teachers are further able to provide their students, prospective participants, with the extended information related to the experimental lesson. It helps the prospective participants to understand what they are going to experience when they take part in the "nuclear e-cology" project. Finally the placing of the experimental lesson as an suggestive activity to school students, year after year, helps the project in maintaining momentum of the research.

Students, participants of the project

The scientific research associated with the application X-ray spectroscopy to environmental science with the experimental lesson entitled "examination of some heavy metals in roadside plants" meets interest of a number of school students both in secondary and high school level. The school students taking part in the lesson had ability to carry out the research via the prepared lesson, with the assistance of the laboratory scientists. According to the number of participants of the continuing edition in the year 2014-15, some of them were told for the lesson by their school teachers and some were told by their friends who formerly participated in the project. This implies that the lesson can fulfil teaching and learning physics at schools. However, the lesson may be not appropriate for every school students. There is the number of participants who quitted the project before the completion of all assignments. The reasons why they have quite the project given by those participants are mainly:

- some school students were not really interested in the lesson (scientific activity). This situation happened in one case of 7 groups registered from the same school. They did not find the scientific

activity of interest by themselves, except for their teacher. They completed activities on field work and preparing samples but they did not have intention to learn physics and to analyze spectra,
- some school students were not longer interested in the lesson. This happened to 6 groups of students who all were studying at the first year of secondary school (12–13 years old). It seemed that at the beginning they were eager to participate, however after they have got a few assignments from the laboratory (e.g., study experimental instruction, survey roadsides, practicing the fit software), they declined their interest.

This information indicates that the activities of the experimental lesson of X-ray spectroscopy should be introduced to school students mainly for the groups of gifted students and students who are interested in science. Students of these groups are potentially able to learn some new and advance subjects in physics and they have self-motivation to carry out the scientific research and to find the results.

Importance of the meetings and e-mail/teleconference sessions

Activities in the experimental lesson were arranged in the way similar to the experimental class at schools that the school students were assigned to work into groups and have a laboratory scientist (instead of a teacher at schools) play the role of lab supervisor. The communication between the experimenters and the lab supervisor aided by the Internet application, especially via video conference (e.g. Google Hangout), is very useful here, because:
- it allows the lab supervisor to help the participants to efficiently conduct the experiment by giving clear instruction, explaining the significance of the activities, encouraging the participants to find out the answer and pointing out potential problems,
- it allows the participants to meet, ask and discuss any problem related to their work with the laboratory scientists that they could perceive the real existence of the laboratory and believe in the real collaboration, not just learning from materials presenting on the web pages,
- it allows the participants to meet other students to exchange data in real time,
- it is flexible as the meeting participants can join video conference from for example laboratories, schools, homes, etc. and it is obviously cheaper and faster than in-person meetings.

For e-mailing, it allows us in regular correspondence for such as updating news, sending information of learning materials, arranging appointments including questioning/answering miscellaneous topics. The idea of communicating approach via teleconference is one of the strongest point of the project offered to the participants, which other distant laboratories could not offer for education purposes. We found by personal observations and from remarks of school teachers using computer simulations and remote experiments on the web, that when a student questions arise, in most cases there are no one who gives the answer or advice. After such experiences, students interest of study on the internet fades out. In order to retain the learners' attention on such distant learning the activity of teleconference (as well as e-mailing) is necessary.

We also arranged a number of meetings at some schools in the area of Lodz Province. It was not regular activates in the general plan for every participants' groups. As the project was newly found, we would like to meet the participants and school teachers in-person and establish long-term relationship. Certainly, the in-person meeting is more efficient than teleconferences. However, the in-person meeting is not as flexible as the teleconference is and it requires some expense for travel.

Report of the group

In general, the school students have some experience on writing lab report (a simple one) in science class since the first year of their secondary school level. Besides dealing with many data sets, the experimental report which they had to write in the "nuclear e-cology" research is nothing extraordinary. It consists of the part of results (with table of data and graphs) which requires data from spectra analysis. The participants were able to complete this part correctly in most cases. This demonstrates that they have learnt about deconvolution of X-ray spectra and the method of spectrum analysis. It can be supposed that if these students would be involved in the work related of spectrum analysis, they will understand what the spectrum is, how to get data from that raw spectrum and how the spectrum analysis programs works. The second part of the report is the part of discussion and conclusions. Students describe there all the findings emerged from the group studies with possible or supposed explanations. Generally, the participants were able to give some explanation with logical, clear manner and straightforward form. However, some weak point appeared quite often and need to be explained and clarified. The main problem is the measurement uncertainty. Students usually wrote what they directly had seen in the graphs. If one point is below the neighboring points the usual claim is that the particular element abundance decreases at particular distance. The little deeper analysis sometimes shows that this is an effect of one, single sample, one contaminated spectrum, or even one wrong net area estimation or mistake in the record file. The scientific criticism seems to be not established yet. The usual childish scrutiny are far too less for our purposes. The “nuclear e-cology” project is the possibility to introduce the scientific methodology also in this aspect. The analysis of the uncertainty is crucial, but it can be applied only in a qualitative way. It can be assumed that students in general do not know what the uncertainty is and how to take it into account in the analysis. The one way is that the laboratory scientists should introduce to the students the way to roughly estimate the uncertainty and show them how to use it. When succeeded, it will be an important step for the students experimentation skills.

Reports of students’ groups were reviewed by us, laboratory scientists in a iterative way: participants’ group submits the report, the lab scientists check it and give them, if necessary, the feedback comments, which were used by the students to improve the report and submit it again. The procedure continues until the final report is created. Information in participants’ report about feature and environment of the research sites, traffic rate data, road category, road age, etc. was found very useful in the understanding of the ‘global’ general results.
From the environmental science point of view, the students addressed their concerns about environment through the discussions and questions of possible causes, sources and impacts of heavy metal pollution, solution of reducing and removing heavy metals accumulating in roadside soil and also ways to prevent emission of the heavy metals from road transportation.

It should be mentioned that all data from the study are recorded in the research database available on the website of the project where anyone can access.

CONCLUSION

Summarizing the physical side of the “nuclear e-cology” project we examined the relative abundances of iron, nickel, zinc, lead, bromine, rubidium and strontium in roadside plants along different studied sites in Poland and Thailand with the X-ray fluorescence spectrometry method. Two general findings are reported:

1. It was found that some heavy metal pollution observed in the analyzed samples depends on the age of the road.
2. It was found that the relative abundances of iron, nickel, zinc, lead and bromine decreased with the increase of the distance from the road.

In more details:

- 1a. The level of pollution in the plant samples in the vicinity of the roads built earlier than 10 years ago are by no means different than for the new roads.
- 1b. The difference depends strongly on the particular element.

- 2a. The distance dependence confirms the effect of the road transportation as a source of these element pollution.
- 2b. The average characteristic decrease length of the relative abundances of iron, nickel, zinc and lead was estimated to be in the range of 40 – 80 m.
- 2c. For the first time the decrease pattern was observed for the relative abundance of the bromine. The average characteristic decrease length for bromine pollution is about 50 m.
- 2d. It was established that the relative abundances of rubidium and strontium did not exhibit a regular gradient as a function of distance from the road. These two heavy elements are probably not derived, mainly, from the road traffic.

From the educational point of view the summary could be made in one sentence: we have created the citizen science project “nuclear e-cology” which involved school students to do research on the important region on the edge of physics, ecology, biology, environmental and nature monitoring/conservation science and, what is more important, we have shown that it works in practice.

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AN INVESTIGATION OF FACTORS AFFECTING PRE-SERVICE SCIENCE TEACHERS AWARENESS IN RENEWABLE ENERGY SOURCES

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ABSTRACT: Due to increasing energy demands and environmental problems in burning fossil fuels (coal, oil, and gas), interest on renewable energy sources has been increased. Scientists try to find new and more effective ways to replace fossil fuels with renewable energy resources. Science teachers' knowledge, attitude and awareness plays an important role for the future. Because, they will be bringing up future generations of school children so that energy can be utilized efficiently. Few studies have explored teachers' awareness level about renewable energy resources, but there is no available instrument that assesses all science teachers' (physics, chemistry and biology) renewable energy awareness. Pre-service science teachers were asked to write a composition about their feelings, opinions, and attitudes towards renewable energy and explorative literature study was conducted to gather an initial pool of items. Item selection took place using qualitative and quantitative methods. Expert-analysis was used for screening the relevance. Exploratory factor analysis with promax rotation was used to determine construct validity and Cronbach's coefficient alpha determined the scale's internal consistency reliability. The instrument demonstrated high internal consistency (alpha 0.90). Exploratory factor analysis yielded a five-component structure termed Expectations from authorities, Relationship between renewable energy and environment, Comparison of renewable energy resources with fossil fuels, environmental awareness and Suitability of country for renewable energy; each sub-scale demonstrated satisfactory consistency: 0.85; 0.82; 0.71; 0.76; 0.82 respectively. The 32-item scale is easy to complete and to administer. This study has also investigated effect of gender and subject of pre-service science teachers on the awareness scale, and the relationship between effect of teachers' subject and awareness of pre-service science teachers. The development of a new and reliable awareness scale to identify pre-service science teachers' attitudes towards renewable energy resources will enable researchers to explore the relationships between science teachers' attitudes and their demographic and education-related characteristics.

Key words: renewable energy education, awareness, energy literacy, preservice science teachers

INTRODUCTION

Since Renewable energy has become highly popular in educational institutions, throughout this process, there has been and will continue to be a need for faculty and students to re-examine preservice teachers' awareness and to re-develop a more comprehensive measure of teachers' awareness. By undertaking this task, it can be designed better courses and guide students and teachers toward successful and fruitful learning experiences.

Renewable energy sources such as solar, geothermal, wind, and biomass are receiving increased attention not just in Turkey but also in the world. The depleting nature and the accelerated demand of commercial energy have forced planners and policy makers to look for alternative sources. It is now generally accepted that renewable energy sources will have to play a major role in the future (Arif Hepbasli, Aydogan Ozdamar, 2001).

Renewable Energy at a Glance

The literature provides several definitions of Renewable Energy supplies. For example: Twidell and Weir (2006, p. 3) define Renewable energy as ‘‘energy obtained from the continuing or repetitive currents of energy occurring in the natural environment’’. The Dictionary of Energy edited by Cleveland and Morris (2006, p. 371) says renewable energy is ‘‘any energy source that is naturally regenerated over a short time scale and either derived directly from solar energy (solar thermal, photochemical, and photo-electric), indirectly from the sun (wind, hydropower, and photo-synthetic energy stored in biomass), or from other natural energy flows (geothermal, tidal, wave, and current energy).’’ (Verbruggen vd., 2010)

Renewable energy supply in Turkey is dominated by hydropower and biomass, but environmental and scarcity-of-supply concerns have led to a decline in biomass use, mainly for residential heating. Total renewable energy supply declined from 1990 to 2004, due to a decrease in biomass supply. As a result, the composition of renewable energy supply has changed and wind power is beginning to claim market share. As a contributor of air pollution and deforestation, the share of biomass in the renewable energy share is expected to decrease with the expansion of other renewable energy sources (Bilgen, Keleş, Kaygusuz, Sarı, & Kaygusuz, 2008).

Solar Energy

The most important component of solar thermal technology is the solar thermal collector. A solar thermal collector is designed to collect heat by absorbing sunlight. (Sopian vd., 2011) Solar energy could eventually replace fossil fuels in most applications. Recently, several different types such as photovoltaic, solar thermal energy, and low temperature solar heat have become more cost-effective (Jager-Waldau 2007). Building-integrated and rooftop photovoltaic are now important aspects of building design. Solar domestic hot water systems are also widely available and cost-effective in many situations. (Taleghani, Ansari, & Jennings, 2010)

Although solar energy is the most important renewable energy source, it has not yet become widely commercial, even in nations with high solar potential such as Turkey. There are limited applications, and most of them are inefficient, both in terms of energy use and economical benefits. The economical feasibility of a solar energy system is mainly determined by its initial cost and long-term efficiency (Kaygusuz & Sari, 2003). The photovoltaic sector in Turkey is still fairly small, providing work for only a small number of employees. The main actors consist of several companies and a number of research institutes (Yuksel & Kaygusuz, 2011).

Wind Energy

This is likely to generate 10% of the world's electricity by 2020 and is now regarded as a conventional energy source. The available wind energy estimates range from 300 to 870 TW (Jefferson 2005). Using the lower estimate, just 5% of the available wind energy would supply the current worldwide energy needs. Most of this wind energy is available over the open ocean and large-scale offshore wind farms are being constructed in many countries. Small-scale, building-integrated wind turbines are becoming available and may be integrated into houses and commercial buildings to provide free energy from the wind (Taleghani vd., 2010).

Biomass

Biomass energy includes fuel wood, agricultural residues, animal wastes, charcoal and other fuels derived from biological sources. It is used by approximately half of the world's population as cooking and/or heating fuel, and it currently accounts for about 14% of world energy consumption. Biomass is the main source of the energy for many developing countries, providing more than 90% of the energy supply in some developing countries. Fuel wood and other biomass fuels are handled and combusted primarily by women, who are largely responsible for repetitive chores, such as cooking, and are often involved in any household industries (Kaygusuz & Sari, 2003).

Wave and Tidal Energy

Wave energy generates electricity, heat or mechanical energy from ocean wave. Some other applications beside electricity generation include desalination, pumping of seawater for marine cultures are potentially viable.(Sopian vd., 2011)

Geothermal Energy

It is expected that the worldwide use of fossil fuels is going to decline in this century, and that geothermal energy will contribute in the replacement of those fossil fuels. Even now, the recent rise of oil and gas prices has made the development of the geothermal resources of Turkey more feasible. In the recent years, among the renewable energy alternatives, geothermal energy in world and our country has become very attractive. The reason for this interest is features of geothermal energy in direct and indirect use (Yuksel & Kaygusuz, 2011).

Social acceptance is recognized as an important issue shaping the widespread implementation of renewable energy technologies and the achievement of energy policy targets. Furthermore, it is commonly assumed that 'social attitudes' need to change to make more radical scenarios about the implementation of renewable energy technologies feasible (E. Moula vd., 2013).

The purposes of this study are to re-examine the concept and the underlying dimensions of science (physics, chemistry and biology) teachers' awareness for renewable energy, and to construct and validate an instrument the Renewable Energy Awareness Scale (REAS). Because this study's REAS framework is a hypothetical model serving to explain physics, chemistry and biology teachers' awareness toward renewable energy, the construct should be validated. Therefore, the present study has used a traditional exploratory factor analysis (EFA) to establish the construct validity of the REAS model. This study will explore the following research questions:

- What is pre-service science (physics, chemistry and biology) teachers' awareness for renewable energy?
- Does the gender of teachers make any difference in their awareness for renewable energy?
- Does the subject they teach (i.e., physics, chemistry and biology) of teachers make any difference in their renewable energy awareness?
- Does renewable energy education given at the undergraduate level make any difference in renewable energy awareness?

METHODS

First of all, a literature review was done, after that, 30 pre-service science teachers from different areas (physics, chemistry and biology) were asked to write a composition about their feelings, opinions, and attitudes towards renewable energy. An item pool was constructed from literature and compositions written by participants. Then, item selection took place using qualitative and quantitative methods: Expert-analysis was used for screening the relevance. 63 items were extracted from the item pool. Approximately half of items in are written in the form of positive statements and the other half in the form of negative statements. Teachers were asked to describe themselves in reference to a 5-point Likert-type scale, with anchors ranging from 1 (strongly disagree) to 5 (strongly agree). The Brief instructions for the completion of this scale are included to ensure that the scale can be self-administered. Participants also completed a demographic questionnaire, which included items on their age, gender and so on.

The REAS was administered to 161 pre-service physics, chemistry and biology teachers taking pedagogical training class at different universities. Exploratory factor analysis with principle component analysis was employed to empirically reveal and demonstrate the hypothesized, underlying structure of renewable energy awareness scale. Before conducting an exploratory factor analysis, the results of the KMO measure of sampling adequacy and the Bartlett's test of sphericity were examined to determine appropriateness of factor analysis. Bartlett's test was significant (BTS value= 2024,61, $p<0.001$), showing that the correlation matrix was significantly different from an identity matrix. Similarly, the KMO Measure of Sampling Adequacy of 0.85 was substantial. Both revealed that it was appropriate to perform a factor analysis (Tabachnick & Fidell, 2007).

Correlation Matrix

The next step was to examine the correlation matrix of the scale for items with high (greater than 0.9) or low (less than 0.4) correlations. A high correlation coefficient between two items suggests that the items are too similar or too redundant and should be removed or rephrased. (Field, 2005). Examination of the correlation matrix of the Renewable energy awareness scale, items that had coefficients less than 0.4 (redundant) were subsequently removed. Sometimes dropping problematic items (ones that are low-loading, cross loading or freestanding) and rerunning the analysis can solve the problem, but the researcher has to consider if doing so compromises the integrity of the data.(Costello & Osborne, 1994). So We have dropped problematic items.

Exploratory Factor Analysis

Exploratory factor analysis EFA (principle component analysis) with promax rotation was conducted as to determine construct validity and Cronbach's coefficient alpha determined the scale's internal consistency reliability. Factor analysis allows for the grouping of related items in a scale into a smaller number of factors or categories (Levett-Jones vd., 2011). The goal of rotation is to simplify and clarify the data structure. Rotation cannot improve the basic aspects of the analysis, such as the amount of variance extracted from the items. As with extraction method, there are a variety of choices. Varimax rotation is by far the most common choice (Costello & Osborne, 1994). There are some techniques used to assist in the decision concerning the number of factors to retain such as Kaiser's criterion; scree test; and parallel analysis. A popularity gaining technique is parallel analysis that involves comparing the size of the eigenvalues with those obtained from a randomly generated data set of the same size. Only those eigenvalues that exceed the corresponding values from the random data set are retained (Pallant, 2013). The remaining 32 items on the scale were checked by language experts to control the intelligibility and grammar.

RESULTS AND FINDINGS

Five factors were found in teachers' renewable energy scale. The total variance obtained by five factors was estimated as 50.23%. According to literature, the higher the variation in the results of factor analysis got, the stronger the factor structure of the scale was considered (Dunteman, 1989). Because it is difficult to reach higher values in social sciences, the variance percentage over 40–60 is considered acceptable in various resources (Namlu & Odabasi, 2007). Therefore, in this study, variance percentage was approximately 50%, which is at the acceptable border. The estimated factor load was between 0.45 and 0.82 values. Table 1 represents the items included in the factors.

Table 1. Rotated Factor Loadings for The 32-Item Renewable Energy Awareness Scale

Item No	Original Item No	Political support expectations for the future	Contribution for environment and country	Comparison with Other Energy Sources	Environmental protection and knowledge	Suitability of country for renewable energy
1	47	0,76				
2	50	0,75				
3	45	0,68				
4	44	0,64				
5	46	0,63				
6	53	0,60				
7	59	0,55				
8	4		0,68			
9	12		0,67			
10	31		0,66			
11	30		0,65			
12	11		0,63			
13	3		0,59			
14	54		0,54			
15	7		0,50			
16	43		0,45			
17	36			0,86		
18	51			0,57		
19	35			0,53		
20	56			0,53		
21	55			0,50		
22	37			0,45		
23	41			0,45		
24	2				0,68	
25	8				0,67	
26	1				0,63	
27	9				0,51	
28	17				0,50	
29	13				0,48	
30	24					0,82
31	23					0,81
32	22					0,78

Reliability revisited the alpha values were for the new Scale and subscales were satisfactory after removal of the poorly fitting items (refer to Table 2)

Table 2. Total Variance Explained by Factors with Eigenvalues

Component	Initial Eigenvalues		
	Total	% of Variance	Cumulative %
1	8,59	26,85	26,85
2	2,28	7,14	33,99
3	1,88	5,88	39,87
4	1,76	5,50	45,37
5	1,56	4,86	50,23

CONCLUSION

In this study, mean awareness score of all preservice teachers was found 3.97 (0,50). On average, male participants had greater average (M = 4,06, SE = 0,54) than to female participants (M = 3,99, SE = 0,50). But this difference was not significant $t(124) = -0.705$, $p > 0.05$; it represents an effect of $r = 0.003$. The average renewable energy awareness of pre-service science teachers was found as 3.93 out of 5.00 for teachers who did not get any course and 4.13 for teachers who got a course about renewable energy, respectively. $t_{(156)}=2{,}23$, p<0,05]. it represents an effect of r = 0.03.

We conducted a multivariate, repeated one-way ANOVA to compare the mean awareness score of the teachers, according to the subject they teach (i.e., physics, chemistry and biology). Any effect of teachers' subject (physics, chemistry and biology) on renewable energy awareness was not observed.

Despite some methodological limitations in our study, this new scale does appear to be a consistent and stable measure of pre-service science teachers' awareness of renewable. Further research is necessary with larger groups of students to confirm these study findings and to evaluate the validity of this scale.

RECOMMENDATIONS

The REAS is a practical measurement instrument that yields reliable data about the renewable energy of pre-service science teachers (physics, chemistry and biology) at individual and group level. The REAS is a one-dimensional scale with five relevant aspects of that dimension: Expectations from authorities, Suitability of country for renewable energy, Relationship between renewable energy and environment, economic effect of renewable energy source, environmental awareness, and comparison of renewable energy. The 32 items on a 5-point Likert scale are easy to complete, resulting in a one-REAS score. Scores can be calculated without time-consuming coding procedures.

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APPENDIX

REAS dimensions and items

Item No:	Dimension/items
Political support expectations for the future	
PSEFF1	Public investments should be increased in order to make effective and rational use of renewable energy and renewable energy resources.
PSEFF2	Instead of fossil fuels that running out day by day, renewable energy resources should be used in the next years.
PSEFF3	I believe that advertisements are one of the most effective way to raise awareness about renewable energy.
PSEFF4	Renewable energy projects to be realized in the region, will contribute to the awareness of renewable energy.
PSEFF5	Necessary arrangements and facilities for renewable energy resources should be made in order to meet the rapid increase in energy demand.
PSEFF6	Replacing fossil fuels that will be exhausted in the future with renewable energy resources makes sense.
PSEFF7	I believe that all countries should use nature-friendly renewable energy resources.
Contribution for environment and country	
CFEC1	Bioenergy is not the energy produced from biological resources.
CFEC2	The use of renewable energy sources instead of fossil fuels does not create a significant difference to stop global warming.
CFEC3	Generating electricity and heat from renewable energy sources, there is no effect in reducing the country's dependence on foreign energy sources.
CFEC4	I do not think, generating electricity and heat from renewable energy resources will contribute to the national economy.
CFEC5	There is no need to use environmentally friendly renewable energy sources instead of fossil fuels for a healthier planet and a safer world.
CFEC6	Geothermal energy is not the earth's internal heat.
CFEC7	I do not believe that it is possible to generate energy from renewable resources which are naturally replenished.
CFEC8	Using renewable energy resources does not mean protecting nature.
CFEC9	Turkey does not have quite positive conditions for renewable energy resources because of its position and climate characteristics.
Comparison with Other Energy Sources	
CWOES1	I think, nuclear energy should be banned while there are renewable energy resources.
CWOES2	We should use renewable energy resources instead of fossil fuels to get rid of climate change which is a major threat for our civilization
CWOES3	When compared with renewable energy resources, nuclear power plants are dangerous, therefore they not accepted by society.
CWOES4	I think, We are not good enough as a society about the use of solar energy efficiently.
CWOES5	I can pay more for electricity generated from renewable resources.
CWOES6	Generating electricity and heat from renewable energy resources reduces the need for nuclear energy.
CWOES7	In our country, the use of renewable energy resources is less than the developed countries.
Environmental protection and knowledge	
EPAK1	Wind turbines are utilized to produce electricity.
EPAK2	Renewable energy resources are more environmentally friendly than fossil fuels.
EPAK3	Sunshine can be utilized to produce electricity .
EPAK4	Generation of electriciy and heat from renewable energy resources have no harmfull effects on the environment.
EPAK5	Renewable energy sources are environmentally friendly that do not ruin the balance of nature, relative to other sources.
EPAK6	It is necessary for the use of renewable energy resources to be listed among environmental protection activities.
Suitability of country for renewable energy	
SOCFRE1	Solar water heating systems is one of most convenient sources of energy for Turkey.
SOCFRE2	Wind energy is One of the most useful renewable energy resources for Turkey.
SOCFRE3	Generating electricity with solar panels is one of the most useful ways for Turkey.

SPIRAL DESIGN OF MICROSCOPE IN BOTH TURKISH SCIENCE CURRICULUM AND TURKISH SCIENCE AND TECHNOLOGY CURRICULUM

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ABSTRACT: *Reflection*, *refraction*, *light, mirror* and *lens* are needed terms for effective learning on microscope. It mainly depends on *reflection* and *refraction*. Students need to engage such scientific terms before the microscope practices. Therefore, this study investigates the contents related to the microscope in accordance with spiral curriculum. For an overall looking to *microscope* content in Turkish Science Curriculum (TSC), the official documents published by the Ministry of National Education were analyzed at part of *reflection*, *refraction*, *light, mirror* and *lens*. The contents which were listed in a comparison way used to examine whether there is a parallelism between such related terms or not. It is obvious that the K-level curriculum includes *microscope*. At 4 grade, students make simple observations using this tool. Each part of microscope are mainly introduced to the children at 6 grade. However it is clear that *light* and *lens* are needed contents to understand the microscope at 4 grade, *lens* is located in TSC at 8 grade. Although *light* is located in TSC in accordance with the spiral curriculum design, lens has not got a similar scope and sequence as it located in curriculum later than microscope practices. For further learning of such activities, it is absolutely required to be aware of the fact that *lens* and *refraction* are important basics for microscope. The result of this study also points out that there is a similar location between TSC and Turkish Science and Technology Curriculum (TSTC) in terms of spiral design of microscope use.

Key Words: science curriculum, microscope, spiral curriculum, lens and refraction

INTRODUCTION

Microscope, the discovery of Leeuwenhoek, based on the lenses which he built into simple and one-lens one (Smith, 1959: 74). After the investigation of compound microscope in which one lens produces enlarged image that is further magnified by the second lens. The light system consists basically of a mirror and a diaphragm. An optical microscope is any device that enables us to see small details in a cell or microorganism by apparently enlarging them. It depends on the fact that light rays change direction when they pass from one lens into another (Schraer & Stoltze, 1990: 14). It is mainly based on lenses within a combination and produced image by various lenses, and mirror and the light rays which reflect it from light to ocular and objective lenses (Schraer & Stoltze, 1990: 15).

With a physical viewpoint, a mirror reflects rays and lenses refract light at their interfaces by the way light rays pass through it (Blatt, 1986: 610). Light sometimes acts a wave, sometimes like a particle. Reflection of light are wave nature of the light as the rays travel to any directions (Serway, 1992: 989). For instance, the eye is not a simple system amenable to the thin-lens approximation. It has optical properties that can be considered equivalent to those of a single lens (Blatt, 1986: 615). "Light" and "lens" are two important terms which need for deeply understanding of such device. "Mirror" can be added to these two terms because it is mainly located in the textbooks with "light" and sometimes "lens" together.

Microscope is a useful tool for the development of the manipulative skills in science education (ACSC, 1998:2; MEB, 2007: 138). It has a wide use in TSTC as quick observations for cell and microorganisms from 4 through 6 grades (MEB, 2005a: 133; MEB, 2007: 139; MEB, 2013:22). Even though science education starts at 4 grade in TSTC, pre-school curriculum includes "microscope use" for simple observations as an experimental tool (MEB, 2005b: 74). Due to the fact that it is mainly based on "light rays" and "lens", students need to learn such scientific terms before the microscope use practices. Therefore this study clearly investigates the contents related the microscope regarding the spiral design of such content need to have been learnt before the microscope observations.

The previous location of microscope-use given above has an important place in elementary science curriculum. For this reason, it needs to locate in curriculum in line with the curriculum development processes such as spiral design. This is Bruner's famous curriculum development model where school subjects are situated developmentally over a number of years with increasing levels of complexity (Doll, 1993: 124). Therefore, the questions such as what shall be taught and when and how are the main concerns of the science curriculum (Bruner, 2003: 2).

The word curriculum, as an educational viewpoint, is that series of things which children and youth must do directed and undirected experiences by the way of developing abilities to do the things well (Bobbitt, 1918: 42). As the distinctions are not clear and the strong combinations are naturally exist among them, the levels in curriculum are continuously changeable for any updating which includes the scope and sequences of such scientific terms. The gradual development of curriculum and textbooks is a required perspective on the contemporary curriculum development studies.

But this belief is not a constant ideology which impresses the democratic and individual learning in science education. Since the flexibility and effect of the contemporary or post-modern ideas such as democratic education, science curriculum contents and methods need to take account of the critiques of modern science and strategies for achieving a more democratic science (Gough, 1998: 194). Bruner's believing which includes the fact that it is quite possible to teach any subject "effectively in some intellectually honest form to any child at any stage of development" would encourage us to think of knowledge in a new light (Doll, 1993: 124). This perspective has a parallelism with democratic science to large degree.

With the idea of Hamilton (1990) which includes that curriculum practice is integral to modern institution of schooling (Pinar et al, 2008: 1), the science curriculum needs to be organized taking care of the internal sequence as well as external effects. This relations in curriculum provide all the parts making connections with the directed and undirected experiences in time. This effort can also be suitable for the individuals development. Therefore this curriculum based-study primarily investigates the sequences of "microscope use" with "light" and "lens" in line with spiral curriculum designing.

METHODS

For an overall looking for *microscope* content in TSC and TSTC, the official documents published by the educational authorities of Atlantic Canada, France, Washington State and Turkey were searched at part of *reflection, refraction, light, mirror* and *lens*. The science curricula and books were subjected to the content analysis. The identified contents which were listed by the researcher in a comparison way used whether there is a parallelism between "microscope use" and such terms or not. Therefore the content analysis of sequences examining these terms are important at part of spiral curriculum design.

Content analysis is a technique which is usually, but not necessarily, used for written contents such as archival data (Lichtman, 2010: 190). It can be used in any context in which the researcher desires a means of systematizing and often quantifying data. Documentary approach is one of the characteristics of this qualitative research design (Bogdan & Biklen, 2007: 44). Documents' content analysis technique involves the steps such as determining the objectives, defining the terms, specifying the unit of analysis, locating the relevant data, developing a rationale, developing a sampling plan, formulating coding categories, reliability and validity, analyzing the data (Frankel & Wallen, 2006: 482-490).

Content analysis of the documents was used in this study since the researcher aimed at identifying the common use of microscope in three different Science Curricula and French Science Textbooks. Microscope use in such documents is suitable and sufficient to compare the scope and sequences by using this technique. For an apparent comparison, the researcher followed and applied the steps of content analysis on data obtained from the documents as follows.

Determining The Objectives

Six kinds of documents were used to identify the relevant data about "*microscope use*" in context. Statements of French Science Textbook at 6 grade (FST) and Turkish Science Textbooks from 3 through 8 grades (TST), and the Washington State Science Standards (WSSS) and Atlantic Canadian Science Curriculum (ACSC) and TSC and TSTC were checked to explain the relevance between such documents at part of "*microscope use*" contents. The researcher made a decision to use such documents since they can be enough to reach a valuable opinion about the use of scope and sequence of "*microscope use*". All the documents are official because they were published by government organizations.

Defining The Terms

The important terms of the study are *reflection*, *refraction*, *microscope*, *mirror*, *lens* and *light*. As these terms are the main parts of the microscope knowledge at elementary level, it is clear that one can understand the inside parts and working conditions of this complex experiment tool. But the students need to learn such concepts before the microscope activities. If the teachers clearly points out the scientific activities or experiments, students can learn the concepts without any impression of any mystery or myth during the science learning process. Furthermore, it is known that learning follows the direction from concrete to abstract concepts and microscope activities are an important step between concrete and abstract concepts in visualization of science education.

Locating the Relevant Data

In accordance with this objectives of the study, TSC, TSTC, ACSC, WSSS, TST and FST units regarding the standards/skills/knowledge/activity about the microscope-terms which are mentioned under the previous headline of methodology were used to identify the relevant data.

Developing a Rotionale

The data sources are related to the objectives because such curricula and textbooks are indicators of *microscope use* in each country. Since the curricula and textbooks which are based on the standards/skills/knowledge/activity of each country include the scope and sequences of *microscope-use* from 3 through 8 grades. This relations is crucial to explain the TSC and TSTC whether the microscope content is located in the curricula or textbooks for a better understanding of the *microscope activities* during the school practices. As each searching examines whether such terms are located in each countries' curricula or textbooks or not, it easy to compare with Turkish ones and others in an easy way.

Developing a Sampling Plan

Both curricula of three countries and textbooks of two countries are sampled from K through 8 grades as such words *reflection, refraction, light, mirror* and *lens*. Both *purposive* and *convenience sampling* which are two of the nonrandom sampling method are used to develop a sampling plan. The researcher selected 6 related documents as they can clearly explain the scope and sequence of *microscope- use* in TSC and TSTC and they are convenient for a comparison from K through 8 grades (Frankel & Wallen, 2006: 103). Sometimes convenience sampling is not very credible and is likely to produce information-poor rather than information-rich cases as selection based on the identified data alone is not enough (Merriam, 2009: 79). In this study, since valuable documents content the related terms, the searching and checking processes of the curricula and textbooks at part of the previous words, has a parallelism with the aim of this study. Therefore the study has the ability of explaining the such relations. As the data of this study can be described and it is clear that how and when the data were collected and the data is related to the paradigmatic assumption of the study and the research questions are answerable given the data described (Hatch, 2002:144; Bogdan & Biklen, 2007: 65), this technique is clearly and easily applied on this study.

Formulating Coding Categories

The researcher identified the *coding categories* after the *defining terms* searching on the six kinds of documents regarding curricula and textbooks. *Coding units* were identified in accordance with the grades from 3 through 8 to compare the age level of teaching and learning of *reflection, refraction, light, mirror* and *lens* in such documents. The TSC and TSTC documents from K to 8 grades were subjected to the content anlysis to find whether there is a parallelism between microscope activities and optic concepts. Both microscope activities and optic concepts such as lens and light were listed in line with the grades from K through 8. You can also see a comparison of TSCand TSTC with WSSS and ACSC and FST in line with this list.

RESULTS AND FINDINGS

Microscope Use in NSES and WSSS

National Science Education Standards (NSES) of the USA present criteria which can be made by state and local personnel and communities, helping them to decide which curriculum, staff development activity, or assessment program is appropriate (NSES, 2010: 12). The experiences and activities about life science in grades K-4 provide a concrete foundation for the progressive development in later grades of one of the major biological concept cell. They can learn living things with their environment by the way of various animals survive (NSES, 2010: 129). In grades 5-8, in which represents middle-school years in Turkey, students should develop understanding of cellular structure of living things. Students in grades 5-8 also have the fine-motor skills to work with a light microscope interpreting accurately what they see (NSES, 2010: 155).

Preparation to the learning of cellular structure and microscope use in life science, NSES provides to learn *light* before the 5-8 grades term. As the abstract ideas of science such as atomic structure of matter, energy, observation is an important process during the period of K-4. All of the three terms explaining the microscope, such as *mirror* and *lens* and *light* need to located in standards in grades K-4 (NSES, 2010: 127). This location of such concepts in USA leads us to the idea that pupils in grades 5-8 are ready to learn *microscope activities* as they were aware of the primarily relevant knowledge about *microscope* mentioned above. Yet, according to the 2000 National Science Education Standards (NRC), K-4 students develop simple skills using microscopes and magnifiers to observe the finer details of living and nonliving things (NRC, 2008: 162). But this is a simple observation and *light* and *lens* and *mirror* and *microscope* terms are located in the standards with a parallel situation to describe the organisms simply without mentioning the cellular structure of them (NRC, 2008: 168).

With a detailed use of NSES in Washington State, the standards do not contain microscope use and its combinations except *light* and general-visual classification of living-and nonliving things in grade K-1. 2-3 grades standards contain "light" as well. Bacteria and fungi as the members of microorganisms are located in the standards in 4-5 grades in Washington State Science Standards (WSSS, 2009: 60). This required the microscope use for a better understanding of such microorganisms and knowledge including the cellular structure of the plants and animals. Microscope and its similar example known as telescope and lens are used in observations in grade 3-5 in WSSS (WSEALR, 2005: 48). Light is a preparation for learning the previous scientific terms in WSSS (WSEALR, 2005: 36)

Microscope Use in ACSC

Microscope and telescope and other tools provide the learners to explore the complex classification system in the world (ACSC, 1998: 35). The first unit "Growth and Development" at second grade in ACSC suggests making observations in which the students may use various equipment such as magnifying lenses, microscope viewers and digital cameras (ACSC, 2005: 118). Before this level, the curriculum includes the use of *mirror* inside a box as a valuable tool to teach children related concepts in the first unit *Students as Individuals* at Kindergarten grade (ACSC, 2005: 14). This grade includes also *light* in a visual viewpoint and concretely as well as *mirror* (ACSC, 2005: 30). At 4 grade ACSC contents microscope in another viewpoint which categorize the optical devices to investigate the development of them in the past, present and future. Additionally this level of ACSC includes the working conditions which means that microscopes make visible objects that are too small to be seen with the naked eye and binoculars extend our ability to see far away objects. In this chapter, it is a useful organization for a curriculum development as it clearly and deeply includes *microscope* with *light* and *mirror* and *lens* together (ACSC, 2002: 40). Briefly, the ACSC organized knowledge of *light* and *mirror* and *lens* which are the basics of understanding the microscope functions clearly.

Microscope Use in FST

Science education in France from 11 to 12 years of age highlights the need to strongly link all scientific disciplines together with technology. This integrated science teaching is a basics for inquiry based learning at the primary level of French science education. Even if the disciplines which are Biology and Chemistry-Physics are separately are being handled, Just as other conceptual understanding in context, *Microscope-use* is located in science education textbooks with this interdisciplinary viewpoint.

For example, bacteria are observed using microscope device under the different magnifying conditions of each binocular and students measures and compares the diameter of the such samples being observed at 6 grade biology textbook (Duco, 2008: 84). This deep understanding of *microscope* at 6 grade probably based on the previous learning from kindergarten to 6 grade level.

Microscope Use in TSC

Microscope is located in TSC from 4 through 6 grades. At K level children can make simple observations with this learning tool (MEB, 2005b: 74). At elementary level in TSC, microscope is used for the purpose of simple observations at 4 grade (MEB,2013:12). It is used aiming at investigating the microorganisms (MEB,2013:18). Students learn the inside part of microscope at 6 grade (MEB,2013:22). The related knowledge such as *reflection, refraction, light, mirror* and *lens are* located in TSC. This location is seen on Table 1 year by year.

Table 1. R*eflection, refraction, light, mirror* and *lens* in TSC (MEB, 2013)

Grade	Skills including "microscope" Number of Units and Name	Contents of Related Skills
3 4 7 8	3.4 Light and Sound 4.3 Introduction to The Substance 7.4 Absorbment of Light 7.6 Electricity 8.4 Light and Sound	Natural Light Resources Light Reflectors Light has no mass Pollution of luminous energy Colour Chart Light energy Transformation of light and electricity Refraction and Lens

As seen on Table-1 students learn *light*, *reflection* and *mirror* before the microscope practices at 6 grade. They do not unaware of the *lens* and *refraction* to understand the working conditions of light microscope at this level because both terms are located in TSC at 8 grade.

There is a similar location of such scientific terms related to microscope in TSTC. As seen on Table 2, the comparison data in relation to *microscope* such as *reflection, refraction, light, mirror* and *lens* were listed to understand the scope and sequences. Here are the data obtained from TSTC:

Table 1. *Reflection, refraction, light, mirror* and *lens* in TSTC

Grade	Skills including *microscope*		Skills including *reflection, refraction, light, mirror* and *lens*	
	Number of Units and Name	Contents of Related Skills	Contents of Related Skills	Number of Units/Name
4	6. Visiting and Recognizing The Kingdom of Living Things	Observing the microorganisms without making connections with cellular structure and parts (MEB, 2005a: 133)	Transparent-Opaque and lighted-mat substance (MEB, 2005a: 74)	2. Introduction to the Substance
			Mirrors reflect the "light rays produced by various light-source (MEB, 2005a: 105)	4. Light and Sound
5	6. Visiting and Recognizing The Kingdom of Living Things	Observation for the classification of microorganisms (MEB, 2005a: 217)	Reflection of light (MEB, 2005a: 223).	7. Light and Sound
6	1. Reproduction, Growth and Development of Living Organisms	Observation and comparison of plant and animal cells using microscope (MEB, 2007: 90). Observing the stomata in plant leaves using microscope (MEB, 2007: 146).	Reflection of light on plane mirror and spheroid mirror. (MEB, 2007: 115)	7. Light and Sound
7	6. Human and Environment	Making observations and investigations for various ecosystems using microscope (MEB, 2008: 311)	Relations between eyes' visual problems and eye-lens (MEB, 2008: 44).	1. Systems of Human Body
			Finding the focal point of convex and concave lenses (MEB, 2008: 218)	5. Light

With the result of the comparison data on Table 2, it is clearly understood that TSTC includes *microscope* from 4 through 6 grades. The biology topics in these grades in orderly include *simple microorganisms' observations* at 4 grade, *classifying the microorganisms in line with microscope observations* at 5 grade, *using microscope becoming aware of functions of each part* at 6 grade. The TSTC includes understanding the *cellular structure* of the living things at 6 grade and therefore TSTC does not content the *cell observation on microscope* at 4 and 5 grade. Even though *microscope use* begins with pre-school science education in Turkey, the real use of it begins at 6 grade as this level includes learning the functions of each part of this experimental tool.

Each part of microscope are mainly introduced to the children at 6 grade. However it is clear that *light* and *lens* are needed contents to understand the microscope at 4 grade, *lens* is located in TSC four years later. Although *light* is located in TSC in accordance with the spiral curriculum design, *lens* has not got a similar scope and sequence as it located in curriculum after the microscope-practices. For further learning of such activities, it is absolutely required to be aware of the fact that *lens* and *refraction* are important basics for microscope.

As compared with the TSTC, microscope has a similar location in TSC. It is clearly point out that *light* is a topic at K grade and *mirror* at 4 grade and *lens* at 7 grade. Though a complex topic called as eyes' visual problems such as myopia, hypermetropia and astigmatism are located in textbooks at 7 grade, the basic concept *lens* which needs for identification of them in a scientific viewpoint is located at 7 grade after four units. This is similar problem with the microscope content at 6 grade for a deep understanding of functions of each part.

This study aims to identify the place of *microscope use* in TSC and TSTC comparing with ACSC, WSSS and FST. As *microscope* can be learnt with its content mainly based on *reflection, refraction, light, mirror* and *lens* together, the science curricula need to include them in line with *spiral curriculum* design. Apparently, these terms are basics of learning *microscope*. Therefore comparison of such topics in various curricula or textbooks is a useful strategy to point out the *microscope content* considering the spiral curriculum design of TSTC (MEB, 2005a: 29) and TSC.

As a result of this comparison data obtained from the tables mentioned above, it is obvious that the TSC and TSTC include *microscope* at K level and from 4 through 6 clearly. At four grades students make simple observations just as K level regarding microorganisms. The parts of microscope device mainly introduced to the children in both TSC and TSTC at 6 grades. However it is obvious that *light* and *lens* are needed contents to understand the related microscope activities at 4 grades, *lens* is located in TSTC at 7 grade and in TSC ad 8 grade.

As compared with WSSS, microscope with *lens* and *light* is a useful learning tool after the 6 grades. It begins at 2 grade in ACSC including both *microscope* and *magnifying lens* observations. FST content learning microscope with *light* and *lens* to understand such observations sufficiently. Additionally, TSTC includes direction change of *light rays* in *magnifying lens* after the *people's vision problems* at 7 grades. The current location of *lens* in TSC is a similar problem to learn the *eyes' visual problems* for the reason that both *lens* and *eye* have not got a spiral design. The current TSC needs a review including the *reflection, refraction, light, mirror* and *lens* in line with this curriculum development model. Teachers need to know the scope and sequence of *microscope use* and *eye* for effective and meaningful learning.

CONCLUSION

The light microscopes were aged, heavy, and had obvious signs of wear and tear due to many years of student use. Some showed signs of age and use such as low luminescence scratched lenses, and limited field of view. The teacher had been told that the schools could not afford replacements and the teachers had to do *the best* with what they had in their classrooms (Dickerson & Kubasko, 2007). Even though such device is very simple as compared with the digital ones or online systems, It has a wide use in science laboratories (Yeşilyurt, 2005). The direct control of the light microscopes and easy-use of parts are some advantages of learning process.

The compound light, or optical, microscope uses two magnifying lenses in series to make things appear much larger to the eye than would be possible with a single lens (Moreno et al, 2008: 1). Physically, lenses refract light at their interfaces by the way light rays pass through it (Blatt, 1986: 610; Serway, 1992: 989). As seen in eye-lens example (Blatt, 1986: 615), some natural event inside or outside the body can be explained by the use of such technological device.

Students are expected to use appropriate technology such as microscope and lens and mirror togather, analyze and interpret data. Children read about scientific events and investigate scientific ideas and use technology to any further development for their understandings (Loughran, Smith & Berry, 2011: 23). As a guide primarily for teacher, science curriculum need to include the gradual learning of *microscope*. Bruner's developmental model (Doll, 1993: 124) is critical to circulate the knowledge (Bruner, 2003: 2) which the children learn gradually.

The idea of Hamilton (1990) which identifies the integration role of curriculum practice (Pinar et al, 2008: 1) is one of the basics of the gradual state of it. Because the relations in curriculum provides the teachers making connections with various situation, this curriculum based-study apparently identifies the sequences of *microscope use* with *reflection, refraction, light, mirror* and *lens* to make valuable connections with such terms in TSC and TSTC.

Microscope use in TSC and TSC has lack of parallelism with *refraction* and *lens* at this viewpoint. Although 6 grade TSC and TSTC include the understanding of microscope's functions, the most important concept related to such experiment tool is located in the curriculum at 8 and 7 grade. In fact, students need to have learnt such knowledge before the 6 grade. It is easy to cope with this curriculum based problem by explaining the *reflection, refraction, light, mirror* and *lens* which can be used by the children with an active participation from K through 6 grade. This simple and clear problem based on the TSC and TSTC from K through 6 grades may stem from the lack of parallelism with the curriculum from 6 through 8 grades. If these concrete topics are located in the curriculum in line with Bruner's spiral curriculum design, eliminating the obstacles originated from the content of *microscope use* in TSC and TSTC can be possible.

RECOMMENDATIONS

These concrete topic *reflection, refraction, light, mirror* and *lens* is a useful one in the process of learning science as it appeals cognitive and emotional and psychomotor abilities of individuals. Though it is a complex device, children use its main feature known as magnifying and enlarging the particles which can not be seen with naked eye. Yet it can be an interesting strategy for them to understand such topics effectively, it is surely as a poor learning, but at elementary level children are suitable for realizing only simple observations under a microscope. For further learning of microscope content, it is required to be aware of its functions especially *reflection, refraction, light, mirror, lens* as they can be basics for learning of microscope functions.

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ANALYSIS OF TECHNOLOGY ADDICTION OF HIGH SCHOOL AND UNIVERSITY STUDENTS USING DATA MINING TECHNIQUES

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ABSTRACT: The rapid evolution of technological devices also makes it increasingly challenging to determine which is the most needed. These devices have become addictive, especially for the young generation. In this study, we have made a survey was composed of 31 questions over total of 240 high school and university students to find out which criterions are related with each other in this survey. We have analyzed survey results using Apriori Algorithm that is one of the data mining techniques to ensure extracting some association rules. In the future, to increase social communication between individuals, based on these rules, a lesson about preventing technology addiction may be prepared than given to the students in high schools and universities to raise awareness.

Key words: Analysis of Technology Addiction, Data Mining Techniques, WEKA, Apriori Algorithm

INTRODUCTION

As a term of technology that is the human knowledge make our lives easier, simpler. It involves tools, systems, methods and materials. The use of technology increasing day by day, it has become an indispensable part of our lives. We use technology for education, learning, securing data, business, communication, human relation, transportation, agriculture etc.

Despite using technology to better our lives, it causes some problems like addiction, physically and psychologically destructive consequences. Especially technology starts to become an addiction when take away from the time that normally spend on social life (relaxing, spending time with family or friends etc.) of a person. Increasing need to use the Internet, spending lots of time staying online longer than intended, constantly need to check smart device (mobile phones, tablets, computers etc.) and more similar behaviors are symptoms of technology addiction. Technology addiction covers Internet, social media, game addiction etc.

Ivan Goldberg put forward Internet addiction in 1996 (Goldberg, 1996; Lin, 2002).Young who is a psychological expert in the University of Pittsburgh confirmed the existence of Internet addiction (Young, 1997; Xiaoqian, 2012). Related works about Internet addiction is given (Scherer, 1997; Greenfield, 1999; Morahan-Martin & Schumacher, 2000; Block, 2007; Ceyhan & Ceyhan, 2009; Alaçam, 2012).

Valenzuela et. al. (Valenzuela et. al., 2008) determined highly positive correlation between Facebook usages of 2603 students, social trust, civic and political participation. In 2010 Bahk et. al. (Bahk et. al., 2010) investigated potential factors as digital media addiction, relational orientation and demographic features whether affecting the use of social networks like Facebook, Myspace.

Weinstein made a comparison between game users and non-game users to determine computer and video game addiction (Weinstein, 2010) in 2010. Chang and An's study is related with effects of Internet game addiction on health-related lifestyle of Korean elementary school students (Chang & An, 2011). Xu & Yuan suggested motivation and prevention factors for online game addiction among adolescents (Xu & Yuan, 2012). Şahin & Tuğrul in their study, they aim to define the levels of computer game addiction of the 4th and 5th grade primary school students (Şahin & Tuğrul, 2012). In 2014, Gökçearslan & Durakoğlu aimed to determine the video game addiction level among various demographic features over 146 students who are 6th, 7th or 8th grades in secondary school in Ankara.

In Turkey, in August 2015, Turkish Statistical Institute published the use of information and communication technology in households and individuals (16-74 age groups) statistics for between the years 2004-2015 except for 2006 (Figure 1).

	2004	2005	2006 (1)	2007	2008	2009	2010	2011	2012	2013	2014	2015
Girişimlerde Bilişim Teknolojileri Kullanımı ICT Usage in Enterprises												
Bilgisayar Kullanımı - Computer Usage	-	87,8	-	88,7	90,6	90,7	92,3	94,0	93,5	92,0	94,4	95,2
İnternet Erişimi - Internet Access	-	80,4	-	85,4	89,2	88,8	90,9	92,4	92,5	90,8	89,9	92,5
Web Sitesi Sahipliği - Having Website	-	48,2	-	63,1	62,4	58,7	52,5	55,4	58,0	53,8	56,6	65,5
Hanelerde Bilişim Teknolojileri Kullanımı ICT Usage in Households and Individuals												
Bilgisayar Kullanımı (Toplam)- Computer Usage (Total)	23,6	22,9	-	33,4	38,0	40,1	43,2	46,4	48,7	49,9	53,5	54,8
Erkek - Male	31,1	30,0	-	42,7	47,8	50,5	53,4	56,1	59,0	60,2	62,7	64,0
Kadın - Female	16,2	15,9	-	23,7	28,5	30,0	33,2	36,9	38,5	39,8	44,3	45,6
İnternet Kullanımı (Toplam) - Internet Usage (Total)	18,8	17,6	-	30,1	35,9	38,1	41,6	45,0	47,4	48,9	53,8	55,9
Erkek - Male	25,7	24,0	-	39,2	45,4	48,6	51,8	54,9	58,1	59,3	63,5	65,8
Kadın - Female	12,1	11,1	-	20,7	26,6	28,0	31,7	35,3	37,0	38,7	44,1	46,1
Hanelerde İnternet erişimi - Households with access to the Internet	7,0	8,7	-	19,7	25,4	30,0	41,6	42,9	47,2	49,1	60,2	69,5

TÜİK, Girişimlerde Bilişim Teknolojileri Kullanımı Araştırması, Hanelerde Bilişim Teknolojileri Kullanımı Araştırması (16-74 yaş arası bireyler)
TurkStat, Use of Information and Communication Technology (ICT) in Enterprises, Use of Information and Communication Technology (ICT) in Households and Individuals (16-74 age group)
(1) 2006 yılında araştırma yapılmamıştır.
(1)The surveys were not conducted in 2006

Figure 1. Information Society Statistics (%), 2004-2015 (Turkish Statistical Institute, (2015))

According to statistical results (Information and Communication Technology (ICT) Usage Survey on Households and Individuals, 2015; Turkish Statistical Institute, 2015) Internet usage of individuals increased to 55.9%. 96.8% of households have mobile phone (incl. smart phones), 43.2% of households have portable computer (inc. tablets) and 20.9 of households have smart TV. In the first quarter of 2015, 80.9% of Internet users participated in social networks. In the first quarter of 2015, 74.4 per cent of Internet users used mobile or smart phones while 28.9 per cent used portable computer (e.g. laptop, netbook, tablet etc.) to access the Internet away from home or work.

In 2012, Xiaoqian improved a model that uses fuzzy mathematics and three layer back-propagation neural network in Internet addiction decision (Xiaoqian, 2012). Huang et. al. in 2014 used Apriori data mining algorithm to find relations and identify association rules among affective ambivalence, Internet use behavior and Internet addiction. Total of 502 online and paper questionnaires evaluated, as a result they found under highly positive affectivity, most behaviors were entertainment oriented, while under highly negative affectivity, behaviors were mostly about social activities (Huang et. al, 2014).

The most widely used scale for studies related to Internet addiction level is "Internet Addiction Scale" was designed Hahn and Jerusalem in 2001 (Hahn & Jerussalem, 2001). Şahin & Korkmaz adapted the Internet Addiction Scale into Turkish. As a result this scale is a valid and reliable instrument to determine internet addiction levels of individuals regarding in the Turkish culture as well (Şahin & Korkmaz, 2011). In this study we used our own survey.

In this study, with the help of online survey we aimed to determine both which criterions more important while buying/using technological devices (mobile phone, tablet, computer etc.) and technology addiction of young generation using data mining technique which is Apriori Algorithm.

MATERIALS AND METHOD

The research was performed in Kocaeli, Turkey. The study sample was consisted of 240 students whose %41.6 were high school students (N_H=100), the rest of the students were university students (N_U=140). The survey consists of 31 questions that were prepared Turkish and given Table 1.

Table 1. Used Survey in This Study

1- Eğitim Düzeyiniz?(*Level of Education?*) a- Lise (***High School***) b- Universite (***University***)	**2- Medeni Durumunuz? (*Marital Status?*)** a- Evli (***Married***) b- Bekar (***Single***)	**3- Cinsiyetiniz? (*What is your gender?*)** a- Kadın (***Female***) b- Erkek (***Male***)	**4- Aylık Geliriniz? (*Total Monthly Income?*)** a- 0-1000 TL (***Turkish Lira***) b- 1000-2000 TL c- 2000-3000 TL d- 3000 TL +
5- Telefon Markanız Nedir? (*What is your mobile phone brand?*) a- Iphone-Apple b- Samsung	**6- Telefonunuzu Günde Kaç Saat Kullanıyorsunuz? (*How many hours a day do you use your mobile phone?*)** **a-** Gerektikçe (***As Needed***)	**7- Sahip Olduğunuz Telefonun Fiyat Aralığı? (*How much your mobile phone?*)** a- 0-500 TL b- 500-1000 TL	**8- Cep Telefonu Alırken Hangisi Önemlidir? (*Which of these more important while buying a mobile phone?*)** a- Enerji tasarruflu olması ***(Energy***

c- LG d- HTC e- NOKİA	b- 0-3 saat ***(Hours)*** c- 3-6 saat d- 6-12 saat e- 12+	c- 1000-2000 TL d- 2000 TL +	***Efficient)*** b- Fiyatı ***(Price)*** c- Markası ***(Brand)*** d- Son Teknoloji Olması ***(Latest Technology)*** e- Kullanışlılık ***(Usability)***
9- Cep Telefonunuz İle En Sık Ne Yapıyorsunuz? (*What do you do most frequently with your mobile phone?)* a- Mesajlaşma/Konuşma ***(Messaging/Speech)*** b- Kamera ***(Camera)*** c- İnternet ***(Internet)*** d- Navigasyon ***(Navigation)*** e- Oyun ***(Game)***	**10- Cep Telefonunuzda En Sık Kullandığınız Sosyal Medya Uygulaması? (*Which of these is the most frequently used in your mobile phone as Social Media App?*)** a- WhatsApp b- Gmail/Outlook c- Twitter d- Facebook e- Instagram/Pinterest f- LinkedIn	**11- Cep Telefonunuzu Ne Zaman Değiştirirsiniz? (*When do you get a new mobile phone?*)** a- Bozulduğunda ***(Break down)*** **b-** Yeni Teknoloji Çıktığında **(*The Emergence of New Technology*)** c- İhtiyaçların Karşılamaması **(*Failing to meet the needs*)** d- Popülerlik/Modaya uyum sağlamak ***(Popularity/Adapt to fashion trends)***	**12- Cep Telefonunuzun İşletim Sistemi Nedir? (*What is your mobile operating system?*)** a- IOS (IPhone/Apple) b- Android c- Windows Phone
13- Cep Telefonunu Ekranınızı Nasıl Koruyorsunuz? (*How do you protect your mobile phone screen?*) a- Jelatin **(*Plastic Screen Protector*)** ***b-*** Tamperli cam ***(Tempered Glass Screen)*** c- Sadece Kılıf ***(Only Phone Case)*** d- Kullanmıyorum ***(I don't use)***	**14- Cep Telefonunuzdaki Aksesuarları Değiştirme Süreniz Nedir? (*How often do you change your phone accessorizes?*)** ***a-*** Her gün ***(Everyday)*** b- Sıkıldıkça ***(When bored)*** c- Eskidikçe/Kırıldıkça ***(Become old/Breaking)***	**15- Sarj Deposu Kullanıyor musunuz? (*Do you use powerbank?*)** a- Evet ***(Yes)*** b- Hayır ***(No)***	**16- Tablet Kullanıyor musunuz? (*Do you use tablet?*)** a- Evet ***(Yes)*** b- Hayır ***(No)***
17- Cep Telefonu/Bilgisayar Alırken Rengi sizin için Önemli Midir? *(Is color important factor while buying a computer/mobile phone?)* a- Evet ***(Yes)*** b- Kısmen ***(Partially)*** c- Hayır ***(No)***	**18- Cep Telefonunuz/Bilgisayarınız Bozulduğunda Yenisini Ne Zaman Alırısnız? *(When do you sell new mobile phone/computer that is break down?)*** a- Bozulacağını anladığımda hemen yenisini alırım ***(I understand that is broken down than get a new one immediately)*** ***b-*** İlk iki gün içinde ***(Within the first two days)*** c- Bir hafta içinde ***(In a week)*** d- Elime yeterli para geçtiğinde ***(When I have enough money in hand)***	**19- Aylık İnternet Kullanımınız? (*What is your monthly Internet usage?*)** a- 250 MB ***(Megabyte)*** b- 1-2 GB ***(Gigabyte)*** c- 2-4 GB d- 4+ GB e- Sınırsız ***(Unlimited)***	**20- Sahip Olduğunuz Bilgisayarın Fiyat Aralığı Nedir? *(What is the range of your computer's price?)*** a- 0-1000 TL b- 1000-2000 TL c- 2000-3000 TL d- 3000+ TL
21- Bilgisayar Alırken Ürünün Hangi Özelliği Diğerlerine Göre Daha Önemlidir? (*Which of these more important while buying a computer?*) a- Enerji tasarruflu olması ***(Energy Efficient)*** b- Fiyatı ***(Price)*** c- Markası ***(Brand)*** d- Son Teknoloji Olması ***(Latest Technology)*** e- Kullanışlılık ***(Usability)***	**22- Bilgisayarınızı Ne Zaman Değiştirirsiniz? (*When do you get a new computer?*)** a- Bozulması ***(Break down)*** b- Yeni Teknolojilerin Çıkması **(*The Emergence of New Technology*)** c- İhtiyaçlarımı Karşılamaması **(*Failing to meet the needs*)** d- Popülerlik/Modaya uyum sağlamak ***(Popularity/Adapt to fashion trends)***	**23- Bilgisayarınızın İşletim Sistemi Nedir? (*What is your computer operating system?*)** a- Windows b- Mac OS –OS X c- Linux/Unix	***24-* Beyaz Eşya Alırken Akıllı Olmasını Tercih Eder Misiniz? *(Do you choose to buy smart white goods?)*** ***a-*** Evet ***(Yes)*** ***b-*** Hayır ***(No)*** c- Fark Etmez ***(Doesn't matter)***
25- Akıllı Beyaz Eşya Kullanıyor Musunuz? *(Do you use smart white goods?)* a- Evet ***(Yes)*** b- Hayır ***(No)***	**26- Akıllı Beyaz Eşyalarınızdan Memnun Musunuz? *(Are you satisfied from smart white goods if you use?)*** a- Evet ***(Yes)*** b- Hayır ***(No)*** c- Kullanmıyorum ***(I don't use)***	**27- Giyilebilir Teknoloji Kullanıyor Musunuz? *(Do you use wearable technology?)*** a- Evet ***(Yes)*** b- Hayır ***(No)***	**28- Hangi giyilebilir teknolojiyi kullanıyorsunuz? *(Which wearable technology do you use?)*** a- Bluetooth Kulaklık ***(Bluetooth Headphone)*** b- Akıllı saat ***(Smart Watch)*** c- Sosyal Medya Bilekliği ***((Social Media)Smart Wristband)*** d- Akıllı Gözlük ***(Smart Glasses)*** e- Hiçbiri ***(None of them)***
29- Aşağıdakilerden Hangisini Daha Sık Değiştiriyorsunuz? (*Which of these you change more often?)* a- Cep Telefonu ***(Mobile Phone)*** b- Bilgisayar ***(Computer)***	**30- Hediye Edilmek İstense Hangisine Sahip Olmak İsterdiniz? *(If you have a gift, which would like to have?)*** a- Akıllı Telefon ***(Smart Phone)*** ***b-*** Bilgisayar ***(Computer)*** ***c-*** Tablet ***(Tablet)*** d- Akıllı Beyaz Eşya ***(Smart white good)***	**31- Yeni Bir Teknoloji Piyasaya Sunulduğunda Hemen Satın Alır Mısınız? (*Do you buy a new generation device when it released?)*** ***a-*** Evet ***(Yes)*** b- Gerektiğinde ***(When it is necessary)*** c- Hayır ***(No)***	

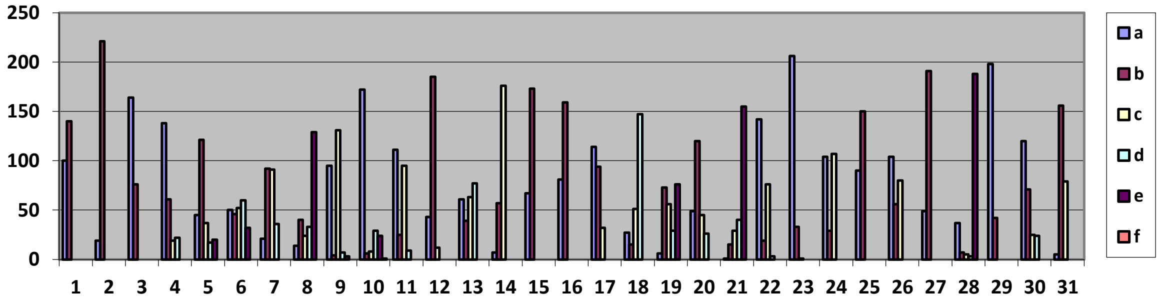

Figure 2. Student Answer Distribution Graph for Each Question in Survey

Student answer distribution graph is given in Figure 2.

Apriori Algorithm

The simplest definition of data mining is obtaining and analyzing meaningful, relevant, significant knowledge from data. It provides to extract four types of relationships these are classes, clusters, associations and sequential patterns.

Association rules technique that is introduced in 1993 by Agrawal et. al. (Agrawal et. al., 1993) is based two important parameters which are minimum support threshold and minimum confidence threshold given below Figure 3 (a) and (b).

$\mathbf{I} = \{\mathbf{i_1, i_2, \ldots, i_n}\}$ is a set of item in the each transaction **T**,
$\mathbf{T} = \{\mathbf{I_1, I_2, I_3, \ldots, I_m}\}$ is a set of transaction **T**,
$\mathbf{D} = \{\mathbf{T_1, T_2, T_3, \ldots, T_m}\}$ is database which includes a set of transaction **T**,
This $\mathbf{X \Rightarrow Y}$ rule is an implication form of an association rules, where $\mathbf{X \subset I}$ and $\mathbf{Y \subset I}$ then $\mathbf{X \cap Y = \emptyset}$. **X** is called as the antecedent item of the association rules (left-hand-side or LHS) while Y is called consequent item (right-hand-side or RHS). The minimum support threshold value discovers the frequent itemsets in database **D** and minimum confidence of $\mathbf{X \Rightarrow Y}$ rule is percentage of the entire transactions number in the database that contains X and also contains Y (Khamphakdee et. al, 2014).

$$\text{Support}(X) = \frac{\text{Support count of } (X)}{\text{Total number of transection in D}} \qquad \text{Confidence}(X \Rightarrow Y) = \frac{\text{Support } (X \Rightarrow Y)}{\text{Support } (X)}$$

Figure 3. (a) Formula of Minimum Support Value (b) Formula of Minimum Confidence Value (Khamphakdee et. al, 2014)

Apriori that is a seminal algorithm for finding frequent itemsets for association rules using candidate generation, proposed by Agrawal & Srikant in 1994 (Agrawal & Srikant, 1994). It is characterized as a level-wise complete search algorithm using anti-monotonicity of itemsets, “if an itemset is not frequent, any of its superset is never frequent” (Wu et. al., 2008).

Algorithm steps of the Apriori algorithm (Wu et. al., 2008):
1- **k** is the size of itemsets, $\mathbf{F_k}$ is the size of the set of frequent itemsets and $\mathbf{C_k}$ is candidate itemset of size k.
2- Scan the database with Apriori. It searches for frequent itemsets of size 1 by accumulating the count for each item collect them to satisfy the minimum support requirement.
3- Following three sub steps are iterated than extracted all the frequent itemsets.
   1. Generate $\mathbf{C_{k+1}}$, candidates of frequent itemsets of size **k+1**, from the frequent itemsets of size **k**.
   2. Scan the database and calculate the support of each candidate of frequent itemsets.
   3. Add those itemsets that satisfies the minimum support requirement to $\mathbf{F_{k+1}}$.

To generate $\mathbf{C_{k+1}}$ from $\mathbf{F_k}$ join step and prune step are used. In the join step; $\mathbf{C_{k+1}}$ is generated by joining $\mathbf{F_k}$ with itself. In the prune step, any k-itemset that is not frequent can't be a subset of a frequent k+1-itemset.

The Apriori algorithm pseudo-code is in the following Figure 4.

```
for (k=1; LK≠Ø; k++) //L 1 = {frequent items};
do begin
generate new candidates Ck+1 from Fk //with function consists of join and prune steps
for each transaction t ϵ database
count of all candidates contained in t //candidatecount
Fk+1 =candidates in Ck+1 with minimum support (candidatecount ≥ minimum support)
end
return ∪k Fk;
```

Figure 4. Apriori Algorithm Pseudo-Code

RESULTS

In this study the answers given by students used as a dataset. Each question was determined as an attribute and attribute names given in the Figure 5. Namely 240 samples have a total of 31 attribute is converted to file format .arff in order to use Waikato Environment for Knowledge Analysis (WEKA) (WEKA, 2016). Than used Apriori Algorithm to find association rules among survey answers. Found best 10 association rules separately given for university and high school students in Table 2.

Table 2. Found Best 10 Association Rules Separately for University and High School Students Using Apriori Algorithm in WEKA

University / High School Student Answers	Minimum Confidence and Minimum Support Percentage	Association Rules
For University Students	Minimum support: 0.6 Minimum metric <confidence>: 0.9	1. BILG_OZELLIK=c GIY_TEK=a 84 ==> HANGI_GIY_TEK=b 84 conf:(1) means that : confidence is 100%
		2. SARJ_DEPOSU=a HANGI_GIY_TEK=a 94 ==> GIY_TEK=a 92 conf:(0.98)
		3. BILG_OZELLIK=a HANGI_GIY_TEK=e 86 ==> GIY_TEK=b 84 conf:(0.98)
		4. ABE_KULLANIMI=b HANGI_GIY_TEK=e 86 ==> GIY_TEK=b 84 conf:(0.98)
		5. ABE_KULLANIMI=b GIY_TEK=b 86 ==> HANGI_GIY_TEK=e 84 conf:(0.98)
		6. KORUYUCU_SURE=a GIY_TEK=a EN_SIK_DEGISTIRILEN=a 86 ==> HANGI_GIY_TEK=b 84 conf:(0.98)
		7. BILG_ISL_SIST=a HANGI_GIY_TEK=e 103 ==> GIY_TEK=b 100 conf:(0.97)
		8. KORUYUCU_SURE=a HANGI_GIY_TEK=e 102 ==> GIY_TEK=a 99 conf:(0.97)
		9. GIY_TEK=a EN_SIK_DEGISTIRILEN=a 100 ==> HANGI_GIY_TEK=b 97 conf:(0.97)
		10. YENISINI_ALMA_SURESI=a 120 ==> GIY_TEK=e 116 conf:(0.97)
For High School Students	Minimum support: 0.65 Minimum metric <confidence>: 0.9	**1.** CINSIYET=a 78 ==> MEDENI_HAL=b 78 conf:(1)
		2. SIK_UYGULAMA=a 69 ==> MEDENI_HAL=b 69 conf:(1)
		3. CINSIYET=a BILG_ISL_SIST=a 67 ==> MEDENI_HAL=b 67 conf:(1)
		4. BILG_ISL_SIST=a 85 ==> MEDENI_HAL=b 84 conf:(0.99)
		5. EN_SIK_DEGISTIRILEN=a 81 ==> MEDENI_HAL=b 80 conf:(0.99)
		6. TEL_ISL_SIST=a 80 ==> MEDENI_HAL=b 79 conf:(0.99)
		7. YENISINI_ALMA_SURESI=a 72 ==> MEDENI_HAL=b 71 conf:(0.99)
		8. BILG_ISL_SIST=a EN_SIK_DEGISTIRILEN=a 71 ==> MEDENI_HAL=b 70 conf:(0.99)
		9. GIY_TEK=b 70 ==> MEDENI_HAL=b 69 conf:(0.99)
		10. AYLIK_GELIR=a 69 ==> MEDENI_HAL=b 68 conf:(0.99)

1	EGITIM	16	TABLET
2	MEDENI_HAL	17	RENK
3	CINSIYET	18	YENISINI_ALMA_SURESI
4	AYLIK_GELIR	19	INT_KULLANIMI
5	TEL_MARKA	20	BILG_FIYAT_ARALIGI
6	KULLANIM_SURE	21	BILG_OZELLIK
7	TEL_FIYAT_ARALIGI	22	BILG_DEGISTIRME_SEBEBI
8	TEL_OZELLÝK	23	BILG_ISL_SIST
9	EN_COK_YAPILAN	24	BE_AKILLI_TERCIHI
10	SIK_UYGULAMA	25	ABE_KULLANIMI
11	TEL_DEGISTIRME_SEBEBI	26	ABE_MEMNUNLUGU
12	TEL_ISL_SIST	27	GIY_TEK
13	KORUYUCU	28	HANGI_GIY_TEK
14	KORUYUCU_SURE	29	EN_SIK_DEGISTIRILEN
15	SARJ_DEPOSU	30	HEDIYE
		31	YENI_TEK

Figure 5. Attribute Name of Each Question

According to Table 2 for example found first association rule for university students means that *"Students who think that brand is most important factor while buying a computer and use wearable technology, 100% of these students have smart watch"* under the given minimum support and confidence metric. The second rule is *"Students who use power bank and use Bluetooth headphone as wearable technology, 98% of all of them has a wearable technology"*. Found first association rule for high school students means that *"Students who are female, 100% of them is single"*, second rule is *"Students who use WhatsApp mostly, 100% of them is single"*. Best 10 association rules for both of high school and university students are given Table 3 with 70% minimum support and 90% minimum confidence percentage.

Table 3. Found Best 10 Association Rules for Both of High School and University Students Using Apriori Algorithm in WEKA

Minimum Confidence and Minimum Support Percentage	**Association Rules**
Minimum support: 0.7 Minimum metric <confidence>: 0.9	**1.** KORUYUCU_SURE=a HANGI_GIY_TEK=a 148 ==> GIY_TEK=a 144 conf:(0.97)
	2. SARJ_DEPOSU=b HANGI_GIY_TEK=c 147 ==> GIY_TEK=b 143 conf:(0.97)
	3. AYLIK_GELIR=a 138 ==> MEDENI_HAL=a 134 conf:(0.97)
	4. SARJ_DEPOSU=b GIY_TEK=b 149 ==> HANGI_GIY_TEK=e 143 conf:(0.96)
	5. TEL_ISL_SIST=a HANGI_GIY_TEK=e 147 ==> GIY_TEK=b 141 conf:(0.96)
	6. HANGI_GIY_TEK=e 186 ==> GIY_TEK=b 180 conf:(0.96)
	7. BILG_ISL_SIST=a HANGI_GIY_TEK=e EN_SIK_DEGISTIRILEN=a 138 ==> GIY_TEK=b 132 conf:(0.96)
	8. CINSIYET=a BILG_ISL_SIST=a 138 ==> MEDENI_HAL=b 132 conf:(0.96)
	9. EN_SIK_DEGISTIRILEN=a HEDIYE=a 130 ==> MEDENI_HAL=a 124 conf:(0.96)
	10. KORUYUCU_SURE=a BILG_OZELLIK=a HANGI_GIY_TEK=a 72 ==> GIY_TEK=a 66 conf:(0.96)

CONCLUSION

In this study, we have analyzed survey results using Apriori Algorithm that is one of the data mining techniques to ensure extracting some association rules. According to analyze results of the best 250 association rules with minimum confidence value is 0.9 and minimum support value is 0.3, %98 of high school students use their mobile phone more than 12 hours in a day to speech and messaging using WhatsApp. Both of university and high school students, who are single, %98 of them care price while buying a mobile phone. University students who use wearable technology %95 of them use computer has Windows operating system.

Different countries give some courses in schools to overcome different addictions and problems like Internet addiction, social media addiction. In Turkey using this type of surveys different addiction (technology, Internet, social media etc.) levels can be detected than should be composed new lesson plans that contains to raise awareness students with variety of important information about them.

In the future this survey research can be applied to more individuals so more meaningful rules can be obtained and these results can be analyzed with more datamining techniques.

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IMPLEMENTATION OF THE INFORMATION AND COMMUNICATION TECHNOLOGY IN LEARNING

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ABSTRACT: Information and Communications Technology (ICT) has a great importance in all aspects of life, including education as well. With the fast technology progress, its implementation in education is inevitable. This paper shows the implementation of ICT in education, beginning with its definition, indicators, techniques and methods of implementation, the obstacles that the implementation faces, and some good implementation practices performed in Mathematics. All the above mentioned aspects are described in this paper including the cycle of subject organization through ICT, which is followed by the creation of electronic files for teachers and students illustrated by an example of the way of organizing these files. There is also discussed for the lesson planning in Mathematics using available applications for each teacher in the R. of Macedonia. This research covers the teachers of the R. of Macedonia of different ages which come both from elementary and high schools. We show the level of Information and Communications Technology usage in education; the obstacles for not implementing it by the teachers; the ways of communication between the teachers; student arrangement and grouping while using Information and Communications Technology; types of applications that the students use; the impact of the ICT on the students; the impact of the ICT on the role of the teacher; the ways of evaluating the students' work by using ICT. Some of the results found by this research are compared by the results found by the research done by the *Institute for Applied Social Science(IT*S) with teachers from Germany, Ireland, Spain, Netherlands and Belgium.

Key words: ICT, indicators, standards, methods, implementation

INTRODUCTION

ICT has became one of the main factors not only in the learning and teaching process, but also it has become an important part of most organizations and businesses (Zhang & Aikman, 2007). ICT covers a large set of devices and tools such as the computers, hardware elements, computer software's, other telecommunication objects etc. (Orby theam, 2005). ICT comprise the use of at least one computer, that convert the information (text, images, sounds, motion) into general digital formats (Lover-Duffy et al. 2003, USDE, 2000; ISTE, 1999). Incorporation of ICT in the teaching and learning process means a change in the traditional methods of learning and teaching. The increasing of using the ICT is the big challenge both for teachers and pupils (Smeets et al. 1999). In (Look, 2005) one can see that students in technology rich environments experienced positive effects on achievement in all subject areas. The ICT activities in the class can be categorized as the combination of devices, learning methods and managing with pupils in the class (Veen, 1994). By the time ICT becomes the integral part of the educational system (Moutlana, 2007). It can increase the educational level in many forms and in many areas (Walsh, 2009). In (Sara et al. 2010) one can see that ICT is very useful because it makes the educational process easier. Even this, the ICT is not used and implemented everywhere. There are different factors and barriers which have the influence in not using the ICT. In (Yildirim 2007) one can find the main factors and reasons of not implementing the ICT. On the other hand in (Hadi & Zeina 2012) one can find the research concerning the barriers of not implementing the ICT. These barriers are categorized into different groups. Some recommendations and classification of these barriers may be found in (Ertmer 1999), (Bingimlas 2009), (Garcia & Francisco 2008) and (Cathleen & Elliot 2011). Studying the obstacles of using ICT in educational process, may assist teachers and others to overcome the barriers and become successful ICT users in the future. Although the ICT cannot replace normal classroom teaching (Kelleher 2000), it has a very important role on the direction of deeper understanding of the principles and concepts of science and could be used to provide new ideas and activities which are very creative, useful, interesting and motivating. Due to ICT's importance in society in general, and especially as the important tool in the process of education in future, identifying the possible obstacles to the integration of the ICT in School would be very important step in improving the educative process. By this research we analyze the situation in the Republic of Macedonia. What is the level of using the ICT in the schools in Macedonia (both elementary and high schools). What is the opinion of teachers concerning the actual situation as well as for different problems they are facing with applying these technologies. This analyze is done after the decision of the government of Republic of Macedonia to implement the project “computer for every pupil”. By this project there were displayed 20000 personal computers in the schools of Macedonia, followed by approximately 100000 LCD monitors, tasters, mousses etc. For 2016 the government also plans to invest the smart tablet for every pupil (approximately 300000 tablets). Taking this into the consideration, we want to see the level of implementing the ICT in the schools of the Republic of Macedonia. Is the mentioned investment by the government productive? What is the comparison of using ICT in Macedonia with the other countries? What are the barriers of using ICT in Macedonia? Are the pupils and teachers satisfied? What are the recommendations? Etc.

METHODS

The population of the study is consisted of the teachers from high and elementary schools in Republic of Macedonia. During the academic year 2014-2015 we surveyed 238 randomly chosen teachers.

For this purpose we have prepared the questionnaire consisted of questions concerning some important data about the using of ICT in the educational process, the school they are coming from, as well as questions concerning difficulties that they are faced during the using the ICT in the teaching process. There were also questions about the encouragement and help that they take from the schools and other institutions. Also there were the question followed by the information for the test scores on Mathematics and Albanian language.

In order to get a clear illustration concerning the interpretation of the gathered data, making conclusions and decisions, we have used the Statistical Analysis Software SPSS.

At the beginning we have analyzed some elements from the descriptive statistics concerning some characteristics, and then we continued with an analysis concerning some other statistical values and dependencies. For analyzing the obtained data in this research we have used cross tabulations. This is done with the purpose to get the clearer picture for the topic of discussion. We have used the chi-square test, the so called t-testing as well as the regresion relationship between some variables.

RESULTS AND DISCUSSION

From the processed data we can see that 76% of teachers have confirmed to have the personal computer. 73% of teachers have available internet connection in any time. So, majority of teachers in Republic of Macedonia have the basic knowledge possible recourses for using and applying the ICT. On the other hand just 25% of teachers are answering that they can use the special classrooms equipped by computers and internet connections in order to use the ICT in the teaching process. The obtained results are unsatisfactory compared by the research performed on the USA (Teachers use of educational technology in U.S. Public Schools, 2009) where one can find that 97% have basic conditions (equipped classrooms) and 93% have access to internet any time.
On the other hand concerning the information about the level of usage of computers in the teaching process, the obtained answers are satisfactory compare with the research done from the institute for applied sciences in Germany, Ireland, Spain, Holland and Belgium. Just 1% of teachers in Macedonia are answering that they do not use computers and just 14% are answering that they use them rarely. 33% use sometimes, 20% often and 23% always. Compared with the mentioned research above these are very good results, because on the mentioned countries just 8% are using always computers in the teaching process, 10% are using often and 29% sometimes. 53% are not using the computers. This information gives a very big difference with the answers in Macedonia.

From the teachers who have answered with yes to the question if they use ICT, 59% of them have answered that they use ICT for solving problems and 26% for writing texts. Another obtained answer is that 64% of teachers are using ICT for training purposes and 38% of them for other applications concerning the subject they are covering.

The answers to the question about the way the teachers help the students in using ICT are as follows: 53% of teachers always are checking the work of the students when they work with ICT, 33% of teachers often do that and 9% are doing such controls sometimes. Just 5% of teachers answered that they do not check the students at all. These results are very similar with the research done by the Institute of Applied and Social Sciences (ITS), where the percentages are 51%, 30%, 12% and 7% respectively. Another interesting result is that 48% of teachers spend more time with the students which have difficulties using ICT. This percentage is bigger compared with the result obtained by ITS, which is 40%.

Analyzing the gathered data one can conclude that 51% of teachers agree that using ICT they are playing more the role of trainers than lecturers. 15% have responded that strongly agree with this conclusion compared with just 29% who disagree and 10% which strongly disagree with this conclusion. These results are similar with the conclusion of ITS institute, where these percentages are 66%, 18%, 12% and 4% respectively. Similar conclusions can be done for some other issues as well. Concerning the time that they spend with students who have needs for additional help the results are as follows: 49% of teachers agree and 15% of teachers strongly agree with the fact that they have more time to spend with this category of students if they use ICT. On the other hand 31% of teachers disagree and 10% strongly disagree with this conclusion. The same results obtained from ITS institute are 58%, 13%, 25% and 4% respectively. This means that in Macedonia using ICT influences more in working with students in needs, compared with other countries.

Concerning the efficiency of the teaching process when teachers use ICT the answers are as follows: 57% of teachers agree that they are more effective when they use ICT and 10% strongly agree with this conclusion. On the other hand 25% disagree with this, and only 10% of teachers strongly disagree with this conclusion. Concerning this issue the obtained results are very similar to the results of the ITS institute where the percentages are 58%, 13%, 25% and 4% respectively.

Concerning the improvement of the communication skills, 57% of teachers agree that they have better communication with the students when they use ICT. 11% of teachers strongly agree with this conclusion. On the other hand 27% of teachers disagree with this conclusion and just 5% of teachers strongly disagree with this conclusion. Comparing by the results obtained from the ITS institute one can conclude that concerning this issue, the results obtained in Macedonia are better. For the same conclusion the research done by ITS has got the following percentages: 49% agree with the conclusion, versus 39% of teachers who disagree with the conclusion.

Another thing which one can conclude by this research is that 29% of teachers have declared that they are under the pressure (or simply they feel stressful) when the use ICT. On the other hand 44% of teachers disagree with this and they have answered that they are not under any stress. These results are little bit worse compared with the results obtained from the ITS institute. According this institute the obtained percentages are 21% of teachers who agree versus 56% of teachers who have answered with disagree.

Concerning the students arrangement using ICT we have got the following answers: From all teachers from elementary schools who are using ICT in the teaching process, in 30% of cases they often divide the students in pairs, 47% of elementary teachers have declared that that pupils often are working individually, 47% of teachers have declared that pupils work often in small groups and just 33% of teachers have declared that when they use ICT they work by the whole class in parallel. These results are different compared by the same percentages obtained from the ITS institute. Concerning the research of the ITS institute the results with the pupils from elementary schools are 43%, 16%, 26% and 8% respectively. The results show that in Macedonia when teachers use ICT, pupils more are working individually or frontally with the whole class, versus the other European countries where the using of ICT in the teaching process is followed by the group work. Concerning the same issue with the students from high schools, the results are as follows: 24% of teachers divide students in pairs when they use ICT, 33% of teachers have answered that the students work often individually when they use ICT, 48% of cases are answering that students work in small groups when they use ICT and 35% have answered that they work with the whole class when they use ICT. The same results obtained from the ITS institute are 37%, 24%, 4% and 4% respectively. All categories except the working in pairs have bigger percentage in Macedonia compared by other European countries.

On this paper we have also analyzed the ways on how the ICT affects the initial stage of preparation for the subject. By using ICT, 66% of teachers have declared that they are more efficient in preparing different teaching materials as textbooks, tests, quizzes etc. 20% are answered that there is no any change concerning this issue. Just 6% of teachers have declared that on this aspect they have more difficulties compared with the traditional methods. 73% of teachers are using different online sources for the topics concerning the lesson. 72% of teachers agree that using the ICT they can improve their professional development. Just 5% of teachers think that professionally they are not developed when using ICT and 15% of teachers think that they are professionally developed on the same way with and without using ICT. Compared with the research done by the ITS institute this is bigger percentage. The research done from the ITS institute shows that in European countries 66% of teachers agree that the ICT helps on their professional development.

Concerning the efficiency of the teaching process, 66% of teachers have answered that the process is more effective when they use ICT versus 52% of teachers in other European countries which claim the same. 18% of teachers think that the efficiency of the work is the same both with using and without using ICT, and just 8% of teachers have declared that efficiency of the teaching process is worse when they use ICT.

Concerning the motivation, 70% of teachers are more motivated when they use ICT versus 7% of teachers who are less motivated when they use ICT. 19% of teachers have answered that they feel the same motivation. Taking into the consideration that concerning the ITS institute, in the European countries just 50% of teachers are more motivated and 41% have answered that the motivation is the same when they use ICT, one can conclude that in Macedonia ICT has bigger impact in motivating the teachers in their work.

The other interesting result is concerning the interactivity in the class when the ICT is used. 65% claim that the interactivity is on the bigger level when ICT is used, versus 34% of teachers by the ITS institute who claim the same. So, in Macedonia also the interactivity in class is increased. Teachers claim that they can administrate the class in more efficient way if they use ICT. This percentage in our research is 66% and 16% of teachers have answered that there is no difference in administration of lessons when using and not using ICT.

Concerning the support given by the school for using the ICT, 25% of teachers think that there is some support, 26% of teachers have answered that this support is minor and 49% think that there is no any kind of support from the school. Concerning the support from the ministry of education, 12% of teachers have declared that they have any kind of support, 46% of teachers have answered that this kind of support is minor and 42% of teachers have declared that there is no any support from the ministry of education.

Concerning the barriers and obstacles of not using the ICT in the teaching process, we have analyzed the reasons by taking percentages only from the teachers who have answered with level 1 (the smallest level) to the question if they use ICT. From this category of teachers, 65% of teachers have mentioned that the reason why they do not use the ICT in the teaching process is the missing of computers in the classrooms. This is very big percentage and is contradictory fact by the level of investment of the state for equipment of schools with computers. This means that there are probably some other problems which make the mentioned project nonfunctional. Another mentioned reason (15% of teachers are mentioning it), is that the teachers do not have confidence in using ICT. This means that the school and the ministry should take into the consideration this fact for organizing additional seminars and trainings for this category of teachers. 10% of teachers do not see the reason for using the ICT. So, there must be found the way for motivating this category of teachers. 5% of teachers think that the lesson plans don't offer possibility for implementation of ICT. There are also answers where as the reasons of not using ICT are mentioned lack of the time, the nature of the subject, etc.

Concerning the using of ICT and its impact on the subject of mathematics we have used the cross tabulation analysis and we have analyzed the significant result using the Pearson value from the so called chi-square statistics. The chi-square statistics is often used to test for the independence of two categorical variables. The null hypothesis is that the two variables are independent, and the alternative is that the variables are related. If the significance value (pearson's constant is less than 0.05, then we will reject the null hypothesis, and conclude that there is a significant dependence between the variables. Among others, we have analyzed the place of school students come (capital, other town, the village) with the level of ICT usage. We may expect students from capital and other towns to have greater access to ICT. Using cross-tabulation analysis we have confirmed this expectation. The significance p-value is 0.037. , This means that out of a hypothetical hundred samples of students, only 3.7% would fulfill the null hypothesis of independence. So, because $0.037<0.05$, we reject the null hypothesis, and conclude that there is a big dependence between the type of school and level of usage of ICT in the teaching process.

In order to analyze the impact of the ICT usage on the subject of mathematics, we have used the so called t-testing. The interpretation is that if the probability of getting two sample means at least as far apart as those observed is 5% or less, then one can conclude that the results are so unlikely under the null hypothesis that the null hypothesis is not true. That is, we reject the null hypothesis that the samples were drawn from populations with the same mean, and conclude that the samples come from populations with different means. We have used this, in order to analyze the score on the test on mathematics versus the level of using the ICT. The score on the test of mathematics was used as the dependent variable, and the level of using the ICT (measured by 1 to 5) was used as the independent variable. The obtained probability value titled Sig (2-tailed) was 0.04. This result means that there is a 4% chance of obtaining sample means at least this for apart if the null hypothesis is true. So, we reject the null hypothesis of equal means, and conclude that the students with higher value of usage of ICT tend to have different results on the math test than do students with lower value of usage of ICT. On the other hand, the t-test output for the score on the test on Albanian language, gives the result 0.847. Since this value is higher than 0.05, we cannot reject the null hypothesis of equal means. So, we cannot say that the usage of ICT in the teaching process has the effect on the test in Albanian language.

Concerning the regression analysis, we conclude that there is a linear relationship between test score on mathematics and usage of ICT. The significant level is 0.0002. So, we reject the null hypothesis of no linear relationship. On the other hand the same significance value for the score in the test of Albanian language was 0.2. this value is bigger than 0.05. From this results one can conclude that the null hypothesis should be accepted, which means that there is no the linear relationship between the score on the test on Albanian language and the usage of ICT.

CONCLUSION

Using the results of this research one can create a clearer and detailed picture concerning the level and different categories of usage of ICT in Macedonia and the implementation of the ICT in the teaching process. From the research one can see the different results obtained from the descriptive statistics concerning the different categories. Some of the percentages obtained for different categories were compared by the percentages obtained from the ITS institution for the same categories which makes possible to make conclusions concerning the cases in the Republic of Macedonia.

Some of the interesting conclusions are as follows: The teachers which were trained on using ICT, use it in bigger level. This means that organizing different trainings and seminars from the schools and other institutions increases the level of using of ICT. Pupils who use ICT in the learning process, have bigger success in problem solving situations.

Also by using the Pearsons chi-square test, we have shown that there is a big dependence between the type of school and level of usage of ICT in the teaching process. The ICT on the villages do not have the impact in the teaching process because it is not used in the sufficient level.

By using the t-testing we have concluded that the students with higher value of usage of ICT tend to have different results on the math test than do students with lower value of usage of ICT. This means that the usage of the ICT has the direct impact on the process of learning mathematics. By the regression analysis we have shown that there is a very big linear relationship between the test scores on the subject of mathematics and the usage of the ICT in the teaching process.

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EXAMINING THE TRANSFER OF LANGUAGE FROM SCIENCE TO MATH WRITING: AS AN EPISTEMIC TOOL

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ABSTRACT: The purpose of this study to examine how students transfer their language practices from science classrooms to math classroom in terms of writing activities. For this aim, 64 5th grade students, who were familiar with the SWH approach that supports multimodal writing from their science classrooms, participated in the study. The students were provided questions to complete a writing activity in their math classrooms in each semester. Multimodal writing samples from two consecutive semesters, and scores of Cornell Critical Thinking (CCT) Test, conducted at the beginning and the end of year, were collected. The findings suggest that students were able to use the writing and representational work from science classrooms to math classrooms, and across time from the first semester to second semester, they improved their math writings in terms of multimodality, and also, writing scores are also significantly predictor of final CCT scores. In conclusion, when students have a rich learning environment, in this context it was the SWH approach, they learn not only content knowledge but also how language can serve as an epistemic tool. It is this use of language that, we believe, is being transferred into new context and is improved by the time.

Key Words: Science Writing, Language, Transfer of Knowledge, Critical Thinking

INTRODUCTION

Transferring of Multimodal Writing from Science to Math learning

There is a significant amount of research on the use of writing to learn approaches in science during last few decades (Gunel, Hand, & McDermott, 2009). The aim of the writing to learn activities is to provide a learning milieu which promotes students critical thinking (Kieft, Rijlaarsdam, & Van den Bergh, 2008; Klein, Piacente-Cimini, &Williams, 2007; Zohar & Peled, 2008) and conceptual understanding (Holliday, Yore, & Alvermann, 1994). Findings of previous research show that including writing to learn activities in science classrooms can have beneficial outcomes on students learning regardless of grade level (Jaubert & Rebierre, 2005; Boscolo & Mason, 2001; Hand, Wallace, & Yang, 2004, 2004; Bangert-Drowns, Hurley, & Wilkinson, 2004). The focus of writing to learn approaches has begun to shift from a process where students need to not only produce text, to incorporate an emphasis on integrating text with various modes. When scientists and engineers communicate through writing, they employ diagrams, charts, symbols, equations by integrating with the text (NRC, 2012). The goal of core science practices is to construct understandings of the knowledge to represent and communicate science concepts. To achieve these goals, students need to do engage in these practices in a manner similar to what the scientist do in real settings. Therefore, students should be able to use charts, mathematics, drawings, and diagrams with integrating text (NRC, 2012). Multimodal representations need to be supported in science classrooms to promote science learning and communication of ideas.

The Science Writing Heuristic (SWH) approach, which combines inquiry and argumentation with an attention on language, employs writing-to-learn approaches by promoting multimodal representation during the writing process. Previous research shows that SWH has a significant impact on students' achievement and Cornell Critical Thinking Test (CCTT) scores. When students engage with argumentation and writing practices in a language rich environment, they can have better results in reasoning and achievement rather than non-SWH classrooms (Chanlen, 2013). Chanlen's (2013) study highlighted that not only were benefits gained initially when implementing the SWH approach, with significant gains made each year of continual use. Further to these results, a recently completed RCT grant using the SWH approach at grade 3-5 showed that benefits are gained in the disciplines of mathematics and reading. Importantly, significant gains were also made in the rate of growth of critical thinking skills. Adey and Shayer (2015) have also emphasized the transferability of learning from one context into another context and situation. After they offered PD for intervention only in science classrooms, they examined results on not only science but also math and English test results. The findings shows that there is significant students' gains on all three area based on test results. Although the intervention was restricted to the science content, substantial gains were obtained in math and English.

These two studies described above examined and compared the transfer of learning across disciplines based on standardized tests. In this study, we would like to examine how students transfer writing gains from science classrooms to math classrooms. The questions guiding this study were;

1. Is there any transfer from science classrooms to math classrooms in terms of writing gains and multi-modality, although the intervention of SWH approach is restricted with science classrooms?
   a. Does students' math writing improve across time? Is there any improvement in their math writing? If there is, which components of students' writing has improvement?
   b. Is there any improvement in students' writing in terms of multi-modal representation?
2. Is there any correlation between CCTT scores and students' writings?
3. Does students' writing predict students' reasoning skills (Critical thinking)?

METHODS

Participants and Design

Participants are 64 5th grade students at a mid-west rural school. They were taught with SWH approach in their science classrooms, however the teachers were responsible for teaching them both science and mathematics. As part of their science experiences the students were required to engage in writing and using multimodal representation. To examine the transfer of use of these language opportunities the students were given a writing task as part of their mathematics classwork in each semester (fall'14 & spring'15). Besides writing, students had taken CCTT beginning and the end of the year.

The teachers involved in this study were previously rated as high implementers of the SWH approach. They agreed to continue to use the approach in science and to undertake to set the writing assignments in mathematics. They had not previously asked the students to do this type of writing exercise in mathematics and wanted to examine if the students were able to transfer the work in science in terms of writing and multimodal use into mathematics.

Table 1. Design of study

1st CCTT	1st Writing	2nd Writing	2nd CCTT

Coding

The rubric which was developed by McDermott (2009) was used as a base to analyze students' writings. The rubric was originally developed for science writings; therefore, it was modified for the requirement of math writings. The final form of rubric includes four categories: (1) text assessment, (2) overall cohesiveness, (3) general non-text mode analysis, and (4) individual mode analysis. Each category has subcategories that are presented in table 2 in detail.

Table 2. Coding Rubric

Text assessment	Assignment expectations	-Grammatically correct -Covered required topic -Accuracy of math concepts
	Audience considerations	-Appropriate language -Identified Key term
Overall cohesiveness	Text tied to alternative modes Alternative modes linked to each other Main conceptual idea continually addressed	
General non-text mode analysis	Non-Text Mode Type Total # of different types of Mode Frequency of use of modes Modes linked to Main Concepts	
Individual non-text mode analysis	Embeddedness strategy	-Type of Mode -Original -Caption -Relation with text
	Characteristic of mode	-Accurate -Conceptual Connection to Text -Mode is Self-Explanatory

The graduate students who scored the writing samples had previously used the rubric on scoring science writings. To analysis the math writings a series of steps were adopted to ensure inter-reliability. First, each scorer analyzed the same 10 samples with discussion following to discuss about the how to modified this rubric and to ensure inter-rater agreement was reached. Second, after agreement on modification, in each round, each student scored 20 samples independently and randomly selected 5 of the scorings to compare the results in terms of reliability. The coding and scoring was a dynamic and continuously in consensus throughout the process with an overall, inter-rater reliability 88% (Miles & Hubermann, 1994)

Analytic Approach

Descriptive analysis including means, standard deviations and participant numbers were calculated for each category of the writing samples. The group differences were examined by computing t-test for each code. By examining the difference we were able to determine whether there was a development on students' math writing across the time, and the transfer is occurred from science classroom to math writings.

Correlations between scores of writing samples and Cornell Critical thinking test (CCTT) scores were calculated. For the regression analysis, the CCTT scores were matched with students writing scores. The regression analysis provided a prediction for the second CCTT (end of year) and show if there was an impact of the first CCTT, first semester writing samples and second semester writing samples on the final CCTT score.

RESULTS

Research Question 1:
Independent t-tests for each category in rubric were computed to compare students writing samples from consecutive semesters. The results are presented in the table 3. Although there were no significant changes in text quality and characteristic of modes, overall cohesiveness, and number of modes have a statistically significant increase. However, the embeddedness of modes had a statistically significant decrease.

Table 3. Comparison of consecutive semester writings

		N	Mean	Std. dev.	P value
Text assessment	fall	64	6.08	1.45	.830
	spring	64	6.13	0.97	
Overall cohesiveness	fall	64	2.61	1.48	.000
	spring	64	4.06	1.74	
Number of modes	fall	64	1.27	0.45	.000
	spring	64	1.64	0.48	
Embeddedness	fall	64	2.19	0.69	.004
	spring	64	1.81	0.75	
Characteristic of modes	fall	64	2.77	0.82	.254
	spring	64	2.60	0.86	

Research Question 2:
The correlation between overall statistically significant categories and CCTT scores was calculated (Table 4). There is a significant growth in CCTT scores and writing scores ($p<0.001$). The correlation between first and second CCTT is high (.680). The correlation is getting higher from first semester to second semester writing scores. Second semester writing correlation with final CCTT is getting higher rather than beginning CCTT.

Table 4. Descriptive statistic for CCTT and Writing scores, and Correlations

	N	Mean	Std. Dev	Correlations		
Final CCTT	64	42.234	6.883	Final CCTT	Beginning CCTT	Fall Writing
Beginning CCTT	64	36.250	7.113	.680		
Fall Writing	64	6.063	2.088	.220	.043	
Spring Writing	64	7.516	2.558	.460	.297	.117

Research Question 3:
A multiple linear regression was calculated to predict students' CCTT scores based on their beginning CCTT, fall and spring writing scores. A significant regression equation was found ($F (3, 60) = 25.668$, $p < .000$), with an R2 of .562. Students' predicted CCTT score is equal to 12.757 + .575 (beginning CCTT) + .539 (fall writing)

+ .712 (spring writing). Both beginning CCTT ($p<.000$) and spring writing ($p=.005$) were significant predictors of final CCTT. Fall writing ($p=.062$) trended toward significant.

DISCUSSION

This study examined the transfer of learning that promotes multimodal science writing into math courses. The students were familiar with having to use writing and multimodal representations as part of science but not as part of the normal mathematics instructional approach. The results would appear to indicate that students were able to using the writing and representational work from science classrooms to math classrooms. Across time from the first semester to second semester, they improved their math writings in terms of overall cohesiveness of writing, and number of modes, although their embeddedness of modes slightly decreased. A possible explanation for this decrease in embeddedness may be nature of the mode they added to use in second semester writing samples. In the first semester, the common mode the students used was equations. We believe that mathematical equations require more connection to the text in order to explain the function they are describing. However, in the second writing task the students added drawings to explain the topic. Drawings, as their nature, can be self-explanatory; thus, this can be a reason for decreasing in the embeddedness.

There are similar increases between growth in students writing and CCTT scores. These parallel results may be explained by previous work that indicates that students' reasoning skills can improved by improving writing skills (Norton-Meier, Hand, Hockenberry, & Wise, 2008). We believe that learning is a negotiation process and writing is also negotiation because it is a learning tool. During the writing process, an individual negotiates with him/herself between his/her prior knowledge and encountered knowledge. This process requires the use of reasoning skills. Multimodal writing is not only simple writing, it requires more negotiation to integrate mode to text, so it requires a higher level of self-negotiation. Thus, we would suggest that growth in multimodal writing skills can support growth in CCTT scores. Besides t-test analysis, Regression analysis also support this idea by showing both of the writing tasks are significant predictor of final CCTT scores.

As a conclusion, if the students learn with understanding, which is the main goal of the SWH approach, they can transfer their learning into new context when appropriate tasks are provided. In this study, the students were taught by teachers who are high implementers of the SWH approach in science classrooms, we believe that students learned with understanding, and were more aware of the critical role of language in the learning process. The students were transferring their development of language as an epistemic tool into a new context: math courses. This resulted in them developing more sophistication on multimodal writing in newer contexts.

Limitations and Implications

This study was conducted in only one school district and all the students were familiar with SWH; therefore, there is no control group to compare the CCTT scores. Because the maturation can be an important factor for increasing in the CCTT scores, firm causal claims are difficult to make in this conditions. Moreover, the size of data should be larger than the number that is used in this study. The planned number was larger than 150 students, but in nature of data collection procedure, the number was decreased.

One important implication of this research is that when students have a rich learning environment, in this context it was the SWH approach, they learn not only content knowledge but how language can serve as an epistemic tool. It is this use of language that we believe is being transferred into new context and is improved by the time.

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EXAMINATION OF PROSPECTIVE CHEMISTRY TEACHERS' PEDAGOGIC CONTENT KNOWLEDGE CONCERNING GRAPHS ABOUT SOLUTIONS, SOLUBILITY, AND CHANGE OF STATES TOPICS

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ABSTRACT: This study explored the nature of the integration of the three components of pedagogical content knowledge (PCK): 1) Knowledge of the Chemistry Curriculum, 2) Knowledge of the Instructional Strategies and Representations, 3) Knowledge of the Assessment. This study was conducted in the context of the teaching graphs about *solubility*, and *change of states* topics of eight prospective chemistry teachers who were attending to chemistry teacher training program of Faculty of Education. The study was designed as a case study and data were collected by means of lesson plans and it was performed with 8 prospective chemistry teachers. Five prospective teachers were asked to prepare a lesson plan concerning *solubility topic* and others prepared a lesson plan concerning *the change of states topic*.

Key words: pedagogic content knowledge, graphs, solutions, solubility, and change of states.

INTRODUCTION

In recent years, there has been a growing interest in the knowledge base of both experienced and prospective teachers. Shulman (1986) presented pedagogical content knowledge (PCK) as central to the knowledge base of teachers and described PCK as "that special amalgam of the content and pedagogy that is uniquely the province of teachers, their own special form of professional understanding". The view of PCK generally encompasses ' a teachers' understanding of how to help students understand specific subject matter' (Magnusson, Krajcik,& Borko, 1999). The components of PCK have been defined in various ways by different authors. Magnusson et al. (1999) have conceptualised PCK for science teaching as consisting of five components: 1) orientations toward science teaching, 2) knowledge and beliefs about science curriculum, 3) knowledge and beliefs about students' understanding of specific science topics, 4) knowledge and beliefs about assessment in science, and 5) knowledge and beliefs about instructional strategies for teaching science.

The orientation toward science teaching component of PCK refers to teachers' knowledge and beliefs about the purposes and goals for teaching science at a particular level. The knowledge and beliefs about science curriculum consist of two categories: mandated goals and objectives, and specific curricular programs and materials. The third component of PCK refers to the knowledge teachers must have about students in order to help them develop specific scientific knowledge. It includes two categories of knowledge: requirements for learning specific science concepts, and areas of science that students find difficult. Magnusson et al. (1999) have conceptualized the fourth component of PCK, which was originally proposed by Tamir (1988), as consisting of two categories: knowledge of the dimensions of science learning that are important to assess, and knowledge of the methods by which learning can be assessed. The component of instructional strategies comprises of two categories: knowledge of subject-specific strategies, and knowledge of topic- specific strategies. Strategies in these categories differ with respect to their scope. Subject-specific strategies are broadly applicable; they are specific to teaching science as opposed to other subjects. Topic- specific strategies are much narrower in scope; they apply to teaching particular topics within a domain of science.

De Jong (2000) advocated that science teacher preparation courses aim at promoting the development of an appropriate pedagogical content knowledge for preservice teachers and according to a constructivist perspective, the acquisition of pedagogical content knowledge is considered a dynamic process in which the preservice teachers actively construct meaning from their actual experiences in connection with their prior understanding. It can be said that that inviting pre-service teachers to prepare lesson plans is very effective because these plans appeared to elicit many important aspects of pre-service teachers' PCK. The lesson plan method has also limitations. For example, this tool does not capture what actually happens in the classroom and does not provide information about pre-service teachers' PCK in action or practice. However, the lesson plan method is a simple and adequate tool for university supervisors and school mentors. It provides them with useful information about the development of pre-service teachers' PCK and influences of course work and practice school activities on this development.

Based on these explanations, the following main problem and sub-problems were developed for this study:
What is the status of pedagogical content knowledge of prospective chemistry teachers about graphs in the topics of solubility and change of states?
Sub-problems:

1. What is the status of knowledge of the chemistry curriculum of prospective chemistry teachers about graphs in the topics of solubility and change of states?
2. What is the status of knowledge of the instructional strategies and representations of prospective chemistry teachers about graphs in the topics of solubility and change of states?
3. Prospective teachers' knowledge of students' learning
4. What is the status of knowledge of the assessment of prospective chemistry teachers about graphs in the topics of solubility and change of states?

METHODS

Context of Study

The present study was situated in the context of the ten semester of a five-year pre-service chemistry teacher education program, qualifying for the teaching of chemistry at upper secondary school level, at Balikesir. The prospective chemistry teachers took courses on general education issues, for instance, development and learning, instructional planning and evaluation, and guiding students, and they take courses on chemistry teaching issues, for instance, misconceptions in chemistry, chemistry textbook analysis, and methods of teaching chemistry topics. The issue of lesson preparation was taught in both general education courses and chemistry education courses to the prospective chemistry teachers.

Research Design

In this study, the case study method which is one of the qualitative research patterns and which facilitates in-depth examination and analysis of one or more special cases was adopted. McMillan (2000) defines case studies as a method for examining one or more events, media, programs, social group or other interconnected systems in depth (op. cit. Büyüköztürk, Kılıç-Çakmak, Akgün, Karadeniz and Demirel, 2014).

Participants

The subjects in the study were eight prospective chemistry teachers (5 females and 3 males; average age 22 and (referred to below as PCT 1-8)). Participants were selected using the case sampling technique, which is one of easily accessible purposive sampling methods. In this sampling method, a close and easily accessible case is selected (Yıldırım and Şimşek, 2005, p. 113).

Data Collection

The data were collected through lesson plans. In the preparation of lesson plans, prospective teachers weren't given liberty but were guided by 6 questions. With the first two questions, they were asked to write down the acquisitions for the lesson in question as well as prior knowledge about the topic. The next question wanted them to pick up a strategy to teach this lesson and explain why they chose that strategy. Then, they were requested to design an activity for the topic in question and prepare questions for assessment purposes. Five prospective teachers were asked to prepare a lesson plan concerning solubility topic and others prepared a lesson plan concerning the change of states topic. This topic is a regular part of the Turkish high school chemistry curriculum

Data Analysis

The data were analyzed through *enumerative approach.* Before proceeding with the analysis, content analysis was performed on the lesson plans to identify the themes. Then, themes and sub-themes were established to combine the codes. To ensure reliability, prospective teachers' answers to the questions were analyzed by the researcher and a field specialist according to identity the number of agreements and disagreements. The formula, proposed by Miles and Huberman (1994), i.e., reliability = number of agreements / (number of agreements + number of disagreements) x 100, the reliability of the study was used to calculate the reliability of the study. The reliability was found to be 92% and the analysis of the data from interviews with prospective chemistry teachers was deemed reliable. Thus, the findings obtained through the analysis of the data were readied for description.

RESULTS AND FINDINGS

1. Prospective teachers' knowledge concerning the curriculum

The findings regarding the knowledge of the prospective teachers about the curriculum were provided in two parts below:

Prospective teachers' knowledge of instructional acquisitions: In this component of PCK, first it was discussed whether PCTs wrote the acquisitions meeting the content of the curriculum topics of solubility and the change of states and to find out the level of the Bloom taxonomy this corresponds to. Categories of Instructional acquisitions PCTs determined were examined. Five prospective teachers (PCT2, PCT4, PCT5, PCT6, PCT7) wrote the acquisitions that are in compliance with the topic to be taught while three (PCT1, PCT3, PCT8) failed to wrote any acquisition. The Bloom taxonomy levels of instructional acquisitions were given in Table 1.

Table 1: Bloom Taxonomy Levels of Instructional Acquisitions PCTs determined

Instructional Acquisitions	Number of PCTs
Knowledge	---
Comprehension	PCT2, PCT5, PCT6, PCT7
Application	PCT2, PCT4, PCT5
Analysis	---
Synthesis	---
Evaluation	---
No acquisitions	PCT1, PCT3, PCT8

An examination of Table 1 for the instructional acquisitions about graphs reveals that 4 prospective teachers (PCT2, PCT5, PCT6, PCT7) came up with the acquisitions that correspond to the "Understanding" level of the cognitive domain of the Bloom taxonomy while three teachers (PCT2, PCT4, PCT5) wrote down acquisitions that are related to the "Applying" level of the same taxonomy. PCT2's statement, "Explains the factors influencing the solubility on the graph" can be given as an example for an acquisition on the "Understanding" level while the same teacher's statement, "Reads the solubility graph and draws solubility graphs for substances" exemplifies an acquisition on the "Applying" level.

Prospective teachers' knowledge of representations of subject matter: The results of the analysis conducted to find out to what extent the prospective teachers' topic presentations in their lesson plans overlap with the curriculum or textbook were given in Table 2.

Table 2: Representations of Subject Matter of Pts In Terms Of Sequence

Representation of topic	Number of PCTs
Meeting the sequence existing in the curriculum or textbooks	PCT2, PCT4, PCT6, PCT7, PCT8
Partly the sequence existing in the curriculum or textbooks	PCT1, PCT3, PCT5
Confused the sequence existing in the curriculum or textbooks	---

Looking at Table 2, it is clear that 5 prospective teachers (PCT2, PCT4, PCT6, PCT7, PCT8) came up with topic presentations in their lesson plans that overlapped with the curriculum or textbook while the topic presentations of 3 prospective teachers (PCT1, PCT3, PCT5) overlapped with the curriculum or textbook only partially.

2. Prospective teachers' knowledge of instructional strategies

The findings regarding the knowledge of the prospective teachers about the instructional strategies were provided in two parts below:

Prospective teachers' knowledge of subject-specific strategies: The subject-specific strategies in the lesson plans were analysed in terms of expository teaching (ET), problem-based teaching (PBT), discovery teaching (DT), and inquiry teaching (IT). The subject-specific strategies followed and reasons are given in Table 3.

Table 3. Strategies Adopted by Prospective Teachers and Reason of Choice

Lesson Plan Topic	Number of PCTs	Strategy Adopted	Reason of Choice
Solubility	PCT1, PCT4,	ET	"Because students know nothing about it and it is hard for them to figure out with their own efforts" (PCT1) "Because the implementation of other strategies would take more time" (PCT4)
	PCT2,	PBT	"Because it is possible to see many examples of it in daily life" (PCT2)
	PCT3, PCT5	DT	"Because it will whet the students' appetite for learning through their desire for exploration, making the process fun and learning a lasting experience" (PCT3) "To ensure that every student can clearly speak their mind" (PCT5)
Change of states	PCT6	IT	"Because student can decide on what they will do and be free in their work"
	PCT7, PCT8	DT	"Because learning by doing and through individual efforts will be more lasting" (PCT7) "Because it is appropriate for giving examples for the topic and asking students to provide examples about it" (PCT8)

Given the data in Table 3, it is clear that 4 prospective teachers adopted the discovery strategy and 2 prospective teachers went for the expository strategy while the problem-based and inquiry strategies were used by 1 prospective teacher each.

Prospective teachers' knowledge of topic-specific strategies: The topic-specific strategies in the lesson plans were analysed in terms of use of representations and use of teacher demonstrations and student experiments.
It was found that 5 prospective teachers (PCT2, PCT3, PCT5, PCT6, PCT7) made room for student experiments in their lesson plans.

3. Prospective teachers' knowledge of students' learning of solubility and change of states topics

This knowledge is can be related to teachers' knowledge of students' difficulties and teachers' knowledge of prerequisite knowledge for learning topics. Here only the findings related to the knowledge of prerequisite for student learning topics were presented. These findings were divided into two sub-themes as prerequisite knowledge for drawing graphs and prerequisite knowledge for reading and interpreting graphs.

Prospective teachers' knowledge of prerequisite knowledge for drawing graphs

The prerequisite knowledge for drawing graphs, as provided by prospective teachers, was analyzed to determine the level of their usage of the sub-skills of graph drawing --namely, axis selection, axis tagging, axis scaling, data entry, creating points and joining points. As a result of this analysis, it was observed that during the graph drawing phase, none of the prospective teachers provided any prerequisite knowledge for axis selection while prerequisite knowledge was provided by 3 prospective teachers (PCT1, PCT4, PCT5) for axis tagging, 2 prospective teachers (PCT1, PCT4,) for axis scaling, 2 prospective teachers (PCT1, PCT4) for data entry and 1 prospective teacher (PCT4) for creating points and 1 prospective teacher (PCT4) for joining points.

Prospective teachers' knowledge of prerequisite knowledge for reading and interpreting of graphs

The prerequisite knowledge for reading and interpreting graphs, as provided by prospective teachers, was analyzed to determine the level of their usage of the sub-skills of reading and interpreting graphs --namely, identifying the dependent and independent variables, focusing on a single point, focusing on interpolation, focusing on extrapolation and focusing on the holistic relationship. As a result of the analysis, it was found that during the phase of reading and interpreting graphs, only 1 prospective teacher (PCT1) provided prerequisite knowledge for identifying the dependent and independent variables while prerequisite knowledge was provided by 5 prospective teachers (PCT1, PCT2, PCT4, PCT5 and PCT8) for focusing on a single point, 1 prospective teacher (PCT2) for extrapolation, 4 prospective teachers (PCT1, PCT2, PCT3 and PCT7) for focusing on the holistic relationship (between variables) and none of them gave any prerequisite knowledge for interpolation.

4. Pre-service teachers' knowledge of the Assessment

The answers the prospective teachers asked in their lesson plans for the assessment and evaluation of the skills for drawing, reading and interpreting graphs were given in Table 4.

Table 4. Prospective Teachers' Preferences for Assessment and Evaluation of Graphing Skills

Lesson Plan Topic	Prospective Teacher	Drawing Graphs	Reading and Interpreting Graphs
Solubility Change of states	PCT1	Open-ended	Open-ended
	PCT2	Open-ended	Open-ended
	PCT3	Open-ended	Open-ended
	PCT4	Open-ended	Multiple-choice
	PCT5	Open-ended	Open-ended + Multiple-choice
Solubility	PCT6	Open-ended	Open-ended
	PCT7	Open-ended	Open-ended
	PCT8	Open-ended	Open-ended

An examination of the data in Table indicates that all of the prospective teachers employed open-ended questions regarding graph drawing in the assessment and evaluation process. For reading and interpreting graphs, 6 prospective teachers used solely open-ended questions and 1 prospective teacher employed solely multiple-choice questions while 1 prospective teacher resorted both to open-ended and multiple-choice questions.

It was further observed that the open-ended questions the prospective teachers prepared in connection with graph drawing entailed the use of the data in a table or in a text for graph drawing purposes while the questions they prepared in connection with reading and interpreting graphs were related to the focusing on a single point or finding of the holistic relationship between variables.

CONCLUSION

In this study, it was found that more than half of the prospective teachers were able to write down proper acquisitions for the subject matter at hand, but these hardly made above the Bloom taxonomy's "Applying" level. Many prospective teachers came up with topic presentations in their lesson plans that complied with the curriculum or textbook. Özden (2008) had studied the effect of the quantity and quality of content knowledge on the pedagogical content knowledge (PCK) and, in contrast with the findings of this study, indicated that the prospective science teachers didn't have sufficient knowledge concerning the curriculum. It was observed that the prospective teachers usually preferred student-centered teaching strategies and student experiments. All of the prospective teachers used graphs as visuals in their lesson plans. In literature, there are studies that reported prospective teachers who preferred teacher-centered teaching strategies in contrast to this study (Usak, 2005; Van Driel, De Jong and Verloop, 2002).

It was concluded that most of the prospective teachers (except PCT1 and PCT4) didn't provide any prerequisite knowledge for the sub-skills of graph drawing, namely, "axis selection, axis tagging, axis scaling, data entry, creating points and joining points" while most of the prospective teachers (except PCT1 and PCT2) didn't present any prerequisite knowledge for the sub-skills of graph reading and interpreting, namely identifying the dependent and independent variables, focusing on a single point, focusing on interpolation, focusing on extrapolation and focusing on the holistic relationship." This finding implies that most of the prospective teachers didn't have the knowledge about potential learning difficulties students may encounter regarding graphs in the topic of solubility and change of states.

It was determined that all of the prospective teachers adopted the traditional assessment and evaluation tools and they didn't use alternative assessment and evaluation approaches. However, considering the importance of the joint use of diverse tools and methods for assessing student achievements, it is recommended that the chemistry teachers should resort to all sorts of tools and methods for assessing the knowledge, skills and attitudes of students in the chemistry class (Ministry of Education, 2013).

Based on the findings of this study, it can be argued that the prospective teachers lacked sufficient pedagogical content knowledge for teaching graphs in the topics of solubility and change of states. This finding was supported by the results of other studies that reported insufficient pedagogical content knowledge (Adams and Krockover, 1997; Van Driel et al., 2002; Van Driel, Verloop and De Vos, 1998).

RECOMMENDATIONS

We believe that the assumption that the prerequisite knowledge for graphs is provided at mathematics or geometry classes will be an obstacle to finding solutions to the problems students may face with regarding graphs. Therefore, it is recommended that prospective teachers should provide students with prerequisite knowledge for drawing as well as reading and interpreting graphs when they will make use of graphs in teaching particular topics.

If the pedagogical content knowledge (PCK) of prospective teachers is improved through lessons like "Chemistry Special Teaching Methods" and "Instructional Principles and Methods," we believe that the difficulties students encounter regarding graphs will largely be eliminated.

With a view to addressing the shortcomings of prospective teachers regarding the use of alternative assessment and evaluation tools, it may be suggested that chemistry teacher trainers should give courses on assessment and evaluation. The development of the PCK of the prospective teachers in other chemistry topics where graphs are used extensively may be monitored starting from the first grade. We also believe that more in-depth information may be gathered about the PCK of prospective teachers by integrating interviews along lesson plans, lesson observations, PCK tests and teacher diaries with the data collection process.

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FOREIGN LANGUAGE TEACHING WITH AUGMENTED REALITY APPLICATION

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ABSTRACT: One of the main aims in Foreign Language Teaching is to actualize natural and entertaining educational environment. Foreign Language Teaching Activities should stress on motivational goals furthering interests and motivation of learners and minimizing their anxiety in language teaching activities. So as to adopt that, these activities should be designed to incite students' interests, curiosity and include some diverse alternatives from school textbooks to handheld technological devices and other electronic appliances. The alternatives for educational purposes may multiply in results of innovations and individual's access to technologies in surrounding educational environment. For the purpose, application of technological innovations and handheld technological devices should bridge the gap between real world and virtual world. In the study, a technological innovation called "Augmented Reality (AR)" is applied. The purpose of the study is to determine attitudes of learners towards AR Application which enables learners to improve their listening skills and promote the motivation towards listening acitivities by using smart phones and tablets. The study focuses on AR assisted learning with listening acitivities in school textbooks. Data were collected from 60 students in a secondary school by using 15 items of the "Augmented Reality Applications Attitude Scale In Secondary Schools" scale. For this AR educational application, three English Language teachers' opinions were consulted. It is assumed that the prototype of the AR educational system will enlarge students' motivation towards listening activities and listening competence and pave the way for a new teaching activity assisted with AR technology in foreign language teaching by shifting time and place of education and learning.

Keywords: English Learning**,** Augmenten Reality

INTRODUCTION

In foreign language teaching, it is imperative to form natural and entertaining educational environment that can promote learners' motivation, arouse learners' interest, and encourage them to learn foreign language. The activities and educational environment need to be created in such a way that can draw attention of students, increase the motivation and confidence of learners to learn English as a foreign language; conversely, limit negative emotions such anxiety and fear as (Musa, Lie, & Azman, 2012; Yang, Chen, & Jeng, 2010). There is an interrelationship between success and motivation. Some studies conducted before have demonstrated that increasing of motivation facilitated language learning process dramatically (Littlewood, 2001).

The various English programs on foreign language teaching have ignored attitudes factors involving motivation and interest and other factors for years. Of the most significant absence is to give enough opportunities to practice English out of the class; that is, in a real circumstances. That's way the technological applications handheld, wireless, smart phone, tablets have been tested in language teaching and different areas lately to curb the limitations mentioned above (Liu, Tan, & Chu, 2010). With usage of AR application, English teaching has enhances outcomes, motivation and interest of learners, and provide amusing and productive learning system by shifting concept of timing and location of language learning and mainly improve four skills-reading, listening, speaking and writing. Augmented Reality systems can be defined as those that allow real and virtual objects to coexist in the same space and be interacted with in real time (Azuma, 1997). The numerous previous studies have also stated that AR applications on English teaching has favorable outcomes in favour of students. Vate-U-Lan (2012) stated the learners increased their achievements by using 3D pop-up book created by AR and enriched the activities and give opportunities to practice language everywhere. Liu et al. (2010) suggested that Augmented Reality supported English Learning enhanced listening, reading and speaking abilities. AR oriented English teaching innovations result in high learner achievements and enable learners to acquire reading, speaking and listening abilities much more successfully than they could before.

In the study, The aim is to design an Language teaching application generated by augmented reality social platform which named ‘Aurasma’ that anyone can use by downloading from ‘android’ and ‘ios’ markets in order to enhance listening skill and limit failure of pronunciation by giving opportunities learners to practice listening activities at anytime and anywhere without CDs, laptops and computers by using their smart phones. The study also aims at creating enjoyable and learner-centered training that improve learners’ motivation and self-confidence and interest in English decrease language anxiety. For these purposes we try to understand how student’s attitude towards our augmented reality language teaching application is.

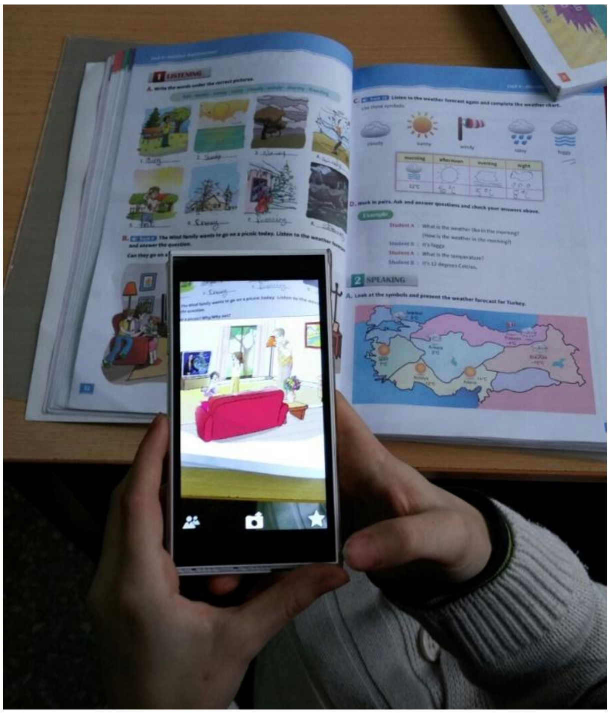

Figure 1. A student when using AR language teaching application in ‘Aurasma’ platform

METHOD

In this study we use an attitude scale (Küçük, Yilmaz, Baydas, & Göktas, 2014) which is consisting of totally 15 substances and three sub-dimensions that will help determining the attitudes of secondary school students towards the use of AR language teaching application. The sub-dimension of scale are “willingness”, “anxiety”, “satisfaction” and its validity and reliability has been proven. The sample of the study is composed of 60 sixth-grade students 33 of males and 27 of females.

First we create score groups to evaluate the scores obtained from attitude scale. Attitude scores were divided into 5 groups is shown at table 1.

Table 1. Rating groups of attitude score averages

	never	*rarely*	*occasionally*	*often*	*always*
Willingness	7 - 12.6	12.7 - 18.2	18.3 - 23.8	23.9 - 29.4	29.5 - 35
Satisfaction	2 – 3.6	3.7 – 5.2	5.3 – 6.8	6.9 – 8.4	8.5 - 10
Anxiety	6 - 10.8	10.9 - 15.6	15.6 – 20.4	20.5 – 25.2	25.3 - 30

After that we analyzed the data to find levels of students’ attitude towards the use of AR language teaching application.

FINDINGS

Attitude scale and its sub-dimensions score for the evaluation of student’s attitude is shown in Table 2.

Table 2. Attitude of students towards the using of AR language teaching application

	$\bar{X}$	S	Minimum	Maximum
Willingness	33.23	3.88	15	35
Satisfaction	9.21	1.56	3	10
Anxiety	8.06	3.60	6	26

When table 2 is analyzed, at the sub-dimension of attitude scale, it can be seen that students have high mean levels of "willingness" and "satisfaction" so students are "always" willingly and satisfy and "never" anxious towards using the AR language teaching application according to table 1. The attitudes of students from scale that the distribution by gender is shown at Table 3.

Table 3. A comparison of scale components in reference to gender

		N	$\overline{X}$	Std. Deviation	Std. Error
Willingness	Female	27	33.22	4.04	.77
	Male	33	33.24	3.82	.66
Satisfaction	Female	27	9.25	1.5	.29
	Male	33	9.18	1.62	.28
Anxiety	Female	27	8.29	3.99	.76
	Male	33	7.87	3.29	.57

According to the table 3, the mean of willingness ($\overline{X}$ female =33.22, $\overline{X}$ male = 33.24) satisfaction ($\overline{X}$ female =1.5, $\overline{X}$ male = 1.62) and anxiety ($\overline{X}$ female =8.29, $\overline{X}$ male = 7.87) are close for both males and females.

DISCUSSION

In this study, we found that the students who use AR applications in English learning show positive attitude towards the mobile AR application in addition they had very comfortable and enjoy during the lessons. Besides they have intention to use this technology in the future for other lessons and subjects because of the application attract their attention and increase their motivation. There are several similar studies also in literature access very similar results (Chang, Chen, Huang, & Huang, 2011; Kucuk, Yilmaz, & Goktas, 2014; Vate-U-Lan, 2012) their recommendation's that more applications could be designed with new simple effective learning environment. Our recommendation that many different education models, styles and teaching strategies can be used with AR technology in classroom and analyzed teacher's opinion which would be suitable. We will adjust our AR application based on the experimental results and the participants' feedback to determine in terms of other variable in the future.

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USING STEM INTEGRATED APPROACH TO NURTURE STUDENTS' INTEREST AND 21ST CENTURY SKILLS

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ABSTRACT: This study aimed to identify the changes of 21st century skills among students after participating in integrated Science, Technology, Engineering and Mathematic (STEM) education programme. The learning activities in this programme applying Project Oriented Problem Based Learning approached as a fundamental pedagogy. A total of 125 secondary school students age 13-14 from four different zone of FELDA regions were involved as respondents. This study employed one group quasi-experimental and survey design to identify student's 21st century skills before and after the programme. The data were analyzed using SPSS 21.0 for descriptive analysis, which later followed by inferential analysis to compare the means (t-test) between pre and post groups. The findings from this study revealed that, the level of 21st century skills among students significantly increase. Interestingly, one of the 21st century skills components namely 'high productivity skills' shows positive changes, from moderate to high level skills. The outcome of this study provide evidence that the application of Po- PBL in STEM education could help students to enhance their 21st century skills by learning how to solve the real world problems based on the authentic and real life experience through project work.

Keywords: 21st century skills, Po-PBL, STEM education, Project based learning, Problem based learning.Digital age literacy, Inventive thinking, Effective Communication, High productivity, Spiritual values

INTRODUCTION

The most important asset to achieve a high income developed nation status is through quality human resource which can face challenges in applying 21st century skills. To spur a world class nation, human resource which is competitive, knowledgeable, creative and possessing positive ethics plays an important role. North Central Regional Educational Laboratory (NCREL) and Metiri Group has created a 21st century education model which is known as enGauge 21st Century Skills [1]. With this model, there are four main criterias which need to be weighed to produce a generation which is capable of handling 21st century challenges. The four criterias are Digital age literacy, Inventive thinking, Effective Communication and High productivity. Another criteria to accommodate the Malaysian context, which is spiritual norms and values was added [2]. This research will study on five aspects of 21st century skills.

The first 21st century skill is Digital age literacy which encompasses communications competency, the analysing and interpretation of data, the understanding and assessment of models, task management and task prioritization, involvement in problem solving, and ensuring wellbeing and safety [3]. Digital age literacy needs to be developed in a student's mind to ensure students maximize technology usage in this 21st century learning. The second skill is Inventive thinking. Inventive thinking is a cognitive activity which helps creative thinking application in a creative and critical manner with skills in problem solving through innovative or specifically designed activities. A few elements or 'life skills' in inventive thought ability was defined by others researcher groups [1, 4], which is adapting and managing complexities, self regulation, curiosity, the willingness to take risks and high level thinking. The next skill is Effective Communication. Effective Communication is a skill which needs to be developed by each individual in this 21st century. It encompasses information delivery, teamwork, interpersonal skills, social responsibilities, interactive communication and communication towards the environment [1]. The learning process becomes much more exciting and valuable when communication activities use ICT as a medium to obtain information, to communicate faster, and as a supporting medium which assists in the learning process. The fourth skill is High productivity, it is defined as a student who is able to produce relevant products, high in quality, intellectual, currently information and original [1]. The student is also skilled in delegating and structuring tasks in terms of importance and priority, and skilled in planning and producing high quality products. The final skill is Spiritual values. This skill emphasizes on the practice of religious knowledge and beliefs, attitude and values.

In dealing with the challenges of the 21st century, the working sector requires workers who possess marketability which encompasses problem solving skills, critical and innovative thinking and the ability to work in a team. To achieve that, students can no longer be assessed based on academic achievements only, but they also need to master 21st century skills. Nowadays, there are many student-centered teaching and learning processes and PoPBL is one of them, which is project centered and orientated. The PoPBL approach which was developed by Aalborg University, Dermark [5], has steps with experiences that activate students and ensure the connection between teaching of science and everyday life. The PoPBL approach is a teaching method in the teaching pedagogy model which was first used in Problem Based Learning (PBL) [6].The basic principles of POPBL can be summarized as (i) Student-centered and able to motivate and gain commitment among students; (ii) focus is more on learning process in finding solution; (iii) Project-Based which has goal and action for change; (iv) Exemplarity; (v) Promote group work/team work, social and communication skills [7]. PoPBL tries to cultivate students' ability, to think critically to learn actively and to solve problems through project based activities. It also develops skill on communication when students have to conduct group discussions. An implementation of POPBL in STEM Programmes therefore had given a great opportunity for the students in self-directed learning and enhanced their soft skills.

In line with STEM's education objective to develop inter-disciplinary thinking, the PoPBL approach is one of the methods that is suitable in STEM's education. PoPBL is seen as an approach that has potential in creating students which will learn better through meaningful teaching which is associated with real life situations and the students can experience the situation themselves. PoPBL is also an alternative teaching method where students are immersed in an environment which focuses on teaching through project work and not solely on oral teaching [8]. The inability of students to apply concepts and skills in the field of STEM which has been taught to solve STEM-based problems and also in everyday life becomes more worrying each day. As a result, students have difficulty in understanding abstract concepts. This problem causes students being unable to apply those concepts in solving STEM-based problem because they do not understand the underlying theory of each given subject.

PoPBL is a pedagogy model which is most favoured in structuring teaching methods [6]. PoPBL incorporates the development of students' personal skills and also encourages creativity [9]. Therefore, through PoPBL, the teaching and learning processes in STEM-based education is hoped to achieve its objective to cater to the needs of the 21st century generation. This is because PoPBL needs to start with research problems analysis followed by project designed to solve problems through activity execution which has already been planned to solve problems which are being analysed [7]. This matter is important because students need a sound basis in STEM to face challenges in their career and go through life in this
21st century [10].

Some researcher [11, 12] proved that the PoPBL approach can elevate students' interest towards science. PoPBL has the ability to develop students' sense of importance for science subjects by making it easy for students to learn science and therefore increases their interest in science [11]. This approach also has an ability to develop new knowledge when it is regarding the issue of low percentage of recycling practices in campus for what has been taught in class [12]. The PoPBL approach able to elevate students' achievements and this statement is proven through the research [8, 9]. Finding show that through the PoPBL approach, students can have a high level of achievement in their work and highly motivated in their learning processes [9]. Through teamwork, PoPBL can elevate students' humanity skills (communication between team members and planning) [9, 13]. Studies of application of PoPBL among students from the Faculty of Electric and Electronics, found that the processes of teaching and learning which employs the PoPBL approach has increased students' ability to analyse and create analog circuits using various types of transistors and diodes.[8].

Science education objectives in Malaysia are to develop competitive human resource at a global level and also become a contributor to the development of the science and technology civilization, resistant, and able to master scientific knowledge and technological craftsmanship [14]. Even so, the decline in students' interests towards science in Malaysia especially [15, 16], will become a challenge in achieving that objective.The average score for Malaysian students in the *Trends in International Mathematics and Sciences Study* (TIMSS) examination clears indicates a downward trend, starting from ranking 510 in 2003, 471 in 2007 and 426 in 2011 [17-19]. PISA 2009 results indicate Malaysia is located at the bottom third out of 74 participating countries and also below the international and OECD average [20]. In 2011, only 45% of student graduates were from the Science stream, including technical and vocational programmes [21]. This scenario cannot be ignored because it will affect Malaysia's efforts in achieving developed nation status in 2020 where Malaysia needs a 33% workforce in the field of science and technology. Steps need to be taken to achieve the targeted number of graduates in STEM-related fields to increase future students' achievements.

In line with that, programmes that incorporate the various disciplines of science such as Science, Technology, Engineering and Mathematics (STEM) conducted outside schooling hours are seen as an alternative that positively affects the efforts to increase interest and involvement in STEM-related careers. Also, the integration of these STEM subjects will spur the minds of students to be creative, critical, innovative, and this in turn contributes to the advancement of technology. STEM education is an approach that explores the processes of teaching and learning between any two or more STEM components or, between any one STEM components with another field of knowledge [22]. The Malaysian education system is already equipped with science, mathematics and engineering which is taught as a stand-alone subject, but the integration of science and mathematics with engineering concepts can be a better practice as compared to the traditional method. In fact, STEM education is the integration of technology and engineering design concepts in the teaching and learning processes of science and mathematics [23]. The Education Ministry (KPM) and PPPM has clearly stated that they will strengthen the delivery of STEM across all education systems. “This new discipline was meant to transform traditional classrooms from teacher- centered instruction into inquiry-based, problem solving, discovery zones where children engage with content to find solutions to problems” [24].

The STEM programme in this research includes a partnership between Universiti Kebangsaan Malaysia (UKM) with FELDA authorities aimed to increase students’ participation in the fields of *Science, Technology, Engineering and Mathematics* (STEM) and eventually become enabling to compete in this 21st century. This programme’s approach is based on multi-disciplinary features, active learning through inquiry, application of 21st century skills, and exposing students to careers in the fields of contemporary science and technology. The learning theories underlying this research are the theories of Constructivism and Constructionism. The Constructivism theory is comprised of five phases, namely orientation phase, idea generation phase, idea restructuring phase, idea application phase, and reviewing phase. The *Constructionism* theory is applied during the idea application phase, throughout the processes of practical activities which involves real world problem solving in the STEM Bitara Module. According to the theory of *Constructionism*, the generation of new ideas will happen effectively if participants are involved in artifact designing processes [25]. This theory emphasizes participants towards artefact designing activities in the learning process [26]. The engineering design process, which is the TMI model [27], is applied by participants in their artefact designing process.

The STEM Bitara Module applies the TMI Model [27] through three main stages, namely, *Think* (T), *Make* (M), and *Improve* (I). During the *Think* stage, after participants have been given a situation or real world problem to solve, they will discuss and work in a group to identify the problem, give suggestions, and make plans. The facilitators will continue to support each participant to ensure they complete this stage effectively. During the *Make* stage, participants build, create, experiment, solve the issue, and any other issues arising during artefact design. After the artefact has been completed, testing is conducted to identify any problems that arise. Finally, at the final *Improve* stage, participants will improve the artefact that they have built by testing and rebuilding the artefact again with improvements to identify arising problems, or build a much better artefact following the guidelines which have been set.

Objective of Study

The purpose of this study was to assess the effect of the implementation of PO-PBL in STEM education programme in terms of students’ 21st century skills by using a one group pre and post-test quasi-experimental design. This study was launched to investigate the following research questions:

1. Were there any significance changes in the students’ 21st century skills in POPBL learning program?
2. Can PoPBL learning program increase students’ 21st century skills?

Methodology of Research

Learning by doing is a way to help students to understand their learning especially the abstract content effectively. An alternative method to promote this way of learning is called PoPBL. Students learn how to solve the real world problems based on authentic and real life experience through project work that emphasizing the creation of artifact. The success of the project work come from the collaboration between students in a team work and teacher as a facilitator. Designing of PoPBL approach with integrated STEM is still new in learning environment. On 2 to 6 June, 2014, the programed called ‘*Bitara-STEM UKM-FELDA Camping program*’ was held in MRSM FELDA Trolak, Perak. This program implemented POPBL with integrated STEM. The learning activities in this program is project based and multi-disciplinary activities that provide students with fun learning by applying students-centered approach. The theme for this program is “Science of Smart Communities”. The learning activities in this program provide students with fun learning by applying students-centered approach which is project based and multi-disciplinary activities. Implementation of POPBL with integrated STEM in this program also in order to develop, 21st century skills, higher-order thinking and research skills. Four separated units of modules was introduced to the students for participate namely (i) Energy, (ii) Urban infrastructure, (iii) Transportation, and (iv) Wireless communication (Figure 1)

Figure 1. Units of intervention and activities

Unit	Modules	Example of Activities
Energy	Introduction of Newton's Law & Electrical Basics Worldly environment Power generation Power storage Biomimicry	Balloon rocket & parachute. Rain in the bottle. Potato battery Hydrogen fuel cell Fish tail
Transportation	Modes of transport Smart transportation Smart highways Intelligent transportation systems. Traffic engineering	Make a circut Robot programming
Wireless Communication	Smart electronics basics Real time communication Space based wireless communication Internet and communication network. Smart wireless communication	Flash LED Cell antenna
Urban Infrastructure	Environmental engineering Soil and land development Building towards to the future Recycling and waste management Natural disasters	Pump It! Water turbine Earthquake Town

Samples

The sample in this study was participants who are participated in 'Bitara-STEM UKM-FELDA Camping program'. A total of 125 lower secondary school students from four different zone of FELDA regions were involved in this study. Majority of participants have an excellent result in their past standard Primary school evaluation test (UPSR), both subject science and mathematic with 'A' score were 60.7% and 77.9% of the participants.

Instrument and Procedures

The instrument used in this research is a set of questionnaires which employ the Likert Scale with five degrees of agreement (1=does not agree at all to 5=agrees very much). This instrument is comprised of two main sections, which are (i) students' interest towards STEM, and (ii) 21st century skills. The instrument used to gauge students' interest towards STEM is an instrument which is adapted from STEM Semantics Survey [28] and this instrument to gauge students' interest toward STEM will gauge (i) students' interest towards STEM content, and (ii) a career in any STEM field. Next, the instrument to gauge 21st century skills is an instrument used was adapted from Arsad et al. (2011) [29], which takes into consideration skill components from *Engauge 21st century skills*, which are (i) Digital age literacy, (ii) Inventive thinking, (iii) Effective Communication, and (iv) High productivity, whereas the additional component of Spiritual values is a component which is adapted to suit the Malaysian Education Philosophy (Figure 2). This instrument has been checked dan verified by experts (construct validation, content and language). The credibility of this instrument is high with both all main contructs achieving a high Cronbach Alpha value for each item in the pilot study which was conducted before at a value of between 0.78-0.86.

Figure 2. Example of Items of 21st Century Skills Elements

Element	Item	Number of items
Digital age literacy	I can understand the concept of science and mathematic that the teacher teach in English I am able to evaluate the information regarding science.	7

Inventive thinking	I can be positive towards the problem with the level of difficulty which is beyond my expectation I am interested to find out new and unusual things that I can find from surrounding	12
Effective Communication	I act as a leader and follower at the same time in completing the assignment. I collaborate with team members in any circumstances	8
High productivity	I plan the time provided to complete each assignment. I created product from my project or practical science	8
Spiritual values	I thankful because I am able to learn science and mathematics. I always associated the science knowledge needed in the world or hereafter	5

RESULT AND DISCUSSION

Findings from pre- and post tests were used to study the effects of PoPBL approach in STEM programmes on 21st century skills. The mean score from pre-tests were compared with the mean score from post-tests using a paired sample t-test. 21st century skills were tested in five aspects, which are (i) Digital age literacy, (ii) Inventive thinking (iii) Effective Communication, (iv) High productivity, and the added component, (v) Spiritual values. Table 3 shows the comparison for mean score from both pre- and post-tests for all aspects tested to gauge students' 21st century skills. Table 3 below also shows the mean score value and the standard deviation (SD) value from both pre- and post-tests for aspects under 21st century skill.

Figure 3. T-test table table for the mean score of students 21st century skills

Skill	**Test**	**Mean**	**Std. Deviation**	**t-value**	**Sig (2- tailed)**
Digital age literacy	Pre-test	3.774	0.419	3.424	0.001
	Post-test	3.916	0.498		
Inventive thinking	Pre-test	4.015	0.412	1.377	0.171
	Post-test	4.082	0.601		
Effective Communication	Pre-test	4.088	0.426	1.942	0.055
	Post-test	4.173	0.598		
High productivity	Pre-test	3.851	0.401	5.878	0.000
	Post-test	4.121	0.481		
Spiritual values	Pre-test	4.550	0.414	0.994	0.322
	Post-test	4.511	0.525		
21st Century Skills	Pre-test	4.055	0.331	2.996	0.003
	Post-test	4.145	0.451		

Based on Figure 3 above, its ~~is evident~~ shows that there is a rise in the mean score values for all aspects of 21st century skill except for *Spiritual values* aspect, which shows a decrease in mean score of 0.039 and there is no significant difference (125)=0.994. As a whole, the findings show that the increase in mean score for 21st century skills happened after students were exposed to the Bitara STEM programme with a t value of (125)=2.996. The findings also show that there is a significant difference for the aspect *Digital age literacy* with a t value of (125)=3.424 and *High productivity* with a t value of (125)=5.878. However, there are two aspects of 21st century skill which do not show any significant difference, which are *Inventive Thinking* with a t value of (125)=1.377 and *Effective Communication* with a t value of (125)=1.942. As a whole, the level of 21st century skills for the majority of students is at a high level. After attending this programme, the percentage of students who exhibit a high level of 21st century skills increased by 4.9%. Figure 4 shows the analysis findings of the percentage of students based on 21st century skills which has been divided into 3 stages, namely low, medium and high.

Figure 4. Student Percentage Based on 21st Century Skills

		Lowest	Moderate	High
Student Percentage Based on 21st Century Skills (%)	Pre-test	0	11.5	88.5
	Post-test	0	6.6	93.4

There are a few important 21st century skills which have to be mastered by students. Through the analysis which has been conducted, it was found that the level of 21st century skills show an increase in every skill after students attended the STEM Bitara Programme with the exception of *Spiritual Values.* The highest increase occurred for *High Productivity* with a difference between pre- and post-tests mean score of 0.27, followed by *Digital Age Literacy* (0.142), *21st Century Skills* (0.09), *Effective Communication* (0.085), and *Inventive Thinking* (0.067).

In the STEM Bitara Programme, the teaching and learning approach which was emphasized upon was the usage of PoPBL methods, which applied various *hands on-minds on* activities, starting with problem identification and ending with a solution to the said problem. Research findings show that through the activities of teaching and learning in the STEM Bitara Programme, it increased the level of inventive thought in students. This is because through activities in small groups, students needed to think together on how to solve the problems that they faced by applying their individual experiences. To achieve that, students needed to explore and make connections between the problem's situation and the situations that they have experienced themselves. Also, the students were required to design new artefacts. Artifact design which was formed based on ideas shared with other team members managed to increase students' inventiveness and this gave a positive effect towards *High Productivity.* This finding is in line with other researches [8, 9] which found that PoPBL can enable high achieving results in students' work.

The research findings also show that students possess *Digital Era Literacy Skill* which was elevated after attending the STEM Bitara Programme. The Internet was used during teaching and learning processes to enable students to find additional information to further strengthen their project or the design which they were developing. Through this PoPBL approach, *Digital Era Literacy Skill* level among students who attended the STEM Bitara Programme was at a high and encouraging level. However, the decrease in the value for *Spiritual Values* (-0.039) after students attended the STEM Bitara Programme needs further research aimed at increasing the value in the future. Therefore, the application of spiritual values during teaching and learning processes should be improved upon to ensure that students are not only inventive, can communicate efficiently, possess digital era literacy skills, possess high productivity levels, but also equipped with spiritual values which is much needed for the good of mankind.

Further data analysis on student percentage based on 21^{st} century skills found that no students were at the lowest level before and after the programme. A high increase in the 21^{st} century skills level occurred after students attended the STEM Bitara Programme for the highest scale, an increase of 4.9%. This proves that the teaching and learning pattern of PoPBL which was applied in the STEM Bitara Programme was suitable and able to capture students' interests to be involved in the processes of teaching and learning and ultimately increased the quality of students' mastery in STEM-based education. Research findings also show that the effectiveness of PoPBL through STEM programmes succeeded in increasing the level of 21^{st} century skills.

Conclusion

Based on the research findings, it can be concluded that the application of the PoPBL approach in teaching and learning processes as implemented in the STEM Bitara Programme can increase the level of five 21^{st} century skill elements, which are Digital Age Literacy, Inventive Thinking, Effective Communication, High Productivity and Spiritual Value. Also, PoPBL as a collaborative teaching strategy can increase communication skills effectively. The implementation of group activities can help nurture attitude and interpersonal skills, such as interacting skills during project presentation, teamwork, hardworking and creative thinking. The model and teaching principle such as this is much needed in today's teaching situation with students who are active and creative to prepare them for challenges in this 21^{st} century. Therefore, the teaching and learning processes need to be relevant and coherent with current times. The STEM Bitara Programme which involved the integration of STEM education was futuristic, flexible, and dynamic can develop human resource which are creative and innovative in the ongoing attempt to master 21^{st} century skills. It can also develop human resource which is clever in planning the future and able to make choices between culture and current values in facing globalization and information boom.

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STUDENT BEHAVIORS AND PERCEPTIONS IN A FLIPPED CLASSROOM: A CASE IN AN OPERATING SYSTEMS COURSE

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ABSTRACT: In technical majors like computer, in laboratories of which students could only have access to hardware and software, using time effectively is of the essence. For students to gain experience, it is important that they have experiments in courses like Network Systems and Server Operating Systems. With the development of internet and Learning Management Systems, more and more instructors have started to flip their courses by using technologies like videos, online homework, social networks, and forums. In a flipped class, students have the responsibilities of their learning. Lessons are presented online, instructors guide the in-class applications and interact more with their students. Having the aim of learning students\' opinions on flipped classes, this study was implemented in a four-hour Network Systems Laboratory with the participation of 25 students, who took the Operating Systems Course in a vocational college during the spring semester of 2015-2016 Academic Year. Instructors loaded the maximum 10-minute videos, course materials and projects on the system. Under the guidance of their instructors students did the weekly projects in class. Three application tests, the averages of which were 54.20, 89.16, and 86.8 respectively, were given to students through the semester. Students were interviewed right after the first and third test applications. After the first test, students reported that the visuals were good, but they preferred the lessons to be delivered by the instructors; after the third test students stated that they did more applications during classes and in laboratory hours of other courses this method also could be utilized to provide more space for applications. The results of this study showed that flipped classes could be effectively used in courses where students don\'t have much time for applications outside laboratory hours, however students need to be informed of the method and the expectations right at the beginning.

Key words: flipped classroom; student perception; blended learning; operating systems

INTRODUCTION

The flipped classroom is one of fashionable student-centered instructional models. Flipped classroom model inverts the learning procedure from the conventional classroom by acquiring students review course materials such as videos, lecture notes, trial exams before class time. To flip classroom, instructors use the most recent technologies such as digital videos to ease and foster instruction and students' learning (Bergmann & Sams, 2012). Especially in technical majors like computer, in laboratories of which students could only have access to hardware and software, using class/laboratory time effectively is of the essence. For students to gain experience, it is important that they have experiments in courses like Network Systems and Server Operating Systems. In these courses, students' autonomy, performance, and motivation can be improved by taking students to the center of instruction (Smit, Brabander, & Martens, 2014).

With the development of internet and Learning Management Systems, more and more instructors have started to flip their courses by using technologies like videos, online homework, social networks, and forums. In a flipped class, instructors take the role of a facilitator while students have the responsibilities of their learning. Lessons are presented online, instructors guide the in-class applications and interact more with their students, while students work on projects, assignments and interacts with classmates in order to support specialized instruction, individualized learning, group learning and high level learning (Yarbro, Arfstrom, McKnight, & McKnight, 2014).

Some studies (Flumerfelt & Green, 2013) claim that flipped classroom learners may surpass their peers in conventional classrooms, while some others point out that learners' responses for flipped classroom are not completely positive (Wilson, 2013). The main purpose of this study is to investigate vocational college students' perceptions of a flipped Operating Systems course.

METHODS

The purpose of this qualitative study was to describe vocational college students' experiences of a flipped Operating Systems course. This study was implemented in a four-hour Network Systems Laboratory with the participation of 25 students, who took the Operating Systems Course in a post-secondary vocational college during the fall semester of 2015-2016 Academic Year.

Instructors loaded the maximum 10-minute videos, course materials and projects on the system. Students watch online videos and read lecture notes on the Course Portal, MOODLE platform, before class. Under the guidance of their instructors, students completed the weekly projects in class.

Three application tests, the averages of which were 54.20, 89.16, and 86.80 respectively, were given to students through the semester. All participants were presented the same learning resources and application tests were used to determine if students had watched videos or read lecture notes. The application tests included authentic subjects related to operating systems.

In order to understand the learning environment of the flipped Operating Systems course data were gathered in two distinct steps. Students were interviewed right after the first and third test applications. Data were collected to better understand the experiences of vocational college students during the flipped Operating Systems course. All Operating Systems course participants were took part in the interviews. Interview questions were designed to identify student perceptions about the model and how this flipped model affected their learning, as well as ideas for enhancing the course.

RESULTS AND FINDINGS

After the first test, students reported throughout the interview that the visuals were good, but they preferred the lessons to be delivered by the instructors. Since it was a method they were not used to at all, they stated that they expected the instructors deliver the lesson and that's the reason they didn't ask any questions during class time.
After the third test, students stated that they had more time for more applications during classes and suggested that in laboratory hours of other courses this method also could be utilized to provide more space for applications. They reported that, in need of an instructor's guidance at moments of confusion or lack of understanding, watching the videos uploaded on the portal was very helpful. Having free interaction with classmates and receiving timely support from their peers during classes were also listed among the positive contributions this method had on their learning.

CONCLUSION

The aim of this qualitative study was to describe students' perceptions of the flipped Operating Systems course. The results of this study showed that flipped classes could be effectively used in courses where students don't have much time for applications outside laboratory hours; however, students need to be informed of the method and the expectations right at the beginning. Additionally, participants experienced that the flipped classroom model used multiple instructional materials that enhanced their individual learning.

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THE INVESTIGATION OF THE USABILITY OF WEB-BASED ASSIGNMENT SYSTEM

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ABSTRACT: Just as in all aspects of our lives, technological advancements have had an impact on traditional methods and techniques in education. The crucial reflections of this transformation in education have shown themselves in the increase of distance education and in the online content sharing, testing and assignment taking traditional methods' place. Online assignment is a model where tasks are given, student responses are submitted, results and feedback are shared on web. The usability of this web-based assignment system should be explored in order to use it effectively in class, identify and solve the problematic issues, and increase both instructors' and students' level of satisfaction. The aim of this study is to investigate the usability of web-based assignment system implemented in a vocational college. For research purposes, System Usability Scale scores of students were examined and students' opinions on web-based assignment were received to identify the points on its usability. In this mixed-design research, data were collected online from System Usability Scale (SUS) and students' responses to open-ended questions. The participants were 204 post-secondary students enrolling at a vocational college during first semester of 2015-2016 Academic Year. Descriptive statistics and t-test were used in data analyses. The average score of 67.14 from SUS application showed that the system can be used. No significant difference was observed between first and second grades. The results of the qualitative analysis of those responses given to open-ended questions revealed that students enjoyed the system, instructor feedback had a motivating effect, but they had challenges owing to absence of enough time and difficulty at having access to computers and web-based assignment system. The results also showed that web-based assignments could be effectively used, but the ease of students' access to computers and internet should be taken into account before utilization.

Key words: Online assignment, usability, LMS, mixed method

INTRODUCTION

Assignments have always been an important part of an education system. Teachers use assignments to enhance learning, motivate students to study and keep track of student progress. Providing feedback for submitted assignments has a valuable role in this process. Conventionally, submissions of assignments, grading and providing feedback for them have been in hard copy format (Grieve, Padgett & Moffitt, 2016). On the other hand, due to emerging web technologies and online learning tools, many universities and the faculty prefer performing these activities online (Hepplestone et al., 2011). Online assignment system is a web-based education tool that enables students to submit their assignments and receive feedback from their instructors with the assignment grade. Online assignment systems are identified with some advantages like effectiveness of administration, its cost effectiveness, issues of security and accountability, improved turnaround time, ease of grading, availability of private feedback, reduction in paper use and creation of an electronic archive of submitted assignments (Collis, Boer & Slotman, 2001; Palmer, 2005-2006; Thomas et al., 1998; Barker, Kortum & Miller, 2008).

Several research studies have been conducted addressing student preferences of online assignment systems. According to Palmer (2005-2006) and Buzzetto-More (2008), students prefer online submission of assignments due to flexibility in timing and scope and the enjoyment of checking grades and feedback online owing to increased privacy. While studies reveal that students and the faculty prefer online assignments and enjoy using them, still their use as examinations is a critical issue because research has shown that implementation of usability principles can help teachers enhance student learning experience and it can improve student learning process eventually (Koohang, 2004). Nielsen describes a usable system as user friendly, easy to use, learn, and remember (as cited in Battal & Cagiltay, 2015).

The purpose of this study was to investigate the usability of a web-based assignment system, determine its problem areas during use, and suggest solutions to those problems. Within this scope, comparing the System Usability Scale (SUS) scores of first and second grade students is another goal aimed at this study.

METHODS

For search purposes mixed-method research design was used in the current study. The participants of the study comprised 204 vocational college students, of whom 130 were first grade and enrolling Computer Literacy course, 74 were second grade taking a Computer Programming course during the first semester of the 2015-2016 Academic Year. As a data collection tool, the System Usability Scale (SUS), which was developed by Bangor et al. (2008) and adapted to Turkish by Çağıltay (2011), was used. This scale involves five positive and five negative statements on a 5-point Likert type scale and possible scores range from 0 to 100 where higher scores indicate better usability. Descriptive statistics and t-test were conducted to analyze quantitative data. The significance level was set at .05 in all analyses. Qualitative data were collected using open-ended questions related to usability of the assignment system and content analysis was run on qualitative data.

RESULTS AND FINDINGS

According to results of descriptive statistics, the mean of SUS score of all participants were 67.14 with a standard deviation of 17.95. The minimum SUS score was 15 while the maximum score was 100. Bargor et. al. (2008) states that any kind of product with a SUS score less than 50 is judged to be unacceptable, products with SUS score between 50 and 70 are marginally acceptable, and products with SUS score above 70 are passable. In current study, the mean SUS score of 67.14 reveals that online assignment system generally perceived to be marginal at best.

An independent-samples t test was conducted to compare SUS scores of first grade and second grade students as presented in Table 1. According to test results, there was no significant difference between first grade (M=68.32, SD=16.33) and second grade students (M=65.06, SD=20.43); t(202)= 1.249, p=0.213.

Table 1
Results of t-test and Descriptive Statistics for SUS Scores by Grade

	Grade									
	Freshmen Students			Sophomore Students			95% CI for Mean Difference			
	M	SD	n	M	SD	n		t	df	p
SUS Scores	68.32	16.33	130	65.06	20.43	74	-1.88, 8.40	1.249	202	0.213

p<.05

The results of the qualitative analysis showed that majority of the students reported positive attitudes towards the system, especially due to time and place flexibility provided for assignment submission. In addition, students considered the personal feedback provided for their assignments as valuable and students felt there was increased privacy when viewing grades online. On the contrary, students expressed concerns over the system due to absence of enough time and difficulty at having access to computers.

CONCLUSION

The purpose of this study was to investigate usability of web-based assignment system implemented in a vocational college for a Computer Literacy Course and Computer Programming Course. In addition, SUS scores of first and second grade students were compared. According to the results, web-based assignment system was found to be useful in terms of usability criteria presented by Bargor et al, 2008. However, no significant mean difference was detected between the SUS scores of first and second graders. The results of the qualitative analysis of those responses given to open-ended questions revealed that students enjoyed the system and instructor feedback had a motivating effect on their learning. This finding is consistent with other studies in literature which also indicated that students enjoy using online assignment system, prefer submitting assignments online, receiving feedback and viewing grades online (Palmer, 2005-2006, Buzzetto-More, 2008) On the other hand, students also had some difficulties due to absence of enough time and access to computers.

The results also showed that web-based assignments could be effectively used, but the ease of students' access to computers and the internet should be taken into account before utilization.

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THE USE OF EDIBLE SCIENCE PROJECTS IN TEACHING SCIENCE CONCEPTS

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ABSTRACT: Educators usually study the question of “how can we provide an easier and more permanent teaching?” As a solution to this problem they agree that activities which draw the attention of the students and which the students get pleased and entertained while doing enable the effective learning in teaching the concepts of science. In this regard project-based learning is one of the effective methods. However, it is not often preferred by the teachers due to the problems in the supply of materials and being long-term activities. Thus, primarily students were made to experience a scientific process by using the processes of project-based learning and a method which had an easy and cheap material supply was used in the study. By using the materials which everyone could buy easily and in a cheap price, senior students of Education Faculty were made to do edible projects. It has been observed that the students’ awareness for the concepts of science increased while the projects were being done and exhibited. It is quite important that these projects are introduced and published in order to popularise the use of such projects in all levels of teaching.

Key words: edible science projects, pre-service science teachers, science teaching

INTRODUCTION

While students have difficulty in learning some concepts of science, teachers also have difficulty in teaching them. In order to overcome these difficulties different teaching methods are tried for attaining success. While all educators aim to achieve an easier and more permanent learning, it is generally thought that activities which draw the attention of the student on one side and which the students are entertained with on the other side enable effective learning. It is emphasized in the constructive approach, which is the common education understanding today, that the students should actively be responsible for their own learning and actively participate in the class and the learning activities. In this regard, project-based teaching is one of the effective teaching methods. Project-based teaching method stands out as a teaching method which the students can use by bringing their previous knowledge together with the new knowledge and produce solutions to certain problems in this way. In the studies related to project-based teaching methods mostly results about the effectiveness of the method are reported (Morgil, Yılmaz and Cingör, 2002; Yavuz, 2006; Erdoğan, 2007; David, 2008; Keser, 2008; Erdoğan, 2012; Hung, Hwang and Huang, 2012; Tseng, Chang, Lou and Chen, 2013;Yılmaz, 2015; Han, Capraro and Capraro, 2015).

While the project is being implemented scientific method is used and the student drives conclusions as to how to solve a problem. However, it is not often preferred by the teachers because of the problems in the material supply and for being long-term studies. When the body of literature is examined, it is observed that there are various problems about project producing and that the teachers avoid using this method due to these problems. In this project it is attempted to introduce the projects related to the scientific concepts produced from edible ingredients as a project which the students and the teacher will want to eagerly implement and doesn’t require significant budget and time for finding the material and implementing the project. In this regard, edible science projects produced with the project-based learning method are examined in this study.

METHOD

Concretisation using project processes from edible ingredients is targeted in this study. For this target edible project samples are implemented on Science Education students in Teaching Technologies and Material Design class and these projects have been displayed.

Sample

The study group is consisted of 4 male and 26 female senior students studying in the department of Science Education at a government university in Istanbul. These students have studied in pair groups. A total of 15 project groups has been formed.

Study process

The study has been implemented in 2015-2016 fall term. Teaching Method and Material Design is a course taught in the last grade of Science Education department. This course taught by researchers consists of three stages. The course is taught under the titles of preparing and using classical course material in teaching, using technology in teaching and developing projects in teaching. For the third stage of the course the students are given a theoretical lesson about producing science project on scientific concepts and project-based teaching during two hours-lesson in the beginning of the term. In this study, teacher candidates have prepared science projects related to basic science topics by using completely edible ingredients. The aim in these projects has been determined as concretisation of especially the scientific concepts with which the students have difficulty in comprehending with the use of project processes within the teaching methods and material design class. ADDIE model from teaching design models has been used in the implementation of this study. ADDIE design model which is one of the anonymous models consists of analysis, development, application and assessment stages (Şimşek, 2009). Assessment possibility which is available in each of the stages in ADDIE model makes room for correction and fulfilment of mistakes and insufficiencies noticed in the process. Each group has prepared different numbers of projects according to the difficulty level of their projects. The following Table 1 shows the names and the fields of the selected projects.

Table 1. Project groups and subjects

Group	Project Name		Project Field
1	Plant Cell Model Skin Layers Model	 	Biology
2	German Cake Experiencing Meiosis		Biology
3	Atom models		Chemistry

4	Solar System Pasta		Astronomy
	Eye model Cake		Biology
5	The Phases of the Moon Cookie		Astronomy
	Life Cycle of the Butterfly		Biology
	Life Cycle of the Frog		Biology
6	Lungs Model cake		Biology
	Hand and Foot Skeleton Cookie	 	Biology
7	Edible RNA		Biology

	Edible Atom Model		Biology
8	Plant Cell Cake		Biology
	Cup Cake Scientific Concepts		Science
9	Candy DNA		Biology
	Brain Cake		Biology
10	Periodical Table Cake		Chemistry
11	Muffin Mitosis		Biology
	Animal Cell Cake		Biology

12	Chocolate Planets		Astronomy
	Animal Cell pizza		Biology
13	Plant Cell pizza		Biology
14	Animal Cell Cake		Biology
	Earth Crust Layers		Geology
15	Periodical Table Cookies		Chemistry

CONCLUSION

In this study, it has been targeted to show the teaching of scientific concepts with the use of science projects from easily found, cheap and edible ingredients by using project-based teaching processes compatible with the scientific process stages. For this purpose, education faculty senior students have been separated to pair groups and each group has prepared science projects using edible ingredients such as candy, cake, chocolate and pasta about a science subject that they have chosen and they have exhibited these projects. As a result of the study it can be said that the projects related to scientific concepts from edible ingredients have been successfully developed and that the students could complete the projects successfully in accordance with their purposes. The fact that this kind of projects can be prepared from edible ingredients which can be accessed easily and in a cheap way can be thought as a different project method. The students have chosen their project topics on their own and prepared their projects using different methods in consideration of their possibilities and situations. It has been observed that the female students generally prepared the ingredients on their own and the male students mostly preferred to use ready ingredients or had the material done by others. It can be asserted that such kind of projects challenges the imagination of the students and improves their creativity. It is observed that the motivations of the students increase with this kind of projects with reactions regarding their presentation of the projects and the following eating activity despite the small problems experienced during the preparation. One of the most striking results about edible projects is that the students not only use the scientific processes and challenges their creativity but also enjoy the project processes while trying to prepare edible projects as a solution to a problem. The presentation of projects and the following tasting of the projects and the comparisons made between the projects have added entertainment and excitement to the study. In conclusion, it can be said that the students have used scientific process skills, their scientific creativity has improved, their interest, curiosity and motivations have increased and especially that they have enjoyed while preparing the edible science projects. It has been observed that tasting the models that they have prepared following the presentation of the projects and sharing these with the other students have resulted in attracting more attention as compared to other projects. Also, there are many studies supporting this conclusion (Morgil, Yılmaz and Cingör, 2002; Yavuz, 2006; Erdoğan, 2007; Keser, 2008; Cam, 2013, Acaray, 2014; Han, Capraro and Capraro, 2015; Yılmaz, 2015).

This study is expected to contribute to the related literature and to be one of the first studies analysing the edible science projects as an innovative approach with the potential of being used as a teaching material as well as being one of the projects which the primary school students can prepare within the science class. The introduction and dissemination of these projects which are implemented for the increase of such kind of projects and their use in all grades of education are quite important.

It is thought that the dissemination of this kind of projects in all stages of education could revive and add entertainment to activities such as science festivals in the middle-schools and that they could increase interest, curiosity and motivation of the students.

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EFFECTS OF COURSE DELIVERY MODE ON STUDENTS SELF-REGULATION SKILLS

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ABSTRACT: With the development of internet and Learning Management Systems, owing to their flexibility in delivery and instant access features, more and more instructors have started to blend or flip their courses by using online learning technologies like videos, online homework, and e-exams. In online learning applications, learners are encouraged to acquire and build their knowledge through interaction with a wide range of resources. For students to gain experience, it is important that they get hands-on practice as well as use time effectively during class periods in courses like Computer Programming. Students equipped with self-regulation skills perform better in choosing learning methods appropriate for their learning pace, completing learning tasks, and achieving learning objectives. Furthermore, students with good self-regulation skills can improve their learning both in blended and flipped courses. Building on this point, this study aims to investigate differences between students' self-regulation skills in a blended and a flipped course. Based on online self-regulatory perspective, five properties were chosen to be notably considerable for blended and flipped courses: perceived self-efficacy, perceived anxiety, interactivity in the online learning environment, perceived satisfaction, and perceived usefulness. The participants were 192 sophomore students enrolling at Computer Programming Course in a vocational college during fall semester of 2015-2016 Academic Year. Data were collected via an online questionnaire. Independent samples t-test was conducted to examine differences in self-regulation skills of students in flipped and blended courses. Flipped course participants reported significantly higher levels of perceived anxiety with online learning environments while blended course participants reported significantly higher levels of perceived satisfaction, perceived usefulness and self-regulation. In this sense, it is assumed that flexible environment of flipped classrooms lead to higher anxiety levels and urges students to seek more instructor guidance.

Key words: flipped learning, blended learning, self-regulation

INTRODUCTION

The advancements in technology extend the boundaries of teaching and learning activities, diminish time and space limitations of traditional classrooms and create new course delivery modes like blended and flipped classrooms. Blended learning is described as a hybrid education program in which traditional and online educational methods (Owston, York & Murtha, 2013) are used and appropriate technology is utilized to administrate teaching (Osguthorpe & Graham, 2003). Blended learning offers many advantages to all members in an educational system like empowering efficient use of classroom space, enhancing adaptability of faculty members in their instructional processes, promoting active learning, increasing student satisfaction and giving responsibility to students on their own learning compared to solely face-to-face or web based classes (Vaughan, 2007). In a blended learning environment, course content is accessed any place via the Web and students can study at their own pace which plays critical role on level of learner satisfaction and achievement (Cigdem,2015).

One of the implementations of blended learning is flipped classroom. Although the term flipped classroom undergoes intense study, researchers and educators have different opinions about flipped learning environments. One of the most widely used descriptions of flipped class is that learning activities are done outside of class and assignments and applications are completed in class during instruction time (Bergmann & Sams, 2012). This approach combines face to face and web based learning modalities of teaching and learning.

In a flipped mode of instruction, students study the topic by themselves before the course meetings, especially using video lectures or presentations provided by the teacher. During lesson hour, students work through assignments or activities like quizzes, worksheets, reflective writing exercises in groups with peers and the instructor. Flipped classrooms make space for hands-on work and students apply the knowledge they gained before the class by solving problems and completing practical work. The teacher assists students whenever they need, rather than giving lectures to whole class.

As online learning environments such as blended and flipped classrooms become more user-centered, connected and ubiquitous, students are inevitably required to manage their own learning activities, which mean to become self-regulated (Artino, 2007). Despite opportunities provided by online learning modes of instruction like flipped and blended classrooms, there is limited research addressing factors affecting self-regulation behaviors of students in these learning contexts. The goal of the study was to answer the following research question: “Is there any significant difference in self-regulation skills of vocational college students enrolling in a flipped and a blended course?”

METHODS

In current study, SRL variables of a conceptual model developed by Liaw and Huang (2013) is used to identify factors affecting self-regulation behaviors of students in a Computer Programming Course offered in both blended and flipped mode. According to Liaw and Huang (2013), learner self-regulation, as a dependent factor, could be predicted by independent factors comprising perceived self-efficacy (PSE), perceived anxiety (PA), and interactivity in online learning environment (IOL), perceived satisfaction (PS), and perceived usefulness (PU).

Convenient sampling method was used in the study. The sample chosen for the study comprised 192 vocational college students from Electronic and Communication Technologies Department enrolling at a Computer Programming Course during the first semester of the 2015-2016 academic year, 103 of whom formed the blended learning group and 89 the flipped learning group. The study was conducted in Computer Programming Course, a must course in Electronics and Communication Technologies Department, in which lecturer provided lecture notes, presentations, code samples, and instructional videos related to “variables, if-else statements and loops” over the intranet on MOODLE.

In the blended mode, students were introduced to topic of the week. After the lecture, students created C# projects in computer labs. At the end of each session, a short summary of the topic and feedback related to common errors were provided to students. In flipped mode, the lecturer tried to activate student responsibility for learning, by asking them to “discover” or “construct” necessary information on their own. Before course meetings, students studied the lecture notes of the week and watched the related videos. During the class hours, students created C# projects and provided feedback if necessary.

Independent sample t-test was used to detect whether there were any differences on the basis of course delivery mode related to online self-regulation skills of students. The significance level was set at .05 in all analyses.

RESULTS AND FINDINGS

Mean values, standard deviations and Cronbach's Alpha of the Online Learning Self-Regulation (OLRS) subscales are presented in Table 1.

Table 1. Descriptive Results of OLRS Subscales

Subscales	N	Items	X	sd	Cronbach's Alpha
PSE	192	4	4,13	,059	0.834
PA	192	4	1,73	,062	0.873
IOL	192	6	3,71	,060	0.835
PS	192	5	3,49	,059	0.818
PU	192	6	3,85	,061	0.933
LSR	192	5	3,74	,066	0.910

Table 2 presents the t-test results applied to all sub-scales. As can be seen, vocational college students’ level of online self-regulation skills showed significant differences based on course delivery mode in PA, PS, PU and LSR sub-scales.

Table 2. t-test Results of OLRS Regarding Course Delivery Mode

Subscales	Course Delivery Mode	N	X	sd	t	p
PSE	Blended	103	4,22	,717	1.901	.059
	Flipped	89	4,00	,932		
PA	Blended	103	1,60	,741	-2.369	.019
	Flipped	89	1,90	,998		
IOL	Blended	103	3,79	,779	1.639	.103
	Flipped	89	3,59	,891		
PS	Blended	103	3,62	,816	2.451	.015
	Flipped	89	3,33	,806		
PU	Blended	103	3,99	,841	2.613	.010
	Flipped	89	3,67	,828		
LSR	Blended	103	3,88	,834	2.621	.009
	Flipped	89	3,54	,989		

CONCLUSION

Flipped course participants reported significantly higher levels of PA with online learning environments while blended course participants reported significantly higher levels of PS, PU and LSR. This could partly be adhered to students' first impact with a flipped class and their lack self-study skills. Having had the traditional education through their school years, the students are not used to the idea of teacher as a facilitator; he or she must explain while students listen. The results about blended learning's significant impact on PS, PU and LSR could be explained by the fact that the instructor presented the subject and guided the students on their studies during class hours.

RECOMMENDATIONS

In this sense, it is assumed that flexible environment of flipped classrooms lead to higher anxiety levels and urges students to seek more instructor guidance. Hence, it is important that students should be informed about the teaching method in the first place and they should be granted more responsibility on classroom work.

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SCIENTIFIC COLLABORATION NETWORK OF ACADEMICIANS IN METU

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ABSTRACT: Scientific collaboration networks (SCNs) are web-like structures generated by collaborating patterns between scientists. Every co-authoring activity corresponds to a link between authors in such a network. Being successful prototypes of evolving complex networks, SCNs display the generic properties of self-organizing structures including social networks, in an aspect mirroring the scientific activities of the authors also. Collecting the scientific collaboration data of Middle East Technical University (METU) from Web of Science, we constructed a SCN spanning the years 1980 to 2015. Performing the network analysis procedures, we calculated the network parameters like average separation, average degree, degree distribution, average clustering coefficient etc. We outlined that the SCN of METU shows small-world and scale-free properties, also having high clustering between scientists.

Key words: Complex networks, scientific collaboration networks, scale-free networks, small-world.

INTRODUCTION

Studying scientific collaboration actions as a complex network provides broader understanding to the interactions between scientists (Newman, 2004). These networks are also good prototypes of self-organizing systems, with high resemblance in underlying organizing principles (Barabasi et al., 2002). The main motivations of scientific collaboration network (SCN) studies are both uncovering the evolving self-organizing principles in time, and also uncovering the bibliographic relations between scientists (Cavusoglu & Turker, 2013). By this view, the tools of network science empower the studies in bibliographic evolution (Wagner & Leydesdorff, 2005).

The advantages of studying SCNs as a complex network is first, they are evolving systems that are expanded by the addition of new authors, and also the establishment of new links between the existing authors. This evolution in time is successfully captured by the publication based storage of scientific papers in the databases like ISI Web of Science, Scopus etc. The second engaging property of these networks are that they are governed by the preferences of the nodes (authors), to publish a paper with another one, purely with their own choices.

Complex systems like SCNs are converted into networks by considering the authors as nodes, while the collaborations of these authors in a particular research paper define the links (Barabasi & Albert, 1999). SCNs display the universal properties like being *small-world* or *scale-free*. Small world property means, despite having numerous nodes, a short path from one node to another can be found and this situation is valid for the majority of the network (Watts & Strogatz, 1998). Scale-free stands for the network topology that the degree distribution is consistent with power-law decay (Albert & Barabasi, 2002; Amaral, Scala, Barthelemy, & Stanley, 2000; Clauset, Shalizi, & Newman, 2009; Virkar & Clauset, 2014). The degree of a node means the number of distinct neighbors it has. The distribution of node degrees in the whole network define the degree distribution, defining the interconnection characteristics of the network.

Together with these universal properties observed in many real networks like biological systems, neural networks, computer networks, power grid networks, linguistic networks, social networks etc., SCNs display resemblance in the other network parameters like clustering and preferential attachment. Clustering means that your neighbors (or collaborators in a SCN) are also neighbors of each other. Preferential attachment means a node just attached to the network prefers to attach the more popular nodes (i.e. nodes having more neighbors, more degree), resulting power-law degree distribution.

The common properties mentioned above emerge in not only the SCN studies in distinct disciplines like engineering, mathematics, physics, surgery etc., but also in interdisciplinary studies (Barabasi & Albert, 1999;

Barabasi et al., 2002; Cavusoglu & Turker, 2013, 2014; Luzar, Levnajic, Povh, & Perc, 2014; Newman, 2001a, 2001b, 2001c, 2004). Nationwide or international analysis are also performed by several scientists (Cavusoglu & Turker, 2013; Ferligoj, Kronegger, Mali, Snijders, & Doreian, 2015; Hoekman, Frenken, & Tijssen, 2010; Luzar et al., 2014; Ma, Fang, Pang, & Li, 2014; Perc, 2010).

This study mainly focuses on uncovering the network characteristics of scientists in Middle East Technical University (METU), as a leading university of Turkey in scientific productivity. For the timespan we investigate, METU is the second leading university with 21,663 publications, just coming after the most productive Hacettepe University with 24,093 publications. The 3, 4 and 5th most productive universities are İstanbul Technical University (19,305 publications), Ankara University (19,039 publications) and Gazi University (18,026 publications) respectively. On the other hand, METU can be evaluated as the most productive, among the universities that do not have department of medical sciences.

METHODS AND RESULTS

We constructed the co-authorship network of METU researchers using ISI Web of Science Data, collected from the online search interface. We used a filtering constraint to achieve the publications addressed to Turkey, starting from the year 1980 to 2015. We also filtered the results in basis of institution to achieve the publications collaborated by METU researchers. We used the cumulative downloading utility of Web of Science to achieve the data in sets of 500 publications' data in each bin.

We constructed the *nodes* (composed of authors) and *edges* (composed of collaboration links) tables where each collaboration pair in a scientific paper results an undirected link between the two authors. We performed the network analysis in Gephi, a tool for complex network analysis and visualization (Bastian, Heymann, & Jacomy, 2009). The results of network analysis are presented and discussed in this section.

This study mainly focuses on uncovering the network characteristics of scientists in Middle East Technical University (METU), as a leading university of Turkey in scientific productivity. For the time span we investigate, METU is the second leading university with 21,663 publications, just coming after the most productive Hacettepe University with 24,093 publications. The 3, 4 and 5th most productive universities are İstanbul Technical University (19,305 publications), Ankara University (19,039 publications) and Gazi University (18,026 publications) respectively.

The linking procedure works as follows: If authors A, B and C write a paper together, we define links between A-B, A-C and also B-C. By the way, we achieved 15,413 authors (nodes) and 101,139 links between these authors. We also captured the time the paper is published, so we had the opportunity to study the time evolution of the network parameters.

We start with presenting the most productive researchers of our network in Table 1. The leading academicians have stunning degrees indicating their productive role in Turkish science literature.

Table 1. Top 30 most productive researchers of METU SCN.

Name	Degree	Weighted Degree
Toppare, Levent	351	1296
Turan, Rasit	277	588
Demir, Ayhan	273	516
Oguz, Temel	257	351
Hasirci, Vasif	250	486
Ozkar, Saim	207	470
Hasirci, Nesrin	206	388
Zeyrek, M.	192	349
Severcan, Feride	179	357
Gunduz, Ufuk	171	444
Korkusuz, Feza	170	296
Yilmaz, Akif	162	255
Sever, Ramazan	162	341
Kiziloglu, U.	161	383
Beklioglu, Meryem	158	237
Sahin, Ertan	156	262

Ozsoy, Emin	154	210
Molnar, J.	153	268
Yalciner, Ahmet Cevdet	145	200
Balci, Metin	144	365
Turker, Lemi	140	331
Weber, Gerhard-Wilhelm	138	215
Tuncel, Gurdal	138	265
Kence, Aykut	136	186
Van den Bleeken, Dieter	133	171
Goncuoglu, M. Cemal	124	203
Yucel, M.	124	349
Ataman, O. Yavuz	124	234
Lin, Shangchao	122	321
Kideys, Ahmet	121	189

We also evaluated the time evolving characteristics of the basic network metrics as in Table 2. These metrics are separately visualized in Figures 1 to 4.

Table 2. Time Evolution of Basic Network Parameters.

	Avg. Degree	Avg. Weig.Deg.	Diameter	Modularity	Avg. Clust.Coef.	Avg. Path Length
1990	0,166	0,389	24	0,88	0,805	8,388
1991	0,197	0,464	25	0,887	0,801	7,719
1992	0,28	0,655	21	0,893	0,808	7,671
1993	0,311	0,74	21	0,896	0,8	7,159
1994	0,382	0,916	23	0,905	0,794	7,119
1995	0,427	1,044	21	0,911	0,8	6,922
1996	0,481	1,184	21	0,915	0,798	6,888
1997	0,615	1,487	23	0,91	0,798	7,014
1998	0,691	1,803	21	0,9	0,796	6,487
1999	0,775	2,031	21	0,901	0,799	6,454
2000	0,886	2,316	21	0,906	0,802	6,441
2001	0,99	2,617	22	0,909	0,805	6,422
2002	1,077	2,901	21	0,909	0,805	6,354
2003	1,177	3,192	20	0,904	0,805	6,145
2004	1,37	3,731	19	0,901	0,808	6,046
2005	1,554	4,232	18	0,901	0,811	5,88
2006	1,789	5,024	18	0,899	0,811	5,773
2007	2,125	5,955	19	0,896	0,811	5,654
2008	2,322	6,542	17	0,893	0,809	5,533
2009	2,58	7,294	16	0,89	0,808	5,476
2010	2,949	8,364	16	0,89	0,809	5,391
2011	3,315	9,38	16	0,886	0,81	5,297
2012	3,63	10,3	15	0,882	0,811	5,227
2013	4,143	11,645	15	0,881	0,813	5,154
2014	4,577	12,83	15	0,877	0,811	5,084
2015	4,689	13,12	15	0,876	0,811	5,066

Average Degree

An evolving network grows with the addition of new nodes and links in time. Average degree ‹k› is a quantity that measures the number of links per author (Barabasi et al., 2002). It is a measure of how many collaborators the authors have in average, indicating the networks interconnectedness also.

We present the time dependency of average degree ‹k› in Fig.1, together with the weighted degree values that is effected by the duplicating connections to existing authors. The weighted degree values are 3 times the unweighted degrees, indicating that the existing links in the network are ~3 times repeated in average. The increasing trend of the average degrees together with the weighted degrees in Fig.1A indicate that the growth rate is faster than linear. The right side figure (Fig.1B) is the "semilogy" plot of the same data, having linear x and logarithmic y axis. A straight line in this axis combination indicates that the growth rate is exponential.

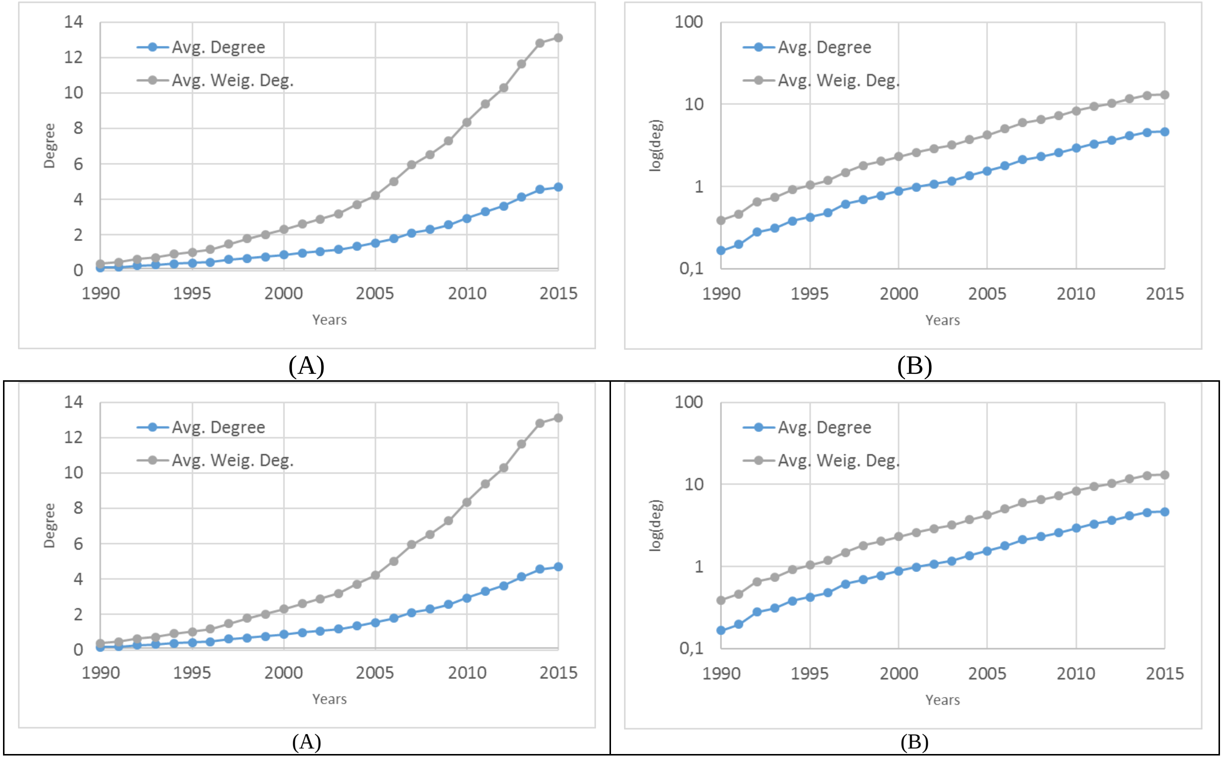


Figure 1. Average Degree and Weighted Degree in Years, (A) Linear Scale, (B) Log-Linear Scale

Average Clustering Coefficient and Modularity

The clustering coefficient evaluates how much a node's collaborators are willing to collaborate with each other. representing the probability that two of its collaborators wrote a paper together (Barabasi et al., 2002). Modularity is a measure for detecting the community structure in networks, indicating the rate of densely interconnected groups of nodes, having sparse connections to the other groups (Leicht & Newman, 2008). Both metrics have values in a range of 0 to 1. High clustering and modularity is an expected output of real networks.

Our scientific collaboration network displays high clustering and modularity features as presented in Fig. 2. The clustering seems to be nearly constant around 0.8. High clustering is an expected output of social based networks like SCNs (Newman, 2001c). Similarly, the real networks display modular structures, being divided into modules that are strongly interconnected but having rare connections to the other modules. The modularity values around 0.9 indicate that the network is highly modular. This indicates that the researchers tend to collaborate within their cliques with high modularity and clustering.

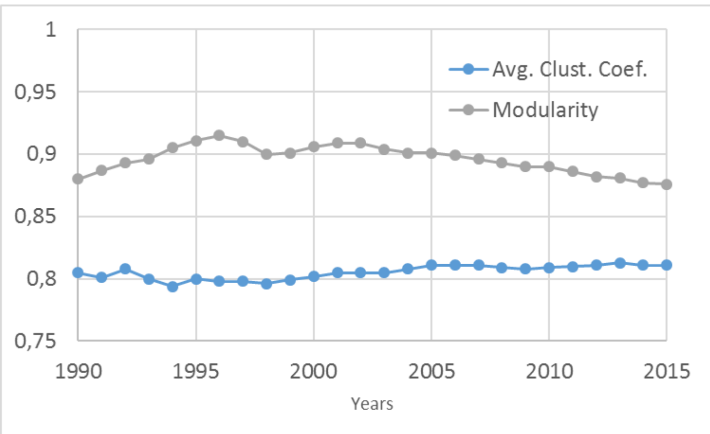


Figure 2. Clustering Coefficient and Modularity in Years

Average Path Length and Diameter

Average path length for a natwork is the mean number of edges along the shortest paths connecting the node pairs. Real networks display relatively short average path length values, that is also known as "small-world phenomenon" in the literature (Albert & Barabasi, 2002). The diameter of the network is the longest of these shortest paths, indicating that the maximum number of links from the most distant edges of the network. The evolution of these metrics are presented in Fig.3.

The average path length seems to converge about 5, consistent with the "six degrees of separation" phenomenon that is used for the "small-world" networks with small distances between nodes (Milgram, 1967; Watts & Strogatz, 1998). The resulting diameter 15 is also relatively small for a large-scale network having ~15 thousand nodes. All these outputs show that the network displays small-world properties.

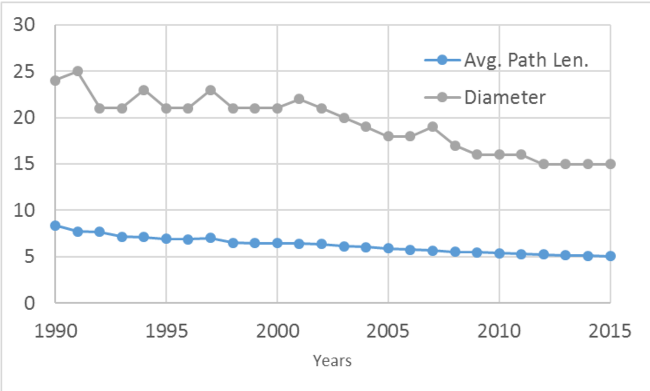
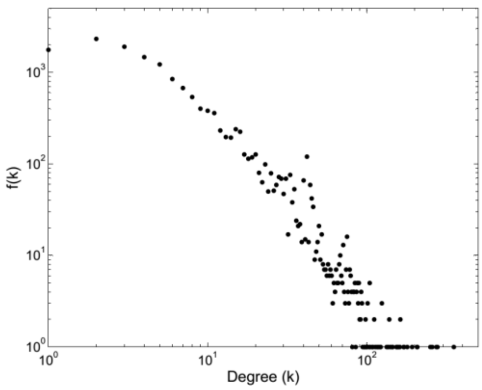


Figure 3. Average Path Length and Diameter in Years

Degree Distribution

Degree distribution *p(k)* is a probability distribution function of a randomly selected node to have k links. Networks having *p(k)* consistent with a power-law tail, are labelled as scale-free networks (Barabasi & Albert, 1999; Barabasi et al., 2002; Newman, 2003). Real networks are generally stated out to be scale-free. The degree distribution graph for the METU SCN is presented in Fig.4. The left side plot shows the frequency values for the degree occurrences, while the right side plot is log-binned and normalized probability distribution achieved from the same data.

The degree distribution in Fig.4B displays two discrete power-law consistent regimes having slopes of -1.8 and -3.5 respectively. These values are also consistent with the previous SCN studies (Barabasi et al., 2002; Cavusoglu & Turker, 2013, 2014; Newman, 2001a). The power-law consistency of degree distribution labels the network as scale-free. A scale-free network is generated with a critical ingredient, preferential attachment. It means that a node tends to connect with the other nodes with higher degrees more likely than the low degree ones (Vazquez, 2003). As a result, we can conclude that preferential attachment is the ingredient of the METU SCN also.



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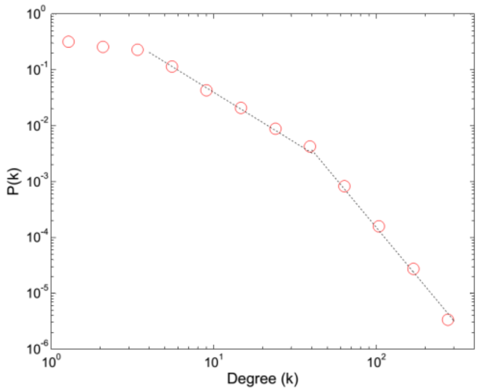

B

Figure 4. (A) Degree Occurrence Frequencies (B) Degree Distribution plots for the METU SCN.

CONCLUSION

The METU SCN displays the generic properties of the SCNs analyzed in the recent studies. It is small-world, having small node-to-node distances compared to a random network. It is scale-free, having a power-law consistent degree distribution. It shows very high clustering and modularity metrics indicating that scientists tend to form micro cliques within their first neighbors, and also mid-sized cliques within their research groups. The growing rate is observed as exponential, with regard to the linear increasing trend of average degrees in log-linear plot.

The SCN of METU has promoted some super-nodes having degrees of 2 or 3 hundreds, as a generic ingredient of scale-free networks. These hub-like scientists also take the role of percolating the network and providing a superior robustness (Barabási, 2016).

According to the METU official website, the university employs about 791 faculty members (professors, associates professors etc.), 225 academic instructors and 1.273 research assistants (METU, 2016). According to this data, there are 2289 academicians in METU. The METU SCN consists of 15,413 authors, approximately 6.7 times the number of academicians. Taking the past academicians of METU into account, we can say that this rate should be ~5 times the academicians that have been employed in METU up to 2015. If validated with the real data of past academicians count, this number can be considered as the attractiveness coefficient of the METU researchers for the non-METU researchers that are introduced to the METU SCN by collaborating with them.

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BRING COSMOS INTO THE CLASSROOM: 3D HOLOGRAM

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ABSTRACT: Three-dimensional structures of heavenly bodies and the fact that people make observations about universe only from their vantage point on Earth make difficult to understand astronomy concepts. Basic astronomy concepts such as shapes, sizes, distances and celestial motion contain spatial thinking ability. The students who lack spatial thinking ability have difficulties to constitute these concepts in their mind. Consequently, the necessity of using different learning environments and materials supported by technology is showed up. Beyond using available instructional materials, creating their own materials not only provides students with accessing to more knowledge through research but also fosters their thinking ability with variables. Concordantly, current study aims to give an artifact implementation example designed three-dimensional hologram mechanism with simple materials oriented teaching basic astronomy topics. Hologram mechanism consists of a truncated-pyramid shaped reflector made of transparent and hard material, a video about astronomy and a screen. The study group consists of volunteer prospective science teachers (N=15) in a Western Anatolian University. The research aim is not only to create permanent artifacts but also support prospective teachers' thinking and problem solving skills using mental processes. The activity is enabled to use participants' engineering and mathematic skills with designing hologram device and technologic tools via video making process. Implementations conducted with by six weekly workshops that each one takes about two hours. Participants created a permanent artifact with activity. Researcher notes and artifact assessment form were used as data collection tools. Prospective teachers' astronomy interests were supported and their astronomy knowledge increased by the artifacts designed by them. Moreover, they have begun developing spatial thinking abilities with moving and three-dimensional model which assists them to perceive depth phenomenon in universe. They experience artifact design process at firsthand and find solutions to encountered problems. Participants learned how to create a three-dimensional model. Furthermore, the activity provides opportunity to use science, technology, engineering and mathematic related skills.

Key words: Astronomy teaching, artifacts, 3D hologram

INTRODUCTION

Main subject of astronomy is celestial objects. When people look at the night sky they observe stars only located in Milky Way galaxy. Beyond that had been mysterious for thousands years due to human observation limit. First observation of extragalactic objects made by Edwin Hubble using a large telescope in 1922-1923. Considering this dates, we are at the beginning of our cosmic journey compare with the emerge of mankind. Humans still struggle to make sense of what's out there in the Universe which lies beyond the limits of even our most powerful telescopes (Siegel, 2015). By nature of the fascinating topics it encompasses, astronomy awakens a great deal of curiosity. People are fascinated to understand different astronomy topics such as day and night cycle, Lunar phases, meteor showers and eclipses.

People make observation about celestial bodies only from their vantage point on Earth. Celestial objects are so far away from earth and it does not allow people to create depth perception. We perceive heavenly objects in the sky as if they are moving in a two dimensional plane. Besides, astronomy contains three-dimensional concepts. It is hard to understand celestial events such as moon phases, eclipses and oppositions without using three-dimensional thinking and three-dimensional geometry. Spatial thinking ability which means rotating and inverting objects in 3D when they are presented graphically in 2D have a major role learning three-dimensional concepts (Barnea and Dori, 1999). Earth-bound observations and lack of spatial thinking ability usually pose problems understand of astronomy topics (Arny, 1994; Barnea and Dori, 1999; Padalkar and Ramadas, 2011). Therefore, students find hard to understand astronomy topics as a school subjects (Yair, Schur and Mintz, 2003; Plummer, Kocareli and Slagle, 2014). In this case, using different learning environments and materials supported by technology are effective for students to enhance astronomy knowledge and to support their astronomy interest (Bakas and Mikropoulos, 2003; Mulholland and Ginns, 2008; Küçüközer, Korkusuz and Küçüközer, 2009; Uçar and Demircioğlu, 2011). Inquiry-based teaching and hands-on activities are more effective than the classical lecture-textbook approach for astronomy education from elementary to university (Percy, 2006). Within this context, beyond using available instructional materials, creating materials by student provides them accessing to more knowledge through research and fosters students thinking ability with variables. Concordantly, purpose of the study is to conduct with an artifact-based activity with designing a three-dimensional hologram assembly.

METHODS

Description of the Study

This study aims to give an artifact implementation example designed three-dimensional hologram mechanism with simple materials oriented teaching basic astronomy topics. The research aim is not only to create permanent artifacts but also support prospective teachers' thinking and problem solving skills using mental processes. The participants comprise volunteer third-year prospective science teachers in a Western Anatolian University. Total number of participants is 15 (N=11 female; N=4 male). Hologram mechanism consists of a truncated-pyramid shaped reflector made of transparent and hard material, a video about astronomy and a screen. The activity is enabled to use participants' engineering and mathematic skills with designing hologram device and technologic tools via video making process. Participants created a permanent artifact with activity Data were collected for the research through researcher notes using for process evaluation and artifact assessment form using for outcome evaluation. Hologram assembly assessment form (see app. 1) developed based upon thermometer assessment form (Oğuz Ünver, 2015). The form consist of three main part which are video, reflector and design and functionality of the hologram assembly. The researcher notes used to understand effectiveness of the activities. Researcher notes takes within the scope of three main questions: *"What are difficulties for participant during activities?" "Which skills are used by participant?" "How do activities affect participants' astronomy interest?* Implementations conducted with by six weekly guided workshops that each one takes about two hours. (see **figure 1**).

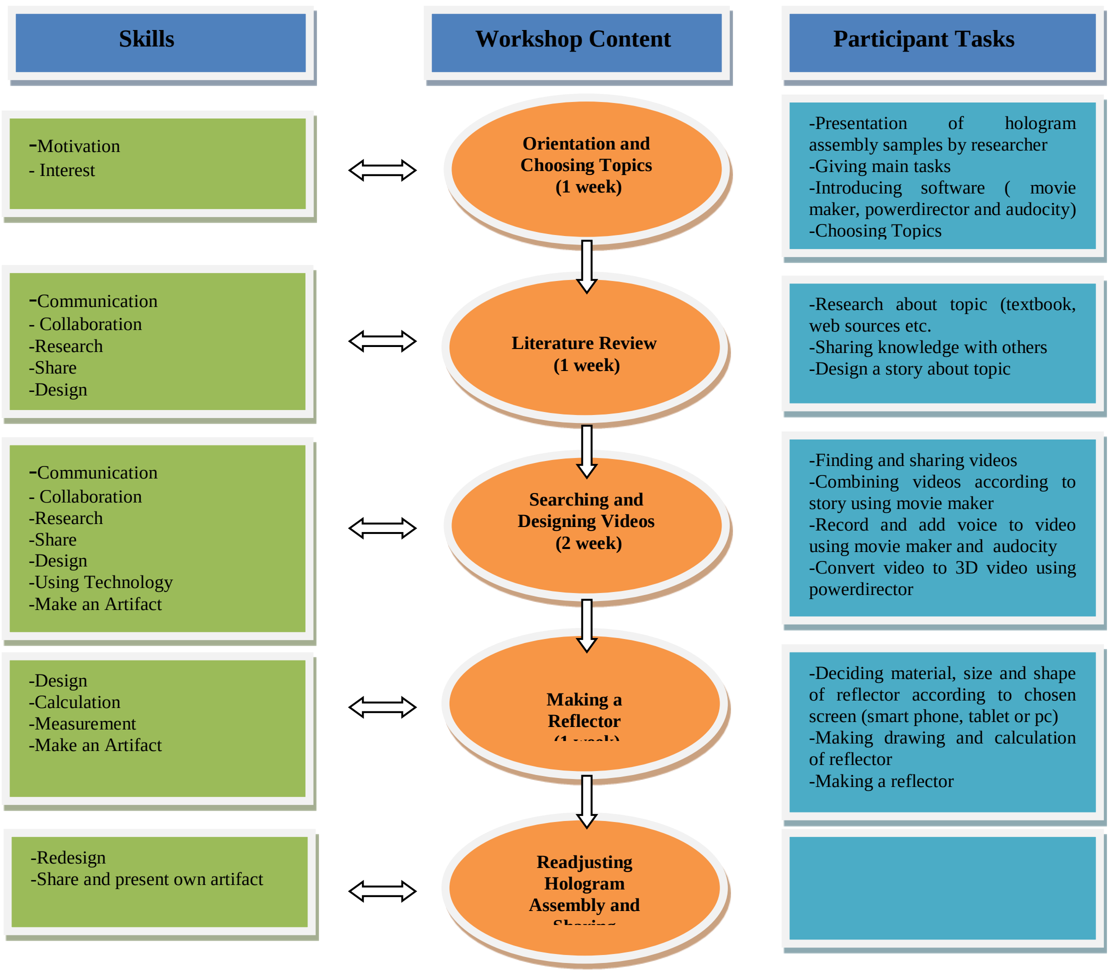

Figure 1. Skills, workshop content and participant tasks during the implementation

Implementations consist of five steps which are orientation and choosing topics, literature review, searching and designing videos, making a reflector and readjusting hologram assembly and sharing. Each workshop provides participants to share their knowledge, skills and experience and to do their tasks collaboratively. During workshops researchers guide participants in different ways such as the define order of tasks, lead to participants determining knowledge and scientific knowledge and motivating them to difficult problem. The workshops support participants individual and group skills such as interest, sharing knowledge and collaboration. The primary aim of workshops are not produce the artifacts, they aim to create an collaborative and inspirational learning environment which constitutes peer learning. One of hologram assembly sample created by a participant shown **figure 2.**

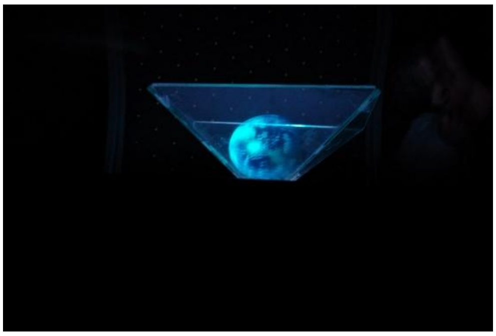

Figure 2. Hologram assembly sample-rotation of the earth

The quantitative data obtained from hologram assembly assessment form analyzed with descriptive statistics. The qualitative data obtained from researcher notes analyze via content analyses by two researchers.

RESULTS AND FINDINGS

The findings of the research are presented as quantitative and qualitative results. The finding of artifact assessment form using for outcome evaluation is shown **Table 1.**

Table 1. Descriptive statistics obtained from artifact assessment form (N=15)

Video			
Topic of video	Black Holes, The Sun, Artificial Satellites, The Milky Way Galaxy, The Seasons, Galileo Galilei, Lunar Phases, The Formation of Moon, Known Universe, Jupiter and Moons, Day and Night Cycle, Light, Universe Models and Rotation of the Earth (N-15)		
Length of videos	Change between 2,16 and 6,15 minutes		
Video contains scientific knowledge	N=12 (Yes)	N=3 (Partly)	N=0 (No)
Appropriate display screen	Smart Phone (N=6), Tablet (N=3), PC (N=6)		
Video contains depth perception	N=15 (Yes)		N=0 (No)
Video contains voice	N=15 (Yes)		N=0 (No)
Video is well fictionalized	N=9 (Yes)	N=3 (Partly)	N=3 (No)
Video quality	N=0 (Low)	N=2 (Medium)	N=13 (High)
Recording format	MP4 (N=13), AVI (N=1), WMV (N=1)		
Hologram Reflector			
Material of hologram reflector	Glass (N=3), Hard Plastic (N=3), Acetate Paper (N=9)		
Hologram reflector is portable	N=15 (Yes)		N=0 (No)
Size of hologram reflector	Change between 3 and 13 cm (high)		
Number of hologram reflector' faces	4 faces (N=15)		
Hologram reflector is symmetrical	N=14 (Yes)		N=1 (No)
Hologram reflector works well	N=14 (Yes)		N=1 (No)
Hologram reflector is transparent	N=15 (Yes)		N=0 (No)
Hologram reflector uses easily	N=12 (Yes)		N=3 (No)
Hologram reflector is durable	N=12 (Yes)		N=3 (No)
Design and Functionality of The Hologram Assembly			
Hologram assembly has low cost	N=12 (Yes)		N=3 (No)
Hologram assembly can use easily	N=15 (Yes)		N=0 (No)
Hologram assembly can use by independent user	N=15 (Yes)		N=0 (No)
Hologram assembly is interesting	N=15 (Yes)		N=0 (No)
Hologram assembly can set up easily	N=15 (Yes)		N=0 (No)
Hologram assembly can store easily	N=9 (Yes)		N=6 (No)
Hologram assembly has long shelter life	N=15 (Yes)		N=0 (No)

As seen Table 1., hologram assembles evaluated in three main themes. The video theme contains content and features of videos . Topics of videos are black holes, the sun, artificial satellites, the milky way galaxy, the seasons, Galileo Galilei, lunar phases, the formation of moon, known universe, Jupiter and moons, day and night cycle, light, universe models and rotation of the earth. There of videos has partly scientific content. The videos are different length between 2,16 and 6,15 minutes and suitable for different display screens. All of videos have depth perception which means background of video is black and contain voice recorded by participants about the relevant astronomy topic. Nine of videos is well fictionalized which means the video has appropriate content knowledge and story. Generally, the videos have high qualities and in MP4 format. Hologram reflector theme is about the features of reflector. Generally, the participants used acetate papers as material. It is flexible and easy to make reflector. Rest of them used glass and hard plastic (CD case). Relatively, this materials are fragile and hard to cut. All of reflector are portable, transparent and has four faces. Sizes of reflectors changes between 3 and 13 cm (high) according to suitable screen. Generally, reflectors are symmetrical, work well, use easily and durable because of used acetate papers. Last evaluation them is design and functionality of the hologram assembly that contains seven criteria. These criteria include the general features an artifact. All of assembles can use easily and set up by independent user. All of them are interesting, can set up easily and has long shelter life. Because of used materials, glass and hard plastic reflectors are fragile, do not fold and have high price.

The qualitative findings obtained from researcher notes were classified in terms of the three basic categories which are difficulties, used skills and astronomy interest. A part of participants' research about selected topic contains web sources. Most of the participants do not distinguish knowledge and scientific knowledge due to being away from the nature of science especially in astronomy and astrology topics. They could not internalize the criteria of scientific knowledge despite being third grade prospective science teacher. Some of participants don't have qualifications and interests for technology. They find hard to make hologram assembly especially in video process. But, participants share their knowledge, experiences and skills during workshops. That allows to peer learning and learned with mistakes. They improve to use technology skills. One of participant emphasized that with fallowing statement. *"At first, finding videos and combining them were very hard. But now, I can use movie maker, powerdirector and audocity software. It is easy to make video in 3D. I can prepare it in a short time. I will create a hologram about biology (Participant 4)".* Also participants have lack of measurement and calculation skills (e.g. using ruler, angels etc). Some participant statement emphasize astronomy interest: "*When I searching for universe I found Cosmos series. It is very fascinating. I almost watch all episodes (Participant 7)".*

CONCLUSION

The current study allow prospective teacher to create their own artifacts using technology, mathematic and engineer skills about an astronomy topic. Prospective teachers created permanent artifacts and their thinking and problem solving skills support using mental processes to find solutions to encountered problems. Also, activity support spatial thinking abilities with moving and three-dimensional model which assists them to perceive depth phenomenon in universe. The activity is enabled to use participants' engineering and mathematic skills with designing hologram device and technologic tools via video making process. Participants learned how to create a three-dimensional model. Prospective teachers' astronomy interests were supported and their astronomy knowledge fostered by the products designed by them. A specific artifact assessment form sample for hologram assembly were developed. Prospective teachers experienced product design process at firsthand.

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APPENDIX

Appendix 1. Hologram Assembly Assessment Form

Video			
Topic of video			
Length of video			
Video contains scientific knowledge	**Yes**	**Partly**	**No**
Appropriate display screen			
Video contains depth perception	**Yes**	**No**	
Video contains voice	**Yes**	**No**	
Video is well fictionalized	**Yes**	**Partly**	**No**
Video quality	**Low**	**Medium**	**High**
Recording format			
Hologram Reflector			
Material of hologram reflector			
Hologram reflector is portable	**Yes**	**No**	
Size of hologram reflector			
Number of hologram reflector' faces			
Hologram reflector is symmetrical	**Yes**	**No**	
Hologram reflector works well	**Yes**	**No**	
Hologram reflector is transparent	**Yes**	**No**	
Hologram reflector uses easily	**Yes**	**No**	
Hologram reflector is durable	**Yes**	**No**	
Design and Functionality of The Hologram Assembly			
Hologram assembly has low cost	**Yes**	**No**	
Hologram assembly can use easily	**Yes**	**No**	
Hologram assembly can use by independent user	**Yes**	**No**	
Hologram assembly is interesting	**Yes**	**No**	
Hologram assembly can set up easily	**Yes**	**No**	
Hologram assembly can store easily	**Yes**	**No**	
Hologram assembly has long shelter life	**Yes**	**No**	

INTEGRATING STEM INTO EARLY CHILDHOOD EDUCATION: IS IT FEASIBLE?

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ABSTRACT: This paper aims to determine the feasibility of integrating STEM into the early childhood education. As such, a survey design was deemed appropriate. Purposive sampling technique was used in which 22 early childhood teachers from 19 urban and rural childcare centres in Malaysia were selected for this study. These 22 early childhood teachers were familiarised to the use of **P**roblem-Based **I**nquiry **L**earning (PIL) in integrating STEM by means of 10 authors-developed STEM Projects through a three-day fully residential training workshop. Upon the completion of the training workshop, the teachers were supported in integrating STEM in their respective classrooms for five-month duration during which, an implementation of a maximum of five STEM Projects was aspired. Two sources of data were gathered from the teachers to determine the suitability of STEM integration in early childhood education: (1) at the end of the training workshop where teachers reported on the suitability of the STEM Projects for early childhood pupils aged 3 to 4+, and (2) at the end of the five-month classroom implementation where teachers reported on the STEM Projects which they have carried out with their 3-4+ year-old children. Findings indicated that, while two of the 10 STEM Projects were perceived as less appropriate by at least 50% of the teachers, eight other STEM Projects were deemed as appropriate. The actual implementation of STEM Projects among the teachers ranges between 60% to 100%, with a mean of 81%. This paper ends with a discussion on the characteristics of the appropriate STEM projects for 3 to 4+ year olds, and equally, implications for STEM education are proffered.

Key words: project-based inquiry learning, STEM education, early childhood education

INTRODUCTION

Given the importance of science education in meeting the challenges and demands of our present and future economy, Malaysian government instituted the 60:40 Policy in 1967 -- 60% of students participating in Science/Technical while 40% in Arts. This is crucial because the National Council for Scientific Research and Development estimates that Malaysia needs 493,830 scientists and engineers by 2020 (Azian, 2015). Nevertheless, such aspired ratio has just yet to be met. Statistics indicate that, as of 2014, only about 45% of students graduated from the higher secondary schools were from the Science stream, including technical and vocational programmes. Moreover, the percentage of secondary school students who chose not to pursue the Science stream despite meeting the requirement based on their Form 3 National Standardised Examination (PMR) had increased to approximately 15% (Azian, 2015).

The dismal uptake of science-based subjects is rather pervasive across the globe. Taking United States of America (USA), for example, the National Science Board [NSB] (2010) reports that the numbers of USA high school graduates choosing to pursue a STEM-related field has declined steadily. In overcoming such decline, the NSB (2010) recommends that research-based STEM preparation should be provided for general education (elementary) teachers in the area of pre-service training and professional development, and that early exposure to STEM opportunities and the opportunity for students to engage in inquiry-based learning should also be provided to all students. Hence the current interest in promoting STEM (Science, Technology, Engineering, and Mathematics) which was introduced by the National Science Foundation (NSF) in the 1990s (Bybee, 2013).

Research indicates that the development of science talent begins in the early years and as such, the science proneness among children could be nurtured through inquiry-based learning in the classroom (Brandwein, 1995). Keeley (2009) lends further credence by stressing the importance of science in the early grades to maximize the cumulative learning processes involved in developing science talent and argues that if children are not given an early exposure to science instruction, their science achievement and conceptual understanding would subsequently be adversely affected. Meanwhile, Pratt (2007) claims that the curiosity and enthusiasm for science among children may continually diminish if not fostered in the early grades. Such diminution and attenuation of interest in science will lead to students either pursuing another interest apart from science, or losing the desire to take an advanced course in science. While science and mathematics are taught across the kindergarten, primary and secondary curricular, these disciplines are not explicitly taught in the early childhood curriculum. Accordingly, an important research question emerges from this scenario, namely, is it feasible to integrate STEM into the current early childhood curriculum in Malaysia?

Early Childhood Curriculum in Malaysia

The Early Childhood Curriculum in Malaysia is called "*Kurikulum* PERMATA *Negara*" (PERMATA, 2013), which is literally translated as "National GEMSTONE Curriculum". "PERMATA", in the Malay language, means gemstone or diamond. It is named as such because the Malaysian Government believes that "every child is precious" just like a gemstone/diamond which needs to be cut, shaped, and polished to reveal its brilliant final beauty. The "*Kurikulum PERMATA Negara*", meant for the 0-4 year olds, was developed in 2007, trialled and implemented nation-wide in 2008.

A document review shows that there is no explicit documentation of STEM in the Early Childhood Curriculum. However, elements of STEM can be inferred from the conceptual model of its curriculum as shown in Figure 1 which is lifted from PERMATA (2013, p. 34).

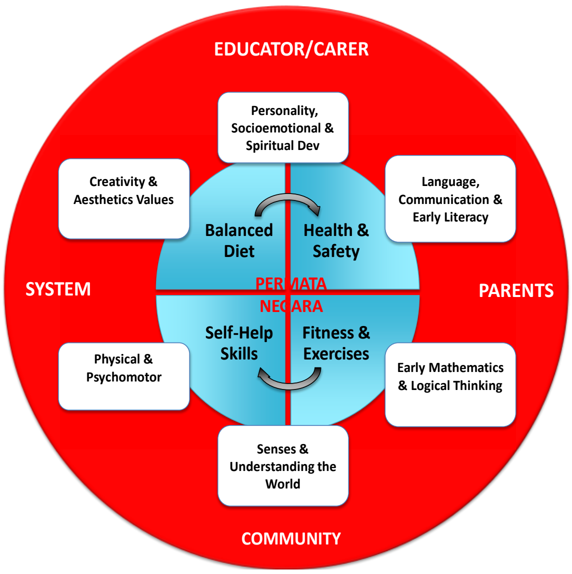

Figure 1. *Conceptual Model for the National Early Childhood Curriculum*

The conceptual model of the Malaysian Early Childhood Curriculum as depicted in Figure 1 shows the amalgamation of the four aspects in the Childcare component with that of the six Learning Areas for the Child Development achievable through the concerted efforts among the "Educator/Carer", "Parents", and the "Community" within a strong supportive "System" from the authorities. The four aspects of Childcare component are *Balanced Diet*, *Health & Safety*, *Self-Help Skills*, and *Fitness & Exercises*, while the six learning areas of children development consisted of: (1) *Personality, Socio-Emotional & Spiritual Development*; (2) *Language, Communication and Early Literacy*; (3) *Early Mathematics and Logical Thinking*; (4) *Senses and Understanding the World*; (5) *Physical & Psychomotor*; and (6) *Creativity and Aesthetics Values*.

Among the six learning areas on children development, two of which allude to STEM, namely the (a) Early Mathematics and Logical Thinking, and (b) Senses and Understanding the World. The former matches the "Mathematics" part of STEM, while the latter, the "Science" part. However, there is a confusion as to what STEM constitutes as indicated by Bybee (2013) who laments that "there seemed to be a lack of clarity about the meaning of STEM" (p. ix), due to the fact that the "meaning or significance of STEM is not clear and distinct" (p. x). Bybee (2013) raises the question of whether STEM refers to "a school discipline such as science or mathematics? … [or, does it refer to] four separate disciplines: science, technology, engineering, and mathematics? Or [does it refer to an integration of] two, three, or all four STEM disciplines?" (p.1). In the context of early childhood education in this paper, we take the position of STEM as being an integration of four STEM disciplines which will be further elaborated during the discussion on STEM integration through **P**roject-Based **I**nquiry **L**earning (PIL).

Pedagogical Approach in Early Childhood Education

One of the characteristics of children is their inquisitive nature, constantly asking questions about the world around them. This leads to the strong advocacy of inquiry-based science education. The advocated pedagogical approach in the early childhood curriculum in Malaysia is that of "play pedagogy" (PERMATA, 2013, p.34) which entails exploration, experimentation and experiencing (3E). However, this "play pedagogy" is devoid of the explicitly stated opportunity for children to inquire (I), and to collaborate, create and communicate (3C) which have been strongly advocated for by early childhood educators (Katz, 2010; Katz & Chard 2000; Helm & Katz, 2001).

Therefore, the pedagogical approach proposed for this study on STEM integration is that of the **P**roject-Based **I**nquiry **L**earning (PIL) which promotes the "I + 3E + 3C" by means of four interdependent phases, namely Inquiry, Exploration, Experimentation/Creation, and Reflection. Figure 2 illustrates the enhancement or up-scaling of Play-Based Learning (i.e., the PERMATA pedagogy) to that of Project-Based Inquiry Learning (Aminah et al., 2015) which is the STEM pedagogy that we have theorised and proposed.

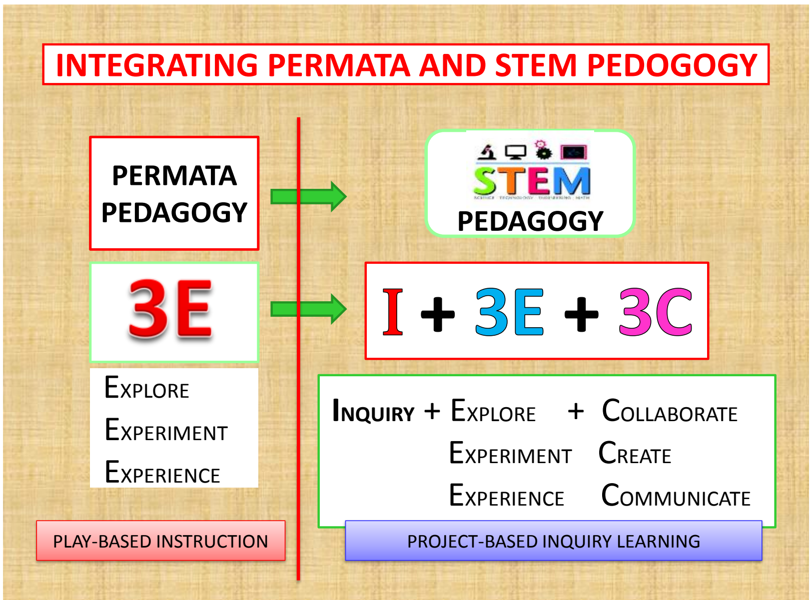

Figure 2. *STEM-Based Teaching and Learning Method*

METHODOLOGY

This study employed a post-intervention and post-implementation survey design in which (i) an intervention in terms of training workshop was given and this was followed by a survey on the suitability of the STEM Projects for 3-4 year-old children from the teachers' perspective, and (ii) the actual classroom implementation was enacted by the participants and this was followed by a survey on the feasibility of the STEM Projects.

Judgmental sampling was used in this study in which the segments of the population represented a variety of early childhood centres in urban and rural parts of Malaysia. In view of the cost constraint, only 22 early childhood teachers from 19 various childcare centres across urban and rural areas of Malaysia were selected as participants.

In the intervention phase, the participants followed through a three-day fully residential in-service training workshop on the integration of STEM through Project-based Inquiry Learning (PIL) held at the Centre for the Gifted and Talented, National University of Malaysia (UKM). In the training workshop, participants were familiarised to the concept of STEM and PIL through PIL itself, in which participants took the dual role of a teacher and that of a child for each project, walking through the 4 phases of PIL under the facilitation of the researchers. Table 1 lists the 10 projects that were presented to the participants during the training workshop. Given that it was only a three-day in-service training workshop and that the time allocated was only sufficient to carry out three full cycle of PIL, each group chose one out of the 10 projects in each round (without any overlapping of projects among the groups) to walk through the full cycle of PIL in a collaborative manner, putting themselves in a dual role of a teacher and that of a child. For example, when they assumed the role of a teacher, they asked themselves “what do we want to know about ....”, and when they switched role to that of a child, they explicated their questions with one of the team members listing down the questions posed by other members. At the end of each round (i.e., each full cycle of PIL), the groups presented the teaching and learning which took place in each of the four phases – Inquiry, Exploration, Invention, & Reflection. They then showcased their projects with other groups celebrated together with them.

Table 1. The List of Projects Presented at the Training Workshop

Project No	Title
Project 1:	Rubber-Band Powered Car
Project 2:	3R – Reduce, Reuse & Recycle
Project 3:	Terrarium
Project 4:	Buttons
Project 5:	Tie and Dye
Project 6:	Composting
Project 7:	Umbrella
Project 8:	Chicken and Eggs
Project 9:	My Ship
Project 10:	Paper

In the classroom implementation, participants were supported with resource kits during a five-month duration, after which the teachers reported on the STEM Projects which they have carried out with their 3-4+ year-old children in their respective classrooms.

FINDINGS

Table 2 indicates the perceptions of the workshop participants (early childhood teachers) as to the suitability of the STEM Projects for 3-4+ year-old children in their respective childcare centres. Over 90% of the participants perceived Project 9 (My Ship) as the most suitable STEM project for their 3-4+ year-old children, followed by Project 2 (3R – Reduce, Reuse & Recycle), Project 4 (Buttons), and Project 5 (Tie and Dye) where more than 80% of the participants perceived that these projects are suitable for their 3-4+ year-old children. Project 1 (Rubber Band Powered Car), Project 8 (Chicken and Eggs), and Project 10 (Paper) were averagely perceived (slightly above 70%) by the participants as suitable for their children. Nevertheless, Project 3 (Terrarium), Project 6 (Composting) and Project 7 (Umbrella) were the least perceived (between 45% – 60%) as suitable.

Table 2: **Suitability of STEM Projects for 3-4+ Year Olds**

Project No		N	f	%
Project 9	My Ship	22	20	90.91
Project 2	3R	22	18	81.82
Project 4	Buttons	22	18	81.82
Project 5	Tie and Dye	22	18	81.82
Project 1	Rubber Band Powered Car	22	17	77.27
Project 8	Chicken and Eggs	22	16	72.73
Project 10	Paper	22	16	72.73
Project 3	Terrarium	22	13	59.09
Project 6	Composting	22	11	50.00
Project 7	Umbrella	22	10	45.45

Table 3 summarises the STEM Projects which have been implemented by the early childhood teachers in their respective childcare centres within a 5 month duration. It was found that Project 3 (Terrarium) was the STEM

Project which garnered the highest frequency in terms of implementation across the childcare centres. All of the childcare centres, except for one, carried out the Terrarium Project with their 3-4+ year olds. Project 2 (3R) and Project 5 (Tie and Die) were implemented by 63% of the childcare centres. While the remaining STEM Projects were implemented by less than 50% of the childcare centres, Project 7 (Umbrella) and Project 4 (Catapult) were implemented by only two (10.53%) of the 19 childcare centres.

Table 3: The Frequency and Type of STEM Projects Implemented

Project #		frequency (n=19)	%
Project 3	Terrarium	18	94.74
Project 2	3R	12	63.16
Project 5	Tie and Die	12	63.16
Project 9	My Ship	8	42.11
Project 10	Paper	8	42.11
Project 6	Composting	6	31.58
Project 8	Chicken and Eggs	5	26.32
Project 1	Rubber Band Powered Car	4	21.05
Project 7	Umbrella	2	10.53
Project 4	Catapult*	2	10.53

* Project 4 – Catapult replaces Button Project due to the validation process by the participants who felt that it is less within the scope of STEM Education.

CONCLUSION AND DISCUSSION

The main finding of this research indicates that it is feasible to integrate STEM into the Early Childhood Curriculum as supported by the survey data of the early childhood teachers collected at two different junctures: (1) at the end of the training workshop where teachers reported on the suitability of the STEM Projects for early childhood pupils aged 3 to 4+, and (2) at the end of the five-month classroom implementation where teachers reported on the STEM Projects which they have carried out with their 3-4+ year-old children.

However, there were some mismatches between the STEM Projects which the teachers perceived as suitable with that of the STEM Projects which were actually implemented in the classroom. For example, while Project 9 (My Ship) was highly perceived as the most suitable STEM Project for 3-4+ year-old children, this project was only implemented in 8 out of 19 (42.11%) childcare centres. By contrast, while Project 3 (Terrarium) was grimly perceived on its suitability as a STEM Project, it was nevertheless the Project which was implemented in 18 out of 19 (94.74%) childcare centres.

Therefore, it would be more illuminating if follow up interview could be done with the teachers so as to uncover the underlying reasoning for the mismatches between what was initially perceived as suitable with that of actual implementation. Although it could be inferred that such mismatches arose out of many reasons, ranging from the suitability in terms of jiving with students' cognitive and ability level, to the curricular demand in terms of jiving with the weekly learning themes for the childcare centres, getting teachers' personal responses seems to be the way forward in getting the valid reasoning.

The feasibility of STEM integration for early childhood education was premised on two existing facts in that the components of science and mathematics are in existence within National PERMATA Curriculum, and that the use of Project-Based Inquiry Learning matches the inquisitive nature of the 3-4+ year-old children to inquire, explore and design, investigate and create/invent, and to talk about their inventions or/and investigations.

Based on these findings, it is suggested that the Permata Division at the Prime Minister's Department relooks at the existing National PERMATA Curriculum and identifies the gaps and opportunity to embed and integrate STEM education into the existing Curriculum. Besides, concerted effort is needed to develop and validate more STEM Projects for the consumption of the early childhood teachers across the various early childcare centres in Malaysia. Should the suggestion be adopted, the Malaysian children will definitely be nurtured with STEM education which eventually leads to more students pursuing science (Pratt, 2007), thus helping the country in realising the 60:40 ratio as echoed in the speech of our Prime Minister given at the United Nations: "Malaysia aims for 60 per cent of its children and young people to take up Science, Technology, Engineering and Mathematics (STEM) education and career for a better future of the country. … There is a need for us to ensure a new generation of children and young people passionate about STEM education so that they want to choose STEM as a career" (Bernama, 23 September 2014).

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THE DEVELOPMENT AND VALIDATION OF A MALAYSIAN-BASED BASIC SCIENCE PROCESS SKILLS TEST

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ABSTRACT: This paper reports the development and validation of a test that measures the basic science process skills for upper primary school pupils as stipulated in the Malaysian science curricula. In the instrument development phase, 58 Basic Science Process Skills (BSPS) items were generated according to a set of *a priori* indicators. These items were vetted by two reviewers to ensure content validity and to establish inter-rater agreement, yielding a Cohen's Kappa value of 0.877, p = < .001. The BSPS Test was then field tested with a group of 197 upper primary students (aged 10-12) that represents top, average, and bottom sets. The dataset was subjected to item analyses, resulting in a quality 29-item BSPS Test. The BSPS Test has a KR-20 reliability of 0.86, and means for difficulty and discrimination indices of items that measured at 0.61 and 0.49 respectively. This paper ends with a discussion as to how the quality 29-item BSPS Test could be used in the classroom alongside the mandatory science practical assessment, thus providing the concurrent validity.

Key words: Basic Science Process Skills, Primary Science, Development, Validation, Malaysia.

INTRODUCTION

The primary school science curriculum in Malaysia has gone through a few waves of reformation, from the Special Project in 1968, Primary School New Curriculum in 1983, Primary School Integrated Curriculum in 1993, to Primary School Standard Curriculum or its Malay equivalent, *Kurikulum Standard Sekolah Rendah* (KSSR) which took effect in 2011. In terms of pedagogical approach, Primary School Standard Curriculum explicitly states that "science emphasizes inquiry method ... [and] in the inquiry process ... scientific skills and thinking skills are employed" (Curriculum Development Division [CDC], 2012, p. 8). Accordingly, inquiry method, built on the premise that students learn best through direct experience and through the incorporation of new and existing knowledge, is considered the "primary vehicle for students to develop meaningful understandings of key science concepts as well as learn about the nature and process of science" (Dunkhase, 2003, p 10). Therefore, inquiry teaching honours previous experience and knowledge, making use of multiple ways of knowing and taking on new perspectives when exploring issues, content, and questions.

One of the ways of knowing is through investigative work which employs scientific skills. As such, Malaysian teachers are expected to inculcate scientific skills through investigative work. In assessing students' acquisition level of science process skill (SPS) as well science manipulative skills (SMS), practical or hands-on activities have been designed and used as school-based practical assessment which is termed as Practical Work Assessment or its Malay equivalent, *Penilaian Kerja Amali (PEKA),* widely known across the country as an acronym, PEKA.

The Malaysian Examination Syndicate (or, *Lembaga Peperiksaan Malaysia* in the Malay Language) stipulates that PEKA should be "carried out as part of teaching and learning process ... [and that] teachers can assess either one construct/skill or several constructs/skills to a small group of pupils or the whole class ... *at least two times* in each year, from Year 3 to Year 6 ... The highest score for each construct could be taken from either year" (Malaysian Examination Syndicate, 2008, p.6).

Although a guide on practical work assessment (PEKA) has been provided for by the Malaysian Examination Syndicate (2008), the effectiveness of implementation of PEKA at school level, nevertheless, is somewhat problematic as documented in previous research findings which indicated that the implementation of PEKA is too taxing and unmanageable, too much science content to cover within the limited time frame, uncertainty in scoring the evidence from the practical work, too many skills to be assessed, insufficient materials and laboratory instruments to go by during PEKA implementation, the burdens of many other duties, too many students to assess, students' negative attitudes towards PEKA implementation, unsure as to how the scoring rubrics are used, poor support system from the management, and difficulties faced by teachers in selecting and managing practical activities for PEKA given that there were no pre-determined practical assessment activities from the Malaysian Examination Syndicate except for the providence of guidelines and scoring criteria (Abdul Rahim & Saliza, 2008; Filmer & Foh, 1997; Noorasykin, 2002; Siti Aloyah, 2002; Wan Noraine, 2010)

Although the Malaysian Examination Syndicate has introduced the school-based, hands-on PEKA to assess students' practical work, such assessment is still subjective in nature as it depends on a teacher's discernment, capability, and acumen in assessing practical work based on the identified constructs of science process skills. Similar problems were faced by American science teachers which prompted Dillashaw and Okey (1980) to suggest the use of a paper-and-pencil group testing format for measuring process skills competency which they reckoned "can be administered efficiently and objectively" (p. 602) without requiring expensive resources. Given the fact that practical work assessment is mandatory, using paper-and-pencil testing could be reckoned as a supplementary to the practical work assessment. It is irrefutable that assessing and knowing the acquisition level of SPS among students are important because should they fail to meet an acceptable level, appropriate remediation is then needed.

As such, there is an urgency to develop and validate a Malaysian-based science process skills inventory which is able to gauge primary students' acquisition of science process skills. Such development and validation is of crucial importance because, from the review of the literature, there was no study done with the aim of developing an instrument capable of measuring the full range of basic science process skills and suitable for upper primary students. Accordingly, this study addressed the key question: *To what extent does the developed science process skills instrument has the sufficient validity and reliability?*

METHODOLOGY

Research Design and Sampling

This study employed the methodology of test items development which comprised two phases. Phase One was characterized by the instrument development process (Cohen, Manion, & Morrison, 2007) that involves (a) identifying the test objective; (b) specifying the content of the test and this entails identifying as well as describing the science process skills to be tested; (c) forming a test specification table and this includes delineating the indicators for each of the science process skills and the expected number of items; (d) writing appropriate test items that match the delineated indicators; and (e) checking items by experts to ensure face validity and content validity. Phase Two was characterized by psychometric analysis where the developed set of items was piloted to establish the internal reliability as well as the difficulty and discrimination indices. Items that have difficulty index within the range of 0.25-0.75 and discrimination index of at least 0.40 would be accepted, while those that do not meet the required range would be either modified or rejected. The steps taken in Phase One are described in the Methodology section while the results obtained from item analysis are described in the Results section.

Phase One: Instrument Development Process

(a) Identifying the Test Objective

The test objective is to develop a quality instrument in terms of research-appropriate validity, reliability, difficulty index, and discrimination index to assess the acquisition of a complete range of 7 basic science process skills as stipulated in the Malaysian science curricula. The instrument should be deemed suitable for upper primary school students.

(b) Specifying the Content

The 7 basic science process skills were adapted from the Teaching and Learning Module on "Pendekatan Inkuari Melalui Kemahiran Proses Sains: Tahun 4" (Inquiry Approach through Science Process Skills) (Curriculum Development Division, 2013). Table 1 summarizes the 7 basic science process skills with their respective descriptions.

Table 1: Description of Basic Science Process Skills

No	Science Process Skill	Description
1	Observing	Using the sense of hearing, touch, smell, taste and sight to collect information about an object or a phenomenon.
2	Classifying	Using observations to separate or group objects, events or phenomena according to similar characteristics.
3	Measuring and Using Numbers	Making quantitative observations using numbers and tools with standardized units or tools which have been uniformised as reference unit. Measuring makes observation more accurate.
4	Making Inferences	Making a plausible (or reasonable) tentative conclusion which may be correct or incorrect to explain a certain event or observation.
5	Predicting	Making a tentative expectation or outcome of a future event based on observation and prior knowledge gained through experiences or based on data.
6	Communicating	Receive, choose, arrange and present information or ideas in the forms of writing, oral presentation (speaking), tables, graphs, figures or models.
7	Using Space-Time Relationship	Describing parameter change such as location, direction, shape, size, volume, weight and mass with time.

(c) Forming Test Specification Table

As shown in Table 2, the Test Specification Table has 3 major columns, namely science process skill, indicator, and number of items in the first, second, and third columns respectively. At least 6 items were generated for each science process skill. Creating more items for each process skill was to ensure that sufficient items remained after the psychometric analysis of pilot data. Furthermore, Reynolds, Livingston and Wilson (2009) argued that test measurement features are enhanced with increasing number of items.

Table 2: Test Specification Table for Basic and Integrated Science Process Skills

Science Process Skill	**Indicator**	**Number of Items**
Observing	Detect differences and similarities.	12
	Identify general characteristics of a group of items.	
	Identify arrangement and order of occurred phenomena.	
	Identify the changes occurred.	
	Focus attention to relevant details from different sources of information.	
	Make comparison.	
Classifying	Group something based on common features.	7
	Describe common characteristic used in classifying/grouping.	
	Group something by using various ways based on different criteria (sequentially).	
Measuring and using number	Use numbers to record measurement and phenomenon.	14
	Record taken reading.	
	Make simple calculation.	
	Calculate and compare the number of items in different groups.	
Making Inferences	Use information from observation to make initial plausible conclusion.	6
	Use various possible information from an observation.	
	Use inference as a tool to determine additional observation.	
Predicting	Use previous data to predict what might be happening.	6
	Use pattern as evidence to make a prediction or expectation.	
	Determine effect or result which might happen from an action.	
	Extrapolate or interpolate to make a prediction	
Communicating	Write to explain an idea or a thing clearly to others.	7
	Use symbol or mathematical equation to convey information about an incident or phenomenon.	
	Use writing, diagram, chart, graph, table or ICT to clarify idea or convey information.	

Using time-space relationship	Describe position (location) and time.	6
	Describe change of direction, feature, object size, volume, weight, mass, according to time.	
	Narrate association between distance travelled and time for a moving object.	
	Determine object location in space and explain the position.	
	Arrange the occurrence of events chronologically.	
	Narrate object shape when it is viewed from different positions or reference points.	
	Identify variables involved in coming activities.	
	Carry out activities to test hypothesis by altering manipulated variable.	

(d) Writing Test Items

A crucial consideration in writing items on science process skills is that of test format. A decision was made to use a paper-and-pencil multiple-choice format. This is because multiple-choice test format is able to assess all the 7 basic science process skills within a relatively short period of time, easy to be administered even for large samples, easy to be scored, objective and can reduce grading mistake. The items in this test are content free in that respondents do not need to invoke scientific facts, theories and laws in order to answer the test items. Each item was written in Malay. This is because the Malay language is used as the medium of instruction in the teaching and learning of science in Malaysia. Table 3 summarises the corresponding items for each of the Basic Science Process Skills.

Table 3: Items for Basic Science Process Skills

Basic science process skills	**Items**	**Total (n)**
Observing	1, 4, 8, 9, 13, 21, 22, 23, 24, 25, 26, 58	12
Classifying	3, 6, 7, 27, 28, 29, 30	7
Measuring and using number	2, 11, 12, 15, 17, 18, 19, 41, 42, 43, 44, 45, 46, 47	14
Making Inferences	20, 31, 32, 34, 35, 36	6
Predicting	5, 16, 33, 37, 40, 53	6
Communicating	10, 14, 48, 49, 50, 54, 57	7
Using space-time relationship	38, 39, 51, 52, 55, 56	6
	TOTAL	58

(e) Checking Items

Two experts – a master science teacher and an experienced science teacher with 26 years and 15 years of teaching experience respectively -- were invited to review the Basic Science Process Skills items to ensure content validity and to establish inter-rater reliability (or, degree of agreement). Their agreements on each of the 7 basic science process skills are tabulated in Table 4.

Table 4: Cross-Tabulation of Agreement between Experts on Categorisation of Basic Science Process Skills Items

	Expert 1							Total
Expert 2	1	2	3	4	5	6	7	
1 = Observing	8	1	0	0	0	1	0	10
2 = Classifying	0	7	0	0	0	0	0	7
3 = Measuring and Using Numbers	1	0	13	0	0	0	0	14
4 = Making Inferences	0	0	0	6	0	0	0	6
5 = Predicting	0	0	0	0	5	0	0	6
6 = Communicating	1	1	0	0	0	8	0	10
7 = Using Space-Time Relationship	0	0	0	0	1	0	5	6
Total	10	9	13	6	6	9	5	58

As shown in Table 4, there were 6 items in which both experts differed in their categorisation or labelling of items. As such, the experts were not in agreement for 6 out of 58 items. Table 5 shows the analysis of inter-rater agreement in categorisation of Basic Science Process Skills items which yielded a Cohen's Kappa value of 0.877, $p = .000 < .002$, which indicates an excellent or outstanding level of agreement between experts (Landis & Koch, 1977; Cohen, 1960). In other words, after correcting for chance effect, the percentage of agreement between experts was found to be 87.7%

Table 5: The Measurement of Agreement between Experts in Categorisation of Basic Science Process Skills Items

Kappa Value	N	Asymp. Std. Error[a]	Approx. T[b]	p
.877	58	.047	15.737	.000

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

(f) Pilot Testing

For pilot purposes, the 58-item Basic Science Process Skills Test was administered to a total of 197 upper primary students drawn from 1 urban and 2 rural primary schools in the state of Perak for duration of one hour 30 minutes. There were 71 (34 males and 37 females) and 126 (53 males and 73 females) students in the corresponding urban and rural primary schools. The detailed breakdown of the respondents who participated in the piloting of items in the Basic Science Process Skills Test is given in Table 6.

Table 6: Breakdown of Participants in the Piloting of Basic Science Process Skills Test

Location		Gender		
		Male	Female	Total
Urban	Year 4	10	13	23
	Year 5	13	14	27
	Year 6	11	10	21
	Total	34	37	71
Rural	Year 4	16	18	34
	Year 5	21	26	47
	Year 6	16	29	45
	Total	53	73	126
Grand Total		87	110	197

Data Collection Procedures

Prior to the commencement of the study, permission was sought from the Educational Planning and Research Division (EPRD) of the MoE. Upon gaining the approval from the EPRD, a letter for permission with the attachment of EPRD approval letter was forwarded to the Perak State Education Department, given that the pilot study was to be conducted in Perak. Once the approval has been obtained from the Perak State Education Department, the headmasters of the selected primary schools were approached in person in getting their approvals to use the upper primary students in their schools as respondents/participants.

In each school, the administration of research instruments was done simultaneously for all the classes under the supervision of teachers in school time. In administering the instruments, the teachers read the same researcher-prepared instructional script. In order to ensure high completion rate, teachers were asked to ensure that all the response sheets were collected at the end of the session.

Data Analysis Procedures

Data collected from the pilot study were subjected to item analyses in which the internal consistency of the BSPS Test measured by means of Kuder-Richardson-20, the index discrimination, and the difficulty index were determined. Based on the review of previous literature, it is decided that for this study, (a) a reliability of at least 0.7 is considered acceptable; (b) $D_{33\%}$ is adopted as recommended by Liu (2008) to determine the discrimination indices for each item; (c) items with the difficulty indices of 0.25 – 0.75 are retained, subject to their acceptable discrimination indices.

RESULTS

Item analysis was carried out on pilot test data for basic science process skills gathered from 197 Year 4-6 primary students and the results are summarised in Table 7.

Table 7: Results of Item Analysis on Pilot Test Data for Basic Science Process Skills: Distracter Analysis, Difficulty Index and Discrimination Index

	Options (* = answer key)					Df=Difficulty Index D=Discrimination Index			Decision
Item	A	B	C	D	Non	Total	Df	D	
1	15 (7.6)	72* (36.5)	109 (55.3)	1 (0.5)	0 (0.0)	197 (100%)	0.60	0.31	Modify
2	187* (94.9)	7 (3.6)	1 (0.5)	2 (1.0)	0 (0.0)	197 (100%)	0.89	0.17	Discard
3	24 (12.2)	149* (75.6)	19 9.6)	5 (2.5)	0 (0.0)	197 (100%)	0.63	0.40	Retain
4	137 (69.5)	33* (16.8)	13 (6.6)	14 (7.1)	0 (0.0)	197 (100%)	0.42	0.32	Modify
5	146* (74.1)	13 (6.6)	29 (14.7)	9 (4.6)	0 (0.0)	197 (100%)	0.67	0.40	Retain
6	32 (16.2)	24 (12.2)	45 (22.8)	96* (48.7)	0 (0.0)	197 (100%)	0.49	0.29	Modify
7	144* (73.1)	15 (7.6)	23 (11.7)	14 (7.1)	1 (0.5)	197 (100%)	0.61	0.28	Modify
8	102 (51.8)	21 (10.7)	40 (20.3)	33* (16.8)	1 (0.5)	197 (100%)	0.17	0.15	Discard
9	14 (7.1)	126* (64.0)	23 (11.7)	34 (17.3)	0 (0.0)	197 (100%)	0.58	0.32	Modify
10	17 (8.6)	10 (5.1)	142* (72.1)	27 (13.7)	1 (0.5)	197 (100%)	0.59	0.18	Modify
11	34 (17.3)	22 (11.2)	107* (45.3)	34 (17.3)	0 (0.0)	197 (100%)	0.54	0.49	Retain
12	9 (4.6)	12 (6.1)	7 (3.6)	169* (85.8)	0 (0.0)	197 (100%)	0.70	0.29	Modify
13	155* (78.7)	13 (6.6)	24 (12.2)	5 (2.5)	0 (0.0)	197 (100%)	0.70	0.46	Retain
14	24 (12.2)	39 (19.8)	121* (61.4)	13 (6.6)	0 (0.0)	197 (100%)	0.52	0.17	Modify
15	11 (5.6)	141* (71.6)	10 (5.1)	35 (17.8)	0 (0.0)	197 (100%)	0.65	0.22	Modify
16	95* (48.2)	28 (14.2)	15 (7.6)	58 (29.4)	1 (0.5)	197 (100%)	0.48	0.43	Retain
17	10 (5.1)	77* (39.1)	19 (9.6)	91 (46.2)	0 (0.0)	197 (100%)	0.45	0.42	Retain
18	33 (16.8)	29 (14.7)	20 (10.2)	115* (58.4)	0 (0.0)	197 (100%)	0.58	0.66	Retain
19	11 (5.6)	24 (12.2)	153* (77.7)	8 (4.1)	1 (0.5)	197 (100%)	0.69	0.20	Modify
20	36 (18.3)	19 (9.6)	37 (18.8)	105* (53.3)	0 (0.0)	197 (100%)	0.53	0.46	Retain
21	12 (6.1)	128* (65.0)	46 (23.4)	11 (5.6)	0 (0.0)	197 (100%)	0.55	0.17	Modify
22	15 (7.6)	25 (12.7)	67 (34.0)	90* (45.7)	0 (0.0)	197 (100%)	0.46	0.40	Retain
23	128* (65.0)	5 (2.5)	27 (13.7)	36 (18.3)	1 (0.5)	197 (100%)	0.61	0.40	Retain
24	40 (20.3)	19 (9.6)	121* (61.4)	17 (8.6)	0 (0.0)	197 (100%)	0.61	0.51	Retain
25	18 (9.1)	22 (11.2)	77 (39.1)	80* (40.6)	0 (0.0)	197 (100%)	0.41	0.29	Modify
26	22 (11.2)	113* (57.4)	28 (14.2)	34 (17.3)	0 (0.0)	197 (100%)	0.57	0.35	Modify
27	25 (12.7)	121* (61.4)	19 (9.6)	30 (15.2)	2 (1.0)	197 (100%)	0.61	0.52	Retain
28	127* (64.5)	14 (7.1)	27 (13.7)	28 (14.2)	1 (0.5)	197 (100%)	0.64	0.42	Retain
29	17 (8.6)	126* (64.0)	43 (21.8)	10 (5.1)	1 (0.5)	197 (100%)	0.64	0.43	Retain
30	138* (70.1)	10 (5.1)	33 (16.8)	15 (7.6)	1 (0.5)	197 (100%)	0.70	0.42	Retain

Item	Options (* = answer key)					Df=Difficulty Index D=Discrimination Index			Decision
	A	B	C	D	Non	Total	Df	D	
31	46 (23.4)	20 (10.2)	126* (64.0)	5 (2.5)	0 (0.0)	197 (100%)	0.64	0.40	Retain
32	18 (9.1)	111 (56.3)	28* (14.2)	40 (20.3)	0 (0.0)	197 (100%)	0.40	0.05	Modify
33	12 (6.1)	12 (6.1)	140* (71.1)	31 (15.7)	2 (1.0)	197 (100%)	0.72	0.51	Retain
34	139* (70.6)	18 (9.1)	26 (13.2)	14 (7.1)	0 (0.0)	197 (100%)	0.65	0.51	Retain
35	37 (18.8)	25 (12.7)	121* (61.4)	13 (6.6)	1 (0.5)	197 (100%)	0.62	0.57	Retain
36	32 (16.2)	25 (12.7)	119* (60.4)	21 (10.7)	0 (0.0)	197 (100%)	0.60	0.37	Modify
37	17 (4.6)	91* (46.2)	70 (35.5)	27 (13.7)	0 (0.0)	197 (100%)	0.46	0.18	Modify
38	10 (5.1)	87* (44.2)	72 (36.5)	28 (14.2)	0 (0.0)	197 (100%)	0.44	0.38	Modify
39	17 (8.6)	132* (67.0)	40 (20.3)	8 (4.1)	0 (0.0)	197 (100%)	0.67	0.66	Retain
40	26 (13.2)	72* (36.5)	34 (17.3)	65 (33.0)	0 (0.0)	197 (100%)	0.37	0.14	Modify
41	4 (2.0)	29 (14.7)	149* (75.6)	15 (7.6)	0 (0.0)	197 (100%)	0.76	0.46	Retain
42	15 (7.6)	12 (6.1)	149* (75.6)	21 (10.7)	0 (0.0)	197 (100%)	0.76	0.54	Retain
43	20 (10.2)	43 (21.8)	101* (51.3)	33 (16.8)	0 (0.0)	197 (100%)	0.51	0.60	Retain
44	12 (6.1)	56 (28.4)	117* (59.4)	11 (5.6)	1 (0.5)	197 (100%)	0.59	0.52	Retain
45	22 (11.2)	24 (12.2)	132* (67.0)	19 (9.6)	0 (0.0)	197 (100%)	0.67	0.49	Retain
46	101* (51.3)	31 (15.7)	40 (20.3)	25 (12.7)	0 (0.0)	197 (100%)	0.51	0.34	Modify
47	53 (26.9)	62 (31.5)	46* (23.4)	36 (18.3)	0 (0.0)	197 (100%)	0.23	0.02	Discard
48	43 (21.8)	62 (31.5)	70* (35.5)	22 (11.2)	0 (0.0)	197 (100%)	0.36	-0.06	Discard
49	36 (18.3)	64* (32.5)	68 (34.5)	29 (14.7)	0 (0.0)	197 (100%)	0.32	0.28	Modify
50	31 (15.7)	45* (22.8)	87 (44.2)	34 (17.3)	0 (0.0)	197 (100%)	0.23	0.05	Discard
51	30 (15.2)	37* (18.8)	94 (47.7)	36 (18.3)	0 (0.0)	197 (100%)	0.19	0.03	Discard
52	86* (43.7)	30 (15.2)	51 (25.9)	30 (15.2)	0 (0.0)	197 (100%)	0.44	0.58	Retain
53	62 (31.5)	42 (21.3)	51* (25.9)	42 (21.3)	0 (0.0)	197 (100%)	0.26	0.11	Modify
54	54 (27.4)	50 (25.4)	23 (11.7)	70* (35.5)	0 (0.0)	197 (100%)	0.36	0.29	Modify
55	98* (49.7)	34 (17.3)	50 (25.4)	15 (7.6)	0 (0.0)	197 (100%)	0.50	0.49	Retain
56	11 (5.6)	31 (15.7)	133 (67.5)	22* (11.2)	0 (0.0)	197 (100%)	0.68	0.55	Retain
57	13 (6.6)	35 (17.8)	32 (16.2)	116* (58.9)	1 (0.5)	197 (100%)	0.59	0.46	Retain
58	34 (17.3)	121 (61.4)	24* (12.2)	17 (8.6)	1 (0.5)	197 (100%)	0.25	0.00	Discard

As shown in Table 7, item #2 has a difficulty index of 0.89 (which is more than 0.75) and a discrimination index of 0.17 (that is lower than 0.20), suggesting that this item is relatively easy and not so powerful in distinguishing between good and weak students. Hence, it is discarded.

Meanwhile, items #8, #47, #50, and #51 have corresponding difficulty indices of 0.17, 0.23, 0.23, and 0.19 that are lower than 0.25, suggesting that these items are rather difficult and less than 25% of the participants who could answer them correctly. Furthermore, all these items have corresponding discrimination indices of 0.15, 0.02, 0.05, and 0.03 which suggest that only a relatively small number of good or top set students are able to answer them correctly. Given that these four items failed to fulfil the required acceptable range of both the difficulty index and the discrimination index, a decision was made to discard these items.

Although Item #48 has a difficulty index of 0.36, it has a negative discrimination index of -0.06, indicating that students who received a lower overall score on basic science process skills chose the correct answer for this item more often than the students who received a high total score. As such, item #48 is discarded. Item #58 is equally a bad item even though it has sufficient difficulty index of 0.25 because its discrimination index is 0.00 which suggests that it is a non-functioning item in differentiating the good and weak students (i.e., the number of students from the top set chose the correct answers for this item as often as the number of students from the bottom set). As such, item #58 cannot distinguish students and hence its exclusion.

While the difficulty indices for items #10, #14, #21, #32, #37, #40, and #53 are within the acceptable range of more than 0.25, their corresponding discrimination indices of 0.18, 0.17, 0.17, 0.05, 0.18, 0.14 and 0.11, nevertheless, were less than 0.20, indicating the deficiencies of these 7 items in discriminating good students from the weak students. In other words, these 7 items are poorly functioning item which, according to Ebel (1979), need to be revised or even be discarded.

Meanwhile, items #6, #7, #12, #15, #19, #25, #49, and #54 have difficulty indices of more than 0.25 with corresponding discrimination indices of 0.29, 0.28, 0.29,.0.22, 0.20, 0.29, 0.28, and 0.29 that range between 0.2 (inclusive) and 0.3, these eight items are marginal items that need to be revised or modified (Ebel, 1979).
For Items #1, #4, #9, #26, #36, #38, and #46 which have difficulty indices of more than 0.25 with corresponding discrimination indices of 0.31, 0.32, 0.32, 0.35, 0.37, 0.38 and 0.34 that range from 0.31 (inclusive) and 0.40, these items are rather good items or reasonably well-functioning items in discriminating between good and weak students, there are rooms for further improvement (Ebel, 1979).

There are 29 items that have difficulty indices within the acceptable range of 0.25-0.75 and discrimination indices of at least 0.4 for basic science process skills. These items are quality items in that they are neither too easy nor too difficult and that they could adequately distinguish between top from bottom set of students. Accordingly, these 29 items, as shown in Table 8, are retained.

Table 8: Items for Basic Science Process Skills to be Retained, Modified, and Discarded Based on Item Analyses

Basic Science Process Skills	Retain	Modify	Discard
Observing	13, 22, 23, 24	1, 4, 9, 21, 25, 26	58
Classifying	3, *27*, 28, 29, 30	6, 7,	8
Measuring and using numbers	*11*, 18, 41, 42, 43, 44, *45*	2, 12, 15, 19, 46	47
Making inferences	20, 31, 34, 35	32, 36	
Predicting	5, 16, 17, 33	37, 40, 53	
Communicating	57	<u>10</u>, 14, <u>49</u>, <u>54</u>	48, 50
Using time-space relationship	39, 52, 55, 56	38	51
Number of Items	29	23	6

(Note: Three italicized items were subsequently removed, while three underlined items would be revised, piloted and adopted so as to strike a balance in the number of items across skills)

DISCUSSION AND CONCLUSION

In terms of reliability, the original 58-item basic science process skills test has the Kuder-Richardson Formula 20 (KR-20) coefficient of 0.85, indicating that the internal consistency reliability of the overall test of basic science process skills was high. This high internal consistency, in turn, indicates that the test was rather homogeneous in nature. After going through a cycle of selection process, the KR-20 coefficient increased to 0.86 for the 29-retained-item test on basic science process skills, with the means for difficulty and discrimination indices measured at 0.61 and 0.49 respectively.
This validated Basic Science Process Skills (BSPS) Test was deemed a quality test in that the items have difficulty and discrimination indices that fall within the acceptable range for research or testing purposes. Besides, it is valid and reliable as a basic science process skills test for the use of upper primary students in Malaysia, particularly amongst the Years 4, 5 and 6.

We do acknowledge the benefits of individual practical work assessment in assessing students' acquisition of science process skills although its use is rather time-consuming, "burdensome" (Dillashaw & Okey, 1980, p.602), and at times problematic (Filmer & Foh, 1997) especially in science classes which are under-resourced (Onwu & Mozube, 1992; Tobin & Capie, 1982). Nevertheless, if the aim were to gauge students' acquisition of each of the basic science process skills in a large scale, say a class of students, within a constraint time-frame, we strongly encourage and recommend science teachers to use these validated items. Depending on the class time available, teachers can pick and choose the number of items needed to measure the corresponding selected number of science process skills. The information obtained from the testing could then be used to make informed decision as to the appropriate remediation needed so as to address the deficiencies in any aspect of the science process skills. For teachers who aim to inculcate science process skills amongst students, the results from using this BSPS Test will help them reflect on the extent to which each basic science process skill has been inculcated and subsequently, plan the next step forward.

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EFFECT OF NATURE OF SCIENCE ACTIVITIES ON NATURE OF SCIENCE AND SCIENTIFIC EPISTEMOLOGICAL BELIEFS OF PRE-SERVICE PRESCHOOL TEACHERS

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ABSTRACT: The objective of the present study is to research the effect of nature of science instruction based on direct reflective approach on the views of pre-service preschool teachers on nature of science and their scientific epistemological beliefs. The study was conducted with 38 Fırat University, Faculty of Education Preschool Teaching Department senior students. The study was conducted with seven activities that were used in previous studies. Views of Nature of Science Questionnaire (VNOS) and Scientific Epistemological Beliefs Scale were utilized as data collection tools. Data was collected by applying the scales before and after the activities. Data collected via the Views of Nature of Science Questionnaire were digitized by assigning 3.5 points for scientifically adequate explanations, 1 point for partially adequate scientific explanations, and 0 point for non-scientific explanations and then assessed based on these scores. SPSS software package was used to analyze quantitative data and required analyses were conducted. It was determined that pre-service teachers had a poor understanding on the nature of science before the applications were conducted. Based on study results, it was determined that most of the illusions of the pre-service teachers on the nature of science were eliminated at the end of the application that entailed direct reflective approach activities. It was also found that beliefs of pre-service teachers on epistemological structure of science improved after the application.

Keywords: Science education, pre-school science education, epistemological belief, nature of science, direct reflectors.

INTRODUCTION

The objective of the science curriculum implemented in Turkey is to educate students as science literate individuals independent of their individual differences (MEB,2013). Schwartz, Lederman and Lederman (2008) indicated that individuals should comprehend conceptual scientific knowledge and the nature of science and scientific research to become science literate. Northcutt and Schwartz (2013), on the other hand, stated that individuals should understand scientific concepts, processes and nature.

Pre-school period is the basis of life. Education received in that period would affect the achievements of students in the following levels of education. The aim of the pre-school science education is the individual to observe, interpret the events around the individual, understand the relationships between these events and generally to achieve basic scientific process skills (Hamurcu, 2003). The aforementioned achievements are related to the nature of science (Ayvacı and Özbek, 2014). Thus, it is proposed that children who encounter scientific subjects for the first time should primarily comprehend the elements of the nature of science (Küçük, 2006; Ayvacı, 2007; Akerson, et al., 2011). In this context, pre-school teachers should pay attention to the the elements of the nature of science while planning scientific activities.

Although science and nature of science instruction is significant in educational process, in several studies, it was found that teachers have various misconceptions on the subject (Abd-El Khalick, 2002; Dickinson, Abd-El Khalick & Lederman, 2000; Wahbeh, 2009). Schwartz (2007) considered the lack of education on the nature of science among the reasons of these inaccurate beliefs on the nature of science.

Positive results obtained from studies conducted on the subject demonstrated that nature of science instruction should be conducted with the execution of a process particularly planned for this purpose (Lederman & Abd-El Khalick, 1998; Abd-El Khalick & Lederman, 2000; Bell, Blair, Crawford & Lederman, 2003; Khishfe, 2004).
Epistemological beliefs include theories related to the nature of learning such as knowledge, nature of knowledge and the process of knowledge acquisition (Hofer and Pintrich, 1997; Schommer, 1990). It is quite important to research these beliefs, since scientific epistemological beliefs of teachers could affect the quality of science education in different ways (Chan, 2004; Hashweh, 1996; Luft and Roehrig, 2007).

The objective of the present study is to investigate the effect of reflective approach based nature of science instruction on pre-service pre-school teachers' nature of science and scientific epistemological beliefs under the light shed by the aforementioned study results. It was considered that the present study would contribute to literature, since there are no previous studies on pre-service pre-school teachers' nature of science and epistemological beliefs.

Objective of the Study

The objective of the present study is to research the effect of reflective approach based nature of science instruction on pre-service pre-school teachers' nature of science and scientific epistemological beliefs.

Research Questions

1. What is the effect of direct reflective approach based nature of science instruction on the views of pre-service pre-school teachers on the nature of science?
2. What is the effect of direct reflective approach based nature of science instruction on scientific epistemological views of pre-service pre-school teachers?

METHOS

To develop the views on the nature of science, activities named Exchange of Cards, Are the Limits of the Science Scientific?, Isn't it so?, What is in the Black box, tangram and the tube?, Footprints, Mysterious Cubes, Black Box, Fosils, Ordering the Events and Young-Old were applied using direct reflective approach (Doğan, Çakıroğlu, Bilican ve Çavuş, 2009). After the activities, characteristics of the nature of science themes were discussed by pre-service teachers, enabling them to reflect their opinion.

Study Model

Empirical method was utilized in the present study. Qualitative method was used to determine the effect of direct reflective approach on the views of pre-service teachers about nature of science and quantitative method was used to determine the effect on their epistemological beliefs.

Study Group

The study was conducted with 38 junior students attending Fırat University, Faculty of Education, Pre-School Teaching Department.

Data Collection Tools

To determine the views of pre-service teachers on nature of science, views on nature of science scale (VNOS-C) was utilized. The scale was designed by Lederman and O'Malley and the scale obtained its final form (VNOS-C) of ten open ended questions after a revision by Abd-El Khalick. The survey was designed to identify the views on changeable nature of scientific knowledge, the empirical nature of scientific knowledge, objectivity of scientific knowledge, creative nature of scientific knowledge, observation-inference relationship in science, the effect of social and cultural structure in production of scientific knowledge, and themes on the nature of science that consists of scientific theories and laws.

To determine the epistemological beliefs of participating pre-service teachers, epistemological belief scale developed by Schommer (1990) and adapted to Turkish by Deryakulu and Büyüköztürk (2002) was utilized. The scale includes 35 items and Cronbach alpha coefficient of the scale was calculated as .71.

Data Analysis

Nature of Science questionnaire items were digitized using the scoring (0, 1, and 3.5 points) proposed by Vasquez-Alonso and Manassero-Mas (1999). Scientifically fit explanations provided by the participating pre-service teachers were scored 3.5 points, partially scientific explanations were scored 1 point, and non-scientific explanations received 0 (Cited by: Kaya, 2005).

Both views on nature of science and epistemological belief scales were applied in pretest posttest format, and the statistical relationship between the test results was investigated with paired sample t-test.

Due to the fact that views on nature of science questionnaire included open-ended questions, assessment of the scale was conducted by two researchers. Used to calculate the reliability of comparative agreement between the two researchers, Cohen kappa coefficient was calculated as 0.85. This value demonstrated that there was almost perfect agreement among the researchers.

FINDINGS

	N	X	Sd.	t	p
Pretest	38	0,89	1,48	-14,343	,00
Posttest	38	1,04	1,76		

It was determined that there was a significant difference between the analysis results of views on nature of science scale pretest and posttest scores ($p < 0.05$). Thus, it could be argued that application of direct reflective nature of science activities developed the views of pre-service teachers on nature of science.

	N	X	Sd.	t	p
Pretest	38	3,11	2,08	7,96	,00
Posttest	38	3,34	2,14		

It was determined that there was a significant difference between the results of the analyses of pretest and posttest data for epistemological beliefs survey ($p < 0.05$). The results of the analysis demonstrated that direct reflective nature of science activities improved the epistemological beliefs of pre-service pre-school teachers.

RESULT AND DISCUSSION

In the present study, the effect of nature of science instruction based on direct reflective approach on the views of pre-service pre-school teachers on nature of science and their scientific epistemological beliefs.

Analysis of the data obtained before the application of nature of science activities demonstrated that pre-service teachers did not possess sufficient understanding for the dimensions of nature of science. This finding is consistent with the results of other studies conducted with teachers and pre-service teachers in other departments in literature (Abd-El-Khalick & Lederman, 2000; Abd-El-Khalick, 2005; Kenar,2008). Comparison of results of the pretest and posttest, which was conducted after the activities were implemented, demonstrated that there was a significant difference between the pretest and posttest data for nature of science views ($p < 0.05$). It could be argued that the application of the activities improved the views of pre-service pre-school teachers on nature of science.

Studies conducted about the views of of students and teachers on nature of science showed that direct reflective approach achieved successful outcomes in nature of science instruction (Abd-El-Khalick and Lederman, 2000; Khishfe and Abd-El-Khalick, 2002; Khishfe and Lederman, 2007; Seung, Bryan and Butler, 2009).

In the current study, analysis of the data obtained from pretest and posttest that was implemented after the instruction of direct reflective nature of science activities demonstrated that there was a significant difference between epistemological beliefs of pre-service teachers ($p < 0.05$).

In studies conducted to determine epistemological beliefs of primary school students, it was concluded that views of students on scientific knowledge were not developed (Khishfe and Khalick, 2002; Kang and Wallace, 2005; Sandoval, 2005; Küçük and Çepni, 2006; Küçük, 2006; Küçük and Bülbül, 2007; Özkal, 2007; Yalvaç et al., 2010; Uzun, 2011). Student beliefs on nature of science and their epistemological beliefs need to develop at early ages. This would be only possible through teachers who have complete knowledge on nature of science and with strong epistemological beliefs. Thus, during undergraduate education of pre-service teachers, their epistemological beliefs should be improved via nature of science courses in order to attain the abovementioned goal (Yılmaz-Tüzün and Topçu, 2008).

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DETERMINATION OF VIEWS OF PRE-SCHOOL TEACHERS ON SCIENTIFIC PROCESS SKILLS AND LEVEL-OF-EFFORT ON BASIC SCIENTIFIC PROCESS SKILLS USE IN SCIENCE ACTIVITIES

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ABSTRACT: The aim of this study is to determine the views of preschool teachers on scientific process skills and basic scientific process skills they included in science activities. Study group included 32 preschool teachers determined with purposive sampling method. A semi-structured interview form developed by researchers to determine the views of preschool teachers on scientific process skills, and to determine basic scientific process skills they included in science activities, a science activity syllabus detailing the application process were used as data collection tools in the present study. Collected data were analyzed with content analysis method. Conducted analyses demonstrated that participating preschool teachers did not possess adequate theoretical knowledge on scientific process skills and were not completely proficient in basic scientific process skills. Teachers stated that science literate individuals would be trained as a result of development of scientific process skills. They reported that the predominantly utilized observation as the basic scientific process skill in science activities they conducted. Analysis of the application process identified that in observation, students were in the position of observation only.

Keywords: Pre-school science education, basic scientific process skills, science activities.

INTRODUCTION

Scientific process skills that are defined as the skills and though processes used by the individual during the process of examining the nature and natural events and production of scientific knowledge (Özmen & Yiğit, 2005) are an integral part of science education. Kujawinski (1997) stated that scientific process skills are significant in the instruction of scientific content, furthermore, Germann, Aram and Burke (1996) expressed that the main objective of science education should be the acquisition of scientific process skills. Because, individuals could solve the problems they encounter in daily life using ways, methods and perspectives that scientist utilize only when they acquire scientific process skills (Bozdoğan, Taşdemir and Demirbaş, 2006).

American Association for the Advancement of Science (AAAS) considers scientific process skills within two categories of the basic and complimentary skills in Science – A Process Approach. Main skills were identified as "observation, prediction, measurement, classification, presentation and conclusion," and high level skills were determined as "identification of the variables, controlling the variables, hypothesis formation, experimentation, expression of the results based on data, graphing, interpretation and modeling" (Cited by Can and Ş. Pekmez, 2010). Learning main process skills is a prerequisite for the development of integrated process skills. Children would not be able to acquire integrated process skills in the following educational levels unless they develop basic process skills during preschool stage (Ayvacı, 2010).

Teachers have a responsibility in students' acquisition of scientific process skills, which are key for both their school and daily lives. The objective of the present study is to determine the views of preschool teachers who play a significant role in the achievement of basic process skills by the students, on scientific process skills, and their level-of-use of basic scientific process skills in scientific activities.

Objective of the Study

The objective of the present study is to determine the views of preschool teachers on scientific process skills, and the basic scientific process skills they used in science activities.

Research Questions

1- How do preschool teachers define scientific process skills?
2- Which basic scientific process skills preschool teachers identify?
3- What are the views of preschool teachers about the importance of scientific process skills in science education?

4- What are the views of preschool teachers on the development of scientific process skills?
5- What are the views of preschool teachers on the responsibility of teachers on the development of scientific process skills?
6- What are the levels of planning and application of basic scientific process skills used by preschool teachers in the science activities they conduct?

METHODOLOGY

Research Model

The present study is a qualitative descriptive study that aims to determine the views of preschool teachers on scientific process skills, and their level-of-use of basic scientific process skills.

Study Group

Study group included 32 preschool teachers selected with purposeful sampling method.

Data Collection Tools

A semi-structured interview form and science activity syllabus were used as data collection tools. To determine the views of preschool teachers on scientific process skills, a semi-structured interview form was designed. To establish content validity of the interview form, two science education specialists were consulted, and proposed changes were implemented in the form. In compliance with the ethics standards, codes such as OÖÖ1, OÖÖ2, … OÖÖ32 were used to replace the actual names of participating preschool teachers. To determine the basic scientific process skills used in scientific activities, participating teachers were asked to prepare a scientific activity syllabus where the application process for scientific activities were detailed.

Data Analysis

Data collected in conducted interviews were analyzed using content analysis methodology. During the analysis of the data collected during conducted interviews, content analysis data for both researchers were coded separately and coherence between these two datasets was calculated using [Agreement / (Agreement + Disagreement) x 100] formula (Miles and Huberman, 1994). Consistency between the researchers who coded the data was calculated as .81. Science activity syllabi were described by coding the basic scientific process skills identified by the teachers during application and planning phases.

FINDINGS

Table 1: Definition of Scientific Process Skills by Preschool Teachers

Theme	Codes	Frequency
Definition of Scientific Process Skills by Preschool Teachers	Skills required to conduct a scientific research.	13
	Steps such as observation, prediction and classification.	9
	Skills required to solve a problem.	8
	High-level thinking.	1
	Skills that children acquire via science activities.	1

Table 1 demonstrates that 13 preschool teachers defined scientific process skills as skills required to conduct a scientific research. Teacher OÖÖ15 defined scientific process skills using the following words:

"[They are] the behavior, skills and performances that individual demonstrated in a conducted scientific study until the end of the study" (OÖÖ15).

Scientific process skills were defined as steps such as observation, prediction and classification by 9 teachers, as the skills required to solve a problem by 8 teachers, as hih-level thinking by 1 teacher and as the skills that children acquire through science activities by 1 teacher.

Table2: Basic Scientific Process Skills Identified by Preschool Teachers

Theme	Codes	Frequency
Basic Scientific Process Skills Identified by Preschool Teachers	Observation	22
	Hypothesis Formation	8
	Classification/Categorization	6
	Analysis	5
	Synthesis	5
	Measurement	5
	Assessment	4
	Data Collection	4
	Data Recording	4
	Problem Solving	4
	Application	3
	Determining the Problem	3
	Research	3
	Prediction	2
	Experimentation	1
	Cause-Effect Relationship	1
	Survey	1
	Testing techniques	1
	Decision Making	1
	Curiosity	1
	Defining	1
	Creativity	1
	Testing the Hypotheses	1

Table 2 demonstrates that 22 teachers identified basic process skills with observation, 8 teachers with hypothesis formation and 6 teachers with classification.

Table 3: Significance of Scientific Process Skills in Preschool Science Education

Theme	Codes	Frequency
Significance of Scientific Process Skills in Preschool Science Education	It is significant in training science literate individuals.	11
	It is significant in achieving active participation of students in activities.	5
	It is significant in producing solutions for encountered problems.	4
	It is significant to achieve the goals of science activities.	4
	It is significant in preparing the students for the future.	2
	It is significant in enabling the students to come up with ideas.	2
	It is significant for the student in understanding the natural phenomena that occur around the student.	2
	It is significant since it is the basis for scientific activities.	1
	It is significant since experiments and observation are continuously conducted in science activities.	1

Table 3 demonstrates that 11 preschool teachers stated preschool scientific process skills were significant in training science literate individuals. Teacher OÖÖ17 used the following expression in defining scientific process skills:

"As a result of preschool science education, students' scientific process skills would improve and science literate individuals would be trained" (OÖÖ17).

Preschool teachers identified that scientific process skills were significant in preschool science education since they promote active participation of students in activities (f=5), produce solutions for encountered problems (f=4), enable science activities to reach their goals (f=4), prepare students for the future (f=2), enable the students to come up with ideas (f=2) and understand the natural phenomena occurring around the students (f=2), form the basis of science activities (f=1).

Table 4: Views on Development of Scientific Process Skills

Theme	Codes	Frequency
Views on Development of Scientific Process Skills	With student-centered activities	19
	By teachers primarily acquiring these skills	7
	By creating the appropriate educational environment via necessary and adequate stimulants	3

Table 4 demonstrates that 19 preschool teachers expressed that scientific process skills could be developed using student-centered activities. Teacher OÖÖ8 stated the following on developing scientific process skills:

"Students could develop scientific process skills in adequate educational settings where they would participate directly in the activities and could express themselves freely under the guidance of teachers" (OOÖ8).

Among the participating teachers, 7 stated that primarily the teaches should have these skills for the development of scientific process skills among students and 3 said that an adequate educational environment should be provided via the required and appropriate stimulants.

Table 5: Teachers' Responsibilities for the Development of Scientific Process Skills

Theme	Codes	Frequency
Teachers' Responsibilities for the Development of Scientific Process Skills	They should organize student-centered activities.	7
	They should ask open ended questions that would promote thinking and arouse interest.	7
	They should provide appropriate educational settings where students could ask questions and exchange ideas freely.	6
	They should guide the students.	6
	They should be fluent in theoretical knowledge on scientific process skills.	5
	They should allow students to conduct experiments.	1

Table 5 demonstrates that 7 preschool teachers stated that student-centered activities were among the responsibilities of teachers in the development of scientific process skills. Teacher OÖÖ9 stated the following concerning the responsibilities of teachers in the development of scientific process skills:

"Students should be active in the application process of the activity. Teachers should occupy the role of a guide in this process. Teachers are required to create adequate educational settings where students could develop their skills" (OÖÖ9).

Preschool teachers identified the responsibilities of teachers in the development of scientific process skills as asking open ended questions to promote thinking and arouse interest (f=7), providing appropriate educational settings where students could ask questions and discuss their ideas freely (f=6), providing guidance for students (f=6), achieving theoretical knowledge related to scientific process skills (f=5) and allowing students to conduct experiments (f=1).

Science activity syllabi were examined in detail to determine basic scientific process skills that preschool teachers included in the science activities and basic process skills aimed in the planning and implementation processes were identified.

Table 6: Levels-of-Use of Basic Scientific Process Skills in the Processes of Planning and Application of Science Activities

Basic Scientific Process Skills	BSPS in Course Syllabus		BSPS in application process	
	F	%	f	%
Observation	35	51,47	35	66,03
Prediction	21	30,89	12	22,64
Comparison	6	8,82	4	7,55
Classification(Categorization	5	7,35	2	3,78
Measurement/Calculation	1	1,47	0	0

Table 6 demonstrates the findings on the levels-of-use of basic scientific process skills in the planning and application processes of science activities by participating preschool teachers.

Participating preschool teachers stated that they would use observation, prediction, comparison, classification and measurement basic scientific process skills in the planning stage of science activities. However, an analysis of the application phase of these activities showed that they were not able to utilize basic scientific process skills as planned.

RESULTS AND DISCUSSION

The aim of the current study was to determine the views of preschool teachers on scientific process skills, and the basic scientific process skills they used in science activities.

Participating teachers defined scientific process skills as the skills that should be possessed to conduct research. However, scientific process skills are applicable to various fields, not only in scientific studies (Padilla, Okey and Garrard 1984; Padillla, 1990). Responses given by teachers about the definition of scientific process skills demonstrated that they had knowledge about these skills, albeit insufficient. These findings were parallel to the results of certain studies in literature (Yıldırım, Atila, Özmen and Sözbilir, 2013; Celep and Bacanak, 2013; Karslı, Şahin and Ayas, 2009).

It was identified that participating teachers did not fully know what were the sub dimensions of basic scientific process skills. Celep and Bacanak (2013) determined in a study they conducted that teachers were not able to express the sub-dimensions of basic scientific process skills.

Participating teachers expressed that development of scientific process skills in preschool science education is important in training science literate individuals. There are also other studies in literature which demonstrated that scientific process skills in science education were significant in training individuals with science literate characteristics (Celep and Bacanak, 2013; Yıldırım, Atila, Özmen and Sözbilir, 2013).

Preschool teachers participating in this study expressed that scientific process skills could be developed with student-centered activities. They have stated the responsibilities of teachers in the development of scientific process skills as organizing student-centered activities and asking open ended questions to students to promote thinking and arouse interest. In studies conducted by Yıldırım, Atila, Özmen and Sözbilir (2013), Türkmen and Kandemir (2011), and Celep ve Bacanak (2013), it was indicated that scientific process skills could be developed through student-centered activities.

In the content analysis conducted to determine the basic scientific process skills used by participating preschool teachers in science activities, it was identified that teachers preferred the scientific process skills of observation and prediction the most in their plans, however, the skills identified in the plans were not realized in the application process. It was identified in the activity plan analysis that teachers perceived observation, one of the basic scientific process skills, as enabling the students to watch the activity. In a study by Kefi, Çeliköz and Erişen (2013) conducted with 35 teachers, it was found that only 5 teachers supported students to observe, while the others wanted the students just to watch the activities instead of active observation in planned science activities. Öztürk Yılmaztekin and Tantekin Erden (2011) arrived at similar findings in the study they conducted.

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DIFFUSION OF M-LEARNING: AN ACCEPTANCE MODEL PROPOSAL

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ABSTRACT: The potential impact of mobile devices on higher education, our understanding of the issues surrounding the use of mobile technology for providing access to library and information resources, and their impact on lifelong learning opportunities are unclear and still evolving. Attempts to apply information adoption models to explain student use and intention to use audio, video, mobile services, and mobile learning have been limited and need further investigation to determine whether these models need modification to address mobile technology acceptance. This paper analyzes college students' acceptance attributes based upon Diffusion of Innovation (DOI) framework towards using the m-learning.

Keywords: m-learning, college students, diffusion of innovation, DOI, Sakarya University

INTRODUCTION

Mobile devices are found to be much more affordable than desktop computers and less expensive access to the Internet (even if the cost of connection is higher) (InfoDev, 2010). This increasing use of mobile devices in education enhanced by advances in mobile technology was studied by Fozdar and Kumar (2007) and Meister (2011). Nassuora (2013) reported a research that stated nine different activities students' performance in higher education setting, with their mobiles (Kennedy et al., 2008). However, the benefits gained from mobile services depend on the intentions of the students to use them for education purpose (Khanh & Gim, 2014).

Researchers across the globe have studied these theories for various technological innovations such as for e-learning context (Chang and Tung, 2008; Ndubisi, 2004; Lee, 2006), for online shopping (Vijayasarathy, 2004) and for Web- based information systems (Yi and Hwang, 2003). The m-learning is relatively a new field in Sakarya especially among students of a state university, up to our knowledge, no prior studies has been undertaken within the context of a state university students' intention to use the m-learning. So this paper tries to fill-in the gap by validating the Rogers' DOI to study the Sakarya university students' adoption to use smartphones for educational purpose.

THEORETICAL FRAMEWORK AND DEVELOPMENT OF HYPOTHESES

This section begins with an examination of the theoretical framework used in the research. Then related literature and a few studies in mobile learning are used to identify as what factors might influence adoption of mobile learning. An innovation is an idea, practice, or object that is perceived as new by an individual or other unit of adoption (Rogers, 2003). According to Rogers (2003), an innovation has five general attributes that influence adoption: relative advantage, compatibility, complexity, observability and trialability.

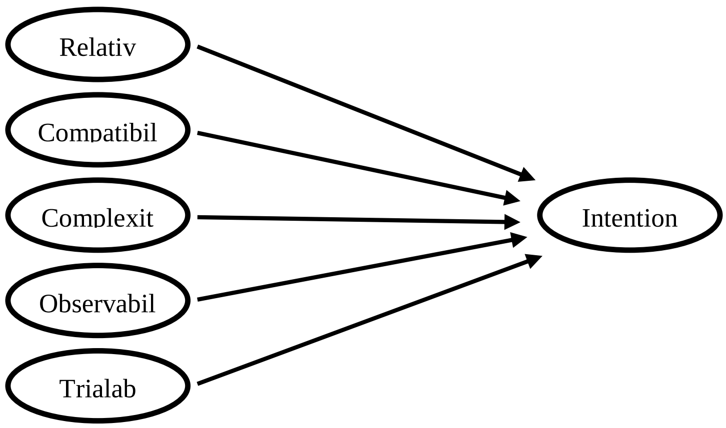

Figure 1. Research Model

Relative Advantage

Relative advantage refers to the degree to which an innovation is perceived as providing more benefits than its predecessor (Moore & Benbasat, 1991). Prior researches suggest that when user perceives relative advantage or usefulness of a new technology over an old one, they tend to adopt it (McCloskey, 2006; Rogers, 2003). This feature of Roger's topology has been studied by various researchers in the context of mobile banking adoption (Lin, 2011; Al-Jabri and Sohail, 2012); e-learning & blended learning (Tshabalala, et al. 2014); electronic commerce (Seyal and Rahman, 2003; Ndayizigamiye and McArthur, 2014); Web-supported instructions (Soffer et al. 2010) and mobile learning (Mcconatha et al. 2008). Therefore we hypothesize that:

H1: Relative advantage is positively associated with the students' intentions to use m-learning.

Compatibility

Clarke (2000) found ease of use to be one of the five significant factors that determined general use of wireless handheld devices. An individual might have a higher intention to adopt mobile learning if they think mobile learning is easy to operate. Again Lu and Viehland (2008) found a support in their m-learning study in New Zealand. Thus on that basis, we propose our second hypotheses:

H2: Compatibility is positively associated with the students' intentions to use m-learning.

Complexity

Cheung et al. (2000) defined complexity where an innovation could be considered relatively difficult to understand and use. They found that complexity influenced the adoption of Internet use. Chau and Hu (2001) and others had demonstrated that attitude towards using a technology was the significant determinant of behavioral intentions. A vast body of research had suggested that there was a strong support to ease the use of this new technology on its adoption (Luarn & Lin 2005; Wang et al. 2009). Chau and Hu (2001) also found that users were more likely to use new innovation if they had strong feelings of easiness with those innovations. Thus it is hypothesized:

H3: Complexity is negatively associated with the students' intentions to use m-learning.

Observability

Rogers (2003) defined the observability as the degree to which the results of an innovation are viable to others. Role modeling (or peer observation) is the key motivational factor in the adoption and diffusion of technology (Parisot, 1997). Similar to relative advantage, compatibility, and trialability, observability also is positively correlated with the rate of adoption of an innovation. Al-Jabri and Sohail (2012) used this in the context of mobile banking and found that it was significant. Thus it is hypothesized:

H4: Observability is positively associated with the students' intentions to use m-learning.

Trialability

According to Rogers (2003), trialability is the degree to which an innovation may be experimented with on a limited basis, where trialability is positively correlated with the rate of adoption. Therefore, more an innovation is tried, the faster its adoption. Potential adopters who were allowed to experiment with an innovation would feel more comfortable with it and were more likely to adopt it (Agarwal & Prasad, 1998; Tan & Teo, 2000). Thus it is hypothesized:

H5: Trialability is positively associated with the students' intentions to use m-learning.

CONCLUSION

This preliminary study on students' use of the m-learning was necessary because the m-learning in higher education institution is still at early stage. The proposed model suggests five constructs of the original DOI are strong predictors of students' intentions on m-learning. We therefore, could use the research model of the study for supporting research on developing m-learning technology for the students in future.

As in most researches containing a model proposal, this study has its weaknesses. Several limitations of this study qualify the findings and suggest direction for future research. The study is limited to its model. By readdressing and expanding the study with extended items from TAM 2, TAM3 and/or UTAUT, will bring further insight that will definitely help to improve the study.

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THE IMPACTS OF ANXIETY AND SELF-EFFICACY BELIEFS OF STUDENTS ON THE ACHIEVEMENT LEVELS ABOUT READING AND INTERPRETATION OF GRAPHS

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ABSTRACT: The aim of this study was to examine the effects of anxiety and self-efficacy beliefs of the eighth grade students on the achievement levels about the reading and interpretation of the frequency polygon and histogram. There were a total of 388 eighth grade students involved in this study. They attended to the study from four different middle schools. The researchers used three different instruments in the collection of the data. One of the instruments was a multiple choice statistics test that included 22 questions about the reading and interpretation of graphs and finding of the measures of both central tendency and dispersion. This test was developed by the researchers who piloted it and found its reliability of *Cronbach's alpha* value as 0.80. The researchers also used a math anxiety scale developed by Şentürk (2010) and a math self-efficacy beliefs scale developed by Umay (2002) in the study. After the collection of the data, the researchers employed the paired samples t-test, independent samples t-test and two-way ANOVA in the analysis of the data. The study demonstrated that the anxiety and self-efficacy levels of the 8^{th} grade students in mathematics had considerable effects on the students' achievement levels about the reading and interpretation of the frequency polygon and histogram. The study also indicated that there were positive relationships between the students' self-efficacy levels and the overall test scores. Furthermore, when their achievement levels were examined according to their anxiety levels, the achievement levels of the students on the test were found successively medium, low and high. The interaction of students' anxiety and self-efficacy levels did not influence the accomplishment levels of the students about the reading and interpretation of the graphs.

Key words: Statistics, graphs, anxiety, self-efficacy beliefs

INTRODUCTION

There are many factors, such as anxiety, gender, curricula, peer-interaction, self-confidence, parental support, self-efficacy, use of technology, knowledge of teacher, and so forth that play important roles on the achievements of students in mathematics (e.g., Baloğlu, 2001; Ashcraft, 2002; Forgasız, 2005; Halat, Jakubowsi & Aydın, 2008). For instance, anxiety is one of most influential factors on student's learning. Because of the math anxiety, many students do not like mathematics and escape from studying mathematics to other subject areas. According to Baloğlu (2001), although math anxiety was a prominent factor on students learning, it did not take much attention of math educators until 1970s. There can be found many definitions for math anxiety in the literature (i.e., Richardson & Suinn, 1972; Tobias, 1993; Ashcraft & Faust, 1994; Tooke & Leonard, 1998; Ashcraft, 2002; McAnallen, 2010). For instance, Richardson and Suinn (1972) defined mathematical anxiety as feelings of tension, nervousness, or fear that constrains success in math. Ashcraft (2002) stated "Math anxiety is commonly defined as a feeling of tension, apprehension, or fear that interferes with math performance." (p.181). Moreover, several researchers (i.e., Tooke & Leonard, 1998) claim that math anxiety, an important emotional factor, negatively affect students' learning and causes negative attitudes toward mathematics. Baloğlu (2001) states that there might be different factors, such as gender, age, socioeconomic statues, teaching style, personality, and so on that may cause math anxiety.

Furthermore, self-efficacy is also very important factor on the students' achievement in mathematics. Self-efficacy can be defined as the belief of an individual in his or her ability to show necessary behaviors to reach or complete specific achievements (Bandura, 1977, 1986, 1997). Moreover, it reflects confidence in the capacity to use the motivation, knowledge and skills. According to the several research findings (Bandura, 1995; Schunk, 1996; Aşkar ve Umay, 2001), self-efficacy beliefs affect people's thoughts, behaviors, activities, choices, and efforts. Research findings support the claims of Bandura. For example, Aşkar & Umay (2001) expressed that individuals with high self-efficacy perception of any situation were persistent and patient, they made great efforts to accomplish a task and they did not easily return back when they faced with difficulties. In this study, the researchers focused on the impacts of the math anxiety and self-efficacy beliefs of the eighth grade students on their achievements in graph reading and interoperations.

Purpose of the Study

The aim of this study was to examine the effects of anxiety and self-efficacy beliefs of the eighth grade students on the achievement levels about the reading and interpretation of the Frequency Polygon and Histogram.

METHOD

Participants

There were a total of three hundred eighty-eight 8^{th} grade students involved in this current study. The participants were from four different middle schools located in the city center of Aydın. The researchers used the convenience sampling procedure in the selection of the participants. This sampling procedure was the most commonly used one in todays' educational research studies (McMillan, 2000; Wiersma, 2000). The participants were classified into three groups, low SES, middle SES and high SES, based on their schools.

Data Collection & Analysis Procedures

The researchers used a multiple choice statistics test that included 22 questions, 9 questions about Frequency Polygon that was drawn based on the test scores of students taken from a math test, 9 questions about the Histogram that was drawn based on the time spent on the social media, and 4 questions about the standard deviation. These questions were about the reading and interpretation of the graphs and finding of the measures of both central tendency and dispersion. Both Frequency Polygon and Histogram had similar questions. For instance, "How many students got 50 points on the Math test?," "How many students got 60 or below 60 points on the Math test?," and so on. This statistics test was developed by the researchers who piloted it and found its reliability of *Cronbach's alpha* value as 0.80.

The researchers also used a math anxiety scale developed by Şentürk (2010) and a math self-efficacy beliefs scale developed by Umay (2002) in the study. After the collection of the quantitative data, the researchers used the paired samples t-test, independent samples t-test and two- way ANOVA in the analysis of the data.

Table 1. Rubric For The Assessment Of The Levels

Self-Efficacy Levels			**Anxiety Levels**		
14-32	**1**	Low	**22-51**	**1**	Low
33-51	**2**	Medium	**52-81**	**2**	Medium
52-70	**3**	High	**82-110**	**3**	High

RESULTS AND FINDINGS

Types of Graphs & Gender Issue

Table 2. Paired Samples T-Test Results For The Graph Reading And Interpretation

Achievement levels	N	$\bar{X}$	SD	df	t	p
Frequency Polygon - Reading & Interpretation	388	4,14	0,71	387	3,475	0,001
Histogram- Reading & Interpretation	388	3,95	0,95			

According to the paired samples t-test results shown on Table 2, the mean score of the eighth grade students was numerically lower on the Histogram than the Frequency Polygon. This numerical difference was statistically significant [$t_{(387)}$=3.475 and p=0.001 < α=0.05]. In other words, the 8^{th} grade students in this study showed greater performance in reading and interpretation of the questions on the Frequency Polygon than the Histogram. Furthermore, Table 3 demonstrated that even though the mean scores of girls in regard to total test scores was numerically higher than that of boys, this numerical difference was not statistically significant [$t_{(387)}$= -1.462 and p=0.145>α=0.05]. That is, both 8^{th} grade boys and girls performed equally on the graphs based on their total test scores.

Table 3. Independent Samples T-Test Results About The Total Test Scores For Gender

Variable	**Gender**	**N**	$\bar{X}$	**SD**	**df**	**t**	**p**
Total Test Score	Boys	155	67,06	16,16	386	-1,462	0,145
	Girls	233	69,27	13,39			

The Effects Of Anxiety And Self-Efficacy Levels On The Students Achievements In Graphs

According to descriptive statistics shown on Table 4; when the students had low anxiety level, their mean scores on the test increased from low self-efficacy level to high self-efficacy level. There can be seen the similar results for the medium and high anxiety levels, too. But, when the students had high self-efficacy level and low anxiety level, they had the highest mean score on the statistic test. When the students had high self-efficacy level and high anxiety level, their mean score on the test were higher than they had high self-efficacy level and medium anxiety level. This is interesting. In reality, it should be vise-versa.

Table 4. Descriptive Statistics About The Anxiety And Self-Efficacy Levels Based On The Test Scores

		Anxiety											
		Low			Medium			High			Total		
		N	$\bar{X}$	SD	N	$\bar{X}$	SD	N	$\bar{X}$	SD	N	$\bar{X}$	SD
Self-efficacy	Low	22	68,18	13,30	16	63,06	15,01	5	64,54	15,54	43	65,85	14,07
	Medium	50	66,90	15,28	171	66,26	14,22	35	65,58	14,84	256	66,29	14,46
	High	13	84,96	11,49	18	70,45	12,59	58	75,15	12,31	89	75,63	12,86
Total		85	70	15,51	205	66,38	14,17	98	71,19	14,11	388	68,39	14,58

Table 5. Two-Way ANOVA Results About the Anxiety and Self-Efficacy Levels Based On the Test Scores

Source	Sum of Squares	df	Mean Square	F	p
Self-efficacy	5334,999	2	2667,499	13,597	0,000
Anxiety	1591,871	2	795,936	4,057	0,018
Anxiety* Self- efficacy	1253,536	4	313,384	1,597	0,174
Error	74350,948	379	196,177		
Total	1897231,405	388			

Two-way ANOVA indicated that there were statistically significant differences found in reference to both the anxiety and self-efficacy beliefs among the groups, but the interaction of both variables anxiety and self-efficacy beliefs did not influence the students' achievements on the statistic test. Scheffe test results indicated that there was a statistically significant difference detected with regard to the anxiety level between the students who had medium anxiety level and the students who had high anxiety level, but there were no statistically significant differences found for the other levels (see Table 6). In fact, one would expect that anxiety has negative effects on the students' success in mathematics. In this case, the students who had high anxiety level had high test score on the statistics test. It might be because of the fact that the participants of this study took this statistics test before the TEOG Exam which may have affected these students.

Table 6. Post Hoc Scheffe Test Results Based On the Anxiety Levels

Anxiety	Anxiety	Mean Differences	SE	p
Low	Medium	3,6142	1,80	0,137
	High	-1,1967	2,07	0,847
Medium	Low	-3,6142	1,80	0,137
	High	-4,8109*	1,72	0,021
High	Low	1,1967	2,07	0,847
	Medium	4,8109*	1,72	0,021

*: p< α= 0.05

Table 7. Post Hoc Scheffe Test Results Based On the Self-Efficacy Levels

Self-efficacy	Self-efficacy	Mean Differences	SE	p
Low	Medium	-0,7580	2,331	0,949
	High	-10,0540*	2,622	0,001
Low	Low	0,7580	2,331	0,949
	High	-9,2960*	1,722	0,000
Low	Low	10,0540*	2,622	0,001
	Medium	9,2960*	1,722	0,000

The Scheffe test results about the self-efficacy levels pointed out that there were statically significant differences found in regard to self-efficacy beliefs between the students who had low self-efficacy levels and the students who had high self-efficacy levels, and between the students who had medium self-efficacy levels and the students who had high self-efficacy levels on the test (see Table 7). In other words, this study showed that students' self-efficacy levels had positive effects on the students' test scores. One would say that there were positive relationships between the students' self-efficacy levels and achievements levels on the statistics test.

CONCLUSION

The findings of this current study showed that the anxiety and self-efficacy levels of the eighth grade students on the statistics test had considerable effects on the students' achievements about the reading and interpretation of the Frequency Polygon and Histogram. Furthermore, when their achievement levels were examined based on their anxiety levels, the achievement levels of the students on the statistics test were found successively medium, low, and high. One would expect that we could match low anxiety level with high math score and high anxiety level with low math score. There is a contradiction with the order of achievement levels based on the anxiety levels found in this study. In this study, the 8^{th} grade students who had high anxiety levels got the highest test scores. It seems that these successful students had anxiety level because of the fact that they were supposed to take the TEOG Exam which may have caused to increase their anxiety levels.

The study also indicated that there were positive relationships between the students' self-efficacy levels and achievement levels on the statistics test. In other words, the students who had low self-efficacy levels had low test scores, or the students who had high self-efficacy levels got high achievement levels on the test. This supports the arguments of several researchers (i.e., Ryan & Pintrich, 1997; Dev, 1998) who stated that there were positive correlations between the student's achievements and motivational levels in mathematics. There were also positive relationships between self-efficacy levels and achievements in mathematics. But, the interaction of students' anxiety and self-efficacy levels did not influence the accomplishment levels of the students about the reading and interpretation of the graphs.

Moreover, this current study pointed out that the participants of this study performed better on the Frequency Polygon than Histogram. This result is not in contrast with finding of Kaynar & Halat (2012) who found similar results about the reading and interpretation of 8^{th} graders on the statistics test included Frequency Polygon, Histogram, and Pie graph. Besides, gender was not a prominent factor on the students test scores. This finding is also lined up with the results of several research studies (e.g., Friedman, 1994; Fennema & Hart, 1994; Halat, 2011; Kaynar & Halat, 2012; Selamet & Halat, 2014).

In short, this current study indicated that both math anxiety and self-efficacy beliefs of the eighth grade students had significant impacts on the students' achievement levels on the statistics test. Gender was not a great factor on the students overall test scores.

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THE INFLUENCE OF GENDER, TEOG EXAM SCORES AND SOCIOECONOMIC STATUS ON THE ACCOMPLISHMENT OF STUDENTS REGARDING READING AND INTERPRETATION OF THE FREQUENCY POLYGON AND HISTOGRAM

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ABSTRACT: The aim of this current study was to investigate the effects of variables, such as gender, TEOG exam scores and socio-economic status on the 8th grade students about the reading and interpretation of the Frequency Polygon and Histogram. The study included 388 eighth grade students who were from four different middle schools. The researchers used a multiple choice statistics test in the collection of the data. This test contained 22 questions about the reading and interpretation of graphs and finding of the measures of both central tendency and dispersion. This test was developed by the researchers who piloted it and found its reliability of *Cronbach's alpha* value as 0.80. In the analysis of the data, the researchers used the paired samples t-test, independent samples t-test and two- way ANOVA. The study pointed out that the participants of this study were more successful in reading and interpretation of Frequency Polygon than Histogram. There was no statistically significant difference found with regard to the value of mode in both types of graphs between the achievement levels of the students. However, the study also indicated that the participants were more successful on the items that required the interpretations of standard deviations than the items which required the computation of standard deviations. Moreover, although gender was not a great factor on the accomplishment levels of the participants on the test, both TEOG exam scores and socio-economic status played prominent roles on the students' achievements on the test. There was a positive relationship between the students' achievement levels and socio-economic status on the statistics test.

Key words: Gender, socioeconomic status, TEOG exam scores, graphs

INTRODUCTION

Research has documented that there have been many research studies done with students at different school levels on various issues, such as problem solving, performance, motivation, gender, effects of technology, parental support, peer-interactions and so on, in teaching and learning of different areas of mathematics, such as geometry, statistics, algebra, trigonometry and so forth for many years (e.g., Ethington, 1992; Middleton & Spanias, 1999; Thompson & Senk, 2001). Nowadays, in particular, many researchers and educators dealing with mathematics education have focused on the difficulties of students, spent more time, tried to find the possible solutions to these difficulties and helped the students overcome their learning difficulties in mathematics. For instance, curriculum change is one of the most important factors that influence the achievements and motivation of students from primary school level to undergraduate level in mathematics (i.e., Romberg & Shafer, 2003; Halat, Jakubowski & Aydın, 2008).

There can be seen many reform-based movements in curriculum change in many countries in the world and also in Turkey since 1980s (i.e., Billstein & Williamson, 2003; Chapell, 2003; Halat, 2007). Connected Mathematics Project (CMP), MATH Thematics, and Mathematics in Context were the middle school standard-based mathematics curricula funded by National Science Foundation (NSF) (e.g., Ridgway, Zawojewski, Hoover, & Lambdin, 2003; Chapell, 2003; Romberg & Shafer, 2003; Billstein & Williamson, 2003). These middle school mathematics curricula come up with different perspectives in teaching and learning of mathematics. The standard-based math curricula were shaped with several educational theories and strategies, such as van Hiele theory, multiple representations, and so on (c.f., Reys et al., 2003). They covered the similar mathematical strands. For instance, the mathematics in context (MiC) covered the following mathematical strands: "-number (whole numbers, common fractions, ratio, decimals fractions, percents, and integers), -algebra (creation of expressions, tables, graphs, and formulas from patterns and functions), -geometry (measurement, spatial visualization, synthetic geometry, coordinate and transformational geometry), and – statistics and probability (data visualization, chance, distribution and variability, and qualifications of expectations)" (p.225). These standard-based middle school mathematics curricula had positive effects on the students' performance and motivation in mathematics (Billstein & Williamson, 2003; Halat, 2006; Halat, Jakubowski & Aydın, 2008).

Reform movements in the world and the great effects of the standard-based mathematics curricula on the students positively influenced and encouraged the Ministry of Education in Turkey to take action and renew the math curricula for primary, middle and high schools (Halat, 2007). The middle school math curriculum included the five strands; numbers and operations, algebra, geometry and measurement, data analysis, and probability. There have been many research studies done on the different part of this math curriculum since it was developed (e.g., Taşpınar & Halat, 2008; Kaynar & Halat, 2012; Selamet & Halat, 2014; Bunar, Halat & Bahar Erşen, 2014). In this study, the researchers focused on the data analysis part of the middle school mathematics curriculum.

Purpose of the Study

The aim of this current study was to investigate the effects of variables, gender, TEOG exam scores and socio-economic status (SES), on the achievements of 8th grade students about the reading and interpretation of the Frequency Polygon and Histogram.

METHOD

Participants

There were a total of 388 eighth grade students involved in this current study. The participants were from four different middle schools located in the city center of Aydın. The researchers used the convenience sampling procedure in the selection of the participants. This sampling procedure was the most commonly used one in todays' educational research studies (McMillan, 2000; Wiersma, 2000). The participants were classified into three groups, low SES, middle SES and high SES, based on their schools.

Data Collection & Analysis Procedures

The researchers used a multiple choice statistics test that included 22 questions, 9 questions about Frequency Polygon that was drawn based on the test scores of students taken from a math test, 9 questions about the Histogram that was drawn based on the time spent on the social media, and 4 questions about the standard deviation. These questions were about the reading and interpretation of graphs and finding of the measures of both central tendency and dispersion. Both Frequency Polygon and Histogram had similar questions. For instance, "How many students got 50 points on the Math test?," "How many students got 60 or below 60 points on the Math test?," and so on.

This statistics test was developed by researchers who piloted it and found its reliability of *Cronbach's alpha* value as 0.80. After the collection of the quantitative data, the researchers used the paired samples t-test, independent samples t-test and two- way ANOVA in the analysis of the data.

RESULTS AND FINDINGS

Graph Reading and Interpretations

Table 1 below showed that the mean score of the eighth grade students was numerically higher on the Frequency Polygon than Histogram. This numerical difference was statistically significant [$t_{(387)}$=3.475 and p=0.001 < α=0.05]. That is, the participants of this study were more successful in reading and interpretation of the questions on the Frequency Polygon than the Histogram. This result supports the findings of several research findings (e.g., Kaynar & Halat, 2012; Selamet & Halat, 2014) who found similar results for the middle school students about the reading and interpretation of graphs. Furthermore, there can be seen numerical differences in terms of students' mean scores of median and range between the Frequency Polygon and Histogram. These numerical differences were statistically significant [$t_{(387)}$=3.327 and p=0.001 < α=0.05; $t_{(387)}$=15.618 and p=0.000 < α=0.05] favoring the graph, Frequency Polygon. On the other hand, although there were mean score differences of the participants about the value of mode between the Frequency Polygon and Histogram, this difference was not statistical significant [$t_{(387)}$=1.399 and p=0.163> α=0.05].

Likewise, paired samples t-test results for the standard deviation (SD) indicated that the participants performed better on the questions about the interpretation than the questions regarding computation (see Table 2).

Table 1. Paired Samples T-Test Results For The Graph Reading And Interpretation

Achievement levels	N	$\bar{X}$	SD	df	t	p
Frequency Polygon (line graph)- Reading & Interpretation	388	4,14	0,71	387	3,475	0,001
Histogram- Reading & Interpretation	388	3,95	0,95			
Frequency Polygon-Mode	388	2,70	2,23	387	1,399	0,163
Histogram -Mode	388	2,49	2,26			
Frequency Polygon -Median	388	2,31	2,27	387	3,327	0,001
Histogram -Median	388	1,86	2,23			
Frequency Polygon -Range	388	3,47	1,92	387	15,618	0,000
Histogram -Range	388	1,73	1,21			

Table 2. Paired Samples T-Test Results For The Standard Deviation

	N	$\bar{X}$	SD	df	t	p
Standard Deviation – Computation	388	2,36	1,52	387	-2,649	0,008
Standard Deviation - Interpretation	388	2,62	1,68			

Findings about the Gender

Table 3 indicated that although there was numerical difference found with reference to the total test score between the mean scores of boys and girls, this numerical difference was not statistically significant [$t_{(387)}$= -1.462 and p=0.145>α=0.05]. Similarly, although there were numerical differences detected in regard to students' mean scores for both graphs between boys and girls, these numerical differences were not statistically significant [$t_{(387)}$= -1.176 and p=0.145>α=0.05 ; $t_{(387)}$=0.357 and p=0.240> α=0.05]. In other words, both 8th grade boys and girls performed equally on the Frequency Polygon and Histogram about the items that required reading and interpretation on the graphs. Gender was not a great factor on the students' accomplishments in graph reading and interpretations.

Table 3. Independent Samples T-Test Results About The Gender For The Variables

Variables	Gender	N	$\bar{X}$	SD	df	t	p
Frequency Polygon - reading and interpretation	Boys	155	4,08	0,74	386	-1,176	0,145
	Girls	233	4,17	0,68			
Histogram – reading and interpretation	Boys	155	3,98	0,95	386	0,357	0,240
	Girls	233	3,94	0,95			
Total Test Score	Boys	155	67,06	16,16	386	-1,462	0,145
	Girls	233	69,27	13,39			

The Effects Of Variables, Socioeconomic Status (SES) And TEOG Exam Scores

Table 4 about the descriptive statistics demonstrated that there can be seen mean scores differences based on the TEOG exam scores and socioeconomic status (SES). For instance, when we looked at the total test scores of the students labeled as high SES, their test scores increased as their TEOG Exam scores also increased.

Table 4. Descriptive Statistics About The Reading And Interpretation Of Graphs For SES & Teog Exam Score

	Test Scores about the Socioeconomic Levels											
	High SES			Middle SES			Low SES			Total		
	N	$\bar{X}$	SD	N	$\bar{X}$	SD	N	$\bar{X}$	SD	N	$\bar{X}$	SD
TEOG Exam Scores 0-45	55	65,78	15,57	58	66,55	12,75	84	60,82	11,90	197	63,01	13,36
46-55	13	68,18	11,58	12	66,66	15,17	12	63,25	9,58	37	66,09	12,14
56-70	21	69,91	12,81	11	72,72	11,31	5	70,90	14,58	37	70,88	12,33
71-85	30	72,42	14,81	8	74,43	7,65	7	70,77	13,34	45	72,52	13,39
86-100	57	80,38	13,14	10	80,00	11,37	5	81,81	11,13	72	80,42	12,64
Total	176	72,31	15,19	99	67,49	13,48	113	63,07	12,71	388	68,39	14,58

According to the ANOVA results shown on Table 5, while there were no statistically significant differences found about the socioeconomic status (SES) and interaction of both SES and TEOG exam scores between the groups, there was a statistically significant difference detected for TEOG exam scores. Regardless of socio-economic status of students, post Hoc Scheffe test results indicated that there were statistically significant differences found regarding the total test scores between the students who had TEOG exam scores, 86-100, and the students who had other levels of TEOG exam scores. Similarly, there were statistically significant differences detected about the total test scores between the students who had lowest TEOG exam scores (0-45) and the students who had the TEOG exam scores above 45 (see Table 6).

Table 5. Two-Way ANOVA About Reading And Interpretation Of Graphs For Socio -Economic Level & Teog Exam Score

Source	Sum of Squares	df	Mean Square	F	p
TEOG Exam Score	9234,269	4	2308,567	13,47	0,00
Socio -economic Level	113,608	2	56,804	0,33	0,71
TEOG Exa.S.* Socioeco. L.	403,070	8	50,384	0,29	0,96
Error	63892,744	373	171,294		
Total	1897231,405	388			

Table 6. Post Hoc Scheffe Results Based On Teog Exam Scores

TEOG Exam Scores	TEOG Exam Scores	Mean Differences	SE	p
0-45	46-55	-3,0800	2,345	0,786
	56-70	-7,8711*	2,345	0,025
	71-85	-9,5119*	2,162	0,001
	86-100	-17,4159*	1,802	0,000
86-100	0-45	17,4159*	1,802	0,000
	46-55	14,3359*	2,647	0,000
	56-70	9,5448*	2,647	0,012
	71-85	7,9040*	2,487	0,041

*: p< α= 0.05

Table 7. Post Hoc Scheffe Test Results Based On The Socioeconomic Status Levels (SES)

SES	SES	Mean Differences	SE	p
High SES	Middle	4,8209*	1,64	0,014
	Low	9,2408*	1,57	0,000
Middle SES	High	-4,8209*	1,64	0,014
	Low	4,4199	1,80	0,051
Low SES	High	-9,2408*	1,57	0,000
	Middle	-4,4199	1,80	0,051

Moreover, although there was no statistically significant difference found for the variable, socioeconomic status (SES), the Scheffe test results indicated that there were statistically significant differences detected about the test scores between the students who had high SES and the students who had both middle and low SES. In other words, the socioeconomic status (SES) had positive effects on students' achievements levels in both graphs.

CONCLUSION

The current study documented that the participants of this study were more successful in reading and interpretation of the questions on the Frequency Polygon than the Histogram. This result supports the findings of several research studies (i.e., Kaynar & Halat, 2012; Selamet & Halat, 2014). For instance, Kaynar & Halat (2012) stated that the eighth grade students involved in their study were successful in the following order, firstly in the frequency polygon, secondly in the histogram, and thirdly in the pie graph. Although their study was done with fifth grade students, the findings of Selamet & Halat (2014) showed that regardless of graph types, frequency polygon and bar graph, there was no statistically significant difference found with regard to students 'graph reading and interpreting.

Furthermore, the current study pointed out that the 8th grade students showed greater performance on the frequency polygon about the items, median and range, than the Histogram. The study also indicated that the participants were more successful on the items that required the interpretations of standard deviations than the items which required the computation of standard deviations.

There were many factors that affected students' success in mathematics. Forgasız (2005) highlighted the importance of searching the effects of gender on students' achievements in mathematics. Therefore, this current study examined the influence of gender on students' graph reading and interpretation. Moreover, although gender was not a great factor on the accomplishment levels of the participants on the test, both TEOG exam scores and socio-economic status (SES) played prominent roles on the students' achievements on the test. There was a positive relationship between the students' Teog Exam Scores and socio-economic status on the statistics test. This result was not in contradiction with the findings of several research studies (e.g., Friedman, 1994; Fennema & Hart, 1994; Selamet & Halat, 2014). For example, Selamet & Halat (2014) claimed that although 5th grade boys performed better on the frequency polygon than girls, there was no statistically significant difference found in reference to the students' graph reading and interpreting on the bar graph between boys and girls. Likewise, the current finding about the gender was lined up with the claim of Kaynar & Halat (2012) who found that in reading and interpretations of the graphs there was no statistically significant difference detected between boys and girls. They also stated that while the math interest as a variable played important role on the students' success in reading and interpretation of the graphs, family- support as a variable was not an influential factor on the students' success.

The findings of the current study imply that the eighth grade students were more successful on the Frequency Polygon than Histogram. In other words, the eighth grade students had difficulties in solving the questions on the Histogram. Therefore, the in-service mathematics teachers should spend more time on the Histogram and solve more questions on the Histogram.

As a conclusion, the participants of this study indicated that 8^{th} grade students showed greater performance on the questions that required reading and interpretations on the Frequency Polygon than the questions which required reading and interpretations on the Histogram. Moreover, even though gender was not an influential factor on the students' achievements on the graphs, both TEOG exam scores and socioeconomic status (SES) played important roles on the students' achievements on the test.

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MAXIMIZING THE GAINS OF COMPUTER ASSISTED INSTRUCTION IN MATHEMATICS TEACHING

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ABSTRACT: The use of computer Assisted Instruction has positive effect in the academic achievement of students in Mathematics. Against this background, the study sought to determine the extent of the utilization of Computer Assisted Instruction in the teaching of Mathematics in the Secondary Schools in Nigeria. The study was carried out in Ika South and Ika-North East Local Government Areas of Delta state, Nigeria. All the Mathematics teachers in the schools were used for the experiment. They were 80 Mathematics teachers made up of 42 males and 38 females. A descriptive survey design was adopted while the research instrument was questionnaire. Five research questions guided the study and the research questions were addressed using graphs, percentage and frequency counts. Three hypotheses were formulated which were tested with t-test statistical tool at 0.05 level of significance. The result of the study indicated that teachers possess knowledge of computer and they have computer sets in their schools but no power supply for their usage. Furthermore, the teachers do not teach Mathematics contents using computer. It was also found that Gender and School location (Urban and Rural Areas) have no influence in the use of Computer Assisted Instruction. Adequate recommendations were made, among which; are that Mathematics teachers should be giving In-Service training by Government on the use of computer to teach Mathematics, they should be encouraged to use computer in the teaching of Mathematics and that schools should be provided with adequate power supply.

Keywords: Maximizing, Computer, Mathematics, Teachers.

INTRODUCTION

In Nigeria, Mathematics is a compulsory subject at the Nursery, Primary and Secondary educational levels. As a result, great emphasis is placed on its teaching and learning. The all-important subject plays significant role in the development of Science and Technology which is the key of National Development (Onwuka and Koko, 2010). In otherwords, no Mathematics, no Science and no Technology.

In the world today, Information, Communication and Technology (ICT) has become a vital tool in the infrastural and economical development of nations(Olowo and Bitrus,2012). To them, ICT is the Scientific, technological and engineering tool used in handling of information, processing applications related to computer.
House(2003) noted the motivational power of computer towards the teaching and learning of Mathematics and averred that children enjoy learning Mathematics with computer which accelerates into higher academic achievement. Similarly, Dugdale (1990) and Etukudo (2009) also asserted that the use of computer Assisted Instruction has a significant positive effect in the academic achievement of students in Mathematics.
As indicated in the National Policy on Education by Federal Republic of Nigeria (2004), one of the National educational goals is "the training of the mind in the understanding of the world around". The National Policy further stressed the fact that in order to realize fully the potentials of educational contributions to the development of the nation, modern educational techniques shall be increasingly used and improved upon in schools at all educational levels. Globally, the modern educational technique is the use of Computer Assisted Instruction in the teaching and learning process.

In Nigeria, the performance of Mathematics is poor at all educational levels; particularly at secondary school level and teacher rates high among other factors militating against poor performance(Agashi and Enemali, 2015). The use of Computer Assisted Instruction(CAI) with all its benefits improves students performance. No educational level can arise above its teachers and teachers hold the key to National development. Against this background, one would want to investigate into the extent of application of Computer Assisted Instruction in the teaching of Mathematics in the Nigeria secondary schools. In other words to investigate whether they are computer literate and to verify the extent of the application of their knowledge in teaching Mathematics. Additionally, gender analysis was carried out in order to verify if female and male Mathematics teachers exhibit differential knowledge in using CAI to teach Mathematics. The researcher also investigated whether the teachers in urban and rural schools possess the same knowledge of CAI in Mathematics.

Statement of Problem

Mathematics is an important and compulsory subject in Nigeria at the nursery, primary and secondary educational levels. The performance of students at these levels has been poor. Many reasons have been adduced for the poor performance, among which teachers factors rates the highest.

Federal Government of Nigeria(FGN) has laid emphasis on the use of modern educational techniques of teaching which can accelerate to improved performance. The use of Computer Assisted Instruction in the classroom is one the modern educational techniques. The problem therefore is: "how many secondary Mathematics teachers are computer literate and arecomputer instruction in teaching Mathematics"?

Purpose of Study:

The purpose of the study is to investigate the extent of the usage of Computer Assisted Instruction in the teaching of Mathematics in the classroom.

Specifically, the Study Focused on:

1. The extent Mathematics teachers possess the knowledge of computer.
2. The availability of computers and power supply in the schools.
3. The application of CAI in the teaching of some specified Mathematics topics.
4. Differential analysis of female and male Mathematics teachers in using CAI.
5. Differential analysis of urban and rural Mathematics teachers in the use of CAI

Research Questions:

1. To what extent do Mathematics teachers posses knowledge of computers?
2. To what extent are computers available in schools?
3. What is the level of mathematics Teachers' competence in the use of computers in teaching Mathematics?
4. Will there be difference between Male and Female Mathematics Teachers in the use of computers in teaching Mathematics?
5. Will there be difference between Urban and Rural Mathematics teachers in the use of Computers in teaching Mathematics?

Hypothesis:

Ho1: There is no significant difference in the use of Computers by Mathematics Teachers in the teaching of Mathematics.
Ho2: There is no significant difference between Male and female Mathematics teachers in the use of computers in teaching mathematics.
Ho3: There is no significant difference between Urban and Rural Mathematics teachers in the use of computers in teaching Mathematics.

METHODOLOGY

The Research design adopted for this study was a descriptive survey design. The study was carried out in Delta State and two local Areas were used for the study. They are Ika North-east and Ika South. All the Mathematics teachers in the two the local Government Areas were used. They are 17 public secondary schools in ika south, while Ika North-east has 16.

The Instrument used for data collection was questionnaire; made up of 20 items with "Yes" and "No" as options. The instrument was validated by experts in Mathematics Education. The experts' views and suggestions were employed and affected in getting the final draft of the instrument. The questionnaires were administered to the Mathematics teachers in the 33 public secondary schools.
In analyzing the data collected, three research questions were answered and graph, while 2 were answered with frequency count. The 3 null hypotheses were tested using t-test statistical tool at 0.05 significant level.

INTERPRETATION OF RESULT

Research Question 1

To what extent do mathematics teachers possess Knowledge of Computer?
Using simple percentage, the graph below shows the responses of teachers on their knowledge of Computer.

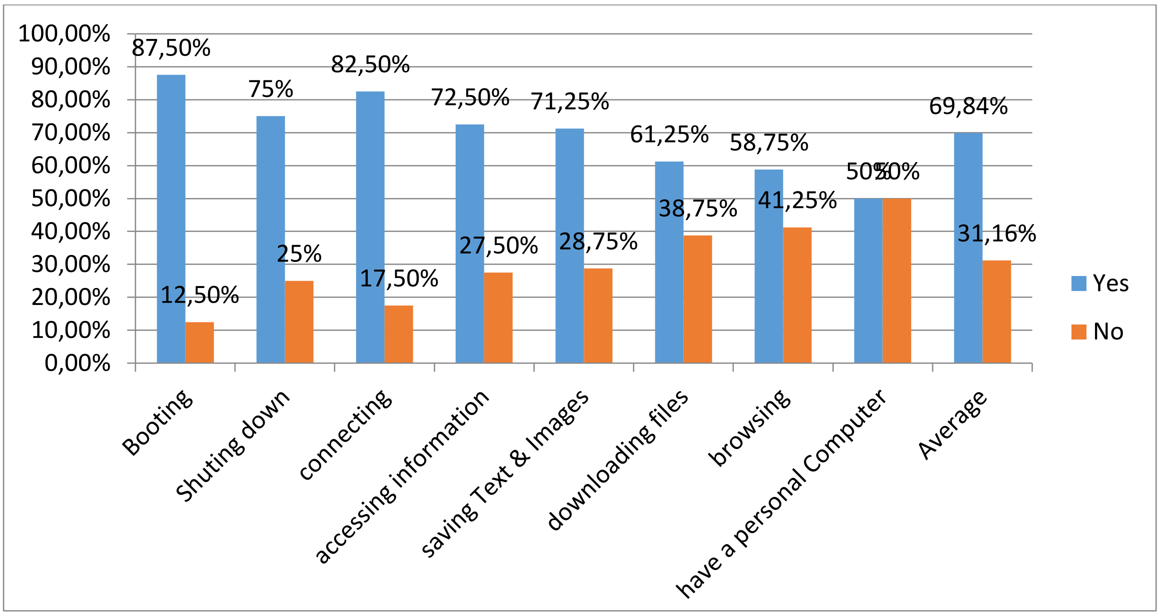

Figure 1: Mathematics teachers Knowledge of Computer

The knowledge of mathematics teachers on computer was accessed using different items in the scale. On the ability of mathematics teacher to boot a computer, the figure 1 shows that 87.50% of the teachers accessed could boot a computer while 12.50% of them cannot. Although 87.50% of the mathematics teachers can boot a computer, only 75% can shut down a computer, while 25% cannot shut down a computer properly. The figure shows that 82.50% of the teachers can connect a computer, 72.50% of them can access information on the computer. In using the computer to save text and images, 71.50% can do that while only 61.25% can download file using a computer; 58.75% can browse using the computer and only 50% of the teachers accessed had personal computer. In all, it was observed that mathematics Teacher have a good Knowledge of computer. As more than 50% (69.84%) of the teacher accessed had a good knowledge of computer.

Research Question 2

To what extent are computer available in Schools?

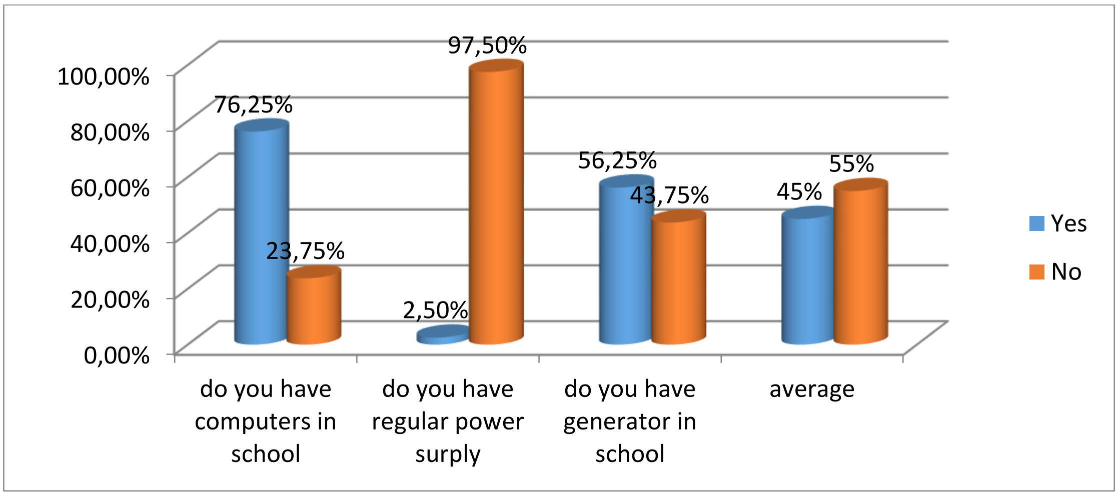

Fig 2. Availability of Computers in schools.

In answering the questions, if computers are available in schools, the figure shows that 76.25% of the teachers accessed had computers in their schools, but only 2.50% had regular power supply to use them and 56.25% had generators their schools to use these computer. From the figure 2, it will be concluded that though computer are available in schools, they are not being used due to lack of power supply.

Research Question 3:

What is the level of Mathematics Teachers' Competent in the use of computers in teaching mathematics?

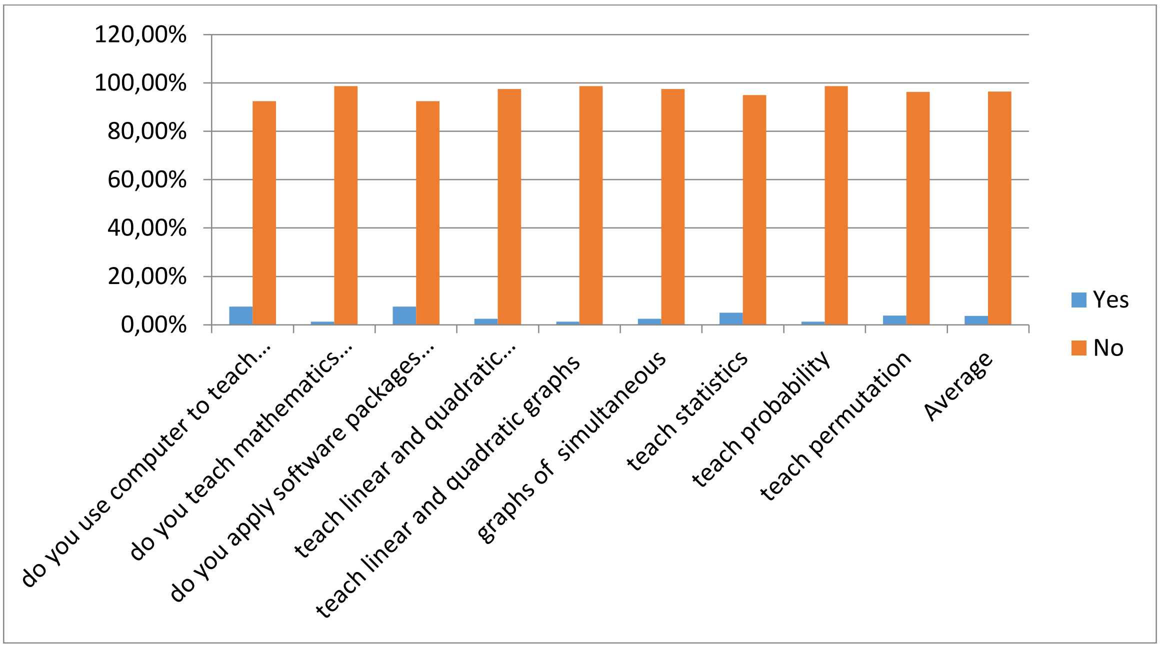

Figure 3: Mathematics Teachers Competence in the use of computer to teach mathematics

From the figure, only 7.5% of the teachers can teach Mathematics with computer while only 1.25 teaches Mathematics using projector. Further more, in the area of contents teaching, the result indicates that 2.5% teach quadratic equations using computer, 1.25% teach quadratic graphs while 2.5% of the teachers use computer in teaching simultaneous equations. Similarly, 5% of the teachers teach Statistics using computer, 1.25% teach Probability and 3.75 teach Permutation and Combination using computer. On the average, 3.61% of the teachers teach Mathematics contents in the classroom while 96.39% do not. Hence, one may conclude that, though computers are available in the schools but the Mathematics do not use computer to teach Mathematics.

Research Question 4:

Will there be any difference between male and female mathematics teachers in the use of computers in Teaching Mathematics?

Table 1: Difference between male and female mathematics teachers in the use of computer to teach mathematics

	Items	Male		Female	
		Yes	No	Yes	No
1	Do you use computers to teach mathematics?	3	39	2	36
2	Do you teach Mathematics with a computer using projectors?`	1	41	0	38
3	Do you apply software packages such as Microsoft Word & Excel in teaching maths?	5	37	1	37
4	Do you teach linear and quadratic equations using computers?	2	40	0	38
5	Do you teach linear and quadratic graphs using computers?	2	40	0	38
6	Do you teach graph of simultaneous equations using a computer?	1	41	1	37
7	Do you teach statistics- mean, median, mode, using a computer?	3	39	1	37
8	Do you teach probability using a computer?	1	41	0	38
9	Do you teach Permutation and Combination using a computer?	2	40	1	37
	TOTAL	20 (5.29%)	358 (94.71%)	9 (1.75%)	336 (98.25%)

From the Data in Table 1, it was observed that both male and Female Teachers were not good at using computer to teach mathematics. As Items 1 – 9 had very low number of teachers answering yes in both male and female mathematics Teachers. The yes answer for male teachers is only 5.29% while that female teachers is only 1.75%. both of them is low. The answer to the research question 4 is : there is no difference between male and female mathematics teachers in the use of computer in teaching of mathematics.

Research Question 5:

Will there be any difference between urban and rural mathematics teachers in the use of computers in Teaching Mathematics?

Table 2: Difference between urban and rural mathematics teachers in the use of computer to teach mathematics

	Items	Urban		Rural	
		Yes	No	Yes	No
1	Do you use computers to teach mathematics?	4	22	2	52
2	Do you teach Mathematics with a computer using projectors?	1	25	0	54
3	Do you apply software packages such as Microsoft Word & Excel in teaching maths?	3	23	3	51
4	Do you teach linear and quadratic equations using computers?	1	25	1	53
5	Do you teach linear and quadratic graphs using computers?	1	25	1	53
6	Do you teach graph of simultaneous equations using a computer?	2	24	0	54
7	Do you teach statistics- mean, median, mode, using a computer?	3	23	1	53
8	Do you teach probability using a computer?	1	25	0	54
9	Do you teach Permutation and Combination using a computer?	2	24	1	53
	TOTAL	18 (7.69%)	216 (92.31%)	9 (1.85%)	477 (98.15%)

From the Data in Table 2, it was observed that both Teachers from urban and rural schools were not good at using computer to teacher mathematics. The urban Mathematics teachers that teach Mathematics using computer is 7.69% while rural Mathematics teachers is only 1.85%; both are low. The answer to the research question 5 therefore is: there is no difference between mathematics teachers from urban and rural schools in the use of computer in teaching of mathematics.

Hypothesis One:

There is no significant difference in the mean score in the use of computer by mathematics Teachers
Using one sample t-test, the hypothesis one was tested

Table 3: One sample t-test of the difference in the difference in the mean score in the use of computer by mathematics Teachers

N	Mean	Std. Deviation	T	df	sig	Remark
80	1.3638	.18960	-6.428	79	0.000	Rejected

Using the average mean of 1.50 as cut off (or bench mark), the table 3 shows that there was a significant difference in the mean score in the use of computer by mathematics teachers [t(79) = -6.428; ρ = 0.00; Mean value = 1.3638]. The null hypothesis is therefore rejected and the alternative holds true. The result therefore implies that there is a significant difference in the mean score in the use of computer by mathematics Teachers. The mean value of 1.3638 was not up to the benchmark. This shows that mathematics teachers are not competent in using computer to teach mathematics.

Hypothesis Two:

There is no significant difference between male and female mathematic teachers in the use of computer in teaching Mathematics

Table 4: Difference in the mean score in the use of computer by mathematics Teachers based on Gender

Sex	N	Mean	Std. Deviation	t	df	sig	Remark
Male	42	1.0556	.17908	1.212	78	0.230	Accepted
female	38	1.0175	.09143				

The table 4 shows that there is no significant difference between male and female mathematic teachers in the use of computer in teaching Mathematics [t(78) = 1.212; ρ = 0.230]. The null hypothesis is therefore accepted. The result maintains that there is no significant difference between male and female mathematic teachers in the use of computer in teaching Mathematics.

Hypothesis Three:

There is no significant difference between the urban and rural Mathematics teachers in the use of computer in the teaching Mathematics.

Location	N	Mean	Std. Deviation	t	df	sig	Remark
Urban	26	1.0769	.22171	1.30	78	0.204	Accepted
Rural	54	1.0185	.08290				

The table 4 shows that there is no significant difference between the urban and rural Mathematics teachers in the use of computer in the teaching Mathematics [t(78) = 1.30; ρ = 0.2o4]. The null hypothesis is therefore accepted. The result maintains that there is no significant difference between the urban and rural Mathematics teachers in the use of computer in the teaching Mathematics.

DISCUSSION.

A look at the analysis of the result in table 3, with the one sample t-test, indicates a significant difference in the mean score in the use of computer by Mathematics teachers. This shows that Mathematics teachers are not competent and they do not use computer in the teaching of Mathematics. The result is in consonance with the findings of Pelgrum and Plomp(1993). They found that only a small proportion of teachers used ICT to teach Mathematics. However, it is at variance with that of Odogwu and Mbah(2015) who carried out their study in Lagos state of Nigeria. Findings of study indicates that majority of the teachers have positive attitudes towards the use of ICT and the teachers are competent in the use of computer in the classroom.

On gender, the result of the t-test indicates no significant difference between male and female Mathematics teachers in the use of Computer Assisted Instruction in teaching Mathematics in the classroom. The result also differs from the study carried out by Odogwu and Mbah(2015); their findings showed a significant gender difference in Mathematics teachers attitudes towards the use of computer .which means male and female teachers do not have the same attitude. Infact, their result indicates that female Mathematics teachers have more positive attitudes towards the use of computer than the male teachers. Similarly, on school location, there was no significant difference in the use of CAI between urban and rural Mathematics teachers. The Mathematics teachers do not use CAI in teaching Mathematics; irrespective of the location of the school.

CONCLUSION/RECOMMENDATIONS.

The study investigated the utilization of Computer Assisted Instruction{CAI} by the Mathematics teachers in the classroom. The study revealed that the Mathematics teachers possess the knowledge of computer, and there are computer sets in their schools but they do not have power supply, most of the time for operation. The findings of the study further indicated that inspite of the computer knowledge they possess, they are not competent to teach Mathematics contents using Computer Assisted Instruction. Based on this, the following recommendations were made.

1. In-Service training should be provided for Mathematics teachers whereby they can practice the contents of secondary school Mathematics using Computer.
2. Mathematics should endeavour to teach Mathematics contents with CAI.
3. There is need to improve on power supply by the authorities responsible for providing learning facilities in schools.
4. Mathematics teachers should be encouraged to use CAI in the classroom by the Government by providing some incentives. This will definitely improve their attitudes, positively.

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CURRICULUM METAPHORS

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ABSTRACT: One Of The Most Common Learning Tools In The Subject Domain Of Education Is Metaphors. It Has Been Said That Learning Is Not Possible Without Metaphors, Let Alone The Usage Of Metaphors In Our Daily Routine Without Even Noticing. A Lot Of Our Common Speech Is Full With Metaphors That Became A Part Of Our Normal Dialogue, To The Extent That We Do Not Consider The "Figure Of Speech" A Metaphor Any Longer.

More importantly, using metaphors to describe curriculum has been a method adopted by scholars trying to "practicalaise" curriculum and give it a living-like sense. Eventually, curriculum metaphors took a steep turn (in some cases) when it started navigating educational policies to undesirable areas of application.

From that perspective, this paper will analyse the favourable/unfavourable effects of curriculum metaphors in general, with addition to an in-depth investigation of the appropriateness, the reliability and validity of notions of *Production*, *Growth*, and *Journey* as curriculum metaphors; explored in a short (but highly influential) article by Herbert Kliebard in 1972, and since, literature has been deliberating and confronting these three metaphors (among others like *Medicine* or *Natural Resources*) for their ability in characterizing curriculum.

Key Words: Education – Curriculum – Curriculum Metaphors - Metaphors.

INTRODUCTION

If any educational institution answered the questions of what, when, how to teach, and what are the result of teaching, then they have designed their curriculum (Print, 1993). Curriculum is a familiar term in the education milieu between educators and scholars. Albeit, the understanding of the concept is quite problematic, still, all agrees that curriculum is related to laying out a plan in order to facilitate knowledge and experience transferred form an educator to a learner, through a set of learning tools, to meet a final objective.

One of the most common learning tools in the subject domain of education is metaphors. It has been said that learning is not possible without metaphors, let alone the usage of metaphors in our daily routine without even noticing. A lot of our common speech is full with metaphors that became a part of our normal dialogue, to the extent that we do not consider the "figure of speech" a metaphor any longer.

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Curriculum

Most people outside the education milieu think of curriculum as the course of study in a classroom (Wiles & Bondi, 1998). This was the common definition in the beginning of this era. The definition itself had evolved over the years from simple explanation to highly sophisticated philosophical concept.

In searching for definition of curriculum, one was amazed by the number of definitions for a single term; Zais (1976) was right when he said "a search for the correct definition of the term is not a very productive enterprise". Finding a sole definition of curriculum had proven to be a problematic task. What was noticed is that most of the definitions being used in the literature were sentences reflecting personal perception and interpretation of the concept. The most practical method I found was followed by Glatthorn (2012), resolving this dilemma by dividing curriculum definitions into prescriptive and descriptive.

Prescriptive definitions of curriculum are statements that describe curriculum with what should take place in the normal path of a study, or what should happen when following a plan in teaching a subject i.e. “how things ought to be” (Glatthorn, 2012). Definitions can be as simple as Tyler’s (1957) “all the learning experiences planned and directed by the school to attain its educational goals”, or Popham & Baker’s (1970)”all planned learning outcomes for which the school is responsible. Or it can be more in-depth, like the one presented by Print (1993) “all the planned learning opportunities offered by the organization to learners and the experiences learners encounter when the curriculum is implemented”.

Descriptive definitions on the other hand, reflects what really happens in the classroom i.e., experience or curriculum in action. Again, definitions vary from being short and simple like Shepherd & Ragan’s (1982) “all experiences of the child for whom the school accepts responsibility” or Caswell & Campbell’s (1935) “all the experiences children have under the guidance of teachers”. Passing by strongly factual definitions like Tanner & Tanner (1995)”curriculum is concerned not with what students will do in the learning situation, but with what they will learn as a consequence of what they do. Curriculum is concerned with results”. To philosophical definitions like the one argued by Wiles & Bondi (1998) “We see the curriculum as a desired goal or set of values, which can be activated through a development process culminating in experiences for students”.

It is important to mention that curriculum is not an instruction book, it is not necessary that what goes in the classroom is fully compatible with what was planned for the curriculum; it all comes back to the interpretation of the teacher (Fisher & Muirhead, 2005). In fact, scholars like Goodlad (1979), Glatthorn (1987, 2000) and Van Den Akker (1998), divided curriculum into several types/phases, with key distinctions. On its importance, but it is not in-line with the interests of this paper.

Metaphor

Kliebard (1982) defines metaphor as “Figure of speech in which a word or phrase denoting one object or idea is used in place of another to suggest a similarity”. The key point here that the learner should be familiar with the object of similarity; otherwise it would not serve the purpose, which is why efficient metaphors allow students to find a personal perspectival meaning of concepts from their own life experiences and re-characterize it in familiar terms or mind images. It is the human nature to break complex concepts into more familiar experiences (Yero, 2002).

Metaphors are used widely in the education process to enhance the means of understanding the topic, using self-imagination instead of textual enunciation. This process helps the learner to visualize new ideologies, free from philosophical and disciplinary boundaries. Baptist (2002) realised this when she said that using metaphors by scholars allows examining of new perspectives, by merging concepts that seems fairly distant.

Curriculum Metaphors

Curriculum metaphors have been used everlasting. Interestingly, the Latin word *curriculum* means run the course (Wiles & Bondi, 1998), Yero (2002) considers this itself a metaphor. Beauchamp (1975) states that, “metaphor is a useful tool for scholars to communicate curriculum concepts and for students to analyze various aspects and value positions”. Metaphors are another way to express how an educator define curriculum and visions its applications, and to what extent he can exploit curriculum to a satisfactory limit. Simply, curriculum metaphors are a reflection of the educator perception and understanding of curriculum. Alternatively, the term *characterization of curriculum* can be used instead of curriculum metaphor, which may have broader applications related to its implementation.

In fact, curriculum metaphor is powerful to the extent that it could determine the educational philosophy of an institute. Perkins (2013) visions the role of curriculum metaphor on two levels; firstly, the educator defines the teaching philosophy according to the metaphor. Secondly, the educator must realize how the metaphor molds the student understanding of his position.

This brings us to the question, why do we need curriculum metaphors? Lakoff and Johnson (2003) answers by saying that using metaphors create social reality guiding the implementers throughout the process, doing actions that fit the metaphor which will reasonably strengthen the power of the metaphor in return, they conclude “In this sense metaphors can be self-fulfilling prophecies”. In other words, the metaphor one adopts influence the way one acts.

Unfortunately, a risky fact about curriculum metaphors, that it conceptualizes and influences the perception of the concept (Lakoff & Johnson, 2003). If a metaphor represents students in a passive way, they will act accordingly, and vies-versa. Also this conceptualization affects the hidden curriculum strongly through the day-to-day teacher / student interaction. Therefore, the metaphor adopted in schools, districts or ministries should be chosen carefully, being consciously aware of the messages sent to all parties concerned. Moreover, choosing a metaphor can be influenced by the surrounding culture / nature of the country or the region. For example, an agricultures society would feel more accustomed with *Growth* metaphor, were an industrial society would adopt *Production* metaphor, and so forth.

Production

Kliebard (1972) said "The curriculum is the means of production" where raw material undertakes several manufacturing processes under a proficient skilled craftsman, to produce a flourished product. The interpretation of this metaphor is clear, raw material is the student, the manufacturing process is the teaching process and its tools, the skilled craftsman is the educator, and the flourished product is the students after successfully passing the subject.

Subsequently, he states "The outcome of the production process is carefully plotted in advance according to rigorous design specifications" referring to an essential point in production and similarly in curriculum, which is the aims and objectives, and here appears the beauty of metaphor, at first, one cannot see the connection between production and curriculum, but when examining in depth, the similarity is obvious. He adds "when certain means of production prove to be wasteful, they are discarded in favour of more efficient ones", this is the self-evaluating process of curriculum, which is considered a necessity in any production operation for self-improvement and development (The Scottish Government, 2008), (Lewis, 1954). Finally, he says that in order to make the most out of raw materials, we need to guide any particular quality found within to "proper production systems" avoiding wasting any potentially useful characteristics.

While some scholars idealized this metaphor like Cook-Sather (2003) saying "The root metaphor of education as *Production* and the multiple branches that spring from it, create a version of reality that is scarcely more humane than the construct of the Matrix". Yet, it had been criticised for the influence it leaves over curriculum as being a template that fits all, neglecting the variance found between students. Brummelen (1993) records that *Production* metaphor was dominant at the start of the industrial era in the 1900s, because of that, it implies that educators will control students in a way that at the end of the teaching period students well be assessed according to "predetermined performance objectives", which he claims it only focuses on bits and pieces of knowledge they need to acquire. Eventually, educators will be degraded to be managers using step-by-step instruction book rather than pedagogues, not in charge, and avoiding creativity and deviating from curriculum to the interest of the student. The students as well, will be templates ready to be molded and tested, before being tossed to the next production line. Perkins (2013) drastically insists that "the meaningfulness of learning is lost when education is viewed as a means for production"

Compared to other metaphors examined in this paper, from my point of view, *production* is the least metaphor reflecting curriculum in light of new educational theories. Mainly because of what was discussed earlier about how metaphor conceptualizes your actions, and the negative effect that it leaves on educators and students for that matter.

Growth

"The metaphor of *Growth* is at least as ancient as civilisation itself……it was the basis of the educational classic *Emile*, of Jean-Jacques Rousseau" Kridel (2010). *Growth* is another metaphor interpreted by Kliebard in his article. He states "The curriculum is the greenhouse where students will grow and develop to their fullest potential under the care of a wise and patient gardener". The role the educator plays in raising of the *"plant"* student is highly pressed upon. This metaphor is related to what Mead (1936) used in describing the educational ambience as a place where the student is engaged in self-discovery and inventional process while insulated from external environment. *Growth* was even chosen to be the official metaphor for New Zealand curriculum (Ministry of Education, 2007).

Kliebard presses that every plant is different than the other having its own nature, although in the same greenhouse; therefore, each plant should be treated individually and "according to its needs", and how hard the gardener tried to alter this nature to meet his desires, it will not be diverted, conversely, I believe that if the gardener tried too hard to manipulate the plant's nature, the outcome may be a deformed hybrid with more flaws than merits. This metaphor emphasizes that curriculum cannot create optimum conditions for everybody to grow in, where diversity is always present and should always be accounted for. Generally, all plants in the greenhouse should be rationed the basic nutrients with reference to the curriculum outlines, with addition to any special treatment that may be required to a particular plant.

Both curriculum and greenhouse are semi-controlled environments, with a mixture of natural and artificial components. In a greenhouse, one cannot entirely demolish external factors (Temperature, light….etc); likewise, classroom environment is opened to external effects and influences. A good gardener like a good teacher should benefit from and utilize all components of the environment, natural, artificial, internal, or external. Indeed some cannot be stopped, but surly can be guided to the interest of the student.

Babtist (2002) expanded *Growth* metaphor into the *Garden* metaphor, she explored into the sociological depth of the concept discussing aspects like faith, power and order. In my opinion, the *greenhouse* term is more suitable than the *Garden,* when describing curriculum, because a greenhouse is more or less a simulated semi-controlled environment, rather than the garden which is open to external factors and limited input control.

Like curriculum, gardens require long carful actions for plants to flower, including personal attendance with full solicitude. Considering that, this metaphor throws on the educator's shoulders the bargain to explore his / her students; it identifies how a teacher can affect positively (or negatively) the development of his / her students. An educator shall use proper nutrients available to help seedlings grow and nourish with knowledge and experiences, considering that every "plant" student needs a certain amount of directing and guidance to flower.

Moreover, it also reflects that students grow from within, focusing into their inner capacities for support and pushing them to interact with the inputs to do so (Kridel, 2010). "Nurturing and fostering life are at the heart of this metaphor. It recognizes how students require the proper support and care in order to become enriched with knowledge and develop" (Perkins, 2013).

Journey

Thirdly, curriculum as *Journey*, or (as addressed in some writings) *Travel*. Kliebard wrote "The curriculum is a route over which students will travel under the leadership of an experienced guide and companion". The first thing you realize in this metaphor is the sense of intimacy that normally grows amid travellers, and among travellers and their leaders. Notice that Kliebard chose to place "guide" before "companion" to highlight the authoritarian position of the educator, which can be useful if handled with caution. And to recognize that the educator has been on the same journey before and he/she is superior in knowledge and experience. On the other hand, his/her role as a companion may be more sufficient in other situations, although the curriculum does not pinpoint these situations and normally left to the educator's sapience.

"Each traveller will be affected differently by the journey" says Kliebard, a group of students in a classroom learning the same subject will have different levels of accepting, absorbing and accommodating information, similar to the group of travellers, some are interested in sightseeing, some in observing the nature, some in learning new experiences. The foresight of the educator is important to discover individual abilities, and use it to guide them along the path predetermined in the curriculum. Taking into consideration that this variability could not (and should not) be resisted or combated, it should be appreciated and utilized in achieving the educational objectives.

In a journey, obstacles cannot be anticipated; the schedule should be always consented for deviation from the original plan, depending on the situation or the circumstances. Student accompanied and lead by the teacher, travels along a semi-defined route, which allows diversion from the main road to different paths and returning to the main road once again (Yero, 2002). Similarly, the educator in a classroom can re-assess items in the curriculum, like learning activities or course outlay, according to his own judgment, putting in mind the curriculum's outcome. In other words, *Journey* resembles the curriculum flexibility for modification.

Clark (2000) sees an illuminating aspect of *Journey*, which is putting people in a condition where they are forced to collaborate and act in conjunction in an alien environment. This helps transforming students into "less self-enclosed" persons looking forward to taking part in group work. Besides, the fact that Traveling is mostly connected to fun and enjoyment, and in most cases volitional; reduces pressure on students and giving them the feeling that they do something they enjoy contributing to its events in their own pace.

Conclusion

In conclusion, using metaphors to describe curriculum had proven to be fruitful in most cases. Yet, wrongly chosen metaphors that does not suit the institution policy, nature or cultural environment, may result in undesirable consequences, especially when combined with improper interpretations from the people responsible of its implementation.

The article discussed three common metaphors; *Production*, *Growth*, and *Journey*. Elucidating the pros and cons of each, and their effect over both educators and learners, explaining how *Production* metaphor provides a scenario of the student being the raw material in the hands of a skilful craftsman, who shapes and turn the raw material into a flourished product. While *Growth* metaphor describes the educator as a careful gardener, obliged to uncover the unique characteristics of each plant / student and ration them accordingly until they flower. And in the *Journey* metaphor, a teacher is a guide and companion who has been on the same journey before, while on the path he tour-guides the students around the roads of knowledge and experiences, knowing that not all travellers has the same input capabilities.

In addition, we discussed how curriculum metaphors conceptualize the understanding of curriculum to the extent that it affects the educational philosophy of the institution and all the parties involved, and how critical this may be, and pressed upon that choosing a metaphor to describe curriculum is a serious matter, because each metaphor may have applications that does not really reflect one's understanding of curriculum. For example, we saw *Growth* as a process where the individual self-expands sitting in an enclosed space, while *Journey* is a process where the individual is opened onto new horizons, jumping from one place to another.

Finally, it is the responsibility of the organization to adopt a metaphor that suits her best, because, at the end, metaphors are personal perceptions and characterization of your own vision.

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INVESTIGATION OF THE EFFECT OF ROBOTIC APPLICATIONS IN ELEMENTARY EDUCATION

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ABSTRACT: In this study, it was aimed to investigate the effect of robotic applications of 7th grade students on their attitudes towards Science Process Skills and Science-Technology-Engineering-Mathematics (STEM). The research group of the study consists of a total of 20 7th grade students in the academic year of 2005-2016. In the study, "Science Process Skills Test" and "STEM Attitude Test" and "Personal Information Form" were used to collect data. In the analysis of the data obtained, t-test, analysis of variance, mean and standard deviation calculations were used to evaluate scientific process skill levels of the students and STEM Attitude Test data. The data obtained from the study will be analyzed with SPSS and the results will be discussed.

Key words: Elementary education, robotic, science process skills

INTRODUCTION

Developing science and technology in all areas requires technology to be used in the education system (Özmen, 2004). According to Cameron (2005), considering the science and technology education in the world, there is a new technological area so-called Robotics that can provide great convenience in data acquisition, laboratory observations in especially science and technology education (Koç Şenol, 2012).

Countries providing conscious and systematic training of Robotics use legos. Legos turn building, design and programming development process of students into more fun, educational and collaborative activities (Yalçın, 2012). In this regard, legos are powerful materials that can be used to entertain students and attract their attentions. Therefore, motivation of teachers will be increased with improved success of students (Marulcu and Sungur, 2012). A learning environment supported with lego-logo is found to have very positive effects on the scientific process skills and self-perception of students (Çayır, 2010). In the learning environments created with lego robot kits, students think about problems, formulates the results, reach the information and search for answers of the problems (Özdoğru, 2013).

Considering the literature related to STEM applications, Ricks (2006) states that there is a significant improvement in the attitudes of students towards science after receiving STEM education in the science camp, Yamak, Bulut & Dündar (2014) state that STEM applications positively improve attitudes of 5th grade students towards science, Freeman, Alston & Winborne (2008) indicate that STEM education improves attitudes of undergraduate students towards science and mathematics.

In this study, the following questions are tried to be answered in order to investigate attitudes of 7th grade students towards Scientific Process Skills and Science-Technology-Engineering-Mathematics (STEM):

- What is the effect of robotics application on the attitudes of 7th grade students towards Science-Technology-Engineering-Mathematics (STEM)?
- What is the effect of robotics application on the Scientific Process Skills of 7th grade students?

METHOD

The aim of this study was to investigate the effects of robotics applications on the attitudes of 7th grades students towards Scientific Process Skills and Science-Technology-Engineering-Mathematics (STEM). The study was carried out as a single group pretest-posttest experimental design. One group pretest-posttest experimental design is one of the weakest experimental designs.

Scientific Process Skills Test and STEM Attitude Test was administrated on students prior to the study. The study lasted for 20 hours in 3 stages. First, Lego Mindstorms Education EV3 Robotics Education Sets, which will be used in Robotics course and activities along with presentations and videos, were introduced to the students. In the second stage, they were informed about the use of robotic programming interface. In the last stage, teachers were asked to design a robot by using lego parts and perform various activities such as moving robot forward-right and make right-left turns by programming, moving car forward without crashing the obstacles by using some sensors and tracking the black line. At the end of these applications, Scientific Process Skills Test and STEM Attitude Test was administrated on students as the post-test.

Sample

In this study, it was aimed to investigate the effects of robotics applications on the attitudes of 7th grades students towards Scientific Process Skills and Science-Technology-Engineering-Mathematics (STEM). The study group consists of a total of 20 7th grade students including 10 girls and 10 boys in the academic year of 2015-2016.

Instrument

In the study, "Scientific Process Skills Test", which was developed by Okey, Wise and Burns (1985) and translated into Turkish by Özkan, Aşkar and Geban (1992) and "STEM Attitude Test", which was developed by Faber et al. (2013) and translated into Turkish by Yıldırım and Selvi (2015) and "Personal Information Form" were used to collect the data.

Data Analysis

The data obtained in this study were analyzed by using SPSS (Statistical Package for Social Sciences) for Windows 22.0. Mean and standard deviation were used as descriptive statistical methods in the evaluation of data. Wilcoxon signed rank test was used to determine the difference between the pre-test and post-test results. Spearman correlation analysis was performed between continuous variables of the study. The findings obtained were evaluated with a confidence interval of 95% and significance level of 5%.

FINDINGS

In this section, statistical operations on the data obtained from the data collection instruments used in the study were performed and the results are given in tables.

Table 1. Wilcoxon test results related to test pretest and posttest scores of students received from scientific process skills test

	Mean	N	Std. Deviation	z	p
Pretest	13,2	20	2,44	-3,52	0,00
Posttest	17,25	20	2,26		

As it can be seen in Table 1, there is a significant difference between pretest and posttest scores of students received from scientific process skills test ($z = -3.52$, $p = 0.00 < 0.05$). The average pretest score of students was found to be 13.2, while the average posttest score was 17.25, respectively. Therefore, it can be suggested that robotics activities contribute positively to the scientific process skills of students.

Table 2. Wilcoxon test results related to test pretest and posttest scores of students received from STEM attitude test

Sub-Dimensions of the Test	Pretest		Posttest		N	Z	p
	Mean	Sd	Mean	Sd			
Mathematics	4,19	0,83	4,54	0,55	20	-2,57	0,01
Science	4,27	0,56	4,44	0,63	20	-2,28	0,02
Engineering	4,44	0,47	4,47	0,86	20	-1,85	0,06
Skills of 21st Century	4,51	0,48	4,46	0,74	20	-0,32	0,75

As it can be seen in Table 2, the difference between average scores received from pretest-posttest of mathematics sub-dimension was found to be statistically significant ($Z = -2.57$, $p = 0.01 < 0.05$). The average pretest score is ($x = 4.19$) smaller than the average posttest score ($x = 4.54$). In the science sub-dimension, the difference between average scores received from pretest-posttest was found to be statistically significant ($Z = -2.28$, $p = 0.02 < 0.05$). The average pretest score is ($x = 4.27$) smaller than the average posttest score ($x = 4.44$). In this context, it can be said that robotics activities have a positive impact on the attitudes of students towards mathematics and science. The difference between average scores received from pretest-posttest of engineering and skills of 21st century sub-dimensions was found to be statistically significant ($p > 0.05$).

Table 3. Spearman's rho correlations coefficients between scientific process skills test (SPS) and STEM attitude test

		SPS-Pretest	SPS-Posttest
Mathematics-Pretest	r	-0,122	0,661**
	p	0,608	0,002
Mathematics-Posttest	r	0,015	0,612**
	p	0,950	0,004
Science- Pretest	r	-0,010	0,502*
	p	0,966	0,024
Science-Posttest	r	-0,063	0,520**
	p	0,791	0,019
Engineering-Pretest	r	-0,237	0,303
	p	0,314	0,194
Engineering-Posttest	r	-0,165	0,280
	p	0,486	0,232
21^{st} Cen. Skills-Pretest	r	-0,130	0,349
	p	0,585	0,132
21^{st} Cen. Skills-Posttest	r	-0,076	0,427
	p	0,752	0,060
SPS-Pretest	r	1,000	0,032
	p		0,894
SPS-Posttest	r	0,032	1,000
	p	0,894	

*p<0,05

There is a moderate level, positive and significant relationship between SPS posttest results and mathematics sub-dimension pre-test results of students (r=0.661, p=0.002 <0.05).

There is a moderate level, positive and significant relationship between SPS posttest results and mathematics sub-dimension post-test results of students (r=0.612, p=0.004 <0.05).

There is a moderate level, positive and significant relationship between SPS posttest results and science sub-dimension pre-test results of students (r=0.502, p=0.024 <0.05).

There is a moderate level, positive and significant relationship between SPS posttest results and science sub-dimension post-test results of students (r=0.520, p=0.019 <0.05).

CONCLUSION

In this study, which was conducted to investigate the effects of robotics applications on the attitudes of 7^{th} grades students towards Science Process Skills and Science-Technology-Engineering-Mathematics (STEM), the data analyzed show that robotic applications have positive effects on the scientific process skills of students (z=-3.52, p=0.00<0.05). These results are consistent with results of (Sullivan, 2008; Çayır, (2010); Çavaş et al. (2012); Koç Şenol (2012); Koç Şenol and Büyük, (2013)) the earlier studies in the literature.

In the study, attitudes of students receiving robotics applications education towards mathematics and science were found to be significantly improved. This result is consistent with earlier studies about development of attitudes of students towards mathematics in the literature (Saad, (2014); Freeman, Alston and Winborne, (2008); Naizer, Hawthorne and Henley, (2014); Gülhan and Şahin (2016); Vollstedt, (2005)), while the attitude development of students towards science is consistent with the results of (Naizer, Hawthorne and Henley, (2014); Ricks, (2006); Yamak, Bulut and Dündar, (2014); Freeman, Alston and Winborne, (2008)) in the literature. According to the data analyses, no significant improvement was observed in the sub-dimensions of engineering and 21^{st} century skills.

There is a moderate level, positive and significant relationship between SPS posttest results and mathematics sub-dimension pre-test results (r=0.661, p=0.002 <0.05), mathematics sub-dimension post-test results (r=0.612, p=0.004 <0.05), science sub-dimension pre-test results (r=0.502, p=0.024 <0.05) and science sub-dimension post-test results of students (r=0.520, p=0.019 <0.05).

As a result, since robotics applications have positive effects on the scientific process skills and attitudes of students towards mathematics and science, schools should provide activities related to robotics applications.

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INVESTIGATION OF TEACHERS' PERSPECTIVES FOR ROBOTIC APPLICATIONS

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ABSTRACT: In this study, it was aimed to determine the opinions of teachers about robotics. This research aims to explore knowledge level and opinions of teachers in regard with robotic applications. In this research one group pretest-posttest design is used. The study group of this research consists of 20 teachers. “Robotic Pre-test”, “Robotics Satisfaction Test”, “Personal Information Form” and a semi-structured interview from developed in accordance with the literature were used to collect the data. In the analysis of the data obtained, descriptive statistics (frequency and percentage distribution) were used to evaluate Robotics Pre-Test and Robotics Satisfaction Test; inductive content analysis was used to analyze the interview data. According to the findings of this study, knowledge level and opinions of teachers in regard with robotics and how they see robotics as a method in education were determined. At end of the study, it was eventually found that teachers have very positive thoughts about robotics. Robotic applications appear to increase their self-belief and confidence.

Key words: teacher, robotic

INTRODUCTION

In the 21st Century, there is a very rapid change and development process in the fields of science and technology and the idea of having these changes and developments with education has not been changed (Açışlı, 2010). There is a close relationship between technology, society and education. The overall skill levels of people change with changing technology and their expectations from education also change (Kurtdede Fidan, 2008). In the process of teaching and learning, "teacher" and "technology" are the two key elements of the teaching-learning environment. Because these two elements have great effect in the learning process of students. In today’s education system, teachers should use technology and teach students how to use technological tools (Güzel Türk, 2012).

Countries providing conscious and systematic training of Robotics use Legos. Legos turn building, design and programming development process of students into more fun, educational and collaborative activities (Fidan and Yalçın, 2012). In design-based activities, where legos are used as teaching tools, more meaningful activities are realized since students use their knowledge in a form that is both physically and mentally active (Marulcu and Sungur, 2012). The use of legos as study materials allows students to question real life problems, work with scientific concepts and use educational technologies beyond learning science (Sungur Gül and Marulcu, 2014).
Considering the studies conducted on robotics in the literature; Büyük (2015) states that robotics significantly affect scientific process skills and motivations of elementary school students towards science and technology course; Fidan and Yalçın (2012) state that science and mathematical intelligence as well as hand skills of minor designers are improved by designing and programming robots with Legos; Koç Şenol (2012) states that elementary school students have positive thoughts about robotics and having robotic-assisted science experiments improves science process skills of students and their motivations towards Science and Technology courses.

Therefore, in this study, it was aimed to determine thoughts of teachers about the robotic applications since it is believed that students may have a better learning if robotic technologies are used in the education system and teachers transfer their knowledge about robotics to the students. For this purpose, the opinions of teachers about robotic applications were investigated before and after the study.

METHOD

This study aims to reveal teachers' knowledge and views about robotics. The study was carried out as a single group pretest-posttest experimental design. Study group of the study consisted of 20 teachers. The Robotic Pre-Test was administrated on teachers prior to the study. The study lasted for 20 hours in 3 stages. First, Lego Mindstorms Education EV3 Robotics Education Sets, which will be used in Robotics course and activities along with presentations and videos, were introduced to the teachers. In the second stage, they were informed about the use of robotic programming interface. In the last stage, teachers were asked to design a robot by using lego parts and perform various activities such as moving robot forward-right and make right-left turns by programming, moving car forward without crashing the obstacles by using some sensors and tracking the black line.

Data Collection Tools

In the present study, the "Robotics Pre-Test", which was developed by Riberio (2006) and translated into Turkish by Koç Şenol (2012), as well as "Robotics Satisfaction Test", which was developed by Silva (2008) and Gibbon (2007) and translated into Turkish by Koç Şenol (2012), and "Personal Information form" and a semi-structured interview form developed by the researcher after reviewing the relevant literature were used to collect the data.

FINDINGS

A total of 20 teachers including 11 women and 9 men participated in the study. 11 of these teachers were Science Teachers, 4 of them were Information Technology Teachers, 3 of them were Mathematics Teacher, 1 of them was Technology and Design Teacher and the remaining 1 was a Classroom Teacher, respectively. 12 of the teachers participated in the study were in the 25-30 age range and 8 of them were in the 30-40 age range.

Before the applications, "Robotics Pre-test" was applied on teachers in order to determine their thoughts about robotics and "Robotics Satisfaction Test" was applied after the applications to see their satisfaction. The answers of teachers in response to both "Robotics Pre-test" and "Robotics Satisfaction Test" are presented in the tables below.

Table 1. Frequency and Percentage Distributions of 1st and 2nd Questions of Robotics Pre-test

	Yes		No	
	f	%	f	%
Question 1: Have you ever used Lego parts before?	7	35	13	65
Question 2: Do you have any information about Lego Mindstorms Robotic System?	4	20	16	80

As it can be seen in Table 1, 35% of the teachers said yes and 65% of them said no in response to the question "Have you ever used Lego parts before?"

20% of teachers said that they have information about Lego Mindstorms Robotic System and 80% of them said that they have no information about the System.

In the study, 95% of the teacher said that they are using computer every day in response to the question "How often do you use a computer" and the remaining 5% said they never use computer.

Table 2. Frequency and percentage distributions of 4th and 5th questions of robotics pre-test and robotics satisfaction test

	Yes				I Haven't Decided Yet				No			
	Pre-test		Post-test		Pre-test		Post-test		Pre-test		Post-test	
	f	%	f	%	f	%	f	%	f	%	f	%
Question 4: Do you think that you can teach science and technology and other courses by using computers and robots?	18	90	20	100	2	10	0	0	0	0	0	0
Question 5: Do you think that you can design appropriate robots for future activities?	12	60	19	95	8	40	1	5	0	0	0	0

As it can be seen in Table 2, 90% of the teachers participated in the pre-test said yes and the remaining 10% teachers said I haven't decided yet in response to the question "Do you think that you can teach science and technology and other courses by using computers and robots?" and 100% of the teachers participated in the post-test said yes in response to this question.

On the other hand, 60% of the teachers participated in the pre-test said yes and the remaining 40% of the teachers said that they haven't decided yet in response to the question "Do you think that you can design appropriate robots for future activities?" and 95% of the teachers participated in the post-test stated that they can design the appropriate robots and the remaining 5% said they haven't decided yet.

Table 3. Frequency and percentage distributions of 6th, 7th and 8th questions of robotics pre-test and robotics satisfaction test

	Partly Difficult				I haven't decided yet				Easy			
	Pre-test		Post-test		Pre-test		Post-test		Pre-test		Post-test	
	f	%	f	%	f	%	f	%	f	%	f	%
Question 6: What do you think about the use of computers in the activities that you perform/will perform?	1	5	3	15	3	15	0	0	16	80	17	85
Question 7: What do you think about the use of robots in the activities that you perform/will perform?	0	0	7	35	14	70	2	10	6	30	11	55
Question 8: What do you think about programming robots in the activities that you perform/will perform?	4	20	4	20	8	40	1	5	8	40	15	75

As shown in Table 3, 5% of the teachers participated in the pre-test said it will be partly difficult for them, while 15% of them said that they haven't decided yet and the remaining 80% said that it would be easy in response to the question "What do you think about the use of computers in the activities that you will perform?" and 15% of the teachers participated in the post-test said that it will be partly difficult for them, while 85% of them said that it would be easy, respectively.

70% of the teachers participated in the pre-test said that they haven't decided yet and 40% of them said that it would be easy in response to the question "What do you think about the use of robots in the activities that you perform/will perform?" and 35% of the teachers participated in the post-test said that it will be partly difficult, 10% said that they haven't decided yet and the remaining 55% said that said that it would be easy, respectively.

20% of the teachers participated in the pre-test said that it would be partly difficult, 40% of them said that they haven't decided yet and the remaining 40% said that it would be easy in response to the question "What do you think about programming robots in the activities that you perform/will perform?", while 20% of the teachers participated in the post-test said that it will be partly difficult, 5% of them said that they haven't decided yet and 75% of the teachers said that it would be easy, respectively.

Table 4: Frequency and percentage distributions of 1st question of robotics satisfaction test

	Not Satisfied		Satisfied		Very Satisfied	
	f	%	f	%	f	%
Question 1: Are you interested in robotic applications?	0	0	3	15	17	85

As seen in Table 4, 15% of the teachers said they are satisfied and the remaining 85% said that they are very satisfied in response to the question "Are you interested in robotic applications?".

In the Robotics Satisfaction Test, 100% of the teachers said that they are more interested in response to the question "How you are interested in robotics currently when compared to your previous thoughts before the project?"

100% of the teachers said yes in response to the questions "Would you recommend your colleagues to use robotic?", "Once you start using robotics, would you follow innovations about it?", and "Do you think you would use robotics in your future courses?".

Some of the answers of teachers in response to the questions "Does the use of robotics affect professional development of the teacher? How?" are as follows:

CONCLUSION AND RECOMMENDATIONS

In this study, it was aimed to determine the opinions of teachers about robotics. The Robotic Pre-Test was administrated on teachers prior to the study in order to receive their pre-knowledge about robotics. According to the results of pre-test, 65% of the teachers have never used Legos before the study. In addition, 40% of the teachers said that they haven't decided yet in response to the question "Do you think that you can design appropriate robots for future activities?" This suggests that teachers may have difficulties in making robots with Legos.

In addition, 80% of the teachers said they have no information about Lego Mindstorms Robotic System. Apparently, the majority of teachers participated in the study have no information about robotics and they have never used lego parts.

Before the application, 90% of the teachers think that they can teach science, technology and other courses by using computers and robots, while all teachers said that they can teach the course with these tools after the study. 60% of the teachers believe that they can design the appropriate robots for the course prior to the study and this ratio increased up to 95% after the study. On the other hand, 60% of the teachers stated that they can design the appropriate robots to be used in the classroom before the study and this ratio increased up to 95% after the study. This shows that although they have no information about the robotic applications prior to the study, these applications improve their self-belief and confidence.

Before the application, 95% of the teachers said that they use computer every day and 5% of them stated that they will have difficulties in the activities, while 15% of them said that they haven't decided yet and the remaining 80% of the teachers said that it will be easy to use computer during the robotic applications. At the end of the application, 15% of the teachers said that they will have difficulties and the remaining 85% said that it will be easy to use computer during robotic applications. Although 20% of the teachers thought that programming would be partly difficult prior to the application, 75% of them stated that it would be easy in the post-test.

According to the data and findings obtained in the present study, which has aimed to present knowledge level and thoughts of teachers about robotics, various seminars and courses should be organized in order to raise awareness of students and teachers, who are educating the guarantee of our future children, about robotics emerging with technological developments.

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EXPLORING THE GRAPHS OF FUNCTIONS USING THE JIGSAW APPROACH

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ABSTRACT: Cooperative learning is a strategy that involves students working together towards achieving a common goal. This learning technique can be carried out in various ways and one such method is by the jigsaw approach. In the jigsaw approach, students become experts in a particular concept and then share their knowledge with other group members. The purpose of this study is to investigate how effective the jigsaw approach is in improving students' performance levels in Mathematics, in particular, in the topic of graphs of functions. This mixed method action research study involves two cycles, conducted in two different local government schools in Brunei Darussalam. Cycle 1 involves a Mathematics class of 19 students and Cycle 2 with 25 students, and both at the Year 10 level. A pre-test and post-test design was used for this purpose. Students' perceptions on cooperative learning were also studied. The results of this study suggest that the jigsaw approach does have a positive effect on students' performance levels in Mathematics. Cooperative learning needs to be practiced more in classrooms as it helps in the development of 21st century skills for the students.

Key words: cooperative learning, jigsaw approach, secondary mathematics

INTRODUCTION

Mathematics is one of the most important subjects, whose applications play an important role in various fields such as medical, finance and so on. Unfortunately, it is also a subject that has very poor student achievement levels worldwide (Naomi & Githua, 2013). This is further backed up by a study done locally in Brunei Darussalam by Hamid and colleagues (2013). They stated, “Mathematics is one of the challenging subjects in which Brunei primary and secondary school students often perform poorly” (p.1). Mathematics is commonly regarded as one of the most disliked and feared subjects amongst students in schools. They perceive a Mathematics class as boring (Zakaria et al. 2013) and hence dread the lesson. On the contrary, students should learn how to enjoy it and to be more enthusiastic about it. Taking all of these into consideration, one of the most important aspects to focus on when teaching Mathematics is students' engagement. According to Christensen et al. (1991), the act of teaching is the same as getting students to participate in learning. By ensuring that student engagement is taking place during a lesson, we as educators are nurturing them to be active learners. Moreover, students who are engaged are also psychologically invested in learning (Lamborn et al., 1992). In fact, this is actually one of the 21st century skills that are expected from the current generation of students. A similar expectation is being held for the students in Brunei, and is being enforced by the current education reform known as SPN21, which is the acronym for *Sistem Pendidikan Negara Abad ke-21*, and translated to the English Language, the National Education System for the 21st Century of Brunei Darussalam.

One of the main objectives of the SPN21 (Ministry of Education, 2013) is to develop 21st century skills amongst students in Brunei, hence, moulding students to become holistic individuals. Internationally, the importance of 21st century skills was brought to everyone's attention when an organisation known as P21, The Partnership for 21st Century Learning was founded in 2002. The Framework for 21st Century Learning (P21.org, 2009) focuses on 3 major areas for student outcomes: Learning and Innovation Skills, Life and Career Skills and Information, Media and Technology Skills. The SPN21 education reform began with a provisional stage of implementation in 2008, whereby only the Year 7 students were targeted (Ministry of Education, 2013). One of the major changes brought about by the SPN21 was in the curriculum and assessment areas. This was seen in the shift of the normal teacher-centred teaching and learning method to a more student-centred teaching and learning method. In the current education world, the traditional chalk-and-talk method is no longer being encouraged in classrooms. Students have to be responsible for their own learning while the teacher only act as facilitator. In other words, students have to be active learners in the classroom.

In order to address the above issue, educators are continuously in search of teaching techniques that not only improve students' understanding but also pique their curiosity and interest towards the subject. A possible way to achieve this is through cooperative learning, which involves a small group of students who work together to achieve a common goal. Students are responsible for both their individual knowledge, and also their groups. This student-centred teaching method or pedagogy can be carried out using a variety of approaches (Damit et al., 2015; Duraman et al., Lim et al., 2015; Sulaiman and Shahrill, 2014, 2015). And one of the approaches is the jigsaw approach. There are certain topics in Mathematics in which students are prone to having misconceptions and difficulties. One such topic is graphs of functions, $y = x^n$.

The Study

The purpose of this study is to investigate the benefits of cooperative learning, in particular, the jigsaw approach, in helping secondary school students to draw and interpret graphs of functions. One's knowledge on graphs starts from the lower secondary years (Year 7 and Year 8), where students are introduced to the Cartesian plane and the axes (Ministry of Education, 2011). In these levels, students learn how to plot points using the x and y coordinates, as well as draw and interprets graphs of straight lines. Students have to be experts in these basic skills in order to successfully draw and interpret graphs of functions, y $= x^n$, where $n > 1$, at higher levels. However, retaining a student who fails to meet the academic requirements in a year level does not necessarily mean that the student will learn concepts better. According to Mundia (2010), repeaters can easily get bored in the class if the teacher does not employ any new and interesting teaching method, also referred to as pedagogy, when teaching a topic. In order to overcome this problem, teachers will have to come up with new pedagogies to improve student learning. They need to find a way to engage students in the lesson, and this can be done using cooperative learning. For the success of this method of learning, students will have to be comfortable with working with each other and discussing ideas. There have been studies conducted locally which claim that learning from group work is indeed effective amongst students. Sulaiman and Shahrill (2014, 2015) found that collaborative learning helped to improve students' performance in Statistics. Cooperative learning also helps students to improve their communication skills, as they are required to discuss their ideas with each other (Lim et al., 2015).

The results from this study will principally be beneficial to its participants. The benefits of cooperative learning have been seen in so many countries and involving students with a range of abilities. A study conducted by Zakaria and colleagues (2010) involving lower secondary students in Miri, Sarawak, Malaysia showed that cooperative learning did have a positive impact on firstly, students' achievement in Mathematics, and secondly, on their attitude towards the subject. According to them, "cooperative learning gives more space and opportunities for students to discuss, solve problems, create solutions, provide ideas, and help each other" (Zakaria et al., p. 274). In addition, by practising cooperative learning in schools throughout Brunei, educators and school leaders are working towards accomplishing one of the main aims of the SPN21, which is, as previously mentioned, to develop 21st century skills amongst the students (Ministry of Education, 2013). A few examples of these demanding skills are communication skills, use of technology (ICT) in learning, collaboration, and critical thinking.

The two research questions guiding this study are how effective is the jigsaw approach in improving students' performance in graphs of functions? And what are the students' perceptions on cooperative learning?

LITERATURE REVIEW

Cooperative Learning

Cooperative learning is when a group of individuals work together towards achieving a common goal (Smith, 1996; Gillies, 2004). Each group usually has 4 to 6 members, where each and every one of them is responsible for each other's learning. It must be noted that by merely sitting in groups and completing a task does not necessarily count as cooperative learning (Smith, 1996). According to Johnson et al. (1998), cooperative learning is made up of five basic elements. First, and foremost, is the 'positive interdependence' among students as they are relying on one another for successfully solving a task. Secondly, the assessment of students' knowledge creates 'individual accountability'. Since students are working in groups, they display a 'face-to-face interaction'. Next, the collaboration between students displays interpersonal skills. The final element of cooperative learning involves the way in which groups work to achieve their goals. This includes their time management skills too.

Cooperative learning can be carried out using a variety of approaches, which can be either formal or informal. Özsoy and Yildiz (2004) found that the learning together method was effective in improving primary level students' achievement in Mathematics. The benefits of cooperative learning can be useful to students even outside of the safe environment of school. This pedagogy promotes great leadership, organisational and teamwork skills (Keikhavani et al., 2015). Being talented in these skills will help in the student's social interaction after leaving school. Employers are constantly seeking for these qualities in job applicants, given that collaboration is the current trend in this 21st century. According to Keikhavani and his team, the successful completion of a task creates a sense of excitement for the students. They are motivated to complete any further tasks. This study was done on primary students though, and there was no mention of the academic abilities of the students. Will secondary students with low abilities still share similar feelings? In addition to that, another factor to consider is the possibility of there being a language barrier.

Jigsaw Approach

In 1971 Professor Aronson and his graduate students invented the jigsaw strategy (Aronson, 2000). This approach is a cooperative learning method whereby each student belongs to two main groups: 'home' group and the 'expert' group. A lesson incorporating this method will begin with the teacher assigning 4 to 6 students in a group, and given a task made up of different segments. This is usually a heterogeneous group so as to have diversity in terms of student backgrounds, gender, and ethnicity. Each student in the home group is then assigned as an expert of each segment. Next, experts from each home group will discuss with students who share the same expertise as them. Students in each expert group will discuss the ways to solve the segment of the task assigned to them. Once this is done, experts return to their home group and share their knowledge with the rest of the group members. A visual representation of the jigsaw approach, taken from Reilley (2010) is shown in Figure 1 below.

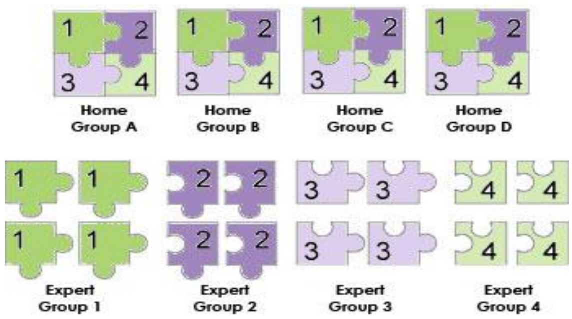

Figure 1. Jigsaw Group Diagram (taken from Reilley, 2010)

An analysis of the different cooperative learning strategies have shown that one of the reasons for the effectiveness of the jigsaw approach is due to the precise methods (Johnson et al., 2000) involved in achieving the common goal. One of the benefits of this approach is that students are responsible for their own learning. It also encourages student-student interaction and therefore helps in the development of their inter-personal skills (Adams, 2013). A study conducted by Zakaria and his colleagues (2013) in Indonesia showed that secondary school students preferred using the jigsaw approach to learn Mathematics. Moreover, these students enjoyed helping each other to learn. This implies that the jigsaw approach can have a positive effect in the development of good collaboration and teamwork skills. Additionally, according to a study involving Vietnamese higher education students (Van Tran, 2012), the students generally did not have anything to dislike about the jigsaw approach.

Students' Misconceptions on Graphs

You and Wiest (2009) conducted a study to investigate how students interpret graphs. According to them, students can have either an iconic interpretation or a symbolic one, where the former means that a graph is seen as how the text is worded whereas the latter means that the graph is seen abstractly. The results showed that a high percentage of seventh grade students had an iconic interpretation of graphs. Symbolic interpretation was seen mostly in adults. This tells us that the seventh graders lack in exposure to real-world models, as opposed to the adults. Therefore, it is essential that teachers incorporate real-world examples in their Mathematics lesson.

The use of activities in the classroom also helps in students' understanding of graphs (Wallace-Gomez, 2014). One of the suggested activities was to turn the classroom into a living graph, where a classroom of students seated in single rows is divided into the four quadrants of the Cartesian plane. A point (x, y) therefore represents the seating position of each student. By carrying out such activities, students become attentive, and are focused and engaged in the lesson. They become active learners in the classroom and this will in turn help their understanding of the lesson content (Freeman et al., 2014).

METHODS

A mixed method approach was employed for this research. By performing both methods, there is more information at hand to answer the research questions (Moss, n.d.). This study involves two cycles, conducted in two different local government schools in Brunei Darussalam. Cycle 1 was conducted in a school in the Brunei-Muara District, hereby referred to as School A. Whereas Cycle 2 was carried out in another school, namely School B, in the Belait District. The two schools are about 100 km apart. This was done to further test the effectiveness of the jigsaw approach. Both cycles were conducted using the same instruments and materials. The Year 10 students were chosen for both cycles since both schools covered the topic of graphs of functions at this level.

In Cycle 1, a convenience sample of 19 students of a mixed academic ability was selected. This sample consisted of 5 boys and 14 girls. This was an easy sample to get within the time frame available for the study (Marshall, 1996). For Cycle 2, the only sample available in School B to take part in the study was a sample of 25 students, of which 16 were boys and 9 were girls. Similar to the sample in School A, the majority of these students had an average to low Mathematical ability.

Instruments

The first research question was to see how effective the jigsaw approach was in the students' performance. In order to answer this question, test scores will be collected and analysed. This was done by means of a pre-test – post-test design, wherein intervention lessons were conducted between the two tests. Additionally, individual feedback was collected from each and every student who participated in the study. Feedbacks from each student were recorded since the sample size was very small. This was done after the post-test.

Data Collection and Analysis

Prior to collecting any data for the study, permissions were sought from the relevant authority agencies. Consent forms from the participants' parents or guardians were also collected. Before conducting the pre-test, discussions were done with the teachers responsible for teaching the topic of graphs of functions to the selected samples. In both School A and School B, the respective teachers carried out their lessons by means of a traditional, teacher-centred pedagogy. A pre-test (refer to Appendix 1) was then designed for the sample to assess their performances on the chosen topic. Checking the validity of the test questions were sought from the teachers. Besides that, the Mathematics school syllabus and past-year examination papers were also used as guidance. The students had one hour to complete the pre-test individually.

Next, an intervention lesson was planned. This lesson incorporated the application of the jigsaw approach to tackle the issues that surfaced from the results of the pre-test. As mentioned before, the jigsaw approach focuses on a student being an expert in a particular content or part of a question (part of a jigsaw puzzle), and after discussing with fellow expert group members, he or she shares this knowledge with fellow home team members to solve the whole question (jigsaw puzzle). Figure 2 below shows the task used for the intervention lesson.

The task consisted of five parts, each covering a particular content area of the topic of graphs. Therefore, each 'home' group had to be made up of 5 'experts'. With the help of the class' name list, the first author assigned members of both the 'home' groups and 'expert' groups. This was to avoid any preference between the students. Before conducting the lesson, students were briefed on the jigsaw approach and how it works. The entire duration of the intervention lessons was 2 hours. This was broken down into 3 sessions. The first 30 minutes was used for discussion with the 'expert' groups. The next 45 minutes was used for discussion with the 'home' group. During these discussions, the first author continuously walked around the class to monitor students' behaviours and to offer any assistance if needed. Finally, the last 45 minutes was used for the sharing of solutions between the 'home' groups. Each 'home' group had a team leader who would explain his group's solutions to the rest of the class. This was where the first author had to step in as a teacher if the solutions or explanations were incorrect. Mistakes were corrected on the spot so as to clear any misconceptions amongst the students.

Question

$$y = x\,(x + 2)\,(x - 3)$$

x	- 2.5	- 2	- 1	0	1	2	3	4
y	p	0	4	0	- 6	- 8	0	q

1. Find the values of p and q.
2. Draw the graph of $y = x\,(x + 2)\,(x - 3)$ for $-2.5 \leq x \leq 4$, where 1 cm represents 1 unit on the x-axis and 1 cm represents 5 units on the y-axis.
3. From the graph, find the maximum and minimum points of the graph.
4. Find the gradient of the graph at (3 , 0).
5. Draw the graph of $y = 2^x$ for $-2.5 \leq x \leq 4$ on the same axes. Use your graph to solve the equation:

$$x\,(x + 2)\,(x - 3) = 2^x.$$

Figure 2. The Task during the Intervention Lesson

Once these sessions were over, a post-test (refer to Appendix 1) was conducted. Similar to the pre-test, the students had one hour to complete the post-test individually. In order to assess the performances of the students, the mean scores of the pre- and post-tests were then compared. A simple t-test was conducted to test the level of significance of the results.

1. What do you think cooperative learning is? Have you done it before?
2. How do you feel about it?
3. How do you find the topic of graphs of functions?
4. You had a chance of learning graphs of functions using the jigsaw approach, how did you find the lessons?
5. Did learning through the jigsaw approach help your understanding on graphs of functions?
6. How would you feel if the jigsaw approach was applied to other topics or subjects?

Figure 3. The Questions Listed in the Student Feedback Form

Moreover, the student perceptions on the jigsaw approach and cooperative learning were collected using the student feedback form (refer to Figure 3). Students had to answer 6 open-ended questions. These questions were based on the jigsaw approach of cooperative learning and whether or not it helped them in the topic of graphs of functions. In order to express themselves clearly, students were given the freedom to answer these questions in both the Malay and/or English Languages.

RESULTS AND DİSCUSSİONS

In order to investigate the effectiveness of the jigsaw approach in the students' performances, test scores were compared and analysed using the IBM SPSS Statistics version 22.0 software. A paired samples t-test was conducted, where the confidence interval was at 95%. Therefore, a p value of less than 0.05, that is, $p < 0.05$, meant that the result obtained was significant and not merely by chance.

Table 1. Paired Samples Statistics for Cycle 1

	Mean	N	Std. Deviation	Std. Error Mean
Pre-test	4.737	19	3.070	.704
Post-test	6.158	19	3.500	.803

From Table 1, we can see a slight improvement in the students' performances from Cycle 1. For the pre-test, the mean test score calculated was 4.737, whereas the mean test score of the post-test has increased to 6.158.

However, this improvement did not necessarily mean that the intervention lesson (the jigsaw approach) had effectively improved the students' scores.

Table 2. Paired Samples Test for Cycle 1

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pre-test – Post-test	-1.42	2.735	.627	-2.739	-.103	-2.265	18	.036

Table 2 shows us that the *p* value is 0.036, which is less than the significance level of 0.05, and hence is considered significant. Therefore, this result suggests that the jigsaw approach does indeed have a positive effect on the students' performances.

Table 3. Paired Samples Statistics for Cycle 2

	Mean	N	Std. Deviation	Std. Error Mean
Pre-test	4.360	25	2.531	.506
Post-test	6.160	25	2.882	.576

Table 4. Paired Samples Test for Cycle 2

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pre-test – Post-test	-1.800	1.683	.337	-2.495	-1.105	-5.347	24	.000017

From Tables 3 and 4 are the results for Cycle 2, and we can see that the difference between the mean scores of the post-test and the pre-test is 1.800. This shows a better improvement in the students' performances, as opposed to that in Cycle 1, where the difference in mean scores was 1.421. By conducting a paired samples t-test, a *p* value of 0.000017 was obtained. Since *p* is less than 0.05, the result obtained is significant. Therefore, the improvement in students' performances is not just by chance, and could have been due to the intervention session conducted between the two tests. In short, the jigsaw approach had a positive effect on the performance level of the students.

The students' feedback for each of the 6 open-ended questions (refer to Figure 3 above) were categorised into 3 different aspects, which are 'positive feelings', 'negative feelings' and finally 'mixed feelings'. Based on the feedback obtained from the students in School A where Cycle 1 of the study was conducted, a majority of them were aware of what cooperative learning is. This was because they were exposed to it before in subjects other than Mathematics. Only 3 out of the 19 students (15.8%) disliked cooperative learning. The third question asked students about their thoughts on the topic of graphs of functions. Half of the sample expressed positive feelings for the question. The subsequent question asked for the students' opinions on the intervention lesson conducted using the jigsaw approach. Each and every one of them gave positive feedback on this teaching strategy. The students enjoyed the lesson. A few of them went on to say that they preferred working in their 'Home' groups. Unfortunately, no reasons were given. All but one student stated that the jigsaw approach helped to improve their understanding of the topic of graphs of functions. The latter had no answer for the question. Lastly, 57.9% of the students stated that they would like to use the jigsaw approach in other topics and subjects and 15.8% of them disagreed. Meanwhile, the remaining students expressed mixed feelings for this question, stating that it depends on the topics.

Similarly, students in School B, for Cycle 2, also responded to the questions in the feedback form. All of the students in the sample were exposed to cooperative learning before the study was conducted. According to them, cooperative learning means teamwork and working in groups. Out of the 25 students, only 64% of them gave positive feedback regarding their experience with cooperative learning, while 20% of the students disliked working in groups. The remaining 16% of students were unsure whether they enjoyed the experience or not.

Unlike the sample in Cycle 1, the majority of the students in this sample find the topic of graphs of functions difficult. When asked about their experience of using the jigsaw approach to learn graphs of functions, 56% of the students gave positive feedback, 20% gave negative feedback and the remaining 24% were unsure. Some of the students' feedback can be seen in Table 5 below.

Table 5. Students' Responses about Learning Graphs using the Jigsaw Method

Question 4	You had a chance of learning graphs of functions using the jigsaw approach, how did you find the lessons?
Student 1	It was fun learning with my home and expert groups. They were very cooperative.
Student 2	Sometimes it's easy and sometimes it's not.
Student 3	I'm still confused with it even after the home group and expert group.
Student 4	It was difficult.

When asked if the jigsaw method improved their understanding of graphs of functions, 60% of the students stated that it did, while 24% of them disagreed. Last but not least, 68% of the students gave positive feedback about applying the jigsaw approach in other topics or subjects. Out of the 16% of students who gave negative feedback, one of them preferred individual work instead of working in groups.

CONCLUSIONS

As mentioned earlier, the study comprised of two cycles, Cycle 1 and Cycle 2. These cycles were conducted in School A and School B respectively. We investigated the effect of the jigsaw approach in students' performances in graph of functions. And this was done by means of a pre-test – post-test design. Based on the results obtained from Cycle 1 and Cycle 2, we can conclude that the jigsaw approach does have a positive effect in improving the students' performance levels. In both cycles, the difference in the mean scores between the pre-test and post-test were significant. Furthermore, this improvement in the students' performance levels happened despite the absence of any real-world examples.

Subsequently, we also investigated the students' perceptions on cooperative learning. Students were requested to fill in the student feedback form. More than half of the sample size in each cycle gave positive feedbacks on cooperative learning and the jigsaw approach. However, not everyone was keen on and comfortable with working in groups. Unfortunately, this is not a satisfactory result. With the focus now on student-centred teaching and learning, it is vital for students to be willing to try new learning strategies.

The SPN21 education reform in Brunei envisages developing the 21st century skills in students. A possible reason for the lack of enthusiasm amongst students when asked about working in groups could be due to the lack of familiarity. Therefore, it is the duty of the teachers to expose students to new pedagogies, which will help in the development of the sought after 21st century skills. In order to carry out such teaching and learning strategies effectively, the teachers should be well accustomed and trained beforehand. Also, it is essential for teachers to realise the importance of students being responsible for their own learning. As educators, we must refrain from the traditional 'spoon-feeding' culture, as this teaching method fails to encourage students to become independent learners (Dehler & Welsh, 2014).

Finding real-world examples to help students in their learning can be a challenging task. However, the results of this study show that it is not always necessary to incorporate real-world problems. With the help of teaching strategies such as the jigsaw approach, students can still learn difficult concepts such as graphs. Educators can apply this approach to various other Mathematics topics to improve the students' performance levels.

Limitations of the Study

For this study, the sample size for Cycle 1 was 19 students and for Cycle 2 was 25 students. These are small-scale samples since other classes in both the schools were not available. Furthermore, both cycles were conducted in local government secondary schools and therefore cannot be used to generalise all secondary school students in Brunei. This is due to the possible difference in teaching and learning environments in the non-government schools. Furthermore, this study only focused on the application of the jigsaw approach in learning the topic of graphs of functions, one of the many Mathematics topics in the syllabus.

Apart from that, the language barrier also proved to be a slight problem. Although English Language is widely used in Brunei, it still is not the students' first language. Since Mathematics is an English medium subject, the tests and intervention lessons were conducted in English. However, the focus of this study was on the effectiveness of the jigsaw approach. The main aspect of this particular learning technique is that students need to share their knowledge and explain their solutions to their group members clearly. Therefore, in order to support discussions amongst the participants in the study, the students were allowed to discuss bilingually, that is, in both the Malay and English Languages.

RECOMMENDATIONS

This study was conducted in only two government secondary schools. Future studies can be done by means of comparisons between government schools and private schools, since both the learning environments might differ from each other. Also, the main focus of this study was on the topic of graphs of functions. Further research on the effectiveness of the jigsaw approach can be done on other Mathematics topics at different levels. It is possible that younger students would perceive cooperative learning differently compared to the sample selected for this study.

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APPENDIX 1: The Pre- and Post-Tests

1. (a) Plot the graph $y = x^2$ for values of x from -2 to 2.
   (b) By adding a suitable straight line to your graph, solve each of the following:
   (i) $x^2 = 2.5$ (ii) $x^2 - x = 1$

2. The variables x and y are connected by the equation $y = 1 + 2x^2 - x^3$.

The table below shows some values of x, and the corresponding values of y, correct to 1 decimal place where appropriate.

x	-1	-0.5	0	0.5	1	1.5	2	2.5
y	4	1.6	1	1.4	2	2.1	1	q

(a) Calculate q, give your answer correct to 1 decimal place.
(b) Using a scale of 2 cm to represent 1 unit on both axes, draw a horizontal x-axis for $-2 \leq x \leq 3$, and draw a vertical y-axis for $-3 \leq y \leq 5$. On your axes, plot the points given in the table and join them with a smooth curve.
(c) Use your graph to find all the solutions of $1 + 2x^2 - x^3 = 2$.
(d) By drawing a tangent, find the gradient of the curve at the point where x = -0.5.
(e) By drawing an appropriate straight line on the grid, solve the equation $1 + 2x^2 - x^3 = x$.

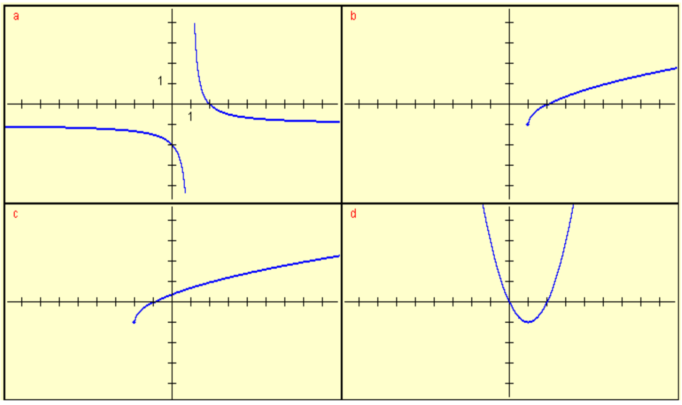
3.

x	1	1.5	2	3	4	5	6	8
y	8	5.3	4	2.7	2	1.6	1.3	1

The given table of values is for $y = \frac{8}{x}$.

(a) Using a scale of 2 cm to represent 1 unit on each axis, draw the graph of $y = \frac{8}{x}$ for the given values.
(b) On the same axes, draw the line of symmetry for your graph.
(c) Find the gradient of the straight line joining (1, 8) and (4, 2).

4. Identify a possible graph for the equation $y = (x - 1)^2 - 1$


a
1
1
b
c
d

THE DEVELOPMENT OF STUDENTS' MATHEMATICAL SKILLS IN THE EVALUATION OF NUMERICAL EXPRESSIONS INVOLVING ORDER OF OPERATIONS

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ABSTRACT: This paper examines the students' ability in using their mathematical skills when performing order of operations. In this study, the 'hierarchy-of-operators triangle by Ameis (2011)' was introduced as an alternative BODMAS approach to help students in gaining a better understanding behind the concept of the order of operations. The study of 21 Year 9 students in one of the government secondary schools in Brunei Darussalam used mixed qualitative and quantitative methods. Comparisons of the scores showed positive progress and greater improvement in the students' performance. Interviews from the students were also analysed to gain further insight. Most of the interviewed students responded that it is easier for them to remember the triangle to remember the order of operations.

Key words: order of operations, numerical expressions, secondary mathematics

INTRODUCTION

Producing highly skilled people requires students to excel in Mathematics. These students must master fundamental arithmetic operation through the understanding of conceptual knowledge. Bautista (2010) suggested that when evaluating numerical expression, it has to 'operate' in an order.

The acronym BODMAS (Brackets, Order, Division, Multiplication, Addition and Subtraction) has been the common teaching method used to help students (Headlam & Graham, 2009). Although the acronym helps the students to remember the order of operations, it does not develop their conceptual knowledge (Ameis, 2011). Thus, this issue needs to be addressed.

The Study

In the local context, when performing operations on the number, students must apply the BODMAS rule. Generally, students are still weak in performing operations. Vanderbeek (2007) suggested that when teaching the order of operations, instead of memorizing the mnemonic device using BODMAS, it should be focusing on the basic fundamental mathematical principle. However, there are some students who understood the mnemonic used and knew which order to perform first, but they still have difficulty in manipulating and solving expressions.

Consequently, this study was based on observations of Year 9 students simplifying mathematical expression containing multiple operations. Hence, the purpose of this study was to investigate how Year 9 students develop their mathematical skills. Carpenter and Lehrer (1999) suggested that the importance of learning skills with understanding to avoid rote application.

One of the purposes of this study was to enhance the basic mathematical skills. Acquiring these skills will help students in the algebra topic (Yahya & Shahrill, 2015). Therefore in this study, another approach was introduced apart from the mnemonic. The focus is on the ability of students performing the order of operations. Students were exposed to the hierarchy-of-operators triangle (Ameis, 2011) focusing on the conceptual knowledge of the order of operations.

This study is guided by the following research questions: Did the Year 9 students develop their mathematical skills when performing the Order of Operations during the evaluation of numerical expression? And how difficult it is for Year 9 students to accept another approach in remembering the Order of Operation?

LITERATURE REVIEW

A study done by DeLashmutt (2007) investigated the role of mnemonics in learning mathematics. She stated that students who practice mnemonics may remember the math concept and will be "able to retrieve them at a later date" (p. 2). However, Kalder (2012) argued that the use of mnemonic such as PEMDAS might also hinder the students. A notable disadvantage of mnemonic is that it does not connect to the conceptual understanding of the order of operations.

In a study by Lee et al. (2013), the researchers used alternative approach. Participants from the experimental group were exposed to the 'Rearranging Numerical Expression' approach whereas the control group used the ordinary Order of Operations method. They found that the experimental group managed to simplify questions by applying the 'Rearranging Numerical Furthermore, the experimental group showed that the students understood the method and this could be one of the ways to develop their mathematical reasoning in using the mnemonic, PEMDAS.

The triangle shown in Figure 1, taken from Ameis (2011), illustrated with 'powers' on top of the triangle, followed by multiplication and division as having the same priority. The addition and subtraction are placed at the bottom of the triangle, also shared the same priority.

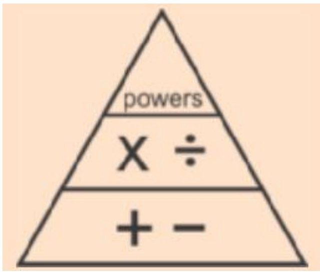

Figure 4. Hierarchy-of-Operators Triangle by Jerry Ameis (2011)

METHODOLOGY

Research design

An action research approach was used as the research design in this study. Yasmeen (2008) mentioned that in educational system, action research is conducted in classroom not only to gain student response, but also to gain feedback on teaching strategies.

The Sample

This study was conducted in a government secondary school in the Brunei-Muara district. There were 21 students from Year 9 doing Mathematics at the International General Certificate for Secondary Education level (IGCSE) were involved.

Procedure

Permissions and consents were sought from the relevant parties before conducting this study. The participants' details are strictly confidentiality in this study. Before the intervention lessons, the students were given the pre-test which is the first step to identify the problem. In the first cycle of action research, intervention lessons in three sessions were completed where one session lasted around 50 minutes. Subsequently, a post-test was given to the students. From the first post-test, we felt that the students had not acquired the necessary skills. By comparing the results in the first post- and pre-test, it was necessary to design another cycle for this study. In the second cycle, the students were placed into groups of two depending on their scores. During the intervention lesson, an activity was set up for the groups. Upon completion, another post-test were given to check the students' development.

Instruments

Mathematics Achievement Test

Scores from pre-test and post-test were collected to assess the students' mathematical skills in evaluating numerical expression involving order of operations. The students were given only 30 minutes. During the test, the students were not allowed to use calculator. Table 1 below listed the problems for different types of operations.

Table 1. Problems for Each Item and the Types of Operations Included

Item Number	Problem structure	Problem	Types of operations included
1	Multiple choice question	$9 \div 1 + 3 \times 0$	Division, addition and multiplication
2	Multiple choice question	$8 + 2 \times 2 - 6 - 1^2$	Addition, multiplication, subtraction and exponent
3	Multiple choice question	$9 + 3 \times (6 - 2) - 8 \div 4$	Addition, multiplication, bracket, subtraction and division
4	Multiple choice question	$3 + 9 \div 3 + 1$	Addition and division
5	Multiple choice question	$14 - 3 \times 2 - 5$	Subtraction and multiplication
6	Multiple choice question	$(3 + 2) \times 2 \div (1 + 9)$	Brackets, addition, multiplication and division
7a	Inserting brackets	$3 \times 4 + 5 - 15 = 12$	Multiplication, addition and subtraction
7b	Inserting brackets	$4 + 8 - 2 \div 2 + 3 = 10$	Addition, subtraction and division
8	Justification of answer	9 + 2 x 6 = 66	Addition and multiplication
9	Comparison	$5 \times 2 - 2 \times 4$ or $5 \times (2 - 2) \times 4$	Subtraction, multiplication and bracket

Each item was scored on a 0-2 point scale. It was essential for the students to show their workings and have correct answers with the appropriate use of the correct order of operations to earn 2 points. However, one point was given only when they showed acceptable workings even though the answers were not exact. Otherwise, the students will get zero point for incorrect answers or no attempt in the problem.

Audio-Recorded Interview

A semi-structured interview was conducted with selected participants from the study sample. The purpose of this interview was to extract more information, ideas from the interviewee and to avoid biasness and for analytical purpose (Gill et al., 2008). The selected students for the interview were the ones who had improved. During the interview, students were essentially asked their understanding of the topics and the difficulty in remembering the methodologies.

RESULTS AND DISCUSSIONS

The results of the pre- and post-tests of the students were analysed quantitatively by using the Statistical Package for the Social Science (SPSS). Meanwhile, the information collected during the interview was combined and analysed for emerging patterns.

The study compared the results between the participants pre- and post-tests. Paired t-test was used to determine significance at the 0.05 level. Table 2 shows the students had great improvement during the second post-tests from the pre-test, the mean of the second post-test (13.43) was greater than the mean of the pre-test (6.14).

Table 2. Mean and Standard Deviation of the Achievement Tests

	Mean	Standard deviation
Pre-test	6.14	4.767
Post-test 1	8.71	7.072
Post-test 2	13.43	6.408

Using paired sample t-test the p-value of 0.000 supports the fact that there is a significant difference between the second post-test and the pre-test of the students ($p = 0.000 < 0.05$). Although the results in Table 2 showed the mean of the first post-test (8.71) was greater than the mean of the pre-test, but the study did not show statistically significant difference as the p-value of $0.127 > 0.05$.

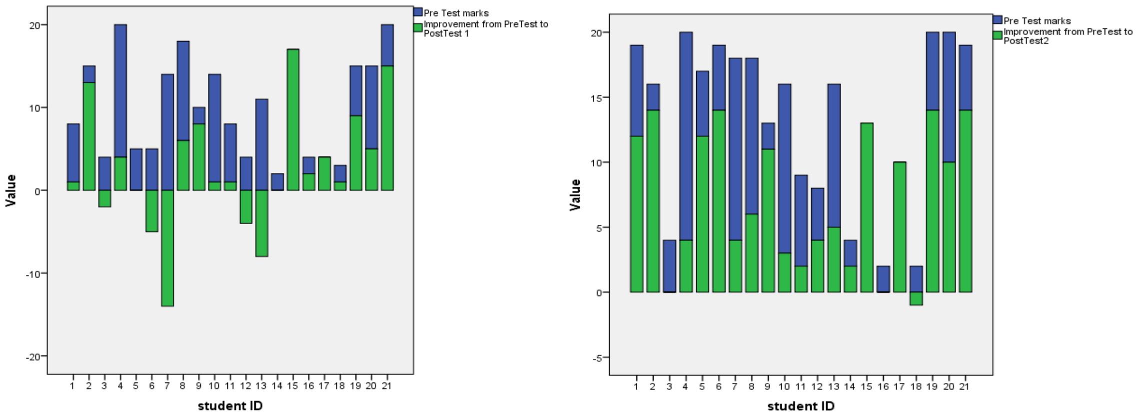

Figure 2. Graphs of Students' Marks Obtained During Pre-test and the Improvement for the Post-tests

Figure 2 above shows the graphs between pre-test of the students and their improvement t. There was greater improvement in the second post-test compared to the first. From analysing the students' pre-test, there was several common type of mistakes, as listed below.

Mistake #1: Evaluating the numerical expression by performing the operations from left to right.
Mistake #2: Multiplying any number by zero.
Mistake #3: Weakness in Exponents

From the interview, it can be concluded that students' conceptual understanding has improved and they prefer to use hierarchy-of-operators triangle.

CONCLUSIONS

Students with strong foundation in conceptual knowledge of Order of Operations may reduce the misconceptions in the topic. Reducing misconceptions will help students be more confident. For every level, it is important that students be given continuous practice and consistent review of the topic to reinforce the concept. Some limitation for this study is the lack of ability of the participants and their lack of English proficiency (Pungut & Shahrill, 2014).

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GPSS TOOL FOR STUDENTS IN STATISTICS EDUCATION

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ABSTRACT: Today, using of existing software and techologies becomes important in education and training. Academic institutions need various educational software tools which are appropriate for their own academic standards, curriculums and assessment tools. Those tools make lectures more clearly, enjoyable and concretely. Therefore they help students understand content of lectures by showing real results with graphics or tables. In the study, to take attention importance of mentioned tools, it is aimed to give a recommendation for statistics education. Many of statistics tutorials are taught in theoretical form in universities. While exercising statistical problems related to theoretical topic with students, some special tools should be applied for analyzing statistical formulas and their results. One of these tool is GPSS (General Purpose Simulation System) which is a software high powered general purpose computer simulation environment, designed for simulation professionals. It is a comprehensive modeling tool covering both discrete and continuous computer simulation, with an extremely high level of interactivity and visualizability. At this point, GPSS tool is introduced and its benefits are explained in terms of its operations supplied to users in the paper. Also, Kolmogorov-Smirnov normality test is applied and implemented in the paper.

Key words: Statistics Education, GPSS Tool, Improvements in Statistics Education

INTRODUCTION

Nowadays, many computer based applications are developed with various purposes. Some of those applications can be taken into consideration in teaching process. Because, applying some software tools in education and training has gained considerable importance. Especially, integrating theoretical and numerical based courses with software tools will be very useful for students in academic institutions. Owing to fundamental concepts and proofs of numerical based courses prevents students from understanding main ideas; significance of using those tools is increasing steadily (Kumar & Kumaresan, 2008). These tools make information learned in the lecture more memorable by providing several functions and visualization capabilities. Beside this, they help lectures become more enjoyable, concretely and meaningful for the students because practicing theoretical formulas or rules in real sense attracts their attention and interests. By this method, students can analyze problems related to course topics and comment out results by obtaining graphics and tables through the tools. Students can explore funny sides of theoretical and symbolic concepts. In this context, statistics education is associated with GPSS tool and it is recommended in the paper. GPSS is an alternative environment to other packages such as Minitab or Excel and suitable for improving special simulation applications. This paper is organized in the following way: The next section introduces GPSS tool and its main functions by giving examples. Third section describes Kolmogorov-Smirnov normality test which we took into account as a method in the paper and then implementation of it is explained with some scenarios through GPSS tool. Fourth section shows results and findings according to the study and last section summarizes our study and points to benefits of both GPSS tool and general usage of software tools in statistics education.

Gpss (General Purpose Simulation System)

GPSS which is a software high powered general purpose computer simulation environment, designed for simulation professionals. It is a comprehensive modeling tool covering both discrete and continuous computer simulation, with an extremely high level of interactivity and visualizability. Student version of GPSS is available and free. This tool provides lots of functionalities for users who desire to make simulations on various subjects. Some of important functionalities are explained below:

FUNCTION: Functions have list members to determine output result. In other words, this command analyses an argument and according to parameter, it chooses a list member. Functions divide into categories based on the usage scenario. D type function can be given as an example for one of these categories. When function works, it randomly generates a value between 1 and 6 depending on probability argument (Figure 1).

```
MY1 FUNCTION RN1,D6
0.05,1/0.15,2/0.40,3/0.80,4/0.90,5/1.0,6
```

Figure 1. D Type Function

TRANSFER: Generally, this command is useful when it is necessary to jump to the location in the program specified by the operand after the comma represented in Figure 2. In the example, when program jumps to OUT block, current transaction terminates.

```
           TRANSFER ,OUT
GO1        SAVEVALUE SAY2+,1
OUT        TERMINATE 1
```

Figure 2. Transfer Command

MATRIX: Matrix entity is an array of elements in GPSS tool and it is applied when users want to store information in the program. Declaration of a matrix and a matrix representation is demonstrated in Figure 3. Matrix is created with 1000 rows and 2 columns.

```
MAT        MATRIX ,1000,2
```

MAT

Dim 1 \ Dim 2	1	2
1	6	6
2	2	3
3	2	6
4	4	5
5	4	3

Figure 3. Matrix Entity

TABLE: A table entity is a set of integers used to collect data for a histogram. Each integer item specifies a frequency class in a histogram. Declaration of a table and a table representation is seen in Figure 4. Table has first frequency class with upper limit as 1, each frequency class increases by 1 and number of frequency classes is stated as 7.

```
TAB        TABLE X1,1,1,7
```

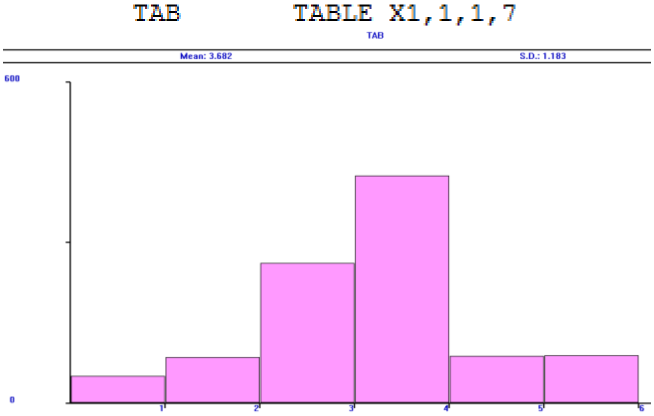


Figure 4. Table Entity

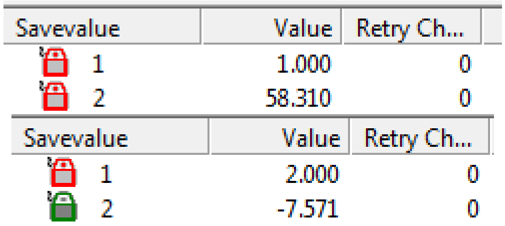
TEST: This command is similar to "if-else" structure. As it is seen from Figure 5, if counter is less than 1000, counter will be incremented by 1, otherwise, program transfers to GO block.

```
FINISH TEST LE X$SAY,1000,GO
SAVEVALUE SAY+,1
```

Figure 5. Table Entity

Also, GPSS provides many advantages for visual education of students which are listed below:

- Students can watch status of all variables of a given statistical problem at different time intervals while simulation is proceeding (Figure 6).



Savevalue	Value	Retry Ch...
1	1.000	0
2	58.310	0

Savevalue	Value	Retry Ch...
1	2.000	0
2	-7.571	0

Figure 6. Savevalue Windows at Different Time Intervals

- Students can monitor distribution of all values derived from any type of distribution to frequency sets on table entity while simulation is going on (Figure 7 and Figure 8).

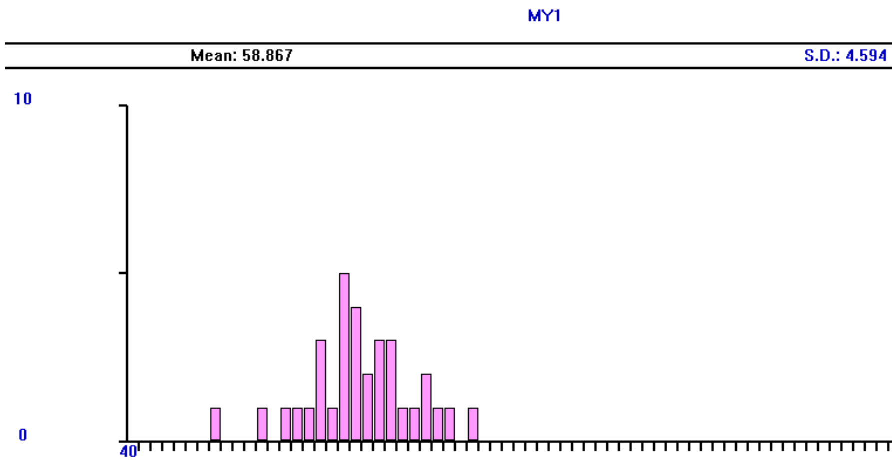


Figure 7. Table -1

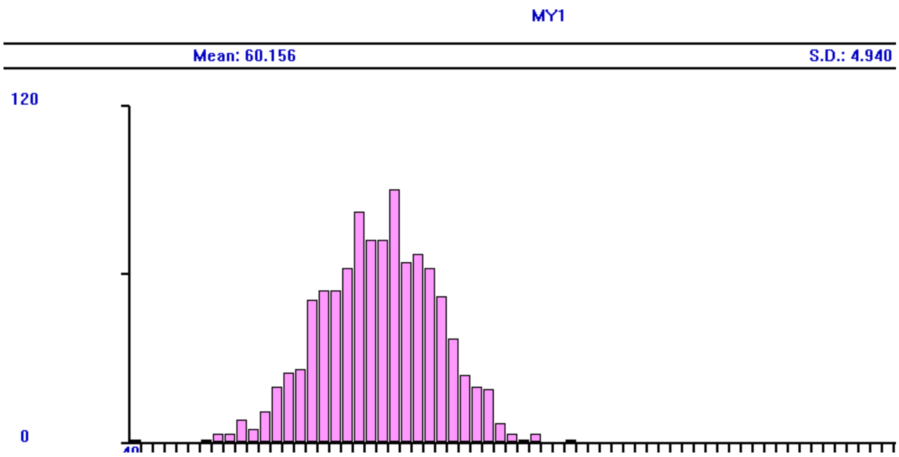


Figure 8. Table -2

- Students can keep track of output values stored in matrix entity during the simulation.
- It provides basic build-in procedures required in statistical problems such as generating Normal, Binomial, Poisson, Exponential, Discrete Uniform distributions with random values. Likewise, it involves some string operations.

METHODS

Some operations which can be computed through GPSS tool and listed above are practiced through a scenario in this part. The scenario is selected as Kolmogorov-Smirnov normality test method which can be realized either theoretically or practically in GPSS environment by the students in the lecture. Kolmogorov-Smirnov normality test is an alternative for goodness of fit test of Chi-Square. Some information about this test technique and an example concerning it is given in detail in the following.

Kolmogorov-Smirnov Normality Test

The *Kolmogorov-Smirnov* test statistic is a *well known test* statistic *used* to solve *goodness-of fit* problems was proposed by Kolmogorov in 1933. Kolmogorov suggested a goodness of fit test for one sample. In 1939, Smirnov who is a Russian mathematician developed a goodness of fit test for two independent samples. Due to similarity between Kolmogorov and Smirnov tests, it is known as Kolmogorov-Smirnov goodness of fit test in practice (Bircan, Karagöz, & Kasapoğlu, 2003). This test technique is nonparametric of the equality of continuous, one-dimensional probability distributions that can be used to compare a sample with a reference probability distribution (one-sample K–S test), or to compare two samples (two-sample K–S test) [2]. An example of deciding whether a sample belongs to normal distribution is explained and then implementation of K-S test is shown.

Example: Let's say that S(x) defines empirical distribution function of x value which is number of values less than x. S(x) is calculated in the following:

Suppose that there is a study with ten observations those are listed below:

95.00 72.97 94.34 102. 64 97.91 106.18 102.67 108.89 112.04 99.32

Firstly, observation values are ordered from least to greatest as shown below. Then empirical function result of each value is found in Table 1.

72.97 94.34 95.00 97.91 99.32 102.64 102.67 106.188 108.89 112.04

Table 1. Empirical Function Result of Each Value

X	72.97	94.34	95.00	97.91	99.32	102.64	102.67	106.18	108.89	112.04
S(X)	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0

Assume that those observation values are taken from a normal distributed cluster whose mean is 100 and variance is 10. Therefore, two hypotheses are claimed in the following:

H_0= The given data follow specified normal distribution with mean and standard deviation 100 and 10, respectively.

H_1= The given data do not follow specified normal distribution with mean and standard deviation 100 and 10, respectively.

Then, for each data value, cumulative distribution function is calculated with formula that is shown in Figure 9. Data values are represented with X. For X=95, cumulative distribution function result is found as shown in Figure 10.

$$P\left[\frac{x-\mu}{\sigma}.\right]$$

Figure 9. Cumulative Distribution Function

$$F(95) = P\left[\frac{x-\mu}{\sigma} \leq \frac{95-100}{10}\right] = P(Z \leq -0.4) = 0.341$$

Figure 10. Cumulative Distribution Function for X=95

Similar calculation is done for all data values in the sample and final result table is represented in Table 2.

Table 2. Cumulative Distribution Function Results of All Values

X	F(X)
72.97	P(X<=72.97) = P(Z<= -2.54) = 0.005
94.34	P(X<=94.34) = P(Z<= -0.47) = 0.318
95.00	P(X<=95.00) = P(Z<= -0.40) = 0.341
97.91	P(X<=97.91) = P(Z<= -0.12) = 0.450

99.32	P(X<=99.32) = P(Z<= 0.01) = 0.504
102.64	P(X<=102.64) = P(Z<= 0.33) = 0.630
102.67	P(X<=102.67) = P(Z<= 0.33) = 0.631
106.18	P(X<=106.18) = P(Z<= 0.67) = 0.751
108.89	P(X<=108.89) = P(Z<= 0.94) = 0.826
112.04	P(X<=112.04) = P(Z<= 1.24) = 0.893

If H_0 hypothesis is true, for all values of X, F(X) and S(X) results should be similar. Otherwise, at least for some values of X, there will be a big difference between F(X) and S(X). Absolute value (D) of the greatest difference between F(X) and S(X) is identified as the test statistics and is computed as shown in Figure 8. Also, all differences related to sample data values are illustrated in Table 3.

$$D=\max [F(X)-S(X)]$$

Figure 8. Calculation of Test Statistics

Table 3. Cumulative Distribution Function Results of All Values

X	F(X)	S(X)	F(X)-S(X)	[F(X)-S(X)]
72.97	0.005	0.10	-0.094	0.094
94.34	0.318	0.20	0.118	**0.118**
95.00	0.341	0.30	0.041	0.041
97.91	0.450	0.40	0.050	0.050
99.32	0.504	0.50	0.004	0.004
102.64	0.630	0.60	0.030	0.030
102.67	0.631	0.70	-0.068	0.068
106.18	0.751	0.80	-0.048	0.048
108.89	0.826	0.90	-0.073	0.073
112.04	0.893	1.00	-0.106	0.106

When last column of Table 3 is examined, it is seen that the largest absolute value is 0.118. Then, that value is compared with the critical value exists in Kolmogorov Smirnov Test Statistics Table. According to the table, for **α=0.05** (significance level) and **n=10** (sample size), the critical value is equal to **0.409**. Due to 0.118 is less than 0.409, H_0 hypothesis can be accepted in this way. Therefore, it can be concluded that there is enough support to say that sample is selected from normal distributed cluster whose mean and standard deviation 100 and 10, respectively (Satıcı, 2014).

Kolmogorov-Smirnov Normality Test Implementation with GPSS Tool

Implementation of K-S test in GPSS tool is based on four methods. Firstly, pure normally distributed sample is tested, then mixture of a normal distribution and a triangular distribution is analyzed, afterwards Weibull distributed sample is considered and finally exponentially distributed sample is examined.
Generally, in each method, following steps are taken into account:

- Generate values randomly for creating a sample
- Find mean and standard deviation of the sample
- Sort the sample in ascending order
- Obtain the empirical and cumulative distribution function of each value
- Obtain all differences between cumulative and empirical functions in the sample
- Select maximum difference and compare with critical value found in K-S table

While writing the program, various procedures are applied to obtain some results. For example; in order to decide if sample distribution is normal, DECIDENORMAL procedure is created (Figure 11).

```
PROCEDURE DECIDENORMAL(KVALUE)

 BEGIN

  TEMPORARY INDEX1,MAXVALUE;
  MAXVALUE=DIFFERENCE[1,1];
  INDEX1=2;
  WHILE(INDEX1<=1000)DO
  BEGIN
   IF (MAXVALUE<DIFFERENCE[INDEX1,1]) THEN BEGIN
    MAXVALUE=DIFFERENCE[INDEX1,1];
  END;
    INDEX1=INDEX1+1;
  END;

   IF (MAXVALUE<=KVALUE) THEN BEGIN
       RETURN 1;
   END;
   ELSE RETURN 0;

 END;
```

Figure 11. DECIDENORMAL Procedure

Moreover, in order to find cumulative distribution function of each value, ZRESULTVALUE procedure is benefited (Figure 12).

```
PROCEDURE ZRESULTVALUE(A)
BEGIN

  TEMPORARY RSQRT2PI,NO1,NO2,NO3,NO4,NO5,K,CND;
  NO1=0.31938153;
  NO2=-0.356563782;
  NO3=1.781477937;
  NO4=-1.821255978;
  NO5=1.330274429;
  RSQRT2PI=0.398942280401432;
  K= 1.0 / (1.0 + 0.2316419 # ABS(A));
  CND = RSQRT2PI # EXP(-0.5 # A # A) # (K # (NO1 + K # (NO2 + (K # (NO3 + K # (NO4 + K # NO5))))));
  IF (A>0) THEN BEGIN
    CND= 1.0 - CND;
  END;

  RETURN CND;

END;
```

Figure 12. ZRESULTVALUE Procedure

RESULTS AND FINDINGS

In this part, all experiments using implementation are evaluated with sample size 1000. Aim of making test with large sample size is to observe power of K-S test because when sample size increases, reliability of test results becomes stronger. Also, it is considered that it will be difficult to represent tables of small sample size. Observations are divided into four categories to measure effectiveness of K-S normality test as mentioned previous part.

Step1: Testing values generated from normal distribution in the implementation

When testing is done with mean 60 (μ) and standard deviation 25 (σ), sample distribution can be seen with GPSS tables in different time intervals through implemented simulation program (Figure 13). K-S simulation gives valid result for this sample by providing a message to the user shown in Figure 14. In addition, program has been designed to produce some result matrixes which store Z value and cumulative distribution function result depending on that Z value of each item in the sample (Table 4 and Table 5). It can be observed from Table 6, the greatest difference (test statistics) is found as 0.018 and it is less than critical value (0.043) so it can be said that sample is normally distributed.

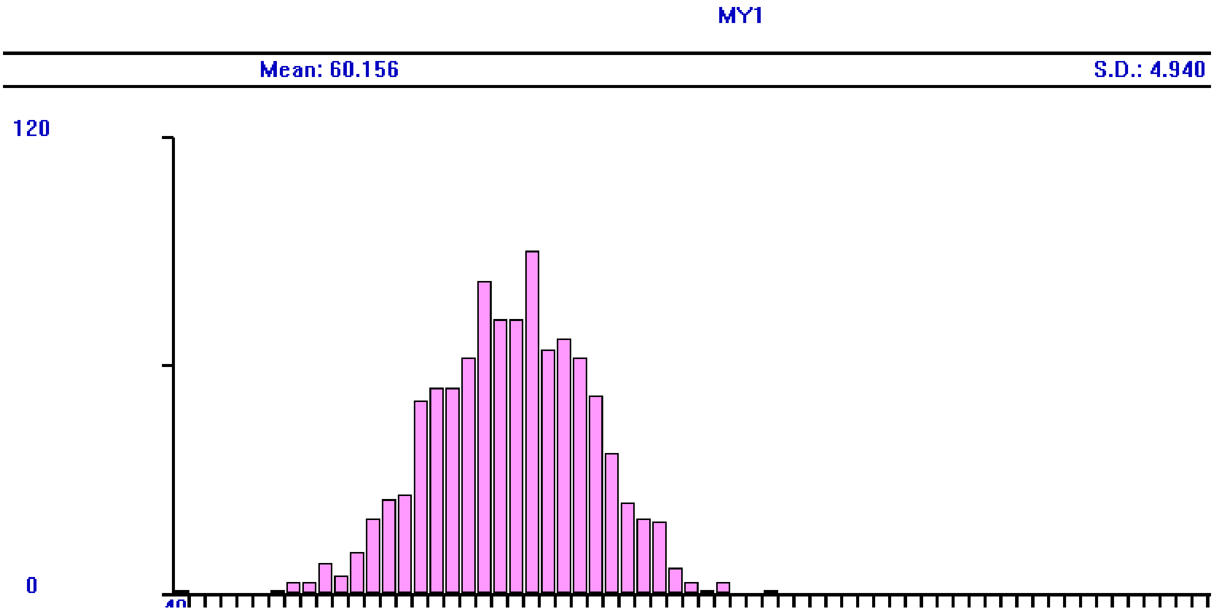


Figure 13. Experimental Table

1
"NORMAL DISTRIBUTION"

Figure 14. Simulation Message

Table 4. Matrix of Z Values

ZMATRIX

Dim 1	Dim 2: 1
1	-4.116
2	-3.023
3	-2.817
4	-2.768
5	-2.679

Table 5. Matrix of Cumulative Distribution Function Results

ZRESULTMATRIX

Dim 1	Dim 2: 1
1	.000
2	.001
3	.002
4	.002

Table 6. Test Statistics for Normally Distributed Sample

- MATRIX WINDOW

DIFFERENCE

Dim 1	Dim 2: 1
555	.018
556	.018
557	.018
558	.017
559	.016

Step 2: Testing numbers generated from mixture of a normal distribution and a triangular distribution in the implementation

In this phase, simulation generates a sample from mixture of a normal and a triangular distribution. While normal distribution has mean 30 (π) and standard deviation 7 (σ), triangular distribution has minimum value 30, maximum value 100 and mode value 90. Result table is expected to appear like in Figure 15 and it is clear that normality is disrupted with triangular distribution. At the end of the simulation, experimental table resembles to the expected table (Figure 16). K-S simulation gives reject result for this sample by providing the message to the user shown in Figure 17. It can be noticed from Table 7, the greatest difference is found as 0.157 and it is greater than critical value (0.043) so it can be said that sample is not normally distributed.

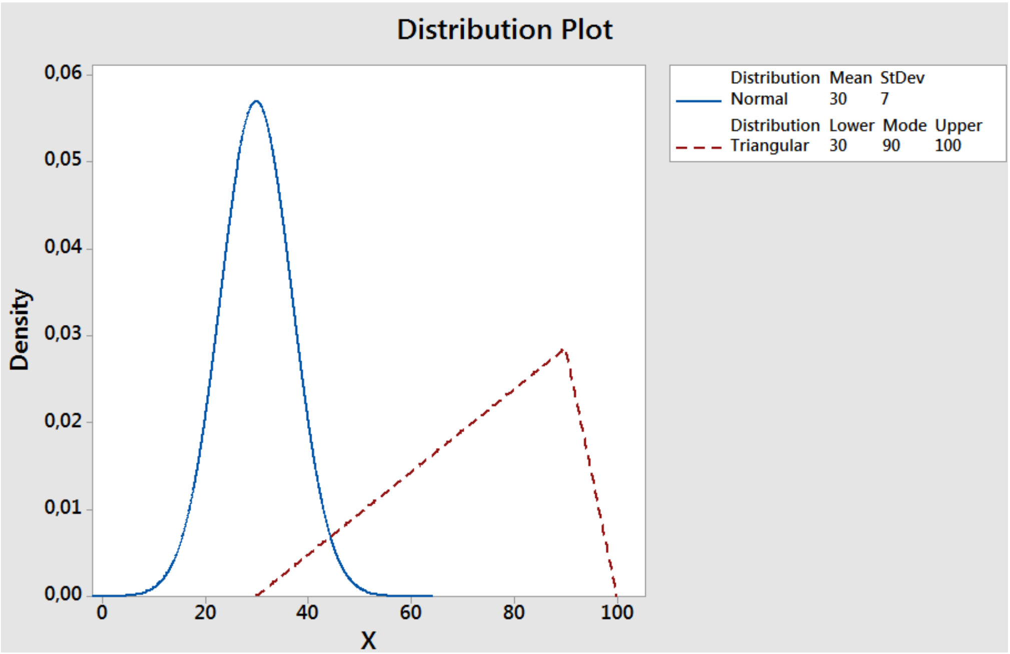


Figure 15. Expected Result Table

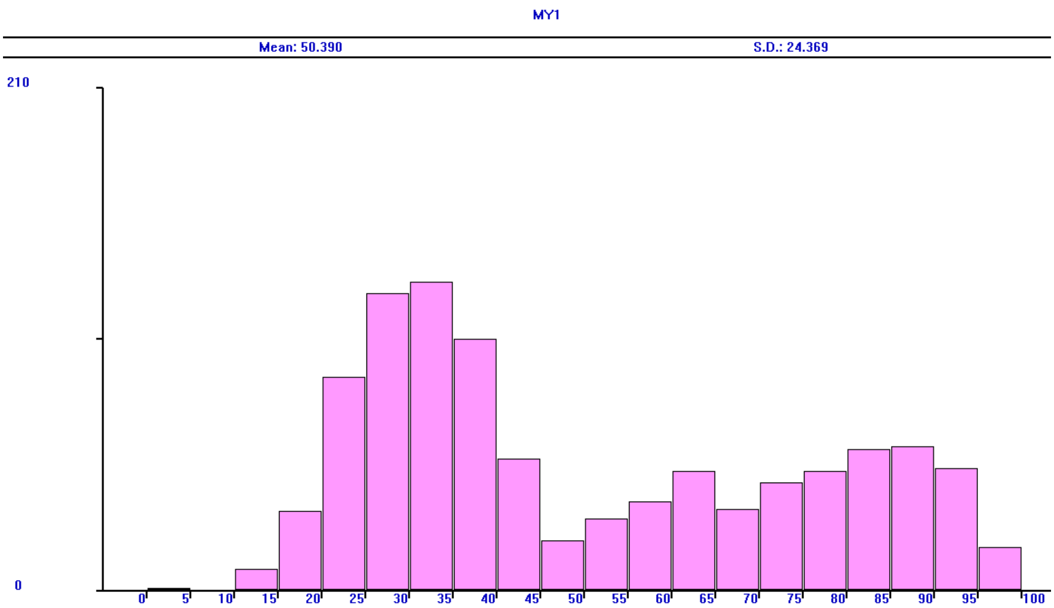


Figure 16. Experimental Table

Dim 1	Dim 2: 1
1	"NOT NORMAL DISTRIBUTION"

Figure 17. Simulation Message

Table 7. Test Statistics for Mixture Distribution

DIFFERENCE

Dim 1	Dim 2: 1
490	.157
491	.153
492	.154
493	.153

Step 3: Testing numbers generated from Weibull distribution in the implementation

In this step, simulation generates a sample from Weibull distribution with shape, locate and scale parameters as 0, 25 and 2, respectively. At the end of the simulation, sample distribution is illustrated with GPSS table (Figure 19). K-S test gives reject result for the sample by giving the message to the user shown in Figure 18. It can be noticed from Table 8, the greatest difference is found as 0.062 and it is greater than critical value (0.043) so it is proven that sample is not normally distributed.

Table 8. Test Statistics for Weibull Distribution

DIFFERENCE

Dim 1	Dim 2: 1
453	.062
454	.060
455	.060
456	.056

RESULTMAT

Dim 2: 1
"NOT NORMAL DISTRIBUTION"

Figure 18. Simulation Message

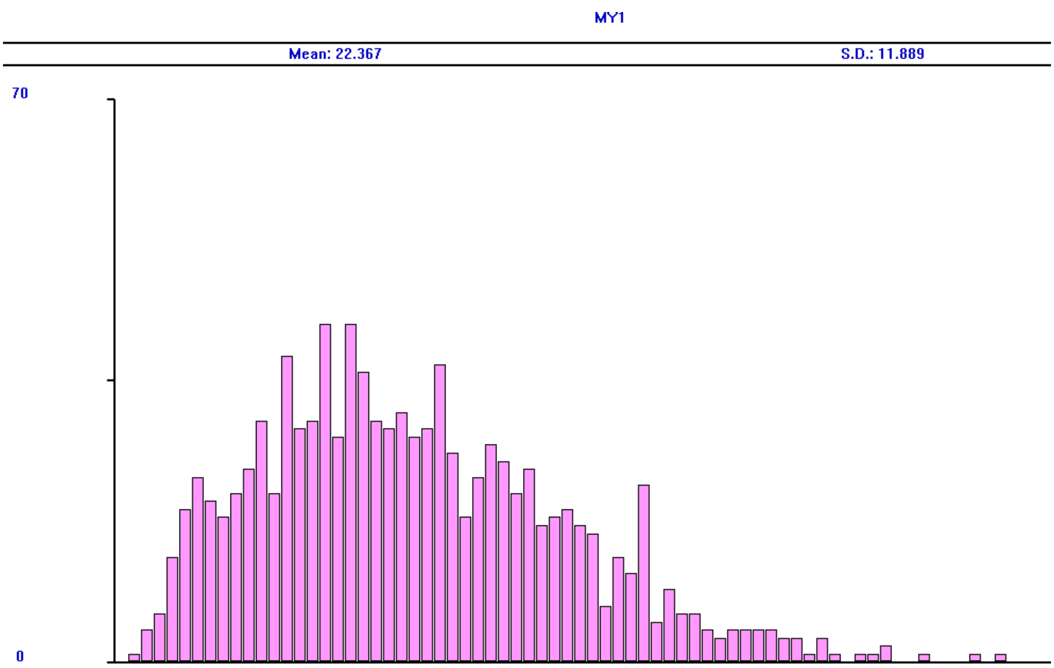


Figure 19. Experimental Table

CONCLUSION

In this study, at first, GPSS Tool and its primary operations are presented. After that, Kolmogorov-Smirnov normality test is introduced and working principle of it is consolidated with an example. Subsequently, implementation of K-S test on GPSS is clarified and then some test cases are evaluated with specific parameters to validate and verify effectiveness of developed program. In each case, program gives valid result and demonstration of the program is strengthened with tables, matrixes and output messages. Processing statistics courses in this manner provides many advantages to both students and teachers. These advantages are listed below:

- Students can make practices on data analysis by handling data operations and documentation of results. In addition, software tools enable them to construct and compare statistical methods and give a chance for simulating special designed applications and displaying statistical results on their own tables or graphs (Biehler, 1997).
- Teachers can learn new things for the curriculum content of the lectures and this situation brings a new approximation to operation of lectures in classes. Consequently, teachers should be adapted and encouraged to use software tools for their students (Biehler, 1997).

From the reasons described above, usage of such tools should be extended and maybe some informative activities can be arranged for the teachers on this subject to increase attention.

RECOMMENDATIONS

GPSS tool is highly recommended for statistics education in academic foundations on account of the reasons referred in previous part and the opportunities it includes. When GPSS is compared to other statistical packets,

- It is free, easy to learn and use.
- Can be preferred effectively and easily to a wide range of problems designed with specific objectives.
- It is suitable for queue systems related with scenarios about service time of a system to its customers (Ündeğer, 2008).
- Most important one is that students could improve their programming and algorithm knowledge with the aid of GPSS by carrying out their user-story simulation projects.

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PROSPECTIVE ELEMENTARY MATHEMATICS TEACHERS' CONTEXTUAL, CONCEPTUAL, AND PROCEDURAL KNOWLEDGE: ANALYSIS OF SELECTED ITEMS FROM THE PISA

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ABSTRACT: The aim of this study is to investigate the difficulties, which Turkish prospective elementary mathematics teachers have in solving the Programme for International Student Assessment (PISA) 2012 released items. Data were collected from 52 teacher candidates through a 26 item-written test. The data indicated that PISA items could be categorized as contextual, conceptual or procedural knowledge. Analysis of data also indicated that the participants encountered problems mostly in items requiring the combined contextual, conceptual, and procedural knowledge. Although many of the participants could produce correct answers for procedural knowledge items, several could not, and few were able to give mathematical explanations and make appropriate estimations for conceptual knowledge items. Implications for teacher education related to the findings of the study are discussed.

Key words: contextual knowledge, conceptual knowledge, procedural knowledge, PISA items, preservice teachers

INTRODUCTION

Recently much has been written about students' mathematics performance in international large-scale assessments such as Programme for International Student Assessment (PISA), Trends in International Mathematics and Science Study (TIMSS), and Progress in International Reading Literacy Study (PIRLS) (e.g., Andrews, Ryve, Hemmi, & Sayers, 2014; Roth, Ercikan, Simon, & Fola, 2015). The influence of such international assessments on both international (e.g., OECD, 2006) and national education policy is considerable (e.g., Yıldırım, Yıldırım, Ceylan, & Yetişir, 2013). Henceforth, there is a need to analyze the items indepth and trace the difficulties encountered by the students in order to make educational decisions.

To this end, we focused on the *Programme for International Student Assessment (PISA)* initiated by the *Organisation for Economic Co-operation and Development (OECD)*. The purpose of our study was to investigate the difficulties that preservice elementary teachers encountered while performing on PISA tasks that require using different types of mathematical knowledge.

Theoretical Background

Types of Mathematical Knowledge

Contextual knowledge is knowledge of how things work in daily life situations in the real world (Leinhardt, 1988). Contextual knowledge tasks in PISA require students to translate from a real-world setting to the domain of mathematics and explain the relationships between the context-specific language of a problem and the formal language of mathematics.

Conceptual knowledge is knowledge of concepts or principles and involves rich connections (Hiebert & Lefevre, 1986). Conceptual knowledge tasks in PISA require students to understand the extent of mathematical definitions, facts and principles.

Procedural knowledge is the knowledge of subcomponents of a correct procedure (Rittle-Johnson & Koedinger, 2005). Procedural knowledge tasks in PISA require students to implement strategies for finding mathematical solutions and apply mathematical algorithms.

METHODS

Participants and Procedure

The sample consisted of 52 third-year preservice teachers majoring in Elementary Mathematics Education at Mersin University, Turkey. The data were collected by the second researcher in the spring semester of 2015-2016 academic year. A 26-item 90 min mathematics test which was originally released by the OECD (2013) was distributed to the participants as a booklet (available from http://pisa.meb.gov.tr/?page_id=617).

Data Collection and Analysis

Problems were categorized using the definition of contextual, conceptual, and procedural knowledge developed by Rittle-Johnson and Koedinger (2005). The authors and another mathematics educator conducted the coding. Before each rater individually coded the problems, they discussed the interpretation of the categorization. Afterwards, they separately coded the items and, met and discussed each of the coding discrepancies coming to 100% agreement for the data.

To clarify and discuss how we determined the type of knowledge, we present a sample item according to three type of knowledge: contextual, conceptual, and procedural (see Figure 1).

Item 25: Revolving Door

The two door **openings** (the dotted arcs in the diagram) are the same size. If these openings are too wide the revolving wings cannot provide a sealed space and air could then flow freely between the entrance and the exit, causing unwanted heat loss or gain. This is shown in the diagram opposite.

What is the maximum arc length in centimetres (cm) that each door opening can have, so that air never flows freely between the entrance and the exit?

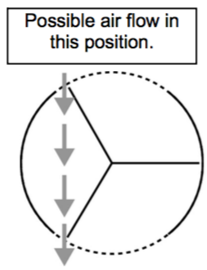

Figure 1. Sample Item (OECD, 2013, p. 34)

Item 25 (*Revolving Door*) demands contextual, conceptual, and procedural knowledge because it provides everyday problems in the real world and non-routine applications (contextual knowledge), includes relationships and connections (conceptual knowledge), and requires calculation the length of an arc (procedural knowledge). Test carried out by the prospective teachers and the difficulty of items was classified according to the percentage of correct answers to each one. In order to identify the errors according to the deficiencies in knowledge type, the responses of prospective teachers were analyzed further.

RESULTS AND FINDINGS

Table 1 presents a classification from more to less difficulty of the tasks. Column 3 indicates the type of knowledge determined by the group of experts: contextual (Ct), conceptual (C), and procedural (P). Column 4 shows the percentage of correct answers given by the prospective teachers.

Inspection of the percentage of the prospective teachers who answered the tasks indicated that they encountered problems mostly in tasks requiring the combined contextual, conceptual, and procedural knowledge (see Table 1). Many of the prospective teachers performed well on the procedural knowledge tasks. However, few were able to make appropriate estimations for conceptual knowledge tasks. For example, the most common incorrect answers given by the prospective teachers were included in tasks 25, 23, 9, and 18, respectively. Accordingly, we analyzed the most common errors and the difficulties with the tasks 25 (Ct, C, P), 23 (Ct, C, P), 9 (Ct, C, P), and 18 (Ct, C, P). For details readers are referred to Aydın and Özgeldi (2016).

Table 1. Classification of the Tasks by Knowledge Type and Level of Difficulty

Item No	Task	Type of Knowledge	Percent Correct
25	Revolving door	Ct, C, P	5.8
23	Garage	Ct, C, P	13.5
9	Sailing ships	Ct, C, P	23.1

18	Helen the Cyclist	Ct, C, P	38.5
3	Drip rate	Ct, P	46.2
8	Sailing ships	C, P	46.2
14	Climbing mount Fuji	Ct, C, P	46.2
15	Climbing mount Fuji	C, P	48.1
1	Apartment purchase	Ct, C	73.1
26	Revolving door	C, P	73.1
17	Helen the Cyclist	C, P	75
20	Which car?	P	80.8
22	Garage	Ct, C	82.5
11	Ferris Wheel	P	82.7
12	Ferris Wheel	C, P	82.7
13	Climbing mount Fuji	C, P	82.7
21	Which car?	P	82.7
24	Revolving door	P	82.7
10	Sauce	P	84.6
6	Charts	C, P	86.5
16	Helen the Cyclist	C, P	86.5
7	Sailing ships	Ct, C, P	88.5
5	Charts	P	90.4
2	Drip rate	Ct, C	92.3
4	Charts	P	92.3
19	Which car?	Ct, C	94.2

Analyses of the errors in the most difficult tasks revealed that most of the prospective teachers had difficulty in (1) interpreting a non-standard problem (Ct), (iii) elaborating visual aspect of the model in the problem (C), and (3) applying algorithms (P).

CONCLUSION

Beyond the well-researched phenomenon of conceptual and procedural knowledge, contextual knowledge has received relatively little attention within educational research. Findings of the present research showed that the majority of preservice teachers have rudimentary contextual knowledge and that they are not proficient in utilizing that type of knowledge while solving non-routine tasks.

RECOMMENDATIONS

The simple message from this research is that preservice teachers encounter difficulties with performing tasks that require using integrated mathematical knowledge that is the blend of contextual, conceptual, and procedural knowledge. A pragmatic solution might be for teacher education programmes to include more emphasis on the acquisition of contextual, conceptual, and procedural knowledge, and how these knowledge types are tied up with preservice teachers' understanding of particular mathematical content.

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ANALYSIS OF PROSPECTIVE CHEMISTRY TEACHERS' VIEWS ON MODELS ACCORDING TO SOLO (STRUCTURE OF OBSERVED LEARNING OUTCOMES) TAXONOMY

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ABSTRACT: In this study it was investigated prospective chemistry teachers' views on the nature of models and the use of models and modeling in chemistry teaching by using Structure of Observed Learning Outcomes (SOLO) taxonomy. A qualitative study was performed on 16 prospective chemistry teachers who attended the fifth grade. Three open-ended questions were used as the data collection tool. The assessment scale, prepared by the researchers, was employed to make the descriptive analysis of what understanding levels on the SOLO prospective teachers' answers corresponded to. The views of the prospective teachers about the model definition were usually found to be in the pre-structural level, which is the lowest level and no view was identified to be at the highest level, which is the extended abstract. The prospective teachers' views regarding the use of models were generally in the pre-structural and untistructural levels and no view in the extended abstract level could be identified.

Key words: Models, Prospective Chemistry Teachers, SOLO Taxonomy

INTRODUCTION

Chemistry is not an easy subject to understand because of abstract nature of chemistry concepts. For this reason, many students have difficulties in learning chemistry. Models play a vital role in teaching and learning chemistry concepts and help students to form concrete ideas about abstract concepts. It is essential that the prospective chemistry teachers have an appreciation of what 'a model' is and that definition should be congruent with the one that is accepted by scientists. Besides, they have to learn that why and how models are used in chemistry teaching. On the other hand, several studies revealed that students and teachers generally do not clearly distinguish the ideas and/or purposes underlying models and the content of the models. Students usually view models as toys or miniatures of real-life objects, and few students understand why models are used in science (Ingham & Gilbert, 1991). Students generally do not give meaning to the process of modeling. Teachers' understanding of the nature of models and modeling were also investigated in the different contexts.

Van Driel and Verloop (1999) carried out a study concerning experienced secondary science teachers' understanding of the nature of models in The Netherlands. The subjects in this study were teachers of biology, chemistry and physics preparing for the curriculum innovation. They used two instruments which one was a questionnaire with seven open items on models and modeling and second one was a Likert-type questionnaire. They found that, in general, experienced teachers subscribed to the view that 'a model is a simplified or schematic representation of reality'. In the Likert-type questionnaire study, they identified three scales that confirmed first results. The first concerned the relation between a model and the target it represents: the extent to which models are seen as a simplified representation of reality. The second concerned the physical appearance of models: whether they could be met in a range of modes of representation. The third concerned the social context of model construction: whether models are the product of human creativity and communication. Harrison (2001) interviewed ten experienced science teachers about their understandings of the analogical models they use to explain science to their students in Australia. Justi ve Gilbert (2003), a semi-structured interview was used in Brazil to enquire into the 'notion of model' held by a total sample of 39 science teachers. Seven 'aspects' of their notions of a model were identified in this study. It was found that teachers with degrees in chemistry or physics had different views about the notion of 'model' to those with degrees in biology or with teacher training certificates. It was seen that the teachers who participated in the aforementioned studies had problems about the definition of a model and using in science classrooms. For this reason to understand how prospective chemistry teachers' knowledge about models is important.

The Structure of Observed Learning Outcomes (SOLO) taxonomy, developed by Biggs and Collis (1982), is one of the significant tools to comprehend cognitive development among students. It provides educators and researchers with a systematic way of classifying and describing the range of performances produced by learners in attempting a particular academic activity such as writing an essay or answering an open-ended question. Biggs and Collis constructed their model on the notion that in any 'learning episode, both qualitative and quantitative learning outcomes are determined by a complex interaction between teaching procedures and student characteristics' (1982, p. 15). The SOLO taxonomy describes non-linearity of students' cognitive development and level of increasing complexity in a student's understanding of a subject through in five stages: Prestructural, Unistructural, Multistructural, Relational, and Extended Abstract. These levels are ordered in terms of various characteristics, including the movement from the concrete to the abstract, the use of an increasing number of organizing aspects, increasing consistency, and the relating and extending of key principles (Biggs, 1999; Biggs & Collis, 1982). The aim of this study is to examine the utility of Biggs' and Collis' (1982) Structure of Observed Learning Outcomes (SOLO) taxonomy as a means to assess prospective chemistry teachers' understanding about models and using models in chemistry lessons.

METHODS

Research Design

This is qualitative study and in the qualitative research, it is important that the data collected should be detailed and in-depth and views and experiences of the individuals studied should be presented as directly as possible so that a descriptive and realistic picture can be presented to the readers who show interest in the matter in question (Yıldırım and Şimşek, 2005, p. 48).

Participants

The present study was situated in the context of the ten semester of a five-year pre-service chemistry teacher education program. The study's sample consists of 16 prospective chemistry teachers (7 male and 9 female) who attend the 4th class of the Chemistry Teaching Department. All of the prospective chemistry teachers have completed their chemistry-related courses. As prospective chemistry teachers encounter many models both at their field courses and field training courses, the participants were selected using criterion sampling, which is one of the purposive sampling methods (Yıldırım and Şimşek, 2005, p. 112).

Data Collection Tool

In the study, a test consisting of three open-ended questions was used as the data collection tool to obtain the views of prospective chemistry teachers about models. During the development of the test, the measuring tools used in the studies conducted about models were examined (Grosslight et al., 1991, Justi & Gilbert, 2003) and questions were formulated based on this assessment.

Data Analysis

For data analysis, the SOLO taxonomy levels and criteria, developed by Biggs and Collis (1982), were taken into account in developing assessment scales for prospective teachers' views about the definition of a model and about the intended uses of models. Descriptive analysis was performed using the assessment scales prepared. Explanation of each level of the SOLO taxonomy, used in the analysis, was given in Table 1. In the descriptive analysis, the data obtained can be summarized and interpreted based on the predetermined themes and direct quotes can be given with a view to reflecting individuals' views in a striking manner (Yıldırım and Şimşek, 2006, p. 224).

Table 1. SOLO Taxonomy Used in the Analysis of Student Responses (Minogue ve Jones, 2009)

	Level	Description
1	Prestructural	The task is not attacked appropriately, the student has no understood the point, or question is reworded.
2	Unistructural	One aspect of the task is picked up and used (understanding as nominal).
3	Multistructural	Several (two or more) aspects of the task are learned but are treated separately (understanding as knowing about).
4	Relational	The components are integrated into a coherent whole, with each part contributing to the overall meaning (understanding as appreciating relationships).
5	Extended Abstract	The integrated whole at the relational level is reconceptualised at a higher level of abstraction, which enables generalization to a new topic or area, or is turned reflexively on oneself (understanding as far transfer and as involving metacognition).

To ensure reliability, the responses by prospective teachers were analyzed by a researcher and a field training specialist according to the SOLO taxonomy to identify Agreement and Disagreement situations. Using the reliability formula, proposed by Miles and Huberman (1994), the reliability of the study was calculated to be 94%. Thus, the findings obtained through the analysis of the data were readied for description. Also, direct quotes were occasionally made for the better portrayal of the views of prospective teachers during the presentation of the findings. Teachers were given the letter codes "PCT" and numbers "PCT1, PCT2, PCT3)

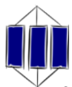
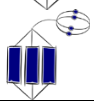
RESULTS AND FINDINGS

In this section of the study, the findings from the analysis of prospective teachers' views concerning models according to the SOLO taxonomy were given in two parts. The first part includes the findings obtained from the analysis based on the SOLO taxonomy of the prospective teachers' views about the definition of a model while the second part is about that the findings related to the views about the intended use of models.

Findings from the Analysis of Prospective Teachers' Views on the Definition of a Model according to the SOLO Taxonomy

In this section, the answers the prospective teacher gave to the question, "How do you define a model?" were analyzed according to the SOLO taxonomy and the findings were given in Table 2.

Table 2. Findings from the Analysis of Prospective Teachers' Views on the Definition of a Model according to the SOLO Taxonomy

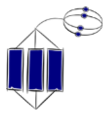
SOLO Understanding Level		f	Sample Answers
Prestructural		8	A model is a person who is taken as an example. (PCT6, PCT8, PCT9, PCT16) A model is the whole of a concept or a limited system. (PCT1) Visualization of the topic to be explained is called a model. (PCT2) Model is the form of narration that threads topics like a chain and it is the way of dominating the class. (PCT7). A model is the form of a topic shown using graphs, charts or slides. (PCT15).
Unistructural		4	A model is what can form visuality. (PCT10, PCT11, PCT12) Models are more concrete things. (PCT13)
Multistructural		3	Models are the tools, materials and activities that facilitate comprehension. (PCT3, PCT5) A model is a material which exemplifies and represents the situation. (PCT14)
Relational		1	A model is a set of graphs, figures and materials used to clarify a topic or theory. (PCT4)
Extended Abstract		0	---

Examining the date in Table 2, it was found that regarding the model definition, 8 of the prospective teachers are on the "Prestructural" level which contains insufficient, disconnected, irrelevant or false information about models. At this level, the leading model definition is "the model in daily life." 4 prospective teachers are in the "Unistructural" level which includes an approach to models from a single perspective as well as a small bit of knowledge about models while 3 prospective teachers are on the "Multistructural" level as they adopt multiple perspectives in their approaches. Only 1 prospective teacher gave answers on the "Relational" level by approaching to models from several angles and associating them in a logical way.

Findings from the Analysis of Prospective Teachers' Views on the Intended Use of a Model according to the SOLO Taxonomy

In this section, the answers the prospective teacher gave to the questions, "Why are models used in secondary education chemistry classes?" and "How are models used in the secondary education chemistry classes?" were found to be similar and related to the intended uses of models, and therefore, they were merged for analysis. The findings from the analysis of prospective teachers' views on the intended use of a model according to the SOLO taxonomy are given in Table 3.

Table 3. Findings from the Analysis of Prospective Teachers' Views on the Intended Use of a Model according to the SOLO Taxonomy

SOLO Understanding Level		F	Sample Answers
Prestructural		3	They are used to summarize a topic.(PCT1) They are used to develop a certain standard across the country. (PCT7) They are used to gain experience from experienced people. (PCT16)
Unistructural		7	They are used to add a visual aspect. (PCT6, PCT10, PCT11) They are used to make abstract concepts more abstract. (PCT3, PCT4, PCT13, PCT15)
Multistructural		2	They are used to arouse students' attention in the lesson and express what will be done and how. (PCT9) They are used to facilitate and reinforce comprehension. (PCT8)
Relational		2	They are used to ensure that student can visualize the concepts that can hardly be understood without seeing, such as the concept of atoms. (PCT14) They are used to make sure that information in committed to the long-lasting memory for effective learning. (PCT2)
Extended Abstract		2	They are used to help students visualize theoretical information such as atoms and envisage them with dummies. (PCT5) They are used to describe the concepts like atoms and bonds, which we cannot see with our eyes in daily life, but which are scientifically proven, and facilitate their comprehension by making them more concrete. (PCT12)

Examining the date in Table 3, it was found that regarding the intended use of models, 3 of the prospective teachers are on the "Prestructural" level which contains insufficient, disconnected, irrelevant or false information about the intended uses of models. 7 prospective teachers are in the "Unistructural" level which includes an approach to the intended use of models from a single perspective as well as a small bit of knowledge about the intended use while 2 prospective teachers are on the "Multistructural" level as they adopt multiple perspectives in their approaches to the intended use of models. 2 prospective teacher are on the "Relational" level as they approach the intended use of models from several angles and associate them in a logical way, and 2 prospective teachers are on the "Extended Abstract" level in which the knowledge about the intended use of models is transferred to different situations and generalizations are made.

CONCLUSION

In this study which measures the levels of prospective teachers' views about models using the SOLO taxonomy, the following conclusions were obtained: The views of the prospective teachers about the definition of a model were found be generally on the Prestructural level of the SOLO taxonomy and the number of prospective teachers declined toward the higher levels, with no teacher making into the highest level, i.e., Extended Abstract. As for their views on the intended use of models, the prospective teachers were generally on the Prestructural level of the SOLO taxonomy and they exhibited an equal distribution of the higher levels.

In literature, Likert-type scales (Treagust, 2002; Güneş, Gülçiçek and Bağcı, 2004) and open-ended questions (Grosslight et al., 1991; Güneş, Gülçiçek and Bağcı, 2004; Justi & Gilbert, 2003) were used to identify the views (of primary and secondary school students, lecturers and experts) on models and modeling. Unlike the literature, this study used the SOLO taxonomy to identify the views of students about models. If we compare the findings of this study to the three levels developed by Grosslight et al. (1991) to study the views on models and their use in sciences, we can say that 1st level in which "models are seen as toys or simple copies of reality" corresponds to the SOLO taxonomy's "Unistructural" level, and the 2nd level in which "models need not to overlap with the real-world objects they model after" corresponds to the SOLO taxonomy's "Multistructural" level. The first two factors of the 3rd level which consists of three factors are “perception of a model not as a replica of reality, but as a service for developing ideas and testing them" and "the person making the model should take an active role in modeling" and they correspond to the SOLO taxonomy's "Relational" level while the third factor, which is "models are changeable and can be subject to tests and they provide information in a cyclical constructivist process" correspond to the SOLO taxonomy's "Extended Abstract" level.

The study's findings imply that there are prospective teachers who have wrong information about the definition and intended uses of models and the number of prospective teachers who nurture views at higher levels is considerably small. The views of prospective teachers about the definition and intended use of models are similar to those Justi and Gilbert (2003) found in studying the views of primary school science teachers and secondary school physics, chemistry and biology teachers about the nature of models. Justi and Gilbert (2003) came up with a classification which categorized the teachers' views about the nature of models from 7 perspectives (Nature, Use, Entities, Uniqueness, Time, Prediction and Accreditation). This study's findings were found to be similar to the classifications "Nature" and "Use." The "Nature" classification consists of 4 categories (i. A reproduction of something, ii. A representation of the whole of something, iii. A representation of part of something, iv. A mental image) while the "Use" classification has 4 factories (i. A standard or reference to be followed, ii. A visualization, enabling a person to 'see' a phenomenon, iii. A way of supporting creativity, the imagining of new contexts and the creation of new ideas, iv. A way of understanding or explaining something).
The views of some prospective teachers about the definition of a model were found to be similar to the category "A representation of the whole of something" in the "Nature" classification while their view about the intended use of models were similar to the categories "A visualization, enabling a person to 'see' a phenomenon" and "A way of understanding or explaining something" in the "Use" classification.

RECOMMENDATIONS

The elimination of the errors and deficiencies in the views of prospective teachers about the definition and intended use of a model is of critical importance for them to use the models correctly and properly in future. Therefore, their views should be analyzed in a way to take into consideration their cognitive levels, when possible. Therefore, in line with the findings of this study, the SOLO taxonomy can be recommended as an alternative tool that can be used to analyze the views of prospective teachers about models.

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EXAMINATION OF EXPERIENCED CHEMISTRY TEACHERS' PEDAGOGICAL CONTENT KNOWLEDGE TOWARDS 9TH GRADE CHEMISTRY CURRICULUM

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ABSTRACT: The aim of this study is to analyze the experienced chemistry teachers' (ECTs') pedagogical content knowledge (PCK) about what extent ECTs' using of 9th grade chemistry curriculum, taking into consideration the objectives, goals and acquisitions. The study was designed as a case study, a kind of qualitative research design, and it was performed with 3 ECTs during the spring semester of 2014-2015 education year. The data were collected by observations, interviews and lesson plans. The data were analyzed through constant comparative method and enumerative approach. It was found that the teachers' PCK related to the 9th grade chemistry curriculum was not sufficient generally. The teachers did not stick to the curriculum exactly. Instead, they thought that, it was enough to follow the course book, even they could intervene the curriculum if it was necessary according to them. At the same time, it was determined that the teachers were not able to fulfill the aims, goals and acquisitions in the curriculum strictly.

Key words: pedagogical content knowledge, curriculum knowledge, 9th grade chemistry curriculum, experienced chemistry teachers, physical and chemical changes

INTRODUCTION

Curriculum can be described that a systematic and intended packaging of competencies (i.e. knowledge, skills and attitudes that are underpinned by values) those students should acquire through organized learning experiences both in formal and non-formal settings. Curriculum contributes to the development of students' thinking skills and science process skills, and the acquisition of relevant knowledge that learners need to apply in the context of their studies, daily life and careers. Well-designed curriculum also plays an important role in forging life-long learning competencies, as well as social attitudes and skills, such as tolerance and respect, constructive management of diversity, peaceful conflict management, justice and inclusiveness [URL-1]

An effective curriculum provides teachers, students, administrators and community stakeholders with a measurable plan and structure for delivering a quality education. Curriculum serves as a guide for teachers during the teaching process. It can be said that the curriculum should do everything for teachers and tell them exactly what to do, when to do, and in what order. They also provide togetherness among teachers in terms of aims, goals, acquisitions, subject order and subject matter knowledge. Therefore, the teachers' sticking to the curriculum which belongs to the level of class is quite important for teaching.

Pedagogical content knowledge (PCK) was introduced as a specific category of knowledge and described as "that special amalgam of the content and pedagogy that is uniquely the province of teachers, their own special form of professional understanding" by Shulman (1986). Cochran *et al*. (1993) have proposed a modification of PCK based on the constructivist view. The components of PCK have been defined in various ways by different authors. One of the components of PCK is *knowledge of the curriculum*. The knowledge about science curriculum consists of two categories: mandated goals and objectives, and specific curricular programs and materials (Magnusson et al., 1999). Knowledge of goals and objectives includes horizontal curriculum knowledge that is the relation of topics in the same grade and vertical curriculum knowledge that is relation of topics taught in different grades (Grossman, 1990). The second component is related to teachers' knowledge about the curriculum that they use and the materials needed to teach science or a particular topic.

Research Question

What is the nature of ECTs ' knowledge of 9th grade chemistry curriculum for teaching?

Sub-Research Questions

1. In which ways do the ECTs stick to the 9th grade chemistry curriculum?
2. What are the ECTs' opinions toward the 9th grade chemistry curriculum's philosophy?

3. What extent do the ECTs adhere to the goal, objective and acquisitions placed in the 9th grade chemistry curriculum?
4. What kinds of connections do the ECTs make in the context of chemistry curriculum during the teaching process?

METHODS

The research was designed as a qualitative study defined by Yin (2003) as: "*In general case studies, are the preferred strategy when "how" or "why" questions are being posed, when the investigator has little control over events, and when the investigator has little control over events, and when the focus is on a contemporary phenomenon within some real-life context* (p.1)." Then the case study model was used. According to Stake (1995: Xi) "*...case study is the study of the particularity and complexity of a single case, coming to understand its activity within important circumstances* (cited in Patton, 2002 p.297)."

The research was performed with 3 ECTs during the spring semester of 2014-2015 education year. The teachers' experiences varied from 26 to 36 years, and they were working at different schools but they were teaching chemistry according to the same curricula. The data were collected by observations, interviews and lesson plans.

Data analysis

Data were analysed with two different approaches: a) constant comparative method b) enumerative approach. In constant comparative method data were compared with data to find similarities and differences (Charmaz, 2006). Then with enumerative approach was used to reduce the subjectiveness of qualitative coding and facilitate identifying the characteristics of each teacher's PCK (Park and Oliver, 2008 p. 267). The objectives were analysed according to Revised Bloom's taxonomy. Revised Bloom's taxonomy (Krathwohl, 2002) has two dimensions, one of them is knowledge dimension, and the other is cognitive process dimension.

RESULTS AND FINDING

Data were analysed for giving answer to sub-research questions and the findings were presented according to the order of those questions.

The ECTs' Ways of Sticking to 9th Grade Chemistry Curriculum

During the interviews the ECTs expressed their experiences about their sticking to 9th grade chemistry curriculum in terms of content of the topics, weeks. Some of them stated that they were sticking to course book instead of curriculum and they were thinking that it was enough. Also some of them stressed out that they were altering the curriculum when they need for example the order of topics or content of a subject. They expressed their opinion with these statements:

> *"...We have a curriculum and a course book. The course book was prepared according to the curriculum. And the smart board programmes were also prepared according to it. So there is not any positive or negative case."* (ECT1, Interview I, p.14)

> *"...I look at the curriculum before planning the lesson. For example tomorrow is 7th of May. According to curriculum where should I be on 7th May, then I plan..."* (ECT1, Interview I, p. 12).

> *"...We stick to the curriculum. We cannot do anything different from it. Even questions should be in the content of the curriculum. If we ask out of the curriculum the question can be cancelled..."* (ECT2, Interview I, p. 7)

> *"...Sometimes the order of topics can be incorrect. Then we organize the order of the topics according to us. We have the right of changing the order..."* (ECT1, Interview I, p. 14-15)

> *"...I broaden the content according to me, give priority to the important topics....*
>
> *....I cannot teach the law of constant proportions without teaching the mole concept. They ask me what does 7/3 mean in Fe_2O_3, so I cannot do without mole. We prepare a new curriculum..."* (ECT3, Interview II, p. 2-3).

Opinions of the ECTs' towards the 9th Grade Chemistry Curriculum's Philosophy

The ECTs explained their opinions towards the 9th grade chemistry curriculum's philosophy with these statements:

> *"...I think the 9th grade chemistry curriculum has a sense... I tell them fundamental level chemistry or advanced level chemistry and the former one is more related with daily-life context. I understand chemistry in this way..."* (ECT1, Interview I, p.13).

The Status of the ECTs' Taking into Consideration the Objectives, Goals and Acquisitions Placed In 9th Grade Chemistry Curriculum

All of the ECTs stated that they could take into consideration them partially not completely. One of them explained her opinion with these statements:

> *"... I cannot tell that I obey them completely. Although you teach the same topic to the same grade you cannot reach to the same point..."* (ECT3, Interview I, p.10).

When the lesson plans were analysed in terms of acquisitions written by the ECTs in the context of physical and chemical changes it was seen that only one of them wrote the same acquisition with the one placed in the 9th grade chemistry curriculum (*...Distinguishes the physical and chemical changes in terms of bond formation and breaking...*). The others were different. Also the levels of them varied according to the Revised Bloom Taxonomy.

The Status of the ECTs' Making Relations in the Context of 9th Grade Chemistry Curriculum

It was determined that all of the ECTs made vertical and horizontal relation both towards to future and past during the lessons in the context of 9th grade chemistry curriculum when the observation and interview findings were analysed. Some of the examples were like these:

> ***"...As we learned before (in the same year)*** *in chemistry, elements are represented with symbols, compounds are represented with formulas and reactions are represented with equations...**(horizontal relation towards past)"*** (ECT1, **Observation** on 31th Marc, 2015).

> *"...For example when we are talking about electronic configuration I tell them* ***in 11th grade (two years later)*** *you will learn this topic more detailed..."* ***(vertical relation towards future)*** (ECT2, **Interview** I, p. 9).

CONCLUSION

According to findings it can be said that as Henze (2008) found although the teachers were experienced they even did not enough experiences of using it. In contrast may be as a good result, the ECTs were aware of the philosophy of the curriculum. Also similar to Lankford (2010) it was determined that the ECTs were thinking that using the course book is enough for sticking to the curriculum. Besides the ECTs expressed that they intervened the order of topics different from the original order placed in the curriculum. This result was compatible with the study of Aydın (2012). In terms of the Revised Bloom Taxonomy the levels of acquisitions were varied. This means the ECTs perceived the topic different from the curriculum. This difference influence the implementation of the topic. At last the ECTs made both vertical and horizontal relations towards to past and future. These relations provide the spirality of the curriculum.

RECOMMENDATIONS

It can be recommended for ECTs to participate in workshops, in-service programmes to become much more professional about implementation of the course. Gacanoğlu and Nakiboğlu (2015) examined the experienced physics, chemistry, biology and mathematics teachers' awareness related to philosophy, application of the curriculum after an in-service programme. They concluded that all the teachers were well-developed in all aspects.

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EVALUATING EXPERIENCED CHEMISTRY TEACHERS' KNOWLEDGE OF ASSESSTMENT IN THE CONTEXT OF PHYSICAL AND CHEMICAL CHANGES

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ABSTRACT: In this qualitative study the chemistry teachers' PCK about knowledge of assessment towards PCC was investigated. The study conducted with three experienced chemistry teachers, the data were collected by observation, interview, and analyzing exam questions within the context of Physical and Chemical Changes (PCC) carried out at 9th grade. The data were analyzed through *constant comparative method* and *enumerative approach.* It was concluded that the teachers asked open-ended questions for assessment of PCC during the lessons, but in the exams they did not ask any question or they preferred multiple choice questions. Their questions were usually at lower levels of Revised both in knowledge and learning process dimensions of it. It is found that, with these questions, their aim was to determine the students' prior knowledge about PCC and to understand if the students have understood the subject or not. It was also found that the teachers had information about assessment relatively, but this was not sufficient.

Key words: pedagogical content knowledge, knowledge of assessment, physical and chemical changes, Revised Bloom Taxonomy, experienced chemistry teachers

INTRODUCTION

Assessment is an integral part of instruction. It provides information about the levels of understanding and also determines whether or not the aims of lesson are being met. To determine whether the teaching is concluded with success or not is possible only with a suitable assessment and then evaluation of the data. Otherwise, students' knowledge structure cannot be revealed and also the success of teaching cannot be determined.

Teachers use several types of assessment strategies to evaluate the growth and understanding of students in their classrooms. Commonly used assessment in science education is often divided into *diagnostic, formative* and *summative* categories for the purpose of considering different objectives for assessment practices ("Types of Assessement", n.d.).

Pedagogical content knowledge (PCK) is a special knowledge domain that distinguishes teachers from other subject specialist (Shulman, 1987; Carlsen, 1999). PCK is a synthesis of all knowledge needed for teaching and learning a certain topic. Assessment knowledge, one of the components of PCK, is quite important for a teacher that he or she must use in order to assess students' understanding of a scientific concept and students' learning outcomes. *Knowledge of assessment of science learning component* is comprised of knowledge of dimensions of science learning important to assess, and knowledge of methods by which that learning can be assessed (Tamir, 1988 cited in Park and Oliver, 2008). Park and Oliver (2008) have also indicated that this knowledge includes knowledge of specific instruments, approach, or activities.

Rollnick et al. (2008) studied with three experienced teachers, two of them were working in high school and the other one was working in a university science course in the context of mole and chemical equilibrium concepts. At the end of the study the researchers asserted that the teachers did not stress the conceptual understanding of the mole concept. Instead of it they focused on calculations because of the external exam system which include algorithmic questions. Newton and Newton (2001) examined the effect of subject matter knowledge in teacher's classroom discourse. They focused on how much time teachers devoted on questioning and telling. According to results teachers spent much time on descriptive/factual questions that could be put under low-level questions category.

Physical and Chemical Changes (PCC) subject is one of the basic and essential subject of chemistry, and also is related to daily life. Learning this subject meaningfully depends on learning particulate structure of matter and chemical bonds correctly. According to Henze et al. (2008) the more teachers know about learners' difficulties and misconceptions the better they assess students' understanding. If the teachers are aware of students' misconceptions related with the subject then they should do diagnostic assessment at the beginning and formative assessment at the end of the course. In this way the teaching process can be determined whether it was successfully accomplished or not.

Research Question

What is the nature of the experienced chemistry teachers' (ECT) PCK in the context of PCC?

Sub-Research Questions

1. What kind of questions do the ECTs ask in the context of PCC during the lesson?
2. In which level of the Revised Bloom taxonomy do the ECTs ask questions in the context of PCC?
3. For what purpose do the ECTs ask questions in the context of PCC?
4. In which part of the lesson do the ECTs ask questions in the context of PCC?
5. What kind of assessment methods do the ECTs use in the context of PCC?

METHODS

The study is an example of qualitative research. With the aim of exploring ECTs' assessment knowledge the study was designed according to the case study model. As Stake (1995: Xi) stated case study is the study of the particularity and complexity of a single case, coming to understand its activity within important circumstances (cited in Patton, 2002 p.297).

Participant Selection

The study conducted with three ECTs. The researchers selected the participants purposefully. Purposive sampling techniques are primarily used in the qualitative (QUAL) studies and may be defined as selecting units (e.g., individuals, groups of individuals, institutions) based on specific purposes associated with answering a research study's questions (Tedlie and Yu, 2007 p.77). Then a criteria, having teaching experience at least 25 years and were working at different schools, defined for gathering deeper data.

Data Collection

Data collection process was performed in the second semester of 2014-2015 education year with 3 ECT, explained in the former section in the context of PCC. Data collection tools were observation form, interview questions, lesson plans, exam questions and materials used during the course.

Data Analysis

Data were analysed with two different approaches: a) constant comparative method b) enumerative approach. In constant comparative method data were compared with data to find similarities and differences (Charmaz, 2006). Then with enumerative approach was used to reduce the subjectiveness of qualitative coding and facilitate identifying the characteristics of each teacher's PCK (Park and Oliver, 2008 p. 267).

RESULTS AND FINDINGS

Data were analysed for giving answer to sub-research questions and the findings were presented according to the order of those questions.

Types of Questions in the Context of PCC Asked by the ECTs

When the ECTs' courses were observed it was seen that all of them preferred asking open-ended questions in the context of PCC. During the interviews they told that they like open ended questions for explaining the cause-effect relations, meaningful learning. One example of ECTs' explanations was presented below:

"... This is the main point which I stress that there is no sense without telling the cause of increasing or decreasing..." (ECT1, Interview I, p. 28)

Levels of Questions Asked by ECTs in the Context of PCC According to the Revised Bloom Taxonomy

When the ECTs' questions were analyzed according to the Revised Bloom Taxonomy (Krathwol, 2002), it was seen that the questions mostly were in low levels both in knowledge and conceptual process dimensions. For example 64.70% of the ECT1's questions were in factual knowledge and remember level, the lowest level of taxonomy. Interestingly ECT3 asked a question as *"...What am I doing from the beginning of the lesson? Which concept am I trying to teach you meaningfully? What do you think?.."* To answer this question the students needs metacognitional knowledge and should create. But this was the 2,94% of her questions.

Phases of PCC Course in which the ECTs Asked Questions

When the observations it was seen that they asked questions in all phases of the course such as beginning of the course, during the course and at the end of the course. Questions asked by ECT1 were like as:

At the beginning of the course: *"...Do I know all three kinds of bonds' formation? (ionic, covalent and metallic bonds)..."*
During the course: *"...I say when salt dissolves in water it is an example of physical change. Why?..."*
At the end of the course: *"...How the physical and chemical changes can explain with intramolecular attractions?..."*

The Aims of the ECTs Asking Questions in the Context of PCC

When the questions asked by the ECTs during the PCC course were analyzed in terms of aims such as diagnostic assessment, formative assessment and summative assessment, it was determined that they had these aims but not completely. For example ECT1 asked a question for diagnostic assessment like *"...What is the prior knowledge of PCC?..."* and for summative assessment an exam question like *"Define the physical and chemical changes and give example to them..." but* did not ask any question during the course for formative assessment.

The Assessment Techniques Used by the ECTs in the Context of PCC

When the ECTs' assessment techniques were analyzed whether they were traditional or alternative, it was seen that they preferred traditional techniques more than the alternative techniques. The traditional assessment techniques which they preferred during the course and exam were open-ended questions. Only ECT2 used an alternative one, he gave an experiment homework to see a chemical change. In the experiment the students had to add lemon to milk and see the change in terms of not returning, decomposition. The next week he asked the students who did the homework and watched the videos and if he were satisfied he gave them 100 points as performance not score,

Moreover the ECTs' lesson plans were examined in terms of their writings about assessment section, it was seen that ECT1 did not write anything, ECT2 wrote *"...giving students a worksheet for assessment and evaluation..."* and ECT3 wrote *"...Solving Questions..."*. Then their performance was observed in the light of lesson plans and it can be concluded that only ECT2's writing was supporting his performance and the others were not.

CONCLUSION

According to data gathered during the research it can be said that the ECTs' assessment knowledge was not sufficient in terms of PCK. In fact they knew how better assessment could be theoretically but in practice they were more traditional, focusing on lower levels. They preferred to ask more open-ended questions, at first sight this could be a good decision but the levels of questions were important. The questions' being at lower levels was supported by the findings of the Revised Bloom Taxonomy. Focusing again to low levels only could not make them to think in a different scientific aspect. Also it was determined that the ECTs asked questions in all phases of the course but did not ask questions for all the aims of diagnostic, formative and summative assessment completely. For example ECT1 asked question to diagnose the prior knowledge and at the end to examine what extent they learned the PCC but did not ask any question during the course. This could cause not determining how a student progressed etc.

RECOMMENDATIONS

In the light of conclusions the recommendations should be like;
The ECTs';

- focusing for different types of questions
- using high level questions according to Revised Bloom Taxonomy such as making them differentiate the PCC in terms of energy, return, physical and chemical properties; then analyzing a phenomena whether it was a physical or chemical change different from most used examples etc.

- asking questions for all three aims (diagnosing, assessing formative and assessing summative)
- using alternative assessment techniques.

It is possible that the ECTs' could not be well-developed in terms of assessment knowledge then they could participate workshops and also in undergraduate level the pre-service chemistry teachers should attend such courses.

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HARNESSING THE POWER OF SOCIAL MEDIA IN ACADEMIC ENVIRONMENTS

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ABSTRACT: The retention of customers is a global problem with serious implications for individuals, public as well as private organizations. Customer retention is a key factor for fiscal success and competitive advantage in today's global economy. Moreover, applying communication and relationship-building techniques is a common practice to increase customer loyalty and retention.

Although retention is crucial to the economic success of an educational institution, higher education administrators often ignore quality customer relationship management as a solution for retention. In order to remain financially viable, higher education administrators needed to place greater interest on customer retention. As college and university enrollment officers attempt to retain students using classic programs and models, many students have shifted their methods of communication to more interactive, self-created content used to position individuals as members of groups. Researchers have also demonstrated the importance of active, two-way communication in the customer relationship management and student retention processes.

Findings from this study may contribute to the existing body of knowledge regarding the potential relationship between student retention and social media. Furthermore, the results of this study might provide guidance for academic leaders to improve student loyalty efforts and increase competitive advantage, thereby influencing long-term profits by reducing student attrition.

Keywords: Social media, Facebook, student attrition, student retention, empirical analysis

INTRODUCTION

The issue of sustainable retention is a global problem with implications for individuals, businesses, and academic organizations (Chrysochou, Krystallis & Giraud, 2012; Hosseini & Albadvi, 2010; Hu, 2011; Sharabi, 2010, 2013; Woodcock & Stone, 2012). Customer retention is a key factor for fiscal success and competitive advantage in a global economy (Chrysochou et al., 2012; Hosseini & Albadvi, 2010; Migueis, Camanho & Cunha, 2013; Woodcock & Stone, 2012). In addition, applying communication and relationship-building techniques is a common practice to increase customer loyalty and retention (Vander Schee, 2011).

Although retention is crucial to the economic success of an educational institution (McPherson & Schulenburger, 2010; Sharabi, 2013), higher education administrators often ignore quality customer relationship management as a solution for retention (Sharabi, 2010, 2013). Sharabi (2010) posited that to remain financially viable, higher education administrators needed to place a greater focus on customer retention. According to McPherson and Shulenburger (2010), tuition accounts for approximately 80% of private institutions' revenue, and student retention through degree completion would produce 4 times the income of a freshman dropout. Furthermore, attrition costs colleges and universities approximately $16.5 billion in 2010, with the average private institution losing approximately $8.3 million (Raisman, 2013).

When university administrators fail to retain a student through degree completion, a seat that a tuition-paying person could fill remains empty (Tinto, 1993). According to Pompper and Kessinger (2006), a college or university financial officer will spend 3 to 5 times more money recruiting a new student than retaining a student already enrolled. When a student leaves a university, administrators must expend additional resources, at the expense of programming and student services, recruiting additional students to fill those vacancies (Pompper & Kessinger, 2006). Budgets at colleges and universities also decline due to short-term losses from reduced tuition and fee payments, as well as room and board revenues. Failed attempts to retain students could ultimately threat the very existence of educational institutions (Hu, 2011; Sharabi, 2010, 2013; Tinto, 1993).

Tinto (1993) claimed that higher education administrators who integrate and involve students in a university community would have a greater likelihood of retaining those students through degree completion. Nonacademic factors related to academic customer service, such as integration and a sense of belonging, account for more than 65% of student departures (Morrow & Ackermann, 2012). By addressing the nonacademic concerns, universities administrators have an opportunity to increase the student population by more than 80% of the total number of student departures (Raisman, 2013). Despite research in the area of higher education retention regarding students' reasons for persisting, less research exists examining the communication practices of colleges and universities to promote retention (Chen, 2012).

As college and university retention officers attempt to retain students using classic programs and models, many students have shifted their methods of communication to more interactive, self-created content used to position individuals as members of groups (Blossom, 2009; Tapscott, 2009). Researchers have demonstrated the importance of active, two-way communication in the customer relationship management and customer retention processes (Goodman, 1999; Heyes & Kapur, 2012; Larivet & Brouard, 2010). Social media provides a platform that fosters interactivity and interaction between organization personnel and various stakeholders. Since 2005, more than 90% of college students participated in Facebook, more customers were willing to engage in Facebook than any other social media platform, and more than 80% of business leaders reported using Facebook as a component of their strategic communication plan (DiStaso & McCorkindale, 2013).

According to the ACT Institutional Data File (2010), fewer than 37% of full-time students enrolled in private universities complete their undergraduate degrees within 4 years. University administrators retain fewer than 70% of freshmen students from the first year to the second year (ACT, 2010). University retention officers fail to retain students as a result of several variables, primarily the failure to fully and correctly integrate those students into the culture and community of the university (Hu, 2011; Morrow & Ackermann, 2012; Pascarella et al., 2011; Tinto, 1993). When university administrators fail to retain students through degree completion, the economic implications might be devastating (Marginson, 2011) because attrition costs in average universities approximately $9.9 million annually (Raisman, 2013).

The purpose of this quantitative correlational study was to examine the relationship between social media and student retention at a higher education institution in Turkey. The future implications of this research may include assisting college and university admission officers in planning efforts to increase retention of college and university students by addressing nonacademic causes of attrition which account for more than 65% of student departures (Morrow & Ackermann, 2012). Improving retention is critical for the economic stability of higher education institutions (Baum et al., 2010; Hu, 2011) specifically for private institutions that receive 80% of revenue from tuition and student fees (McPherson & Shulenburger, 2010). According to Raisman (2013), higher education administrators could increase their total student populations by as much as 84% of the total number of student departures by placing a greater focus on nonacademic customer service issues.

METHODS

The objective of this research is to determine if, and if so to what extent, a relationship exists between the use of Facebook and first-year students' intentions to reenroll in the School of Business at the participant university, a small, private, 4-year institution of higher education in Turkey. In order to accomplish this purpose, a quantitative methodology and correlational research design is used.

The research data is gathered through a verified valid and reliable survey instrument, the Institutional Integration Scale (Pascarella & Terenzini, 1980), distributed to all first-year students enrolled in the School of Business at the participant university. The Institutional Integration Scale (Pascarella & Terenzini, 1980) is utilized as the primary element in the data collection instrument. The first section of the instrument contains the Institutional Integration Scale (Pascarella & Terenzini, 1980). The second section of the instrument contains items, original to this study, relating to social media usage.

The Institutional Integration Scale (IIS; Pascarella & Terenzini, 1980), based on Tinto's (1975) theoretical framework, was developed to assess student self-reported levels of social and academic integration. The IIS measures five facets of institutional integration. The following provides information regarding the number of items in each subscale, the coefficient α values for the sample data, and an example item from each subscale: Peer Group Interactions (7 items, $\alpha = .83$, "It has been difficult for me to make friends with other students"), Interactions With Faculty (5 items, $\alpha = .82$, "My non-classroom interactions with faculty have had a positive influence on my career goals and aspirations"), Faculty Concern for Student Development (5 items, $\alpha = .73$, "Few of the faculty members I have had contact with are generally interested in students"), Academic and Intellectual Development (7 items, $\alpha = .75$, "I am satisfied with my academic experience at [institution name]"), and Institutional and Goal Commitment (6 items, $\alpha = .68$, "It is important for me to graduate from college"). The scale possesses desirable properties that are appealing for use with college students, such as being relatively short and simple to administer (less than 10 minutes to complete).

First-year students in the School of Business at the participant university, who had completed fewer than 30 semester hours by the beginning of the fall semester of 2015, comprised the population for the study. As of the release of the fall 2015 data reports, the participant university had 403 students enrolled in the School of Business including 176 first-year students. Research data is analyzed with SPSS 20.

Ensuring an adequate sample size is critical to the statistical power of a study. Too few participants can result in low statistical power, whereas using a sample that is too large is unnecessary and can overextend study results (Connaway & Powell, 2010; Paccagnella, 2011). There were several potential benefits of selecting the entire 2015- 2016 participant university School of Business first-year class of students; (a) using a larger number of students might allow for a broader understanding of the more general student population, (b) first-year students offer the greatest potential financial benefit to the university through retention (Pompper & Kessinger, 2006), and (c) the results of drawing from the full freshmen class provided an adequate sample size providing the most representative, and therefore ethical, results for the study.

According to Pompper and Kessinger (2006), no significant difference in reasoning for attrition at the first-year, sophomore, junior, or senior year exists. However, for the institution, the most important time to capture students is their first year at college. Students leaving during the first year mean at least 3 years of lost tuition and fee revenues for a university (Tinto, 1993).

RESULTS AND FINDINGS

To what extent does a relationship exist between the time first-year students spend on Facebook and students' intentions to reenroll at the participant university?

The mean value for likelihood to reenroll was 4.45 and for time spent on Facebook was 3.65. The mode for likelihood to reenroll was 5 (Strongly Agree) and for time spent on Facebook was 4 (1 hr. – 2 hrs.).

The relationship between the time first-year students spend on Facebook and students' intentions to reenroll at the participant university was examined using Pearson correlation (r) coefficient. There was a weak, positive correlation between the two variable [$r = .152$, $n = 124$, $p > 0,05$.] with greater time spent on Facebook associated with higher likelihood of reenrolling at the participant university. According to the results there is no statistically significant relationship between online social networking time via Facebook among first-year students enrolled in the School of Business at the participant university and students' intentions to reenroll after the fall semester in the program at the participant university.

To what extent does a relationship exist between the time the first-year students spend on Facebook and their social integration at the participant university?

To answer this research question, regression analyses is used to examine the relationship between time spent on Facebook and the sum of Scale 2: Interactions With Faculty.

The mean value for the Interactions With Faculty scale was 4.0677 and for the time spent on Facebook was 3.65. The mode for the Interaction With Faculty Scale was 5 (Strongly Agree) and for the time spent on Facebook 4 (1 hr. – 2 hrs.).

Linear regression examines how one variable is affected by changes in another variable. The relationship between time first-year students spend on Facebook and students' social integration (as measured by the sum of Scale 2 on the survey) at the participant university is examined using simple linear regression. There was a moderate, positive relationship between time spent on Facebook and social integration (based on Interactions With Faculty) at the participant university [$ß = .301$, $t(122) = 3.490$, $p = .001$). Students who spent more time on Facebook reported higher levels of interaction with faculty members.

To what extent does a relationship exist between the number of faculty members a first-year student befriends on Facebook and their academic integration at the participant university?

To answer this research question, regression analyses is used to examine the relationship between the number of faculty members a student befriends on Facebook and the sum of Scale 3: Faculty Concern for Students, then to examine the relationship between the number of faculty members a student befriends on Facebook and the sum of Scale 4: Academic and Intellectual Development, and finally, to examine the relationship between the number of faculty members a student befriends on Facebook and the sum of Scale 5: Institutional Goal Commitments.

Linear regression analysis indicated that there was a moderate, positive relationship between the number of faculty members a student befriends on Facebook and students' academic integration (based on Faculty Concern for Students) at the participant university [$ß = .390$, $t(122) = 4.679$, $p < .001$]. Students who befriended more faculty members at the participant university reported higher levels of faculty concern for the students.

Also, there was a moderate, positive relationship between the number of faculty members a student befriends on Facebook and students' academic integration (based on Academic and Intellectual Development) at the participant university [$ß = .447$, $t(122) = 5.518$, $p < .001$]. Students who befriended more faculty members at the participant university reported higher levels of academic and intellectual development.

There was a moderate, positive relationship between the number of faculty members a student befriends on Facebook and students' academic integration (based on Institutional Goal Commitments) at the participant university [$ß = .313$, $t(122) = 3.623$, $p < .001$]. Students who befriended more faculty members at the participant university reported higher levels of institutional goal commitment.

CONCLUSION

This study could improve business practice by providing guidance for organization leaders to increase customer loyalty efforts and increase competitive advantage, thereby influencing long-term profits by reducing customer (student) attrition. The economic success of an organization and the ability to retain customers are directly connected (Marginson, 2011; Sharabi, 2013), and, in a difficult market, leaders of organizations should place higher value on the role of social media as a means of customer retention (McCorkindale, 2010). Administrators of colleges and universities lose nearly $16.5 billion annually as a result of student attrition (Raisman, 2013). As a result, failure to retain students could ultimately threaten the existence of educational institutions (Hu, 2011; Sharabi, 2010, 2013; Tinto, 1993).

This study examined nonacademic factors related to academic customer service, specifically academic and social integration, associated with student retention. These nonacademic factors account for 65% of student departures (Morrow & Ackermann, 2012). Tinto (1993) noted that creating a strong sense of community and strengthening relationships with students are key factors to improving retention rates at colleges and universities. Likewise, Raisman (2013) posited that college and university administrators could increase overall student populations by more than 80% of the number of student drops by addressing these nonacademic factors.

In order to effectively communicate with students and foster academic and social integration, administrators should alter current communication tactics (Sharabi, 2010, 2013; Tapscott, 2009). Heyes and Kapur (2012) and Larivet and Brouard (2010) suggested the importance of active, two-way communication in the customer retention process. Dagger and David (2012) and Goodman et al. (1995) asserted that organizational leaders that actively engaged in meaningful discussion with customers achieved greater customer retention and customer satisfaction. This study focused on the role of Facebook as a platform to foster interactivity and interaction between higher education institutions and student customers. Since 2005, more than 90% of college students participated in Facebook, making it the most popular social media platform for this population (DiStaso & McCorkindale, 2013). Furthermore, social media platforms provide a significantly more cost effective means to reach current and potential student customers than more traditional marketing communication tactics (Sharabi, 2010, 2013).

The results of this study demonstrated that students who had more faculty or staff friends on Facebook and students who spent more time on Facebook also expressed a greater sense of academic and social integration at the participant university. As a result, placing an intentional focus on Facebook interactions between college and university administrators and students could significantly reduce student departures thereby decreasing revenue loss resulting from student attrition.

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IDENTIFYING CONSTRUCTS OF WEBQUEST LEARNING AS PERCEIVED BY PROSPECTIVE ELEMENTARY TEACHERS THROUGH DESIGN PROCESS

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ABSTRACT: The aim of this study was to explore prospective elementary mathematics teachers' perspectives on WebQuest learning through the design of topics in elementary mathematics. The data sources included prospective teachers' written responses to the assignments developed for forming their opinions and understanding how they perceived the WebQuest learning process. 48 prospective teachers were participated in this study. Participants' written responses were analyzed according to three underlying constructs of WebQuest learning affecting teachers' perceptions: constructivist problem solving, social interaction, and scaffolded learning. While designing WebQuest, findings revealed that most of the responses addressed making real-life connections in WebQuest learning. Moreover, prospective teachers were aware of the importance of transferring knowledge from different fields (art, science, and architecture etc.), developing better interpersonal and small group skills, and facilitating mathematical content comprehension. Methodological and practical recommendations were provided for further studies to highlight primary factors and constructs of the WebQuest learning.

Key words: WebQuest learning, design process, prospective teachers

INTRODUCTION

With the rapid growth of innovative technologies and the Internet, the use of technology plays an ever-increasing role in the teacher education. Besides other subject areas, the integration of technology in mathematics curriculum and instruction have been an essential component of the learning environment (Niess, 2005). However, there is still some problems reported regarding the use of technology in most teachers' practice (Hofer & Grandgenett, 2012). Therefore, prospective mathematics teachers should be prepared to develop knowledge of subject matter and technology in their teacher preparation programs. As Garofalo, Drier, Harper, Timmerman and Shockey (2000) have suggested that the most effective way to use technology to give rise to student learning is supporting them via incorporating their teaching with activities involving mathematical thinking by technological tools. To provide such an argument, WebQuest design was selected in this study to demand prospective mathematics teachers to link mathematical topics for creating authentic tasks.

The WebQuest, developed by Dodge and March in 1995, provides a constructivist inquiry framework (Dodge, 1997) in which students involve in authentic tasks by using web links. In general, the WebQuest is a web-based learning tool which functioning as a scaffold or form of assistance that supports students' learning. In other words, as Tuan (2011) asserted, the WebQuest is a scaffold learning structure and it is comprised of web links involving vital resources and authentic tasks aiming students to develop their performance through group processes. By using the WebQuest, students have a chance to collect, synthesize, and assess information through defined factors (Manning & Carpater, 2008).

As Dodge (1997) asserted that the WebQuest can be used for improving time on task, using information to problem solve, and utilizing higher order thinking skills. Moreover, Lim and Hernandez (2007) accentuated that critical thinking, knowledge application, social skills and scaffold learning are four constructs supporting the WebQuest. According to their categorization, critical thinking develops through creating a new artifact while knowledge application is highlighted in the design process and support engagement in problem solving and creativity. Similarly, collaboration and accountability might be supported by working in group projects. Finally, they continues by saying in their classification that scaffold learning is the structure in which transformations are promoted. Besides this classification was mentioned in their article, Zheng, Stucky, McAlack, Menchana, and Stoddart (2005) derived new factors critical to WebQuest learning. Based on their empirical evidence, three constructs (constructivist problem solving, social interaction, and scaffolded learning) were explored, and suggested that "these new constructs needs to be taken into account by those who design WebQuest" (Zheng, et al., 2005, p.46). Although researchers have tried to uncover the main constructs of the WebQuest, still limited knowledge exist of how these constructs are interpreted and highlighted in a real WebQuest design process.

Therefore, this research study examined here sought to address this gap by exploring prospective elementary mathematics teachers' perspectives on WebQuest learning through the design of topics in elementary mathematics.

METHODS

Participants and Procedure

48 undergraduate teacher candidates were participated in this study. The teacher candidates had enrolled in the Middle School Mathematics Teacher Education program in a Southern university in Turkey. This sample was a fair representation of the population of elementary mathematics education at the university.

The data were collected in the Spring semester of 2015-2016 academic year. A WebQuest design template was developed by the authors and distributed to the participants. The template provided an instructional framework in terms of WebQuest design which a well-designed WebQuest typically contains six steps: 1) introduction, 2) task, 3) information sources, 4) description of process, 5) performance evaluation, and 6) conclusion (Dodge, 1997). Moreover, it included a research report for the design procedure in which the participants were required to write how to gather, synthesize, and evaluate the information obtained from the Internet resources.

Context

WebQuest design was addressed in class as a part of technology integrated mathematics course that requires them to connect mathematics with technology in an authentic context. In the beginning of the course, the principles and objectives in the Turkish elementary school mathematics curriculum were briefly overviewed. While examining the principles and standards, the idea of integrating technology into the mathematics lessons was introduced. The first author was the instructor for the course. Throughout the course, the instructor tried not to impose real-life applications and to make connections with different fields.

To design WebQuest, participants were required to select the objectives from the middle school mathematics curriculum and try to connect their objectives to their WebQuest tasks. They were free to select their topics such as numbers, algebra, and geometry. Those tasks were addressed to a group working and to be investigated by students. After completing design process, participants reflected their opinions and understanding how they perceived the WebQuest learning process to the assignments. They were asked to respond in writing to the open-ended questions: 1) What would learners benefit from the designed WebQuest? and 2) What kinds of opportunities would the designed WebQuest provide learners?

Data Analysis

Participants' written responses were analyzed according to three underlying constructs of WebQuest learning affecting teachers' perceptions defined by Zheng et al. (2005). The analysis of the responses provided descriptive information about the overall picture of the prospective teachers' opinions and perceptions about the WebQuest learning. All responses were analyzed for coding. Initially, the authors independently reviewed the categories and justifications proposed by the participants to identify the major themes and sub-themes. Later, they jointly revised the themes through discussion and comparison. After the themes and codes were identified, the authors independently coded a sample of 48 participants' responses and then discussed until 100% interrater reliability was reached on themes and interpretations. Later, the frequencies of the targeted major themes and sub-themes were identified. In the results section, selected participant responses were used to illustrate the common themes.

FINDINGS

Designing a WebQuest required a substantial amount of problem to find an appropriate examples and websites. The WebQuest environment required prospective teachers to be self-directed in their work. The prospective teachers decided to where to begin their work, how to gather and synthesize the information. This process was neither easy nor familiar for prospective teachers.

48 prospective teachers responded to the open-ended questions and provided a variety of written answers. While the range of responses varied, the most common responses were related to the investigation of the relation between mathematics and art. They used different examples from various art forms (e.g. music, dance, visual arts, sculpture, and architecture) as a context for connecting their tasks. Table 1 showed the constructs (i.e.

major themes) and concepts (i.e. sub-themes) used in evaluating the responses in terms of WebQuest learning. The three constructs were identified below based on the current research findings that focused on the essential components in WebQuest design.

Table 1. Themes used in evaluating prospective teachers' responses

Major Themes	Sub-themes	Number of participants (out of 48) who mentioned
Constructivist problem solving	Examining problems from multiple lenses	6
	Proposing a solution with more than one approach	2
	Transferring knowledge from one problem solving situation to another	3
	Pulling knowledge from different fields to solve problems	32
Social interaction	Promoting accountability among learners	4
	Gaining a better understanding of each other's point of view	3
	Promoting interaction between learners	3
	Developing better interpersonal and small group skills	15
Scaffolded learning	Facilitating subject content comprehension	30
	Better understanding how to achieve learning goals	10

Constructivist Problem Solving

As presented in Table 1, analysis of participants' written responses showed that the construct of constructivist problem solving was operationalized on the concepts of examining problems from multiple lenses, proposing solutions with multiple approaches, transferring knowledge from one situation to another, and pulling knowledge from different fields to solving problems. Among these concepts, the last one played a critical role in the WebQuest design.

Pulling Knowledge from Different Fields to Solve Problems (n=32)

The main issue for this concept was combining participants' knowledge from different fields (e.g. music, nature, and architecture) to design WebQuest tasks. The analysis of responses indicated that most of the participants developed, applied, and converted their knowledge from real-life context to their WebQuest tasks. For instance, a participant who used example from architecture as a context for exploring the rules of perspective such as true shapes, vanishing points, and horizon lines and stated,

> After this activity, students will be able to understand the concept of perspective which emerges from vanishing points and horizon lines, and see and apply how to draw a cube in two point perspective. They will be able to see the relationship between mathematics and daily life by realizing the mathematics used in art and architecture.

This view addressed how real-life connected cases would enhance students' engagement in mathematics. There were similarities in the responses, like the following example taken from another participant:

> It is really important for students to realize that ratio and proportion - like many concepts in mathematics- are used in music. In that manner, students will be knowledgeable with musical note and rhythm in music, realize how to rhythms form patterns; therefore, it will be very easy to learn new concepts.

In both examples, participants provided context in which they presented their understanding of mathematics and connected the topics to the real-life. Briefly, they relied on making connections and used knowledge from different fields to design WebQuest.

Social Interaction

The findings suggested that the construct of social interaction included: (a) promoting accountability among learners, (b) gaining a better understanding of each other's point of view, (c) promoting interaction between learners, and (d) developing better interpersonal and small group skills. Although all concepts of the social interaction seemed to be interrelated, the concept of developing better interpersonal and small group skills became prominent in the analysis.

Developing Better Interpersonal and Small Group Skills (n=15)

The main issue for this concept was developing students' group working and interpersonal group skills. These responses focused on evaluation of individual perspective about group working and pointed out the strengths of group working when learning with WebQuest. For instance, a participant stated,

> Students will be able to learn not only the transformation geometry but also the related concepts such as reflection, symmetry, rotation and reflection, and their practice. In group working activities, they will be realize their positive and negative sides, and they will have a chance to learn cooperation. To illustrate, they will help their team mates who could not perform his/her tasks, and they will get to know yourself.

In this reflection, she identified the team roles that allow group working to happen and concentrated on achieving the task and taking responsibility for own learning. This implied that participant realized what students would learn about group working. Similarly, another participant stated,

> After a tessellation project which will be a group project, students will change ideas and make cooperation between group members in that environment. On the other hand, their interpersonal and small group skills will be developed.

Here, it could be claimed that group working extends students' interpersonal skills considering that WebQuest teaching provides opportunities for students to discus different point of views and listen to each other. In brief, these statements referenced the importance of social interaction and developing interpersonal skills.

Scaffolded Learning

Analysis of the responses indicated that the construct of scaffolded learning was operationalized on the concepts of facilitating content comprehension and better understanding how to achieve learning goals. As an important concept of facilitating content comprehension, it played a critical role in the construct of scaffolded learning.

Facilitating Subject Content Comprehension (n=30)

In this category, the responses specifically commented on what kinds of activities should be given and how it should be presented to facilitate the content comprehension. All of them voiced their teaching perspective when designing WebQuest. One participant stated,

> Since students will find the rules and steps for number and figure patterns by themselves, their subject learning might be easy. Moreover, students will learn rules of patterns with more than one method via visiting pre-determined web links.

Here, she relied on gathering, synthesizing, and evaluating the information gained from the web-based resources that allow students to facilitate the content comprehension. In a similar vein, another participant noted,

> Students will be able to recognize right triangular pyramids, learn how to construct them, and find how to draw faces of pyramids. In that sense, students' geometrical thinking levels should be developed within this activity. Moreover, it might be expected their visualization skills will be improved. Indeed, students could learn how to make connections between Egyptian pyramids and the concept of right triangular pyramids. Through this way, students' learning and making generalizations might be facilitated.

Regarding the given information, participants pointed out that WebQuest provided an easily relatable context in which students can strength their mathematical knowledge. It could be claimed that participants recognized how to use technology in their teaching to enhance student learning.

CONCLUSION

Improving mathematics teaching and learning with technology should be highlighted in the use of technology in mathematics teaching rather than teaching only about technology (Garofalo et al., 2000). In this research, the WebQuest design was selected to require prospective teachers to connect mathematics with technology in an authentic context. As Manning and Carpater (2008) suggested that the WebQuest can be used as a model for prospective teachers' education program. We are aware that the WebQuest process was not completed. Nevertheless, it has been very encouraging for us to discover prospective teachers' designing mathematical tasks in relation to everyday examples. When teaching with technology comes into prominence for mathematics teachers as Richardson (2009) suggested, they should take into consideration simultaneously to teach mathematics concepts in an environment where students have a chance to inquiry with ideas, make conjectures, test hypotheses, and form generalizations. As Garofalo (2000) suggested that in using technological tools, interconnection of mathematical topics and linking with real-world phenomena are two important ways to facilitate mathematical connections. Throughout the study, the prospective teachers investigated the relation between mathematics and art. They discussed and presented everyday life tasks within the certain mathematical topics and gain experience about how they used the everyday tasks in their mathematics instruction. Tuan (2011) asserted that students are encouraged to see valuable thematic relationships between topics, make a connection with real-world of learning, and affect their mental processes through the WebQuest. It could be concluded that they lead to a significant positive change in their perspective about designing tasks in relation to real-life connection.

Social interaction as a second construct emerged through analysis emphasized the developing better interpersonal and small group skills of the participants. The same conclusion has presented in the literature that each team member have to investigate the topic covered in the course, and then make a contribution to the final group tasks (Tuan, 2011). As Agyei and Voogt (2012) points out that involvement in design teams for the mathematics tasks can provide them both to improve interaction and interdependence among other team members and to uncover how to share knowledge and ideas with the help of developing communication and insight.

As for scaffolded learning highlighted by participants in their design process was functionalized as facilitating content comprehension and better understanding how to achieve learning goals. This finding confirms the theoretical argument that the use of WebQuest might be eligible as scaffolding via offering assistance to students by providing information on design topics (Latuperissa, 2012).

RECOMMENDATIONS

Designing WebQuests might support prospective teachers for integrating technology into their future teaching (Kundu and Bain 2006). Wang and Hannafin (2009) had a similar argument about the usage of the WebQuest for prospective teachers to develop technology integration skills before entering the teaching profession. Some empirical studies have examined the underlying constructs of WebQuests. Zheng, Perez, Williamson, and Flygare (2008), for instance, tried to explore factors that significantly predicted teachers' perceptions. Regardless of these efforts, the area remains under-researched. Therefore, further research including qualitative and mixed methods is suggested to better reveal main factors and constructs of the WebQuest learning. Moreover, some suggestions might be offered to research further studies regarding design processes and effects of main WebQuest elements through design.

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PROMOTING LEARNER AUTONOMY THROUGH CLIL CLASSES IN HIGHER EDUCATION

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ABSTRACT: In this paper, we present a CLIL module that combines teaching of English and content related to environmental and geosciences. This is an experimental CLIL module devised and implemented at the Faculty of Geography, University of Belgrade with the second-year students of the Environmental Sciences Department and Geography Department. The organization and development of the module was conditioned by the students' needs, motivation and interests, their foreign language proficiency and their prior education. The main objective of the module was to promote learner autonomy. Students themselves selected the topics they wanted to study. The general themes were climate change, environmental devastation and water scarcity. Students had to find information on these issues and come up with possible solutions, which they presented to their classmates. They were assigned to write an essay on a selected topic and prepare a presentation for the class. Unlike teacher-centered environments in which students are given grades, in this CLIL module the assessment was performed by the students themselves. They evaluated their own learning, monitored their progress and assessed the achievement together with their classmates.

Key words: learner autonomy, CLIL, higher education, geosciences, environmental sciences

INTRODUCTION

Content and language integrated learning (CLIL) is a learner-centered approach that is increasingly being encouraged in higher education in many countries, including Serbia. Both research and teaching experience show that CLIL promotes learner autonomy. By taking responsibility for their learning, students become aware of the learning objectives and consequently decide on the learning techniques, materials and tasks. Also, they engage in monitoring their own progress and evaluating achievements (Little, 1999, pp. 82-86). In a traditional classroom, the emphasis is on instructor's teaching rather than on students' learning. Students passively acquire knowledge and do not take responsibility for their own learning, whereas teachers set the pace and establish the conditions of learning, regulate the flow of classroom communication and assess students' achievements. On the contrary, in a learner-centered classroom teachers are no longer providers of information, but facilitators of learning. Their goal is to transform students into "autonomous, self-directed and self-regulating learners" (Weimer, 2002, p. xx).

CONTENT AND LANGUAGE INTEGRATED LEARNING (CLIL)

CLIL refers to every form of learning and teaching when a foreign language, which functions as a medium for learning content, is taught simultaneously with content of a curricular subject. Various CLIL approaches are organized at all levels of education - primary, secondary and tertiary. Research has shown that students who participate in CLIL often outperform their peers who attend regular foreign language classes on tests in reading, writing and listening because CLIL presents the most natural way of developing foreign language skills (Prnjat, 2015, p. 172). Integrated learning, being learner-centered, allows students to develop metalinguistic awareness that helps them compare the languages more easily and accurately, guess the meaning of words from context and improve productive language skills. Generally, CLIL students demonstrate higher foreign language fluency than students who attend traditional foreign language courses (Cummins 1984, Marsh 2002, ICF Report, 2014). Unlike a traditional foreign language classroom, within a CLIL setting a foreign language is not taught but promoted (Serragioto, 2003, p. 3, Seradjoto, Prnjat & Guljelmi, 2008, p. 41), since it has the role of the vehicular language. Students use both their foreign language skills and previously acquired content knowledge to learn new content.

CLIL as a Learner-centered Environment

Many educationists and language teachers support the idea that the constructivist learning theory forms the basis for learner-centered environments (Fosnot 1996, Nunan 1988), in which teachers are no longer considered as exclusive content experts. Instead, they encourage students to discover content through problem-based learning. Students find the content that explains or resolves the problem. In most cases, they do this work in pairs or small groups. In a traditional teacher-directed classroom, interaction between students is under teacher's control, whereas in learner-centered approaches, students are in charge of interactions. They make decisions with whom they will work, and how. They decide upon the preferred learning techniques, select materials and design tasks.
Furthermore, apart from developing and enhancing students' linguistic and general academic skills, CLIL approaches contribute to development of their cognitive abilities as well. Students become better in remembering, understanding, reasoning, comparing, judging, problem solving, etc. When they analyze data, they consider different perspectives and perceptions; they explore and generate possibilities; they generate own hypotheses and devise plans (Fosnot, 1996, p. 29). Also, studies have shown that integrated learning improves the ability to learn and study. It promotes learner autonomy and responsibility, strengthens confidence and motivation, and provides "a holistic educational experience" (Coyle, Hood & Marsh, 2010, p. 1). One of the major benefits of learner-centered education includes increased intrinsic motivation, which leads to higher achievement and greater satisfaction with the course of study. Research has shown that personal involvement and commitment to solving a problem, confidence in one's abilities to succeed, and a perception of control over the learning process lead to more efficient learning and higher achievements (Nunan, 1988, p. 3) . Unlike teacher-directed approaches in which extrinsic motivators such as grades or degrees motivate students to learn, in learner-centered approaches, students are presented with issues that are interesting enough to motivate them. In other words, students face the problems that are provoking and tempting enough to encourage them to seek solutions, thus making their actions purposeful and meaningful.

Gardner's theory of multiple intelligences is particularly significant for integrated learning (Gardner 1993). Being cognitively demanding, CLIL tasks require implementation of several types of intelligence. In addition to verbal intelligence, which is prevalent in teaching of foreign languages, other intelligences that assist in processing of non-linguistic content of curricular subjects are also activated (Prnjat & Marković, 2014, p. 115). For example, interpersonal intelligence is dominant in discussions, cooperative learning, pair and group work; logical-mathematical intelligence is used in problem solving, hypothesizing, collecting and classifying data; spatial-visual intelligence prevails in interpreting and comparing charts and tables, etc.

Learner Autonomy

The concept of learner autonomy has been first introduced by Henri Holec who defines it as "the ability to take charge of one's own learning" (1981, p. 3). David Little (1999, pp. 82-86) distinguishes three fundamental pedagogical principles of learner autonomy in foreign language learning:
1. Enabling students to take control over the learning process – students are involved from the very beginning of the teaching process in determining learning objectives, planning, monitoring and evaluating teaching activities and learning outcomes.
2. Purposeful use of a foreign language – foreign language is used as the main language of instruction from the beginning of the teaching process.
3. The use of language as a cognitive instrument implies the use of written language.

Gradual transfer of control over the learning process from teachers to students requires their mutual cooperation in determining curricular activities and goals. Through joint planning of activities and evaluation of acquired knowledge, a teacher should help students to determine short-term and long-term objectives and the ways in which they can be achieved.

Educating students to use a foreign language in different contexts (academic, professional and social) is the main goal of teaching a foreign language for special purposes. Knowledge of a foreign language can be acquired only if it is used as the dominant language of teaching and for purposes of authentic communication. Therefore, a teacher should use only the foreign language when teaching, but in a way that is meaningful for students – with necessary simplifications and adjustments. Also, teachers should motivate their students to use a foreign language as much as they can in authentic communication rather than in the form of established phrases and replies or memorized dialogues.

The principle of using a foreign language as a cognitive instrument implies the use of written language when curricula and objectives are determined, during the development of tasks and assignments and for the evaluation of teaching and learning achievements.

Learner Autonomy and Learning Styles

Research has shown (Dunn & Griggs, 2000) that each learner has a preferred method of processing information and that this preference is recognized as one's own learning style. By observing students' reactions to different activities and tasks, teachers may conclude which type of learners their students are, and customize their teaching materials and activities accordingly (Prnjat & Marković, 2014, p. 115). For example, if a majority of students are visual learners, teachers may try to use more often visual aids such as pictures, photos, graphs, diagrams, etc.

Likewise, students' motivation depends greatly on how meaningful they consider teaching materials and class activities to be. Therefore, foreign language teachers should try to vary tasks and activities so that all types of learning styles have an equal presence in the classroom. In particular, teachers who work with large mixed ability classes have to make sure that learners of all abilities find learning a foreign language motivating and rewarding (Ibid.).

THE CLIL MODULE

In this section, we present an experimental CLIL module that combines teaching of English and content related to environmental and geosciences. The module was devised and implemented with the second-year students of the Environmental Sciences Department and Geography Department at the Faculty of Geography, University of Belgrade. The main objective of the module was to promote learner autonomy. Students themselves selected the topics they wanted to study related to the general themes of climate change, environmental devastation and water scarcity. They were assigned to write an essay on a selected topic and prepare a presentation for the class explaining the issue and proposing the solutions. Unlike teacher-centered environments in which students are given grades, in this CLIL module the assessment was performed by the students themselves. They evaluated the progress and assessed the achievements together with their classmates.

The module lasted one month and was carried out as an extracurricular activity. The group consisted of 30 students, who had voluntarily enrolled on the module, and whose English language proficiency was at B1 – B2 level. Students themselves decided whether they were going to work individually, in pairs or in small groups. The linguistic objective of the module was to create an interactive teaching and learning environment in which authentic materials presented in English were used (e.g. brochures, reports and videos published by various UN agencies and news agencies). Learning new content related to the selected topics was a non-linguistic objective, whereas development of learner autonomy, cognitive and academic skills presented a shared objective that referred to both linguistic and non-linguistic aspects of this CLIL module.

Students selected the following topics: the greenhouse phenomenon, consequences of climate change (global warming, melting of polar ice caps and glaciers, rising of sea levels, the phenomenon of extreme weather conditions, etc.), the problem of food and drinking water shortage, the problem of endangered plant and animal species, etc. They presented the issues in the class and discussed possible solutions with their classmates. Also, they conducted peer assessment, thus providing valuable feedback to the teacher and their classmates alike. The overall assessment of the progress and achievements was exceptionally positive. Students perceived learner autonomy as the most important factor for successful foreign language learning.

CONCLUSION

Results of numerous studies (ICF Report 2014, Marsh 2002) show that implementation of integrated teaching and learning at the tertiary level has positive gains for students in terms of foreign language acquisition, development of learner autonomy and promotion of academic and cognitive skills. Also, as roles of teachers and students are gradually changing, teachers cease to be primary providers of information and students passive recipients of knowledge. This process of gradual 'autonomisation' (Little 2003, Dam 1995) of students is best achieved through the use of a target (foreign) language as the preferred medium of teaching, development and acquisition of a set of useful learning techniques and activities, and ongoing evaluation of the learning process and outcomes, achieved by a combination of teacher, peer and self-assessment. In a learner-centred CLIL classroom, students and teachers work together in determining curricular materials, activities and goals. However, learner autonomy is best promoted when there is cooperation and support among students, which can be achieved through project work. By participating in project work, students learn from each other, share ideas, plan and implement activities, analyze and evaluate the acquired knowledge and assess the learning outcomes.

Furthermore, they develop metalinguistic functions that help them establish a connection between the 'academic' and 'practical' knowledge and become more proficient in and beyond the classroom, which is one of the main objectives of foreign language teaching.

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SIMULATION MODELS IN THE PROCESS OF DESIGNER'S EDUCATION

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ABSTRACT: The clothing industry is quickly becoming a high-tech industry due to rapid advances in technology which contribute to high quality design, cutting, stitching and finishing techniques. Furthermore, a designer today has to improve professional capability according to industry's requirements. The word 'designer' is a broad description covering many different functions. A designer in a large company may specialize in a particular area and be part of a team, whilst in a very small company a designer may have to perform all the above tasks. In both cases they could be handled by using computer aided design systems at each stage of the design process. Most of the stages are already presented by specific pattern design systems: and design process in them could be provided in two-dimensional or in three-dimensional space. A student is a future professional and his capability has to be considered accordingly to the future state of the science and technology. That is why, pattern design systems and virtual three-dimensional models of the garments must be used as designer's tool in educational process and they must be presented in all studied courses, though some stages of apparel design are not formalized yet. However, visual aids and handout materials are common useful facilities in professional education, and even if manufacturing does not use such simulation models they might be useful for the students. Our work is devoted to review of different virtual models of garments and their particular parts, as well as simulation models of the design process in sewing industry. Those models were developed by authors and are recommended for use as visual aids in educational process.

Key words: simulation models, virtual model, three-dimensional design, running simulation

INTRODUCTION

The clothing industry is quickly becoming a high-tech industry due to rapid advances in technology which contribute to high quality design, cutting, stitching and finishing techniques. Hence, a dress designer today has to improve his or her professional capability according to industry's requirements.

Aldrich, W. (2008) showed that the word 'designer' is a broad description covering many different functions. A designer in a large company may specialize in a particular area and be a part of a team, whilst in a very small company a designer may have to perform all the above tasks. In both cases they could be handled by using computer aided design systems at each stage of the design process. Most of the stages are already presented by specific pattern design systems: and design process in them could be provided in two-dimensional or in three-dimensional space.

A student is a future professional and his or her capability has to be considered accordingly to the future state of the science and technology. That is why, pattern design systems and virtual three-dimensional models of the garments must be used as designer's tool in educational process and they must be presented in all studied courses, though some stages of apparel design are not formalized yet.

However, visual aids and handout materials are common useful facilities in professional education, and even if manufacturing does not use such simulation models they might be useful for the students.

Stančić, Seljan, Cetinić, & Sanković (2007) say that simulation models could be used as a tool in education system, from primary and secondary school up to a high school system where the use of specific simulation models helps certain research helps in decision-making, or in the course relation to creation of simulation models.

There are many examples in literature that represent simulation models in garment industry which make it easier for students and teachers to explain and understand given lessons. The simulation model of the combing process

(Ryklin, & Katovich, 2013) could be considered as instance of such a model, as well as a model of flexible module-type sewing lines developed by Mokeeva, Proforuk, Zaev, & Zybareva. (2002). Often simulations are used for assembly line balancing; examples of such models are described in Waldemar (2011) and Daniel, Amare, & Solomon, (2010). Zamyatina (2009) considers different types of simulation models and specifics of their building that could be applied in different fields of study and research. The specifics of development the simulation model of design process in clothing industry were shown in the previously published work (Zakharkevich, 2015).

However, as it persuasively shown by Dunne (2012), apparel design as a discipline and industry has often been characterized as highly resistant to change in processes. She considers that this is because of the extremely short product cycle and ever-increasing pressure to reduce costs and duration of the design process. Other product-producing industries such as consumer products or automobiles embraced 3D simulation and visualization technologies decades ago. By contrast, the apparel industry has been much slower to adopt even 2D CAD-based drawing systems for garment patternmaking.

At the same time, Dunne (2012) admits that although such 3D technologies may be only almost ready enough for industrial practice, as teaching tools they offer unparalleled advantages in shortening the trial-and-error feedback loop and enabling more effective visualization of the relationship between the 2D pattern and the 3D body/garment relationship. Thus, the use of simulations represents the natural way of “learn by doing”. Students use 3D simulations in order to understand complex system “garment-human body”.

Different categories of computer simulations in clothing industry in connection with the learning process are the main subject of the current study. Such simulation models interactively imitate the reality which would otherwise be very difficult (or very costly) to show to the learners.

METHODS

The models that provide the representation of real processes are the result of the simulation software further development. A new class of software called also simulation software enables users to rapidly build lightweight, animated simulations of some objects or processes, without writing code. There are a lot of software products which provide us with such ability; and in a particular case we have to choose that software package which allows us to reach the goal of a lesson or educational course.

Software for Design Process Simulation

Arena (Rockwell Automation) is the perfect tool to introduce students to the principles of simulation and all modern modeling approaches, and to teach them to apply it in apparel design. Arena is a very flexible modeling tool. It allows users to simulate problems in any kind of industry, including supply chain, logistics, manufacturing, healthcare, etc. Thanks to its unique adaptability, Arena alone can substitute many other tools. Arena’s visual development environment speeds up the model building process. Prebuilt object libraries allow users to create models by dragging and dropping elements from palettes. Besides that, one of the obvious advantages of Arena is that the student’s version of Arena software could be free downloaded from the official web site.

Design process simulation in apparel design is a model-based representation of technical and drafting processes in software. Basic prerequisites are a thorough knowledge of the properties of the particular types of garments and the specifics of their design, of logical sequence of drafting, and of mathematical models of design process.

Process simulation software describes processes in flow diagrams where unit operations are positioned and connected by streams. The entity-relationship model of the design process would be the base for the flow diagram in Arena.

Software for 3D Clothing Simulation

New developments in virtual reality are creating moving models and electronic fashion shows, or virtual store displays. It is now possible to access virtual models online and see them from all angles as they rotate in real time. The garment image can be remapped with any of the different fabrics shown on the screen. The aim is to reduce the number of samples made up in the design room.

Once a pattern is completed for a design, the next process is to create a made up garment sample, often before the decisions are made. At least four CAD suppliers are offering different versions of creating samples within a 3D environment. One of the most common systems in this field is Julivi Clo3D software.

RESULTS AND FINDINGS

In order to achieve the main purpose of our work we need to select and describe a range of simulation models which could be used as visual aids for the dress designer education.

3D Clothing Simulation

3D clothing simulation is usually considered as one of two mutually inverse actions: putting on virtual clothes on virtual body or unfolding 3D mesh of virtual clothes into 2D planar form. In educational process the first method should be applied to garment simulation; and the second one is better to use for building the parts of virtual garments.

Garment Simulation

Usually the finished pattern is made up into fabric to check the proportions and shape. Garment samples are prototype garments that allow us to check the proportions of the garment and the quality of the garment fit. Nowadays designers often check garment fitting with 3D tools in CAD-systems by displaying virtual models of the garments on the screen (figure 1).

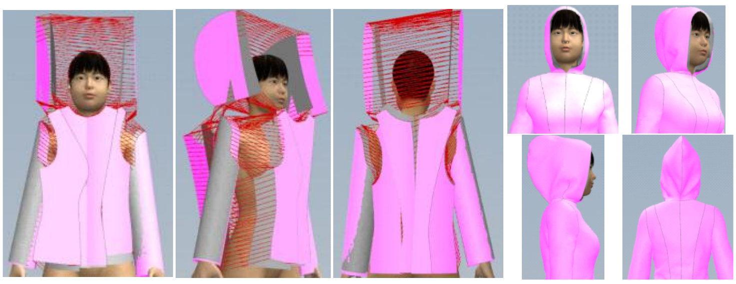

Figure 1. Virtual Reversible Garment in Julivi Clo3D Software

To see how well the garment fits, the customer can change the Rendering Style to one of the follows styles: “Stress Map”, “Strain map”. Stress is the tension to exert on a fabric per unit. Customer can see different tension of a particular body part of the avatar or its movement. Different tension is shown in different color and number (gf/cm^2) on the garment. The blue indicates areas that fit loosely; the red indicates areas that are tight. Strain is a geometrical measure of garment deformation exerted by external forces. Different tension appears in different color and percentage of deformation.

Often during the study process there is a necessity to compare two or more garment samples, and virtual models of the garments are particularly useful in this case. However, in Julivi Clo3D both rendering styles (stress and strain maps) reflect garment samples as uninterrupted color pieces of virtual cloth, and there is no possibility to compare precisely similar points in different samples because consumer can see just a color, and no mesh or points as it showed on the figure 2. That is why we have computed a minimal number of separate observations that allow to compare two or more garment samples with a confidence level not less than 95 %. Hence, any empirical study in which the goal is to make inferences about the similarity of garments samples or their parts – to compare constructions or design methods, – has to be conducted with the sample size that equals or is more than 110.

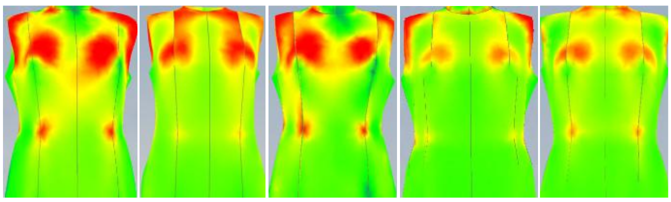

Figure 2. Stress-maps of the Virtual Garment Samples

Garment Parts Simulation

In order to provide understanding features of the relative position of the different garment pieces we developed 3D models of separate garment parts. Virtual models of the separate parts of the garments are presented by the figure 3 and figure 4. Sequence of building the 3D form of the pocket is considered as the alteration of the flat image into the 3D form by tools of the Rhinoceros software: Surface / Extrude Straight / Extrude Along Sub Curve. Sequence of building the virtual form of the hood was described in the previously published work (Zakharkevich, 2012).

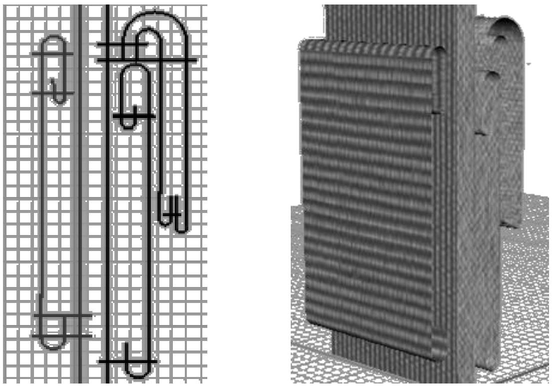

Figure 3. 2D and 3D Forms of the Pocket

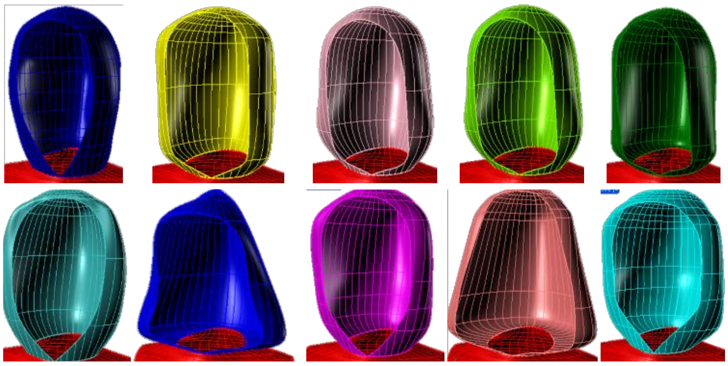

Figure 4. Virtual Samples of Hoods

Simulation Model of the Design Process in Sewing Industry

We assumed that designer might be able to draft any number of new garment designs based on the design of particular garment design that was successfully drafted before. As the instance for the simulation model we chose three garment types: an anorak, a coat, and a jacket.

Anorak – a waterproof jacket, typically with a hood, of a kind originally used in polar regions.
Coat – an outer garment worn outdoors, having sleeves and typically extending below the hips.
Jacket – an outer garment extending either to the waist or the hips, typically having sleeves and a fastening down the front.

Analysis of the design process in sewing industry and data base of transformation elements that were described in works of Zakharkevich (2013) and Zakharkevich, & Pochuprin (2014) were used as input dataset for the simulation.

Constructing a Flowchart Model

The entity-relationship model of the design process was formed, and this model was used as the base for the flowchart model (figure 5). In Arena simulation package, the flowchart represents the flow of entity in the system. Garment designs of the particular garment type are the entities in the model. All entities were represented as particular modules. Each module was described with some attributes, which could be changed for different sewing companies (table1 and table 2).

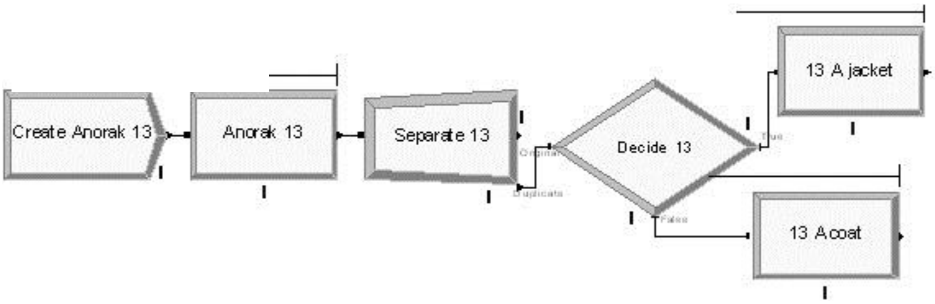

Figure 5. The Basic Fragment of the Flowchart Model

Table 1. Changeable Characteristics of the Modules of the Simulation Model

10	Function	Description of the module	Parameter	Parameter function	Description of the parameter	Specifics of the parameter
Create	Entities enter the simulation here	The necessity of drafting the garment design	Type	Type of forming the arrival flow	Method of determination a number of orders for drafting the garment design	Constant (average value) Schedule
			Value	Average time value between the entities arrivals	A time between orders to drafting the garment design	Constant (average value for the particular sewing factory)
			Schedule Name	Name of the schedule that defines frequency of the entities arrival	Name of the schedule that defines frequency and particularities of orders for drafting the garment design	Schedule 1
			Units	Time units for the time between the entities arrivals	Time units for the time between the orders for drafting the garment design	Day, hour
Process Anorak №A (Process Jacket №A; Process Coat №A)	An activity, performed by resources and requiring some time to complete	Development of the garment design documentation	Priority	Priority of the modules that use the same resource	Urgency of drafting the ordered garment designs	High, Medium, Low
			Resources	Resources, which would be working with the entities in the module	Number of designers	1 ÷ 5 (define for the particular sewing factory)
			Units	The time units for the numerical delay duration	The time units for the duration of drafting the garment design	Day, hour
			Allocation	Defining the urgency of accounting the cost characteristics	Defining the urgency of accounting the cost characteristics for the garment design documentation	Value Added (add the cost of developing of the garment design documentation)
			Delay Type	Distribution type of the delay of the entity in the module	Distribution type that reflects particularities of human work	Triangular
Separate №A	Duplicate entities for concurrent or parallel processing, or separating a previously established batch of entities	Duplicate files of the projects and/or garment design documentation that were drafted previously	# of Duplic	A number of duplicates of the incoming entities	A number of the garments designs that could be obtained by alteration the particular anorak design	Must be defined according to specifics of work on the particular sewing factory
Decide	A branch in entity flow	Description of the decision making process	Percent True	A value that defines the percent of the entities, which flow by the branch True	Percent that defines a number of the jacket designs	Must be defined according to specifics of work on the particular sewing factory
Resource	Definition of the resources and their features	Specifics of the designer work	Capacity	A number of resources that are in system	Number of designers	1 ÷ 5 (define for the particular sewing factory)
			Busy	A cost of processing by resource (per hour)	A cost of drafting the garment design by designer (per hour)	Must be defined according to specifics of

						particular case
			Idle	A cost of resource when the resource is not active	A cost of resource when designer is not busy with drafting	Must be defined according to specifics of particular case
Schedule	Schedule	Frequency of the entities arrival	Type	Schedule type	Schedule of the orders for the drafting of garment design	Arrival (schedule for the module Create)

Table 2. The Permanent Module Parameters of the Simulation Model

Module	Parameter	Parameter function	Description of the parameter	Specifics of the parameter
Create	Name	Module Name	Specified index of the anorak design	Create №A
	Entity Type	Entity Name	Specified index of the anorak design	Entity №A
	Entities per arrival	A number of entities per arrival	A number of designs, that make up a single order	5 (according to the result of analysis of the design process in sewing industry)
	Max arrivals	Maximal number of entities that could be formed by module	Maximal number of garment designs that could be ordered for drafting	Infinite
	First Creation	A moment, when first entity arrives into the model	A moment, when firm gets a first order for a draft of garment design	0,0
Process	Name	Module Name	The name of the garment	Anorak №A (Jacket №A, Coat №A)
	Type	Logic scheme of the module	Specifics of the drafting process of anorak design	Standard (without submodels)
	Action	Type of proceeding in the module	Operating procedure during developing designs of anoraks by designer	Seize Delay Release (designer is busy with drafting for a while and then stays idle for some time)
Separate	Name	Module Name	Specified index of the original anorak design	Separate №A
	Type	The method of distribution within the module entities	The method of distribution of the duplicated designs of the original anorak	Duplicate Original (Duplicate the anorak design documentation that was drafted previously)
	Percent Cost to Duplicates	Percent of original entities that must be duplicated	Percent of anorak designs that must be duplicated	100 %
Decide	Name	Module Name	Specified index of the anorak design	Decide №A
	Type	Type of decision logic	Definition of the numbers of coats and jackets	2-way by Chance
Resource	Name	Resource Name	Designer	Designer
	Type	Definition of the resources capacity	Definition of designers number	Fixed Capacity
	Schedule Name	Schedule Name	Schedule Name	Schedule 1
Schedule	Name	Schedule Name	Schedule Name	Schedule 1
	Time Units	The scale of the time axis in the graphics schedules	The scale of the time axis in the graphics schedules	Days

Running Simulation with Arena

Prior to run the model, we need to specify the run conditions including project information and the length of the simulation run. In particular case the length of the simulation run is a year.

Once the simulation starts to run, some animation will be displayed as the simulation progresses. As shown in the following figure, entities in a box shape (as specified in Entity data module) move from one module to another. Below each module, number of entities created in processing, and disposed are displayed. At the top of the Process module displayed is the status of the queue of the resource (number of waiting entities) with the entity pictures.

Besides that, two diagrams on the figure 6 reflect the number of the jackets designs, and the number of the coats designs.

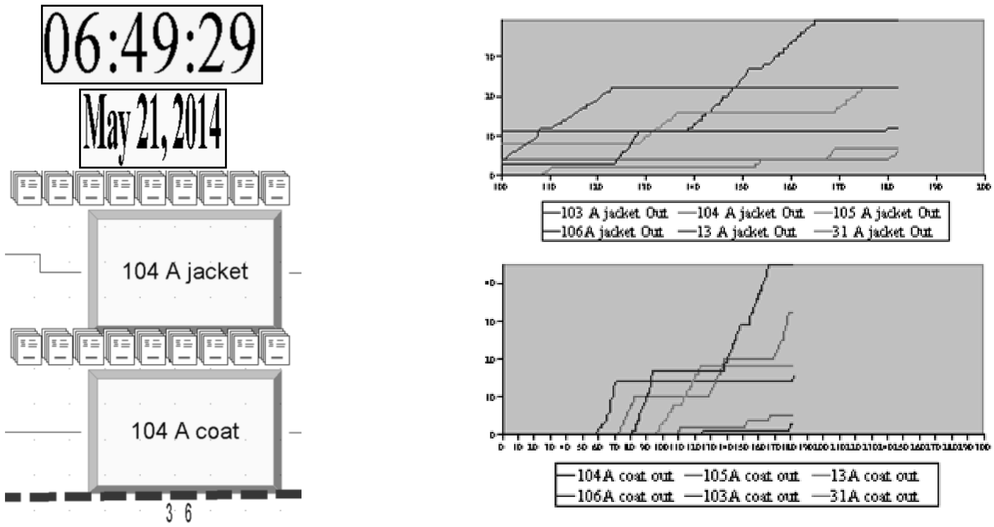

Figure 6. Fragments of the Model Window (Flowchart View)

At the end of the simulation run, a message box will prompt to ask you whether you would like to view the reports. Clicking "Yes" displays the reports as shown below. As a result of the simulation we can get the "Statistics Collection" and analyze some parameters of the design process. Among them are the time characteristics, the number of designers (busy, scheduled), the cost characteristics, the number in (out), and the instantaneous utilization, etc (figure 7).

Usage

Instantaneous Utilization	Average	Half Width	Minimum Value	Maximum Value
konstryktor	0.9995	(Insufficient)	0.00	1.0000

Number Busy	Average	Half Width	Minimum Value	Maximum Value
konstryktor	2.9986	(Insufficient)	0.00	3.0000

Number Scheduled	Average	Half Width	Minimum Value	Maximum Value
konstryktor	3.0000	(Insufficient)	3.0000	3.0000

Scheduled Utilization	Value
konstryktor	0.9995

Figure 7. Reviewing the Output Reports

CONCLUSION

Developed visual aids and handout materials are useful facilities in professional education, and even if manufacturing does not use such simulation models they might be useful for the students. That is why, pattern design systems and virtual three-dimensional models of the garments can be used as designer's instrument in educational process and they must be presented in all studied courses, though some stages of apparel design are not formalized yet.

Besides that, developed simulation model forms are the required premises for the further development of methods of the designer's training and for lowering the risk of making false decisions under the conditions of rapid changes of project situations.

RECOMMENDATIONS

We think that the issue of described simulation models in education of dress designer has at least three main aspects.

Firstly, simulation models can and, in our opinion, should be used as a complement to the process of education. Therefore, we can conclude that the simulation models can be used throughout the curriculum of future designers, from the beginning of the study to the very end of it. Thus, all kinds of 3D virtual models, from models of different parts of garments to the garment as a whole, as well as simulation models of technological/design processes in sewing industry and apparel design can be used.

Secondly, in our opinion, the curriculum should, at the higher levels of study, incorporate course(s) related to development of the simulation models. The simulation model of design process in sewing industry could be used to predict the results of the rapid change in the production of women's outerwear; hence it could be a basis for the development of the models that predict results of the rapid change in production of any other assortments of clothes. Obviously, the simulation model that we described in this work is not the only one to use in designer's education but it was used as a real instance of implementation of simulation models in education.

Thirdly, we think that some simulated models must be complemented by real objects, i.e. garments. Hence, students would be able to test their work by themselves even without the instructor. For instance, it was shown in the figure 8.

Figure 8. Virtual and Real Garment Samples

Thus, in our work we have described the 3D models of garments and 3D models of garment parts, as well as simulation models of the design process in sewing industry. Those models were developed by authors and are recommended to use as visual aids in educational process.

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AN EDUCATIONAL APPLICATION OF 3D PRINTING TECHNIQUE USED FOR INSOLE PRODUCTION

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ABSTRACT: In this study, it was implemented a biomechanical application of 3D printing technique for insole production. Basically, in terms of the arch height, there are three foot types including high, normal and flat arch. Moreover, if the alignment of the foot is taken into account, foot types can be classified as neutral, supinated and pronated foot. Each foot class has different shape and foot size. An insole is a device that is placed into the shoes to provide comfort and to correct the alignment of the lower limbs. Design of the insoles could be implemented according to specific foot geometry of subjects. These kinds of insoles are called generally as customized insole and have total-contact characteristics. Total-contact insoles are effective in reducing pain as distributing the pressure and improving the foot function. To produce a total-contact insole, the geometric data of foot plate surface should be known. In order to carry out this task, molding process is widely performed. Advances in scanning technology enable insole designers to obtain 3D CAD (three-dimensional computer-aided-design) model which represents the shape and dimensional data of an object. The model, namely, solid model could be imported to various commercial or educational software and be modified for special purposes. Therefore, molding process is discarded and molding cost is prevented with the method of 3D scan. Many 3D scan devices exist to obtain 3D data that may require high cost for an insole device. Thus, people even not having engineering background could obtain 3D foot model using various free available image capturing programs integrated in a mobile phone. In this educational application, it is aimed to manufacture a customized full-contact insole by means of a 3D printer and a 3D scan mobile application. The scanning software, which combines the photos of the object captured from the different angles, was used to obtain 3D CAD data of the geometrical shape of the foot in this study. Then, the data was imported as a model to a CAD software and modified for a subject shoe. Next, the model was converted into STL file format and imported to a 3D printer device. Finally, the solid model of the insole was printed and placed into the shoe. By taking advantage of new facilities of technological improvements, subject specific insoles could be designed and manufactured. These kinds of educational applications regarding 3D scanning and printing technologies have the potential to increase the prevalence of use of custom made biomechanical instruments which are developed to increase the quality of daily life of human being.

Key words: Insole design, scientific education, 3D printer

INTRODUCTION

Insoles are devices inserted into shoes to support feet and to absorb shock effect in a comfortable manner. The insole is a device to reduce some difficulties due to the defects causing from human foot shapes such as presented in Table 1. Furthermore, the insoles, known generally as custom insoles, should be designed and manufactured according to foot shape and biomechanical needs of individuals. There are many studies investigating the design and effect of insoles [1, 4]. A mold of the foot sole is taken and insole is produced considering this mold geometric shape in the conventional method of the custom made insole manufacturing. Thus, the insole exactly fits to the surface of the foot. A custom made insole has total contact characteristic that reduces the pain and distributes the pressure. Also custom insoles can be modified considering some kind of deformities such as varus/valgus, and, in this way, can improve the posture by supporting the foot in a neutral position. Moreover, complaints such as hip, knee and lower back pains caused by poor foot function could be reduced using custom insoles restoring the natural foot function.

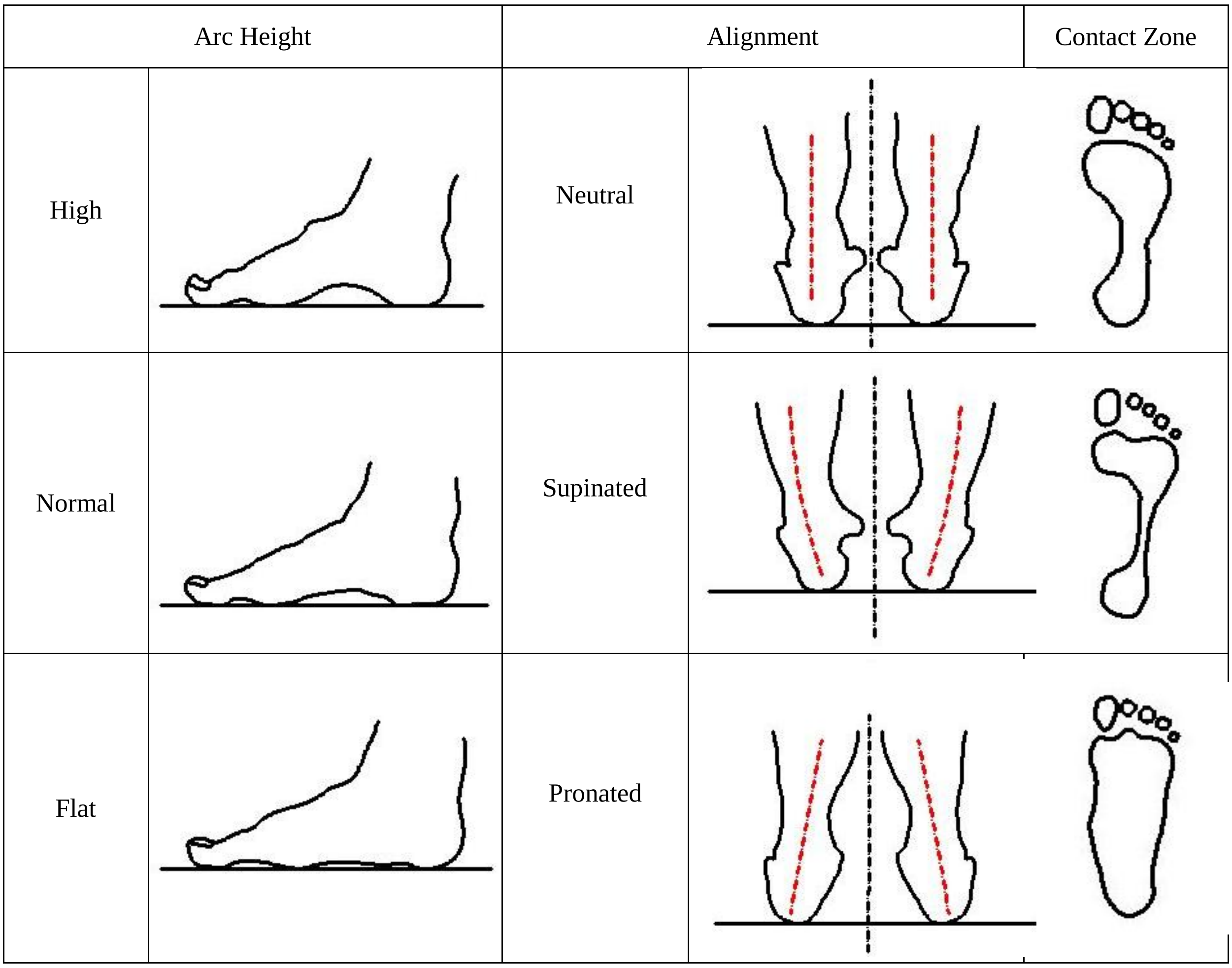


Figure 1. Human Foot Structures and Contact Zones

With the advancements in 3D printer technology, it is possible to easily and quickly produce the solid objects from 3D CAD data. Comparing with the traditional manufacturing methods, 3D printers that use various additive manufacturing methods lead to shorter and more efficient production especially for the manufacture prototypes and custom-made objects. 3D printer technology has been used for manufacturing the orthotic devices in some novel studies [6]. The insoles designed in a CAD software could be also manufactured by a 3D printer. The customized CAD model of an insole can be derived from a CAD model of the foot sole of an individual. The CAD model of foot sole can be captured by scanning the surface of person foot sole geometry with a 3D scanner system. In this application study, an open source and android based “123D catch” software, which is a free mobile application, was used to capture the 3D scan data of the foot sole. In this method, insoles are produced without the molding procedure and insole model can be modified before manufacturing.

3D printing technology, which is a prominent tool for the last decades, enables to print 3D models of any real objects specifically for customized molds and prototype products [5, 7]. The design and production industry of custom insoles has been highly affected by the advances of 3D printing technology. This method, which is time, labor, cost and source saving, is performed using different kinds of materials such as PLA (Polylactic Acid) and ABS (Acrylonitrile Butadiene Styrene). The method is also known FDM (Fused Deposition Modeling) that implies a production technique employing a moving nozzle that is heated to melt and extrude the material. It builds the objects layer by layer and sustain precise surfaces.

In this study, in order to improve the teaching methods for novel technologies with educational concerns, a subject specific customized mold insole was designed and produced. The study represents an educational application which includes the main steps of insole design and production using up-to date technologies so that people and especially students could adopt to latest developments.

METHODS

This application study involves a series of steps which are critical for production of custom made insoles that is aimed to improve the poor gait and the posture of people. As a starting step, in order to obtain 3-D geometrical data of the subject foot, a series of photos were taken using mobile phone which operates Autodesk 123D Catch open-source software. The photos should be taken in an angle interval of 0 and 360 degrees so that one tour around the object was needed to be completed. The software required a time duration about 60 minutes to process the photos. The model constituted by the software could include some defects originated from environment in which photos or foot were taken. It is necessary to perform a cleaning operation to discard these undesirable defects. The operation could be achieved using various open-source softwares but, in this study, Autodesk Meshmixer which is also open-source software was used to carry out this task. The modified foot sole is still a rough surface. The smoothness operation was performed to refine the surface quality and this step was also implemented using Meshmixer software tool, as well. The outer surface of foot sole and the inner surface of the designed insole should have the same topology to sustain a good adaptation and to satisfy the subject specifity.

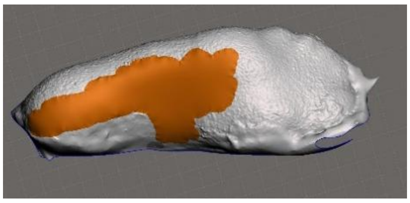
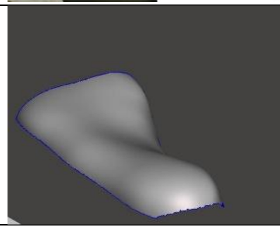
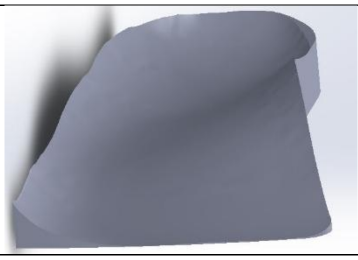
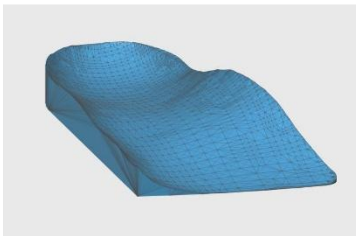
TASK	PROCESS	OUTPUT
TAKING PHOTOS		
CLEANING & SURFACE OPERATIONS		
SOLID BODY OPERATIONS		

Figure 2. Processes and outputs of design steps

In order to obtain the same shape of foot for insole, 123D Design, which is a reverse engineering and also open-source software was used. The output of this step is still a surface in stereolithography (stl) file and must be transformed to a CAD file in order to perform required solid body operations. The surface of the insole which has the same topology with the foot surface, then, converted to a solid body using a conventional solid body modelling program.

After a series of operation, including fillet, radius, extrusion and cutting, the model was ready to print. Aforementioned design steps are shown in *Fig 2*. Manufacturing of the insole model was carried out using a 3D printer device, which is namely Ultimate 2 Extended and based on fused deposition modeling technique. Printing is the last stage of whole process. Schematic representation of work flow is given in the *Fig. 3*.

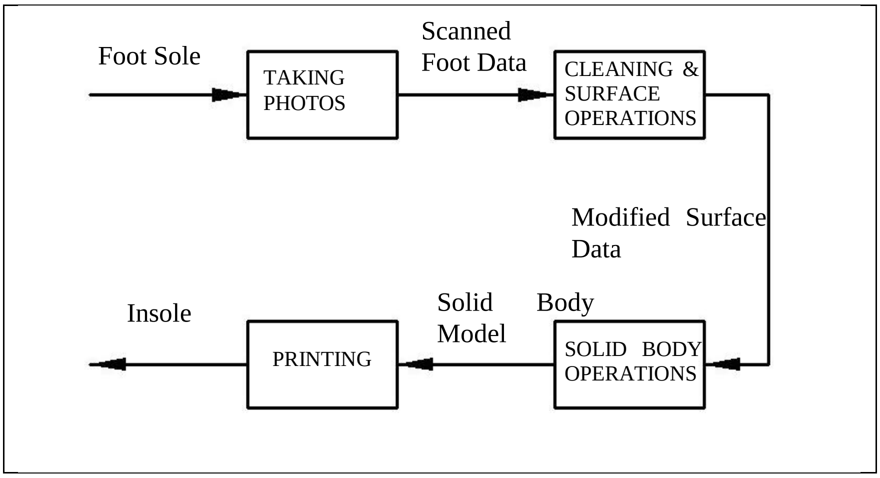


Figure 3. Schematic representation of work flow

The PLA material was fed to the 3D printing device in our laboratory which is extensively used for biomechanical purposes. Produced insole model is shown in Fig. 4.

Figure 4. Fresh insole model after printing process

RESULTS AND DISCUSSION

In this paper, the procedures for design of subject-specific insoles were discussed and the production of insoles by taking the advantages of 3D printing technology was evaluated. Design and manufacturing processes were completed in accordance with the functional requirements such as total contact, customizable, labor and cost effective and easily producible. In addition, the produced insole has shown a good match to the foot surface of the subject. Since adaptation of foot sole to insole surface is critical for comfort in posture and gait, an appropriate match is a crucial result for the study. Moreover, it was also shown that improvements in science and technology would provide effective solutions on production processes of subject specific designs and products.

The study also shows that from stl to CAD part, there are numerous steps must be carefully done using open-source and commercial softwares. The actual geometry of foot could be reflected in the computer model by benefiting from capabilities of those programs.

Additive materials technology has been utilized in the study and it is clearly experienced that this kind of technology is prominent and also promising for biomechanical and educational purposes.

CONCLUSION

This study was undertaken to design and produce a subject-specific insole and to evaluate the benefits of 3D printing technology. Returning to the question posed at the beginning of this study, it is now possible to state that the improvement of science and technology could provide effective solutions on production processes of subject specific designs and products. This study present the main steps in a sequence for design and manufacture of insoles.

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A BIOMECHATRONIC APPLICATION ON PROSTHETICS FOR UNDERGRADUATE ENGINEERING STUDENTS

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ABSTRACT: Human hand prosthetics imply a great challenge to researchers to help regaining the lost motor functions for amputated people. A relatively high amount of labor and budget are required to reach the ordinary prosthetics for amputees. Improvement of assistive technologies has provided to design and manufacture more functional hand prosthetics. Novel tools employed in assistive technology including 3-dimensional printers and user-friendly electronics complementary devices have made a great contribution to prosthetics area with fast and cost effective solutions. Although a significant development of technical facilities has been occurred, prosthetic hands with high functionality could not gain wide currency since the manufacturing and design processes require more educated engineers and biomechanicsts. Introducing the design and manufacturing steps of prosthetics for educational purposes in engineering and life sciences could be very effective in order to ease accessing the more functional prosthetics and to increase the prevalence of use. Education of new methodology and devices provides crucial opportunities to enhance the ability and usage of new generation prosthetics. In this study, a prosthetic hand design, control and manufacturing implementations were carried out by undergraduate students in the context of dissertation study. The custom based human hand prosthetics was manufactured according to following steps. Three-dimensional CAD models of prosthetic hand components including palm and fingers were designed in a solid body modeling software. Then, the model parts were printed using 3-D printers and they were assembled. The forces were transmitted to the fingers via elastic strings which were controlled via Arduino controlled servo motor. The programmable motions of servo motors enable to direct control of fingers. Specific education on design, manufacturing and control of human prosthetics has the potential to provide a high impact on obtaining more functional and cost effective prosthetics which enables more people to regain their lost motor patterns.

Key words: Assistive technologies, human hand prosthetics, science and engineering education

INTRODUCTION

Lower limb amputation of human arm represents an important limitation of individuals who survived from partially losing their limbs. Amputated people are exposed to various difficulties in performing many daily life activities. Basically, human hand, which is a critical part of human body, enables to carry out vital motor tasks. Scientific and technological resolution about amputation to regain lost functions of human hand focused on the design and production of prosthetics. Human hand prosthetics are designed and manufactured not only for cosmetics reason, but also contribution to perform lost functions. Prosthetics, which are complementary tools for amputated people, is a kind of assistive technology. Rapid advancements in technology and science affect the production process of prosthesis. By means of new technological facilities, the new generation prosthetics are more functional and able to response to more requirements of patients. 3-dimensional printing technology and electronics devices have contributed to developments of prostheses in terms of fast and cost effective prosthetics production. Several attempts have been made to improve human hand prosthetics [1, 5]. The studies have documented that design and control of prosthetics are critical issues for these assistive devices. Development of technical facilities could enable to reach more functional and precisely controllable prostheses by improving design and manufacturing processes that are employed up to date. In addition to this, introducing and teaching the technical aspects of the novel devices and methodologies could provide an easy access to the more functional prosthetics and to increase the usage rate.

One of the newly developed methods to obtain prototype of models is 3-dimensional (3D) printing technology. There are numerous studies about biomechanical applications of 3D printing method which is based layer by layer production with additive materials [6, 10]. Therefore, this novel method has a great potential to contribute prosthetics production area which requires light and cost effective components.

Another important subject needed to be highlighted is the model library of *Enabling The Future* community [11]. The community includes a group of people from various disciplines and populations would expect different aims and performance from the prosthetics devices. It is also aimed to spread production and using new generation prosthetics benefiting from 3D printer devices. The library, which includes the models of human hand prosthetics from different design perspectives, allows people to improve available designs or to create another one.

In this study, it is aimed to produce a prosthetics hand for educational purposes to make undergraduate students be able to produce prosthetics components. One of the main objects of the study was to use 3D printing technology aiming to provide some functional requirements such as light in weight, easy to produce and labor and cost effectiveness.

METHODS

In order to produce the human arm prosthetics and also to control the entire model, the necessary procedures could be classified as design, printing, assembly and control stages. The details of all work steps are given below.

Design of Components

The components of the prosthetics, which allow individuals to grasp or hold an object, could be designed by according to a wide range of criteria. Therefore, there are many designs for prosthetics limb components in use. In the study, although the elements of human hand prosthetics could be designed specifically in the first step as a self-contained study, a model, namely the raptor hand, was obtained from the model library of the *Enabling The Future* initiative to reduce cost, time and labor expenses. Then, the model taken from the library was imported to a CAD software. The CAD software, which is able to import the (stl) files, is a beneficial tool to monitor the design and observe all the components with detail. The components of the raptor hand model were shown in *Fig. 1*.

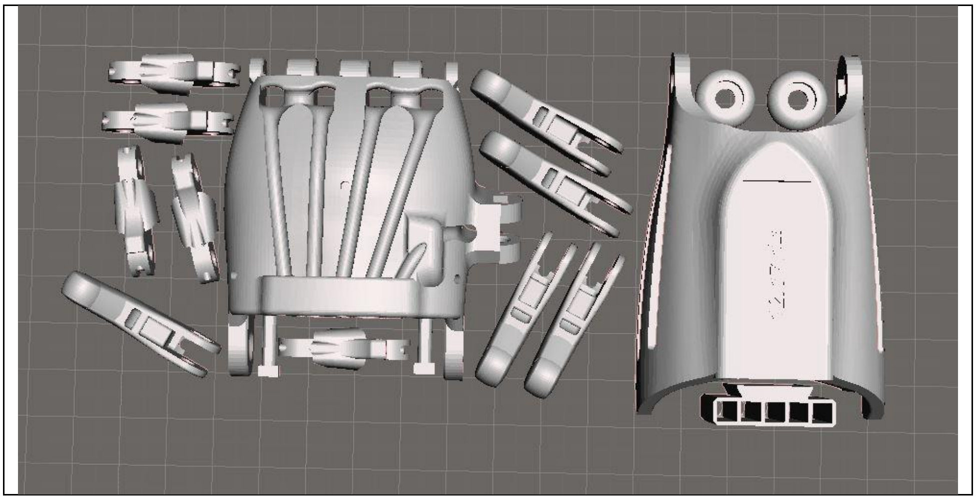

Figure 1. The components of the raptor hand model

Printing Process

Printing process is a critical section of the study. Surfaces of the model components should have a good quality and the material fed into the 3D printer's nozzle should satisfy desired functional requirements, such as flexibility and formability. In this study, printing material was chosen as PLA (Polylactic Acid) which is widely used for educational, medical and engineering purposes. All components were printed using 3D printing device (Ultimaker 2 Extended, Netherlands).

Assembly of Parts

Printed components of human hand prosthetics model was engaged to each other, so that the whole model could be obtained. Palm, joints, fingers and fishing lines are the components of the model and shown in *Fig. 2*.

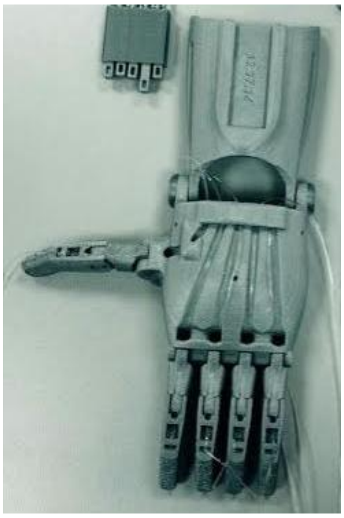

Figure 2. The entire prosthetics model

Control of Prosthetics

Control process is still one of the most challenged issues in the prosthetics area. The main objective of the studies in the literature is to reach dexterous and intuitive control of these artificial hands. However, the amputation level and the limited capability of existing electronic devices, which are used currently in prosthetics, are important barriers for researchers. In this study, the control of prosthetics was carried out by both passive and active approaches. If the subject uses his/her residual limb to to move the fingers, the control is called as passive (*Fig. 3a*). However, if the servo motors and electronic circuits based system provides motion of fingers and the whole components of prosthetics, this kind of control is named as active (*Fig. 3b*). For both of the control methods, fishing lines were used to transmit the force and to manipulate the fingers. Additionally, two servo motors and an Arduino Card that is used to drive motors were employed to execute limbs motions in active control.

a) b)

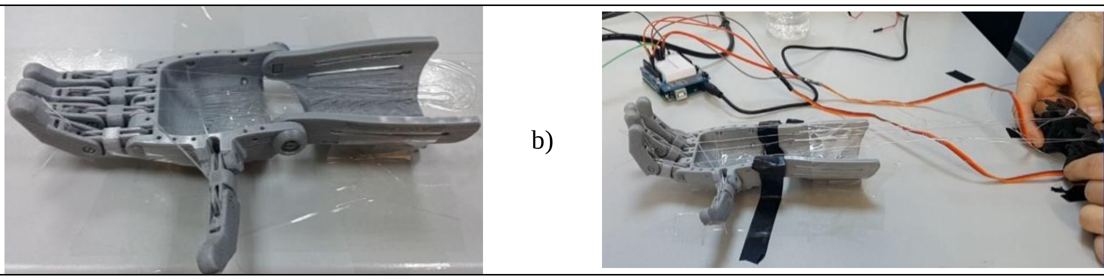

Figure 3. The control types of prosthetics; a) passive and b) active control

RESULTS AND FINDINGS

In this study, the design, production, assembly and control steps of new generation prosthetics are presented and discussed. Moreover, a prosthetics hand was produced using a 3D printer device and could be controlled by means of complementary electronic devices such as servo motors and Arduino card. The control was also implemented both actively and passively. Moreover, it was shown that the obtained prosthetics has the potential to provide similar characteristics to the new generation models in terms of weight and control capability. Additionally, the models enable the operator to modify all the system, if necessary. The components of models can be independently modified. As a result of the study, a tutorial, which includes the design, production, assembly and control steps, was provided for undergraduate students to build their own projects.

The study also contributes to understanding of the effects of technological advances on assistive devices' design and production considerations. The facilities of novel methods such as 3D printing method involving limb components productions promises to reach lighter and cheaper prosthetics designs.

The limitations of the study are the delay in the active control and low surface quality of components obtained from 3D printer device. Future studies about prosthetics should take into account these crucial concerns.

CONCLUSION

Human hand prosthetics, which are devices to compensate the lost functions of amputated people, was produced benefiting from a novel technological facility such as 3D printers. The study includes the procedures for undergraduate engineering students to design and produce prosthetics. It was also shown that the success of the prosthetics design was firmly related to technological improvements.

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http://enablingthefuture.org/

CREATING REAL LEARNING EXPERIENCES RATHER THAN TEACHING BASED ON THE TRADITIONAL TRANSFER OF MATHEMATICAL INFORMATION, AT COLLEGE LEVEL

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ABSTRACT: Innovation in Education is a must in the 21st century education around the world. TEC de Monterrey in México as a system, is working hard in preparing and making their teachers innovate and use new educational models. Teachers are constantly implementing new teaching and learning techniques, not only to have better teaching practices in all fields, but to build life skills in their students. Competences such as collaborative work, problem solving, leadership and critical thinking are some of the skills that are cultivated through these techniques. A group of Mathematics´ teachers at Tec de Monterrey Campus León in Guanajuato México, have been using challenges in class as a way to create real learning experiences by using technology, flipped learning, mystery stories to improve reading comprehension skills and mathematical knowledge. Mathematics lessons have changed from simply transferring extensive amounts of information to creating the conditions for students to develop long life experiences. In a preliminary survey about math lessons in our campus, more than 54 % of the total students in this project, mentioned that they find math courses in general very hard, tedious, mechanical and without challenges. This study suggested that students learned math faster and deeply in a dynamic and fun way, 91 % of students in the final survey answered that learning math in this way was more meaningful and enjoyable, improving the enthusiasm about learning math among students. Math scores went up in the groups that followed this new educational technique.

Key words: learning experience, dynamic, innovation, challenge.

INTRODUCTION

We are living in times of significant change, our societies, institutions, businesses, occupations and the way we communicate and interact with others continue to evolve, therefore it is the responsibility of the educational community to generate new learning platforms, models and strategies that when implemented to the students will help them coalesce to the XXI century professional life. In the Tec de Monterrey, we strive to provide relevant learning experiences that include hands on experience in the community and an important level of maturity to deal with different cases, situations, problems and projects. As Karl Fisch so wisely stated in 2007 (Fisch, 2015) "We are currently preparing students for jobs that don't yet exist, using technologies that haven't been invented in order to solve problems we don't even know are problems yet", and our challenge as educators consists of taking advantage of our students' years with us, so as to help form the future leaders of these changes.

We live and learn with every aspect of our personality. When we combine our emotional knowledge with our physical knowledge, we achieve true human learning, which, according to Claxton (Claxton, 2008) occurs when we no longer know what to do, and therefore any learning experience will pose a certain risk, a gamble in which we must accept uncertainty free from any anxiety or anguish, living each new challenge as an element of a complex society in which a culture for learning will emerge that will stimulate the individual's confidence in his or her learning ability in any situation. Let us embrace this idea and allow every student to actively experience their responsibility for their own learning and that of their teammates, (Gomez, 2016) following a determined set of instructions, training and actions that based on technology and several communication strategies will develop personal and social skills which will transform into a habit of collaborative learning.

Although we will not generalize, it is a common to find in students entering higher education in Mexico, that a large percentage of them deem certain subjects as too difficult, rejecting fields such as mathematics, arguing that it is a boring and useless branch of education. According to a survey conducted by the National Survey of Habits , Practices and Cultural Consumption by CONACULTA (Cultura, 2010), 77 % of the population of Guanajuato reported not reading any books , 49% reported not reading newspapers and 58% never reads magazines. With this data it came as no surprise that in 2012 of the 108 countries that make up the UNESCO, Mexico has the next to last place in reading index, estimating that a mere 2% of the Mexican population has a permanent habit of reading.

METHODS

The pedagogical proposal presented in this innovation project was to promote the passion for reading while simultaneously uncovering the charm behind the world of mathematics, for this purpose the book: The Mathematical Novel was included in the classroom and homework sessions, thus allowing the students to experience a more individual and collaborative approach to the numerical challenges presented in this book, along with weekly activities associated with the Schoology educational platform.

Text Selection and Generation

One of the motivators behind this project was to increase each students annual reading tally by at least one book by the end of this mathematics course. For this reason, choosing a book that would be of an attractive genre and writing style for students between the ages of 18 and 21 was of paramount importance. A murder novel was chosen; in which the challenge was to discover who the killer was.

To generate empathy, the novel revolves around four young university students who witness the last minutes of life of the city's ruler, whom explains to them the importance and the negative impact on the community if they do not catch his murderer. Therefore, with his dying breath of air, he urges them to catch his murder and he gives them the first clue that they must follow. Coincidentally, the beginning of this novel also elaborates on the traits and hobbies of the students, who share a dislike for mathematics.

Each chapter of the novel includes two elements that allow the reader to link mathematics with reading comprehension innovatively:

- One challenge (from a total of 9) that they must solve and send online to the city's ruler to demonstrate that their investigation is on the right track. To solve this challenge, it is necessary to use the mathematical knowledge and skills that were presented in class each week.
- One clue (from a total of 9) that can be solved by using mathematical logic, deduction and common sense that have been acquired in previous stages of the students' life. This clue will allow the characters to continue their search and come closer to finding the murderer's hide-out.

Activity Distribution for the Students

This activity was designed to be implemented in 12 weeks, the project began with a survey of reading habits, and the students' opinion about the relationship between learning about math and reading comprehension.

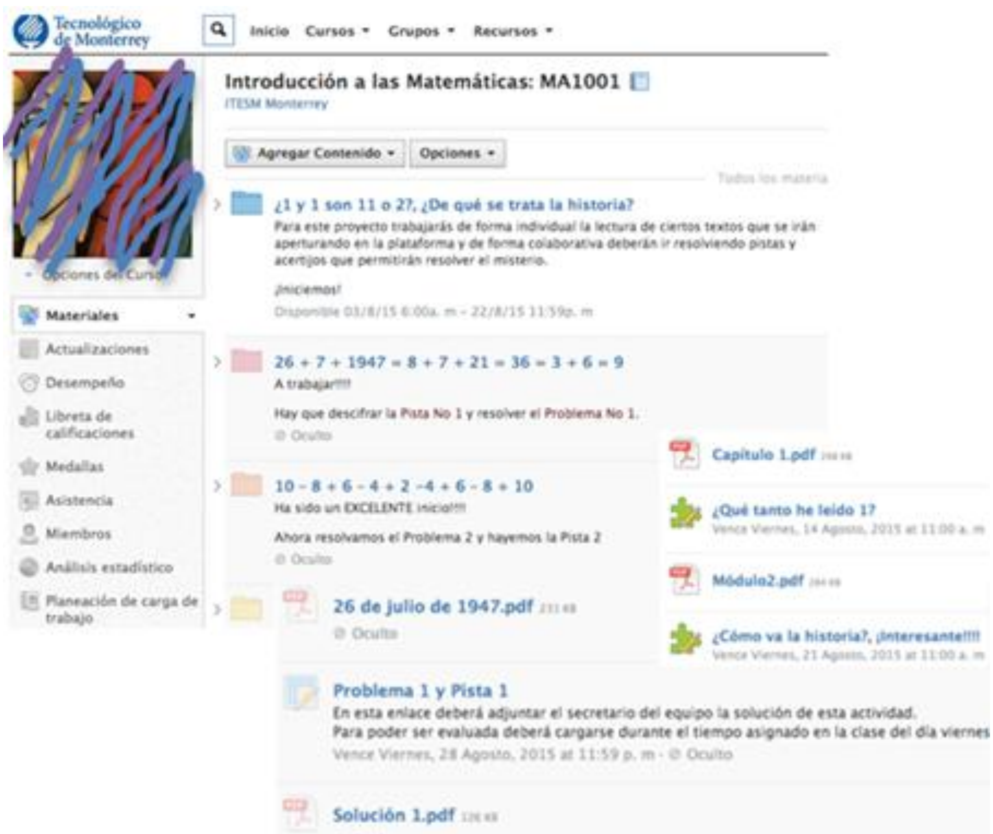
- During the first project class, when the project was presented, the students were divided into groups of four and roles were assigned, stressing the importance of individual work, which in this case consisted of reading the chapter pertaining to each week; and teamwork which consisted in
  - one student who would be responsible for organizing the time allotted in the classroom,
  - one responsible for formalizing a proposed solution,
  - one in charge of questioning and validating the results,
  - and finally another that would deliver the work to the platform.
- During the first two weeks the students had to read chapter 1 and 2 respectively and during class on Fridays they would take a reading comprehension quiz. This phase helped determine each student's initial reading comprehension level as well as introducing the story to the students.
- From week 3 to 11, the individual reading was divided into two parts:
  - The first part of the corresponding chapter was made available every Monday, in which the characters are confronted by two elements: a challenge and a clue. To have time to read the chapter and propose solutions individually the students disposed of half a week, since during class on Thursdays, the students were given time out of class destined to work collaboratively on solving both elements, generating evidence and come to a proposed solution which must then be uploaded to the Schoology platform.

   - The second part of the chapter becomes available for the students to read from Friday to Sunday. During this section of the chapter the characters describe the correct solutions they reached and they continue their search. This way the students can effectively compare their proposal to that of the characters' and witness the correct interpretation of the challenges and clues.
- From weeks 6-12, during class on Fridays, students were evaluated individually and online regarding the elements that were described in the chapters, so as to measure the variation in reading comprehension.
- During week 12, and after each team handed in their proposed solution to the ninth and final challenge and clue, the final solution and conclusion to the mystery of the novel became available on the platform.
- During week 13 the students were again surveyed on their reading habits and their opinion of the relationship between learning mathematics and reading comprehension.

Implementation

This project can be found on the Schoology platform and was implemented on the students of the August-December 2015 semester of the class MA1001 Introduction to University Level Mathematics, which is integrated by students who are lacking in some of the required areas to begin mathematics in their corresponding careers.

To begin the semester, the platform was organized and each student was given clearance to access it. The two surveys were uploaded, along with three reading evaluations, the 9 block, including the readings with the problems that must be solved and the clues that must be deciphered, as well as the solutions that were reached by the characters from the novel and the 9 spaces in which each team must turn in the result of their work. Each of these elements was programmed so that it would only become visible to the students after a specific date.



Responsibility of the Teachers

The development and implementation of this project required the collaboration of several teachers that were in charge of different responsibilities: a language teacher was responsible for writing the novel, a mathematics teacher was in charge of the problems and mathematical challenges that were related to the subjects covered each week as well as programing the math classes into the semester; an instructional designer validated the pedagogic proposal and uploaded the program on Schoology, and last but not least, was the teacher in charge of accompanying and evaluation the students' work, who also was responsible for encouraging individual reading and emphasizing each team's responsibility of uploading their work onto the platform. Each week the teacher evaluated each of the solutions and assigned the appropriate sticker to each development, it is important to note that the although the solution might not have been accurate, creativity, enthusiasm, team work and strategy were evaluated, so as to encourage the passion for math and reading.

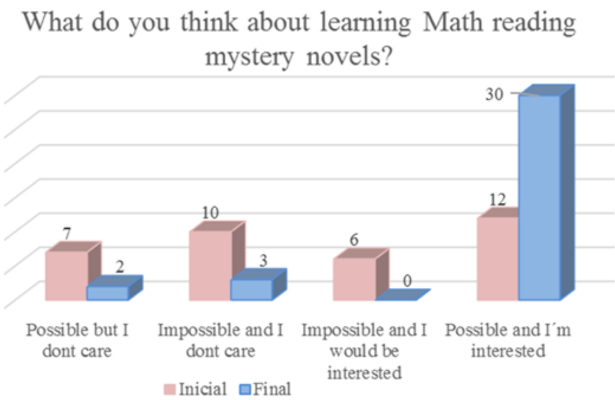
The team of professors that collaborated in this project would record weekly incidences to measure the project's effectivity and implement improvements, in which the following variables would be reported:

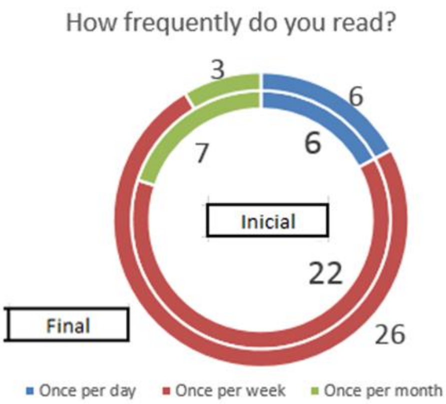
- The planned activity could be carried out, virtual activities were completed each session by means of the platform,
- All products or evidence were handed in/received in time for their evaluation,
- Instruments were employed -such as rubrics and checklists- from the platform to evaluate the activities,
- Describe the reasons that lead to registering an incidence or lack of.

RESULTS

To evaluate the project, two variables were considered. On one side, the students interest and perception for reading and the possibility of improving their mathematical skills reading, and on the other side, their competence in solving mathematical reasoning problems as well as their reading comprehension, both of which are basic for the Plan 2020 of the Tecnológico of Monterrey.

Considering that the project included the months of August to November, 12% of the participating students reported a change in their reading habits from 1 time a month to one time a week. There was also a significant increase of those of the sample who believed they could learn mathematics reading a mystery novel, at the beginning of the semester 34% believed this affirmation was possible, whereas by the end of the semester 86% agreed with this affirmation.





Figures 1 & 2. Results at the inicial and final of the proyect.

Regarding the reading comprehension competency measurement of the project, the group had an average of 46/100, 85/100 and 78/100, which was related to the increasing number of visits to the course on Schoology and the time each student was connected to the platform. As time the semester continued, these indicators also increased, demonstrating a 69% rate of improvement of their reading scores as measured by their level of retention, comprehension and memorization.

As far as the work turned in regarding the mathematical clues and challenges, these evaluations also demonstrated an evolution in the group average since they were of 76/100, 87/100 and 93/100 at the midterm cut. This demonstrates an improvement in their competence for logical reasoning and mathematics. It is important to mention that even by the second evaluation, the students continued to question the validity of the evaluations since not all of the elements in the book had yet been covered by their math sessions; however by the last delivery dates, this was no longer and influential factor and the academic achievement rose by 22%.

These numbers allowed us to consider the project succesful, however these are some of the comments we received from the students:

- It was easy to read and solve the problems as a team because we helped eachother out.
- I liked that the lectures were programed and distributed from the start. We got better at how we solved the problems and we also helped each other with the reading.
- Schoology's claneder would let us know via email about the deadlines on the reading, which was helpful, especially since there was a lot of reading for some of the weeks.
- During exam week, I lost the thread of the story.
- I don't like reading, and I didn't like that I had to read to do math, however this semester I read this book.

that inspire us to keep inovating, creating more stories and new ways to make their learning experience more meaningful.

CONCLUSION

The objective of this project consisted in implementing some of the tools proposed by the Model Tec21 to improve the students' abilities by joining two elements, mathematics and Reading. One of the most important findings of this project was that the students were able to learn in a completely different way, without so obviously following a lesson plan, the learning experience became something innovating, stimulating and challenging. In the students' mind it seemed impossible to imagine that a mystery novel would hold all the elements of a math program. It was also equally gratifying for the students to discover that their preconception that "I was born bad for math and for problem solving" was nothing but a myth. The students were able to propose creative and insightful strategies to find the solutions to the clues and challenges from the novel. Although they sometimes doubted their proposed solutions because they recognized it did not fully adhere to the methodology proposed in the classroom, they discovered that there are several different ways to apply their knowledge to solve a problem. This project would have been demonstrated less effective results if we had not integrated several of the elements that these new generations learn and work with, including: the importance of knowing their role in a team, so as to guarantee their participation in teamwork, the use of a technological platform not only made the reading easier, it also enhanced the follow-up, turning in the assignment and the feedback from each student. These elements made the project more familiar and pleasant for the students.

RECOMMENDATIONS

The next step consists in inviting more teachers from different areas to join us in linking their corresponding subjects to a good story. This project won't only apply to mystery and mathematics; it applies to any subject in which the student can take their knowledge and the information they learn in class to a fun, imaginative context in which they can practice it.

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AN INTERACTIVE APP FOR STEM LEARNING IN MOBILE DEVICES

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ABSTRACT: Low achievement in mathematics education has been an increasing problem in the recent years in some countries. According to a 2010 study from the U.S. Department of Education, blended learning classes produce statistically better results than their face-to-face. There is also an increasing number of students using smartphones and tablets in schools. Mobile devices gained popularity as an educational tool and there are many schools that use them frequently in educational activities to improve learning. In this paper, we present the development of an application for smartphones and tablets to provide activities that students can do outside the classroom or at home and increase the time they spend learning and practicing mathematics. With this app students solve mathematic activities and are helped by the presentation of videos with the problems resolutions.

Key words: m-learning, mathematics, gamification, multimedia, mobile devices

INTRODUCTION

Low achievement in mathematics education has been an increasing problem in several countries. For example in Portugal, in 2014, the average classification in the 12th grade exam, from 0-20, was of 7.8. Mathematics exams in the 1st cycle, 2nd cycle and 3rd cycle had an excessive percentage of negatives (levels 1 or 2), 36%, 54% and 47%, respectively.

According to a 2010 study from the U.S. Department of Education, blended learning classes produce statistically better results than their face-to-face. B-learning combines face-to-face instruction with online learning and has yielded strong results since officially being researched as an education model. An advantage of this approach is that it increases the flexibility and individualization of student learning experiences, and it also allows teachers to expand the time they spend as facilitators of learning.

The recent availability of smartphones and tablets with increased processing power and usability, accessible on a large scale, allow an exponential expansion of social and participative web technologies.
It is also important to note that these students are the generation of digital games and social networks. We cannot ignore that they are no longer the same for which the education system was designed a few decades ago. See, for example, the prospect of Heide and Stilborne (2000), for whom "the technological revolution has produced a generation of students who grew up with multidimensional and interactive media sources. A generation whose expectations and world views are different from those that preceded it" (p. 27).

In this context it is wise to consider the integration of digital media and mobile devices (tablets, phablets, smartphones), allowing students to set personal goals, to manage educational content and to communicate with others in the right context.

According to Fernandes and Ferreira (2012), the use of information technology made many changes in the way of teaching and learning. The use of mobile devices that are widely available is also giving the opportunity to students and teachers to change the teaching/learning process.

In this paper, we present the design and development of a mobile application for the teaching and learning of mathematics. Students can use this app in the classroom or outside the classroom in a blended learning model to solve problems. When students have difficulty in solving a problem they can watch the resolution of it. In this way, we want to provide the same opportunities to low-achieving students that may struggle to learn the materials covered in class. Students have also access to complex problems that may provide additional stimulation for top performers students. In this way, we can provide a platform that is capable of accommodating students with different mathematic skills.

Motivation

Results from the 2012 Program for International Student Assessment (PISA), show that Norway, Portugal, Spain and Turkey are below the OECD average in mathematics, with a mean performance of 489, 487, 484 and 448 score points.

The countries that show significant improvement in PISA performance – Brazil, Germany, Greece, Italy, Mexico, Tunisia and Turkey – are those that manage to reduce the proportion of low-achieving students. In Norway, Portugal and Spain about one out of four students, in Turkey about one out of two students, still do not attain the baseline proficiency Level 2 in mathematics. It means that in the best of the cases, low achievers students can extract relevant information from a single source and can use basic algorithms, formulae or procedures to solve problems involving whole numbers.

The PISA report also concludes "improvement in performance rarely comes at the expense of equity in education". There are exceptions to this. "Between 2003 and 2012, Poland and Portugal increased the proportion of high performers in mathematics as they simultaneously reduced the proportion of low performers. Improvements in mathematics performance in Mexico, Tunisia and Turkey, all of which scored well below average in their first PISA tests, are observed mainly among low-achieving students. This usually means greater equity of education opportunities in these countries too. " (OECD, PISA in Focus 2015/01. pp.4).

Regardless the controversy over PISA tests results, this situation calls for actions aiming at improving instruction strategies for teaching and learning mathematics.

In this paper it is presented a mobile app that is looking for improving mathematical performance and achievements for all students including also those in the PISA share of low achievers and the top performers.

The development of this mobile application plans to extend traditional learning environment to a virtual classroom setting that will keep students connected for learning mathematics by the exploration of motivating math tools that will enable students to practice more. This application enables the exploration of video lectures and gamification in smartphones, phablets or tablets.

We want to take advantage of mobile devices for teaching and learning. The recent availability of smartphones and tablets with increased processing power and usability, accessible on a large scale, allow an exponential expansion of social and participative web technologies. However, in many countries teachers and students do not use mobile devices for teaching and learning purposes. It is also important to note that these students are the generation of digital games and social networks. In this context it is wise to consider the integration of digital media and mobile devices (iPad, iPod, tablets, smartphones), allowing students to set personal goals, to manage educational content and to communicate with others in the right context. However, according to the EU Commission initiative Opening Up Education (25 September 2013), between 50% and 80% of students in EU countries never use digital textbooks, exercise software, podcasts, simulations or learning games. Most teachers at primary and secondary level do not consider themselves as 'digitally confident' or able to teach digital skills effectively, and 70% would like more training in using ICTs.

This application will contribute for the implementation of a blended model for teaching and learning mathematics that will accommodate gaming mechanics that it is two-fold: complexity and detail. It has three different levels of problems complexity: beginners, intermediate and advanced. On the other hand each problem has two levels of explanations/resolutions: detailed and concise.

In this way, all students are accommodated in a learning environment centered in the student. The low-achieving students that may struggle to learn the materials covered in class, can study and repeat the materials as many times as they may need to learn. Students will have access to complex problems and activities that may provide additional stimulation for top performers students. Teachers will also be more confident to give homework activities to their students. It is known that it is important to assign homework, to help struggling or underachieving students to learn the material covered in class, to ensure that the material is stored in students' long-term memory, or to provide additional stimulation for high performers. But homework can be particularly burdensome for disadvantaged students. Their parents' may not have the skills to help them, they may not have the resources to support them on private lessons. We aim at providing the same support for all the students so that we can contribute to weaker the relationship between students' socio-economic background and mathematics performance.

Aplication Design and Implementation

This section describes the design and development of the mobile application that students use to study mathematics.

The application is powered by a web server and a relational database management system to store and query the data about users, worksheets of problems and relations between them (Figure 1). Each worksheet includes a set of questions of a selected theme, chapter and grade (year) of the mathematics curriculum. Information about users' activities is also stored in the database such as the date and time of the login, selected worksheets and submitted answers.

The web server provides the back office platform that enables teachers to upload questions, instructions for the evaluation and videos. It also allows users with mobile apps to login, access worksheets of problems and videos and upload answers.

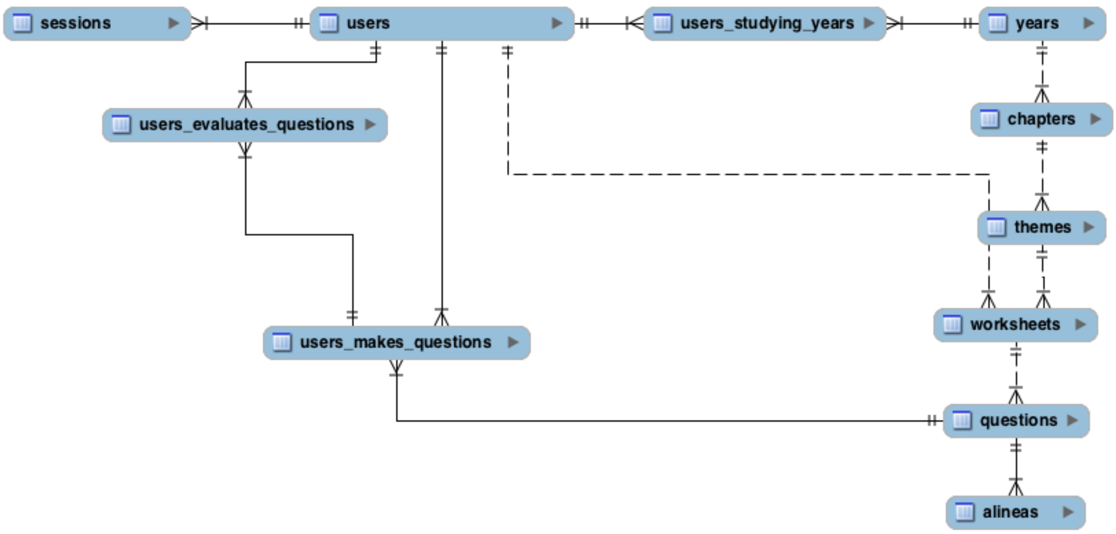

Figure 3. Relational database structure to support the mobile application

Teachers can use a back office page that is accessed through the browser to upload the questions (Figure 2). In an intuitive interface the teacher uploads for each question the year, the chapter, the theme and the worksheet of the problem. Then the different sub-questions are defined. For each sub-question the teacher chooses if it is a multiple choice or open sub-question, the number of points, the instructions for the evaluation and two videos, detailed and concise, with the resolution of the sub-question.

In this way, the teacher creates the worksheets of problems that students have to do to practice the mathematic problems using the mobile device. These problems are uploaded to the server. This data is later available to the mobile app where students have access to the different questions and the videos with the problem resolutions.

This also enables teachers to produce the contents and make them available to their students. An alternate way to produce mathematic activities and problems is to use the textbook companies provided materials, when lecture videos are provided, and exercises that are readily available for teachers and can be uploaded in this platform.

In this way, teachers can use their own produced materials or textbook companies' contents to create their own activities targeted to the particular needs of each class and individual student. We believe that this can be very motivating for students and it also helps in delivering lectures, hands-on activities and customized study modules. This is a main advantage of this platform for education because teachers can tailor activities to each student.

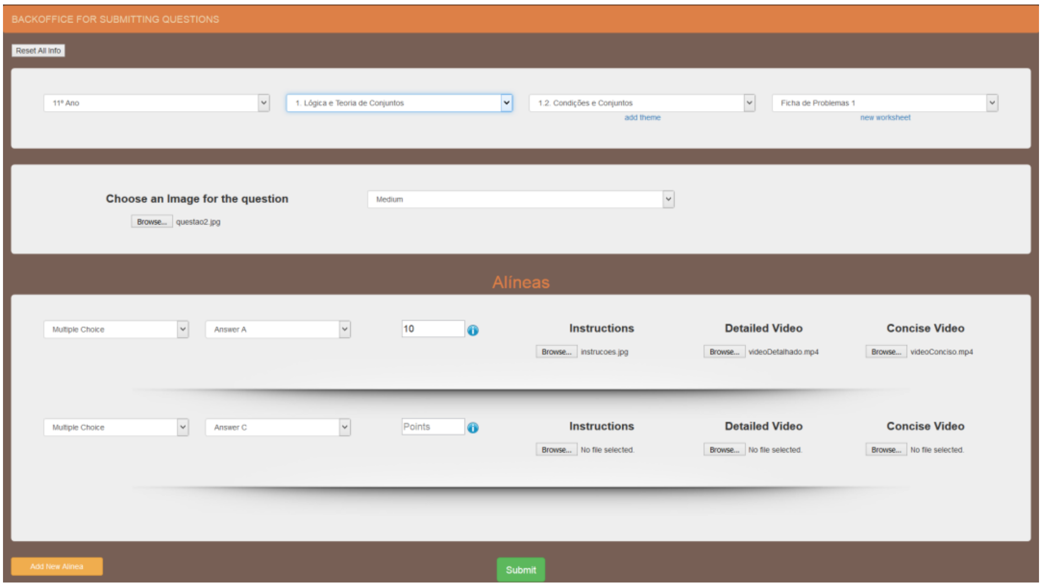

Figure 4. The teacher uploads worksheets of problems with instructions for evaluation and videos resolutions

Students use the mobile app in a smartphone or a tablet to solve the worksheets of problems that were made available by the mathematics teacher. After making the login the student has to choose the worksheet of problems that he wants to solve (Figure 3). Each worksheet of problems relates to the year, chapter and theme of the mathematic curriculum from the 10^{th} to the 12^{th} grade.

After selecting the worksheet of problems the students starts solving questions (Figure 4). At this point it is shown a question at a time. If the question is a multiple choice, the student selects the right answer in a very straightforward way and the app can automatically identify if the answer if correct or wrong.

When the question is an open question then the student makes the resolution and takes a picture, using the mobile device, which is uploaded to the server for later evaluation by the teacher, himself and one of his peers, another student.

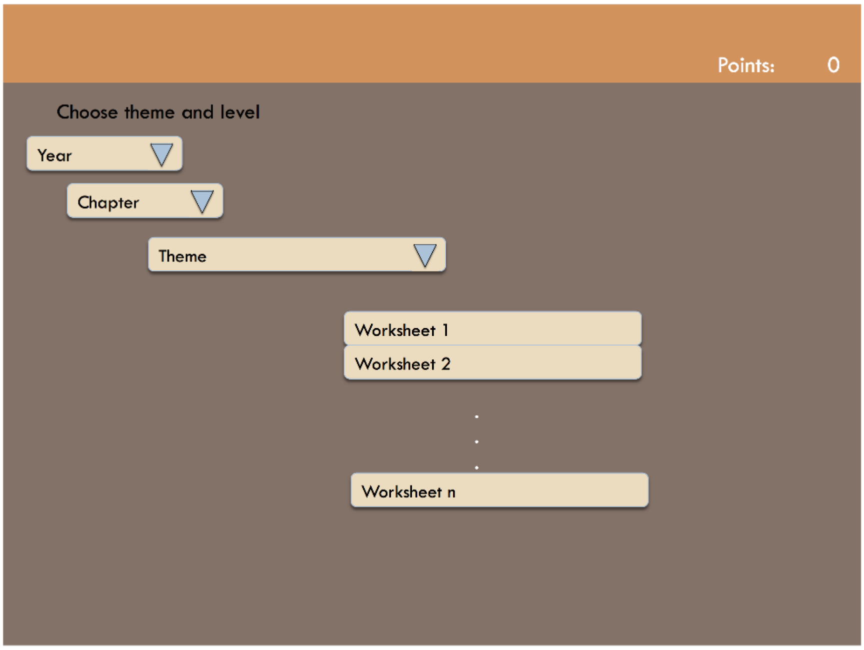

Figure 5. The student chooses the level to play. He plays by solving worksheets of problems

When the student finds it difficult to solve the problem, he can access to the videos with the problem resolutions. The video with the resolution of the problem is well suited for teaching problem solving. It allows students to learn at their own pace and in their own learning style. The videos with the problems resolutions are well adapted for classes with students who have different levels of knowledge of the subject. There are students that can view the materials once and have a good understanding of the mathematical problem. Other students can view the videos several times to better understand the subject. This is an advantage over the traditional classroom where many times the students do not understand and do not ask to repeat the subject until they are able to understand. The use of videos for teaching and learning is effective for both visual and auditory learners as there is video and narration that is less complicated than written explanations (Spilka and Manenova, 2013).

With the number of students increasing in the class this is an important tool to enable students to work at home and leave classroom time to implement problem based learning methodologies together with virtual learning classrooms.

The use of this application also enables to register the student specific achievements in the user database. This data can be later used by the teacher to understand the students' achievements.

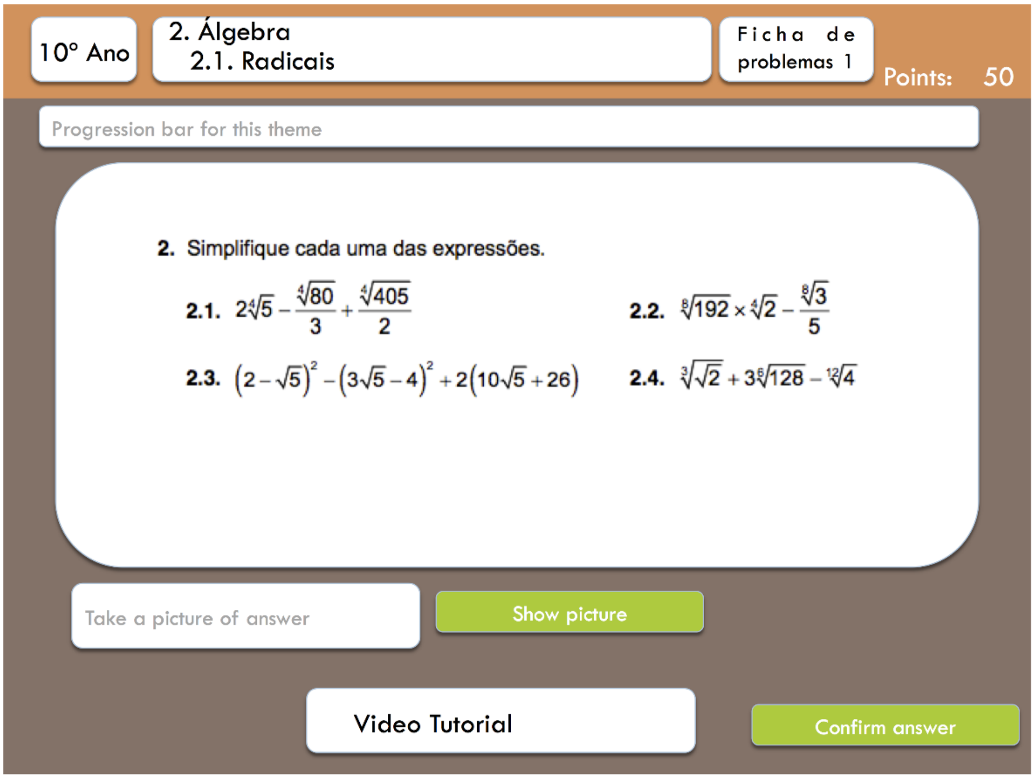

Figure 6. The student solves problems from the worksheet. He earns points each time that he has correct answers

The app presented in this paper let teachers extend the class into a virtual class in a form of blended learning in which students can view video lectures and solve problems outside the classroom. This can be especially interesting for learning mathematics. If students can learn at home from watching video lectures and solving problems, time in-class can be dedicated to explore more motivating problem solving. Math teachers have a difficult situation. Studying math is many times a cumbersome task. But this can be changed if the teacher takes advantage of the technology that is currently available in the classroom. Students are surrounded by multiple devices, such as smartphones and tablets, which give them access to multiple media that is easily available. This is an opportunity for the teacher. The technology related to teaching/learning will have a vital role in the coming years in the education field.

CONCLUSION

The increasing processing power of mobile devices and the increasing number of mobile devices makes possible the use of these devices for educational purposes.

Math teachers have a difficult situation. Studying math is many times a cumbersome task. Low achievement in mathematics education has been an increasing problem in the recent years in several countries has seen in the 2012 PISA results.

In this paper, we show the development of an interactive mobile application to make available mathematic problems and the videos of problem resolutions enabling the expansion of the classroom into a virtual space where students can have more time practicing problem solving.

We show that technology is accessible and easy to use by math teachers and students.

ACKNOWLEDGEMENT

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INVESTIGATION OF MATHEMATICS TEACHERS' VIEWS ABOUT IMPROVING PROBLEM SOLVING SKILLS

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ABSTRACT: Since problem solving skills play a central role in middle and secondary school mathematics curricula, this made mathematics educators give importance to this subject. Improving problem solving skills of students is one of the primary aims of education so it is very important to make students gain problem solving skills. Thus, the aim of this research is to investigate views of middle and secondary school mathematics teachers related to improvement of students' problem solving skills. Qualitative research method was used in this study. The research was done on fall term of 2015-2016 academic year. The study was conducted with 115 mathematics teachers (60 middle school and 55 secondary school) working at state schools. Data were gathered by a form consisted of open ended questions and analyzed by descriptive and content analysis techniques. At the end of the research, it is found that teachers had information about the importance of problem solving skills improvement in mathematics education. Also, it is determined that participants thought teachers should have a central role in improving problem solving skills and students should strive in problem solutions. In addition, it was found that teachers believed that mathematics and other lessons improved problem solving skills and improvement in problem solving skills had a positive effect on the achievement in mathematics and other lessons. Lastly, teachers thought that students whose problem solving skills had improved were more successful than the other students and had higher self-confidence than others. They also stated that since it had an impact on improvement in problem solving skills, it should be given importance to level of students when the textbooks were prepared.

Key words: problem solving skills, mathematics education, middle school mathematics teacher, secondary school mathematics teacher

INTRODUCTION

John Dewey problem is defined as a situation which confuses people's mind, finds the strength to fight it and make it question all judgments that the mind believes in (Gelbal, 1991). Olkun and Toluk (2004), defines the problem as situations where the individual is enthusiastic about solving the problem, does not know the way to reach the solution, yet may solve it with knowledge and skills that he or she possesses. Mathematical problem is a problem which needs to be solved, yet ways to find the solution are not obvious and cannot be solved by the individual immediately (at first glance) (Grouws, 1996). Also, a problem is a cognitive and behavioural process which the individual encounters in everyday life under his or her specific conditions and the solution is managed by the individual himself or herself (D' Zurilla, Nezu, & Maydeu-Olivers, 2002; Kneeland, 2001).

Problem solving can be defined as "deciding what to be done in cases what to be done is not known" (Altun, 2015). Finding a solution, developing a strategy or deciding on a method for the solution when faced with a problem that is not understood is almost impossible (Altun, 2015). For this reason, it can be said that problem solving is of vital importance. One of the objectives of mathematics education is to improve problem solving skills (Karataş & Güven, 2004; Reusser & Stebler, 1997). National Council of Teachers of Mathematics (NCTM) published a document named Curriculum and Evaluation Standards for School Mathematics in 1989 (NCTM, 1989). NCTM (1989) described problem solving as "the central focal point of the mathematics curriculum".

The importance of improving problem solving skills is emphasized in updated mathematics curricula in Turkey as well (Ministry of National Education [MoNE], 2009, 2013a, 2013b). In this context, it is mentioned regarding improving elementary school students' problem solving skills in mathematics curriculum that "utilizing problem solving to teach mathematics, raising awareness regarding the contribution of problem solving to learning, teaching students to use problem solving skills in situations encountered during mathematics course, other courses and everyday life, teaching them to apply problem solving steps in a meaningful way, raising their confidence in relation to problem solving, giving them positive feelings and thoughts regarding problem solving" (MoNE, 2009, p.14). In the middle school mathematics curriculum, the importance of "giving place to problem solving activities, paying attention to improving students' communication, mathematical connection, reasoning skills" is emphasized (MoNE, 2013a, p.VI). In the secondary school mathematics curriculum, it is suggested "to place students in problematic situations which they might face in their everyday life, teach them how to deal with these situations and give them reasoning skills" (MoNE, 2013b, p.53).

Considering that improving problem solving skills is one of the main objectives of NCTM (1989) standards and mathematics curricula of MoNE (MoNE, 2009, 2013a, 2013b), teachers should make it a priority to improve problem solving skills of students. Individuals encounter various problems in their everyday lives. They are expected to be able to solve these problems. This is only possible with improvement of problem solving skills. If problem solving is made a part of everyday life in school, problem solving skills can be improved easily (Henton, Marotz-Baden, & Kieren, 1979).

Kilpatrick (1985) notes that the success of a student in problem solving depends on his or her improvement in skills related to problem solving process. In teaching programs, the importance of raising students who are able to associate everyday life with mathematics, solve the problem step by step, discuss reasons behind solutions, work in groups, and have positive attitudes toward mathematics (MoNE, 2009). In addition, considering that one of the main reasons behind negative attitudes toward mathematics is students' lack of confidence in their problem solving skills, the significance of improving problem solving skills in mathematics course can be seen more clearly (Yıldızlar, 2001). It should be remembered that understanding the problem, planning the solution, carrying out the plan, checking the correctness and validity of the solution, generalizing the solution, and creating similar/original problems, which are Polya's stages of problem solving, must be observed in efforts to improve students' problem solving skills (MoNE, 2013a, p.IV).

A literature review shows that problem solving skills are increasingly emphasized in mathematics education. (Baker & Shaw, 1987; Blissett & McGrath, 1996; Farrel, Meyer, & White, 2001; Karahan, Sardoğan, Güven, Özkamalı, & Dicle, 2006; Karataş & Güven, 2004; Korkut, 2002; Mandin, Jones, Woloschuck, & Harasym, 1997; Nelson, Golding, Drews, & Blazina, 1995; Sawyer, MacMullin, Graetz, Said, Clark, & Baghurst, 1997; Soylu & Soylu, 2006; Taşkın, Yıldız, Kanbolat, & Baki, 2013; Yıldız & Baltacı, 2014; Yıldız, Baltacı, & Güven, 2011). Also, it is mentioned in teaching programs that problem solving process should be aimed at topics handled in each class (MoNE, 2009, 2013a, 2013b). In order for teachers to give problem solving skills to their students, they need to know about the importance of improving problem solving skills in mathematics education. For this reason, it has become important to investigate teachers' opinions and suggestions regarding improvement of problem solving skills. Therefore, it is an important topic of research to find out opinions of teachers regarding improvement of students' problem solving skills.

The Purpose of the Study

The main objective of education is to teach individuals to think, use their logical power, and become better problem solvers (Shin, Jonassen, & McGee, 2003). Therefore, this study aims to reveal opinions of middle and secondary school mathematics teachers regarding improvement of students' problem solving skills.

METHOD

This section contains information about the research method, study group, data collection tool, and data analysis.

Research Method

Therefore, this study aims to reveal opinions of middle and secondary school mathematics teachers regarding improvement of students' problem solving skills and utilizes the qualitative research approach to this end. Qualitative studies aim to investigate and understand social phenomena in their environment (Yıldırım & Şimşek, 2008).

Study Group

The participants of the study consists of 115 (60 middle school and 55 secondary school) teachers serving in middle schools and secondary schools located in the provinces of Trabzon, Giresun, and Manisa during the fall semester of 2015-2016 academic year. Purposive sampling method is usually preferred in qualitative studies (Meriam, 1998). The maximum diversity sampling is one of the purposive sampling methods (Yıldırım, Atila, Özmen, & Sözbilir, 2013). This study utilizes the maximum diversity sampling to determine common or different aspects in a variety of situations, thus describe the problem in a wider framework (Büyüköztürk, Kılıç-Çakmak, Akgün, Karadeniz, & Demirel, 2009). This study consists of voluntary teachers serving in high-end schools who stated that they were knowledgeable about improving students' problem solving skills. Demographic characteristics of teachers are given in Table 1.

Table 1.Certain Demographic Characteristics of Teachers

		Middle School		Secondary School		Total	
Characteristics	**Categories**	**f**	**%**	**f**	**%**	**f**	**%**
Gender	Male	24	20.9	26	22.6	50	43.5
	Female	36	31.3	29	25.2	65	56.5
Age	20-25	4	3.5	7	6.1	11	9.6
	26-30	19	16.5	10	8.7	29	25.2
	31-35	14	12.2	20	17.4	34	29.6
	36 and above	23	20.0	18	15.7	41	35.7
Years of service	0-5	22	19.1	15	13.0	37	32.2
	6-10	20	17.4	18	15.7	38	33.0
	11-15	7	6.1	10	8.7	17	14.8
	16-20	10	8.7	9	7.8	19	16.5
	21 and above	1	0.9	3	2.6	4	3.5
Educational status	3 years of educational institute	1	0.9	3	2.6	4	3.5
	Faculty of education	47	40.9	30	26.1	77	67.0
	Faculty of arts and sciences	7	6.1	20	17.4	27	23.5
	Master’s degree	5	4.3	2	1.7	7	6.1

It can be seen from Table 1 that 56.5% of the teachers were female, 65.3% were over the age of 30, 34.8% had a professional experience of 11 years and above, and 67.0% were faculty of education graduates.

Data Collection Tool

A form consisting of eight open-ended questions was used for data collection. The questions in the form were created by the researcher examining the literature related to problem solving skills. The help of two Turkish language teachers was taken and opinions of two experts in the field of mathematics education were taken for the content validity of the questions. Necessary corrections were made based on the feedback supplied by experts and teachers. The comprehensibility of the questions was checked via the pilot study performed with 15 mathematics teachers. Forms were filled by the teachers in a time and place where they could express their opinions conveniently.

Data Analysis

Descriptive data analysis and content analysis techniques were used together for data analysis. The data were firstly analyzed with descriptive analysis. Then, the data were analyzed at a deeper level with content analysis and codes and categories were created. After the determination of codes and categories by the researcher, the frequency and percentage of codes were calculated. Since some teachers gave answers to a single questions that could be considered in multiple codes, the sum of code frequency may be more than the number of mathematics teachers participated in the study. The data are presented for the reader in tables and sample sentences from answers of the teachers can be found below tables.

The data collected via forms were transcribed by the researcher and three randomly selected data were coded by two researchers independently. The consistency between the codes was calculated using the formula [Agreement / (Agreement + Disagreement)] and the conformity among researchers was found to be 0.86. Also, abbreviations such as S1, S2, … , S115 were used instead of real names of the teachers.

FINDINGS

The frequency and percentage values related to codes created from opinions of teachers regarding the importance of improving students’ problem solving skills in mathematics education can be found in Table 2.

Table 2.The Importance of Improving Problem Solving Skills in Mathematics Education

Category	Codes	f	%
The Importance of Problem Solving Skills in Mathematics Education	1. Helps solve problems in everyday life.	84	73.0
	2. Gives different perspectives.	29	25.2
	3. Teaches different ways to solve a problem.	25	21.7
	4. Facilitates to understand the problem.	14	12.2
	5. Allows for finding practical solutions.	13	11.3
	6. Contributes to mental development.	13	11.3
	7. Improves self-confidence.	12	10.4
	8. Improves the success in mathematics course.	11	9.6
	9. Improves the ability to read and understand.	9	7.8
	10. Improves the ability to perform operations.	7	6.1
	11. Improves the ability to interpret.	6	5.2
	12. Improves critical thinking.	6	5.2
	13. Makes it possible to focus on the problem.	5	4.3
	14. Improves decision-making.	5	4.3
	15. Improves analytical thinking.	5	4.3
	16. Makes individuals more successful in everyday life.	4	3.5
	17. Makes students enjoy mathematics.	3	2.6
	18. Raises solution-focused individuals.	2	1.7
	19. Encourage students to think.	2	1.7
	20. Provide connecting subjects to each other.	2	1.7
	21. Improves creative thinking.	1	0.9

As seen in Table 2, the teachers mostly mentioned that improving students' problem solving skills helped them solve everyday life problems, gave them different perspectives, allowed them to find different ways to solve the problem, and facilitated to understand the problem. Some answers given by the teachers to first four codes are given below:

"A student with an improved problem solving skill can handle problems in everyday life. (S11)"
"Problem solving skill allows for seeing problems from different perspectives... (S11)"
"Problem solving teaches students to find alternative solutions to problems that they encounter in their everyday lives and try routes which will make their lives easier, thus it is beneficial for them. (S34)"
"When these skills are improved, students will understand problems more easily and reach solutions more efficiently and rapidly. (S15)"

The frequency and percentage values related to codes created from opinions of teachers regarding responsibilities of teachers related to improving students' problem solving skills can be found in Table 3.

Table 3.Responsibilities of Teachers in Improving Problem Solving Skills

Category	Codes	f	%
Responsibilities of Teachers	1. Guides students.	37	32.2
	2. Teaches problem solving strategies to students.	19	16.5
	3. Makes students like mathematics.	7	6.1
	4. Provides students with problems of different kinds.	6	5.2
	5. Encourages students.	6	5.2
	6. Arouses a sense of wonder in students.	5	4.3
	7. Associates topics with everyday life.	4	3.5
	8. Gets down to students' level.	4	3.5
	9. Provides solutions of problems clearly and understandably.	2	1.7
	10. Improves students' creativity.	2	1.7
	11. Explains problem solving steps.	2	1.7
	12. Prepares problems suitable for students' level.	2	1.7
	13. Knows his or her students well.	2	1.7
	14. Makes students like reading.	1	0.9
	15. Gives students opportunities to prove themselves.	1	0.9
	16. Gives the course using materials.	1	0.9
	17. Gives the course in a student-centered manner.	1	0.9

As can be seen in Table 3, the teachers believed that their responsibilities in improving problem solving skills mostly included guiding students, teaching problem solving strategies, and making students like the mathematics. Some answers given by the teachers to first three codes are given below:

"The teacher must be an example and guide the student. (S29)"
"I believe teachers should ... teach appropriate strategies to improve students' problem solving skills. (S30)"
"The teacher should make it possible for students to like the course and students should make an effort. (S5)"

The frequency and percentage values related to codes created from opinions of teachers regarding responsibilities of students related to improving their problem solving skills can be found in Table 4.

Table 4.Responsibilities of Students in Improving Problem Solving Skills

Category	Codes	f	%
Responsibilities of Students	1. Making an effort to solve problems.	34	29.6
	2. Trying to apply what he or she learned in school in everyday life.	21	18.3
	3. Being determined.	16	13.9
	4. Reading books.	12	10.4
	5. Being curious.	5	4.3
	6. Exchanging knowledge with the teacher.	5	4.3
	7. Studying hard.	3	2.6
	8. Being active during classes.	3	2.6
	9. Fulfilling his or her responsibilities.	2	1.7
	10. Trying to improve his or her self-confidence.	1	0.9
	11. Trying to improve his or her communication skills.	1	0.9
	12. Making comments.	1	0.9
	13. Not being biased toward the course.	1	0.9
	14. Solving problems.	1	0.9

As can be seen in Table 4, the teachers believed that students' responsibilities in improving problem solving skills mostly included making an effort to solve problems, trying to apply what they learned in school in everyday life, being determined, and reading books. Some answers given by the teachers to first four codes are given below:

"...Students must make an effort to solve problems that they encounter. (S2)"
"...Students should try to apply what they learned in everyday life. (S31)"
"...The responsibility of students ... is to be determined to study. (S34)"
"...I believe that having a different perspective and producing creating ideas are related to reading books avidly... (S36)"

The frequency and percentage values related to codes created from opinions of teachers regarding whether mathematics and other courses have any contribution to improving students' problem solving skills can be found in Table 5.

Table 5.Effects of Mathematics and Other Courses on Improving Problem Solving Skills

Category	Codes	f	%
Contribution of Courses to Improving Problem Solving Skills	1. Mathematics and other courses positively affect the improvement of problem solving skills.	100	87.0
	2. Mathematics course positively affects the improvement of problem solving skills.	6	5.2
	3. Mathematics and other courses have no effect on the improvement of problem solving skills.	4	3.5
	4. Turkish course positively affects the improvement of problem solving skills.	3	2.6
	5. Mathematics and Turkish courses positively affect the improvement of problem solving skills.	1	0.9
	6. Mathematics course has no effect on the improvement of problem solving skills.	1	0.9

As can be seen from Table 5, the teachers mostly believed that mathematics and other courses positively affected the improvement of problem solving skills. The answer given by one of the teachers related to the first code can be found below.

"All courses; mathematics, life sciences, and Turkish courses in particular, are very important in the improvement of problem solving skills. (S23)"

The frequency and percentage values related to codes created from opinions of teachers regarding whether improving students' problem solving skills have any contribution to their success in mathematics and other courses can be found in Table 6.

Table 6.Effect of Improving Problem Solving Skills in Student Success in Mathematics and Other Courses

Category	Codes	f	%
Effect of Problem Solving Skills in Student Success	1. Positively affects success in mathematics and other courses.	111	96.5
	2. Positively affects success in science courses.	1	0.9
	3. Sometimes increases success in mathematics course.	1	0.9
	4. Positively affects success in mathematics course.	1	0.9
	5. Has no effect on success in mathematics and other courses.	1	0.9

As can be seen in Table 6, the teachers mostly believed that improving students' problem solving skills positively affected their success in mathematics and other courses. The answer given by one of the teachers related to the first code can be found below.

"Improving students' problem solving skills has a positive effect on their success in mathematics and other courses. (S42)"

The frequency and percentage values related to codes created from opinions of teachers regarding characteristics of students with improved problem solving skills can be found in Table 7.

Table 7.Characteristics of Students with Improved Problem Solving Skills

Category	Codes	f	%
Characteristics of Students with High Problem Solving Skills	1. Is more successful in classes.	47	40.9
	2. Has higher self-confidence.	31	27.0
	3. Solves problems more easily.	19	16.5
	4. Understands problems more easily.	8	7.0
	5. Shows a solution-oriented approach.	8	7.0
	6. Has a broader perspective to life.	8	7.0
	7. Has higher critical thinking ability.	6	5.2
	8. Has more leadership qualities.	5	4.3
	9. Gives more accurate decisions.	5	4.3
	10. Is more curious.	4	3.5
	11. Is more active.	3	2.6
	12. Has higher analytical thinking ability.	3	2.6
	13. Is smarter.	2	1.7
	14. Likes reading more than others.	2	1.7
	15. Is more interested in classes.	1	0.9
	16. Has higher motivation.	1	0.9
	17. Associates subjects with each other more easily.	1	0.9
	18. Questions more frequently.	1	0.9
	19. Is more careful.	1	0.9
	20. Has a higher readiness level.	1	0.9
	21. Asks more questions.	1	0.9

As can be seen in Table 7, the teachers mostly believed that students with improved problem solving skills were more successful, had higher self-confidence, and solved problems more easily. Some answers given by the teachers to first three codes are given below:

"Students with high problem solving skills understand problems that they encounter more easily. They are more successful. (S52)"

"Students with high problem solving skills become self-confident individuals... (S23)"
"Students with high problem solving skills cope with issues more easily...Students with low problem solving skills struggle in the face of adversity. They have a hard time. (S2)"

The frequency and percentage values related to codes created from opinions of teachers regarding characteristics of students with low problem solving skills can be found in Table 8.

Table 8.Characteristics of Students with Low Problem Solving Skills

Category	Codes	f	%
Characteristics of Students with Low Problem Solving Skills	1. Has lower self-confidence.	20	17.4
	2. Has a harder time solving problems.	15	13.0
	3. Is not successful in classes.	15	13.0
	4. Has more difficulties understanding problems.	8	7.0
	5. Has a tendency toward rote learning.	4	3.5
	6. Cannot think multi-dimensionally.	3	2.6
	7. Has weaker critical thinking ability.	3	2.6
	8. Has little interest in classes.	2	1.7
	9. Has lower motivation.	2	1.7
	10. Is more nervous.	2	1.7
	11. Has difficulties in associating subjects with each other.	1	0.9
	12. Dislikes reading.	1	0.9
	13. Has difficulties in decision-making.	1	0.9

As can be seen in Table 8, the teachers mostly believed that students with low problem solving skills had lower self-confidence, had a hard time solving problems, and were relatively less successful in classes. Some answers given by the teachers to first three codes are given below:

"Students with low problem solving skills demonstrate ... lack of self-confidence. (S50)"
"Students with low problem ... avoid problems and issues as much as possible and continue their lives without solving any problems or solving any issues. (S22)"
"Students with low problem solving skills are not really successful in classes. (S48)"

The frequency and percentage values related to codes created from opinions of teachers regarding to what particularities textbook authors should pay attention in order to improve students' problem solving skills can be found in Table 9.

Table 9.Particularities to Which Textbook Authors Should Pay Attention in order to Improve Students' Problem Solving Skills

Category	Codes	f	%
Particularities to Which Textbook Authors Should Pay Attention in order to Improve Students' Problem Solving Skills	1. Level of students should be taken into account when preparing problems.	42	36.5
	2. Problems should be taken from daily life.	13	11.3
	3. Number of problems should be high in textbooks.	13	11.3
	4. A comprehensible language should be used for problems.	6	5.2
	5. Problems should be attention-grabbing.	6	5.2
	6. Problems should be ordered from easy to difficult.	5	4.3
	7. Problems should be suitable for students' readiness.	5	4.3
	8. Social environment of students should be taken into account when preparing problems.	4	3.5
	9. Solutions of problems should be given in textbooks.	3	2.6
	10. Problems should include visual elements.	3	2.6
	11. Information given in problems should conform to the reality.	2	1.7
	12. Problems should be ordered from simple to complex.	2	1.7
	13. Textbooks should include problems that will encourage students to research.	2	1.7
	14. Textbooks should include open-ended problems.	1	0.9
	15. Textbooks should include up-to-date problems.	1	0.9

As can be seen in Table 9, the teachers mostly believed that, when preparing textbooks, level of students should be taken into account, problems should be taken from daily life, and the number of problems should be high. Some answers given by the teachers to first three codes are given below:

"Preparing understandable textbooks which are appropriate for level of students should be paid attention. (S17)"
"Textbooks should include problems from everyday life. (S13)"
"Textbooks ... should include a high number of problems. (S56)"

DISCUSSION & CONCLUSION

This study aims to find out opinions of mathematics teachers regarding improvement of students' problem solving skills.

Teachers expressed the importance of problem solving skills in mathematics education in that they help students solve problems of everyday life, provide different perspectives, allows students to find different ways to solve a problem, and facilitate to understand the problem. Thus, it seems that teachers have an awareness regarding the improvement of problem solving skills. Emphasizing the importance of problem solving skills in teaching programs seems to have created an awareness in teachers. With regard to mathematics education, improving students' problems solving skills will help them solve mathematical problems and mathematics courses in their academic lives, cope with and overcome problems that they encounter in their everyday lives.

The teachers believed that their responsibilities in improving problem solving skills mostly included guiding students, teaching problem solving strategies, and making students like the mathematics. It seems that teachers are informed about their responsibilities in improving problem solving skills, although partially. It is pleasing that teachers assume such responsibilities. Because improving students' problem solving skills is only possible with the use of appropriate teaching methods, techniques, and strategies (Tertemiz, Çelik, & Doğan, 2014; Yazgan & Bintaş, 2005). These roles are also consistent with the teacher as a guide, adopted in the constructivist approach. Also, teachers who have the understanding that "each child can learn mathematics (MoNE, 2009)" are expected to adopt the approach that "student values mathematics". If students believe mathematics is valuable, they may recognize it as worthy of dealing with, protect it and thus enjoy it. It should be remembered that this love will take them to success.

The teachers believed that students' responsibilities in improving problem solving skills mostly included making an effort to solve problems, trying to apply what they learned in school in everyday life, being determined, and reading books. It should be remembered that teachers should motivate students to fulfill these responsibilities, draw their attention to the course, give them opportunities to apply what they learned, and encourage them. Also, for reading comprehension activities, which is a very important issue in understanding the problem, teachers should emphasize the importance of reading and try to help students perceive reading as a positive habit rather than a task. To this end, teachers may hold reading hours as an in-class activity to encourage students read.

The teachers mostly believed that mathematics and other courses positively affected the improvement of problem solving skills. It is highlighted that understanding the problem, devising the solution, carrying out the plan, checking the correctness and validity of the solution, generalizing the solution and creating similar/original problems, which are Polya's stages of problem solving, must be observed in efforts to improve students' problem solving skills (MoNE, 2013a, p.IV). In this context, Özsoy (2005) reported that students with low mathematical success also had low problem solving skills, although these students were successful in the stage of understanding the problem, they were relatively less successful compared to other students in stages of planning, carrying out the plan, and checking solution. In the same study, it was mentioned that there was a significant relationship between mathematical success and problem solving skill and problem solving skill positively affected mathematical success. These finding supports the results of our study.

The teachers mostly believed that improving students' problem solving skills positively affected their success in mathematics and other courses. This result suggests that teachers are able to establish interdisciplinary associations. Similarly, Yıldırım et al. (2013) found that the majority of prospective science teachers believed that courses other than the science course contributed to improvement of their scientific process skills and they were able to establish interdisciplinary connections. The improvement of students' problem solving skills will positively affect all courses included in the teaching program. Because this skill should not be perceived as a skill specific to mathematics and it should be remembered that it helps individuals offer solutions to all problems encountered in everyday life, and solve these problems step by step.

The teachers were found to believe that students with improved problem solving skills were more successful in classes, had higher self-confidence, and solved problems more easily. This result is parallel with the objective of "allowing students to have confidence in their problem solving skills, giving them positive feelings and thoughts regarding problem solving (MoNE, 2009)", which is one of the objectives of elementary school mathematics curriculum. Based on this emphasis in the curriculum, it can be said that "the student who can solve problems or the student with improved problem solving skills becomes more successful in classes and this success makes the teacher, the family, and the student happy". In this context; solving, research, review, exploration, and experiencing activities in the problem solving process allow students to find the strength to cope with adversities, increase their self-respect, and thus deem themselves adequate socially and emotionally (Britz & Richard, 1992). The teachers were found to believe that students with low problem solving skills had lower self-confidence, had a hard time solving problems, and were relatively less successful in classes. This may lead students with low problem solving skills to have difficulties in their everyday lives in future and fail in school.

The teachers mostly believed that, when preparing textbooks, level of students should be taken into account, problems should be taken from daily life, and the number of problems should be high. Foong and Koay (1997) found that teachers mostly chose verbal problems involving everyday life situations in textbooks when determining mathematical problem types to use, which supports our findings. In the study conducted by Gökçek and Hacısalihoğlu Karadeniz (2013), the fact that the question type in MoNE's mathematics textbooks was insufficient to prepare for national university exam was found to lead students to use alternative sources containing different question types and their solutions. Therefore, in addition to the updated curriculum, reviewing textbooks might be a good step toward improving students' problem solving skills.

RECOMMENDATIONS

The following recommendations are presented considering the outcomes of the study:

1. In-service trainings (seminars, courses, etc.) may be held to further enhance teachers' knowledge and abilities related to improving problem solving skills.

2. Efforts may be made to increase teachers' determination to improve problem solving skills, allow them to see themselves as a part of the process and encourage them to overcome their deficiencies if any.

3. In order to improve their problem solving skills, students may be supported in terms of mathematics, given more access to mind games, encouraged to see relations, check the accuracy of the solution, make use of concrete models or materials, establish rich models in the stage of understanding the problem, and utilize the paper folding method (MoNE, 2009, p.14).

4. Teachers may be more careful about relating problems used in class to everyday life. This way, students will be more interested in solving the problem and become more successful in classes.

5. It may be useful to add an elective course such as "Improvement of Problem Solving Skills" to mathematics curricula.

6. Prospective teachers may perform problem solving activities outside the mathematics course as well, which will enhance interdisciplinary connections.

7. Performing studies related to improving problem solving skills in "Special Teaching Methods I and II" classes included in the 3rd year course schedule of the mathematics teacher education program is believed to be helpful in reducing possible issues in future. Increasing the prospective teachers' level of knowledge and eliminating their shortcomings regarding improving problem solving skills may be useful. Thus, prospective teachers will feel sufficient when they start service.

8. It may be useful to pay attention to whether problems in mathematics textbooks prepared in accordance with the updated curricula are practice-based. The number and quality of problems and solutions in mathematics textbooks prepared in accordance with the updated curricula may be increased.

9. This study was conducted with teachers only. Opinions of prospective teachers and students in primary school, middle school, and secondary school may be taken for a more comprehensive study.

10. Observations may be made to investigate how teachers and students behave during the problem solving process and what sort of difficulties they encounter.

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THE ADAPTATION OF THE NATURE OF TECHNOLOGY SCALE TO TURKISH

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ABSTRACT: The purpose of the present study was to adapt the instrument for assessing students' concepts of the nature of technology scale developed by Pey-Yan Liou to Turkish language in order to assess its reliability and validity, and to analyse the gender and school differences. The scale consists of 29 items and six sub-dimensions named technology as artifacts, technology as an innovative change, the current role of technology in society, technology as a double-edged sword, history of technology, and technology as a science-based form. Data in this study were collected from a total number of 360 students studying at four different high schools. Validity and reliability studies were carried out. As part of validity studies expert opinion was collected, linguistic equivalence and confirmatory factor analysis were used. As part of reliability studies Cronbach Alpha's coefficient of internal consistency was calculated. In accordance with the analyses carried out in this study, the scale was adapted to Turkish language as a valid and reliable scale.

Key words: nature of technology, scale development, reliability, validity

INTRODUCTION

The answer we get can be remarkably different when we ask the question "What is the (nature of) technology?" to a young student or an old man. In our age, even infants suddenly find themselves in a technological world in all areas of the life. That's why we need to investigate how new generations' concepts of nature of technology are formed. Technology plays a significant role in meeting the future challenges and fulfilling the demands of the global economy for a nation's growth. The nature of technology has been rarely discussed despite the fact that technology plays an essential role in modern society (Liou, 2015).

What is the nature of technology?

There is considerable disagreement over the definition of technology. Although there is a lack of consensus over the role technology should play in the curriculum, technological concepts are being taught, are expected to be taught, and should continue to be taught (DiGironimo,2011). The definition of the nature of science has been more widely discussed than the definition of nature of technology. The concept of nature of science is dynamic and involves systematic thinking about science which has changed through the development of science (Celik and Bayrakçeken 2006). The meaning of NoT can be broadly defined as human-made systems and processes (NRC, 2011). In Technology for All Americans Project, the standards to get a concept of the nature of technology are defined as an understanding of the characteristics and the scope of technology; core concepts of the technology and the relationships among technologies and the connections between technology and the other fields of the study (ITEA, 2000).

Purpose of the Study

The purpose of this study was to adapt the instrument for assessing students' concepts of the nature of technology scale developed by Pey-Yan Liou (2015) to Turkish language in order to assess its reliability and validity.

METHODS

The Participants

Table 1: The Participants

School Type	Grade			Gender	
	9th	10th	11th	Male	Female
Science High School	27	24	28	37	42
Anatolian High School	93	83	55	88	143
Anatolian Religious Vocational High School	51	-	-	51	-
Total	171	107	83	176	185

The participants included 361 high school students of whom 185 were female, 176 were males. The participants study in three different high school types in the Province of Karaman/Turkey. It took about 15 minutes for students to answer the scale.

The scale consists of 29 items and six sub-dimensions. First, to understand students' perceptions of technology, Liou collected students' written statements via an open ended question. Content analysis was utilized to discuss and categorize students' statements regarding technology and its related issues. Third, a revised questionnaire, modified from the results of the second stage, was administered to a whole new sample. Finally, exploratory factor analysis and reliability analysis were applied to determine the structure of the items and the internal consistency of each scale. The Student Concepts of the Nature of Technology Questionnaire was developed based on the proposed theoretical framework and was supported by the students' qualitative data.

After getting the permission from Liou for the study, the items were translated into Turkish language by three experts who are fluent in both English and Turkish. The original scale and the translated ones were sent to English teachers. The backtranslation process which means translating a document that has already been translated into a foreign language back to the original language - preferably by an independent translator, was completed in this way. According to the expert opinion the scale items were organized again.

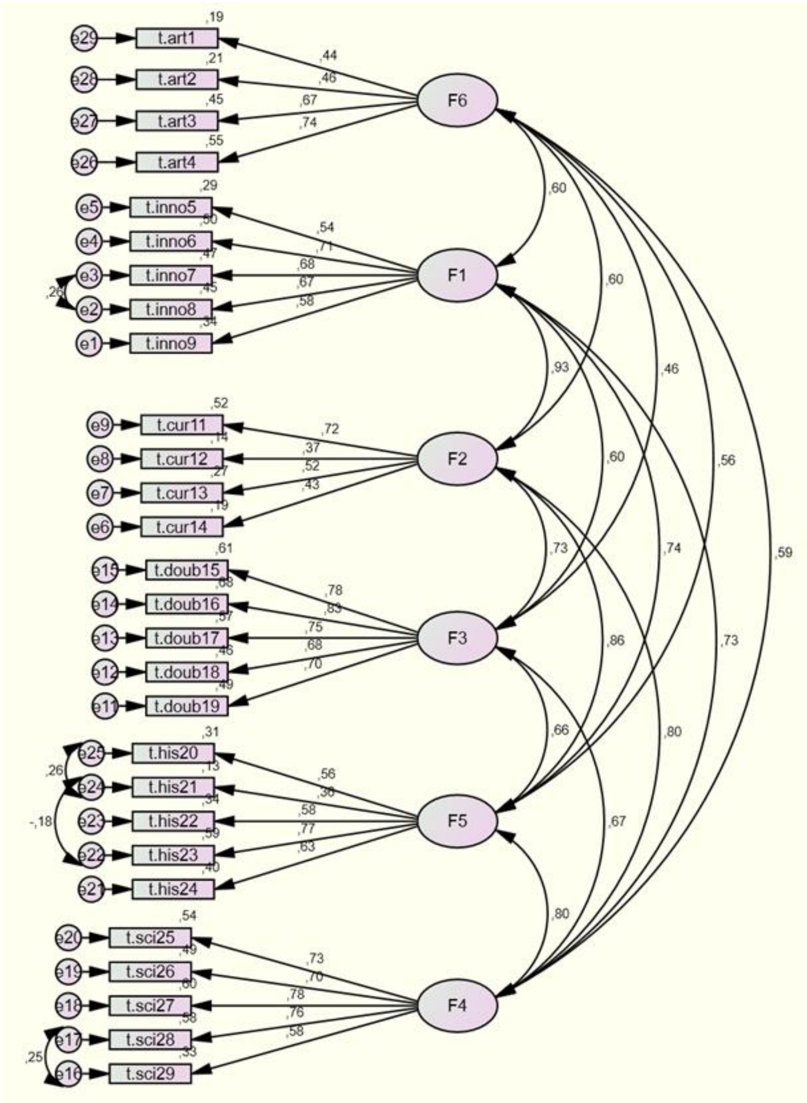
RESULTS AND FINDINGS

Confirmatory Factor Analysis

An explanatory factor analysis had already been made by the developer of the scale. So the theoretical pattern of the scale had already been revealed. Therefore the researchers felt no need to make an explanatory factor analysis again. Confirmatory factor analysis (CFA) was employed to model a six factor solution through the use of AMOS program. According to the first confirmatory factor analysis item-10 in the dimension of "The current role of technology in society" eliminated whose factor load was .21. Because this score was below .30 which is regarded as a breakpoint (Kline,2005).

After ruling out the item-10, another CFA was performed on the dataset obtained from 361 participants. As a result of the analysis conducted, goodness of fit indices of the 6-factor model were examined and it was found that chi-square value ($\chi 2$=535,311 sd= 331, $\chi 2$/sd=1.617 p=0.00) was significant. In confirmatory factor analysis, if the $\chi 2$/sd rate obtained is smaller than 3, then this shows that the model has favorable goodness of fit values (Kline, 2005; Tabachnick & Fidell, 2007).

According to the model formed, the standardized factor loads are between .82 and .36. All these values are above .30 which is regarded as a breakpoint (Kline,2005). It is also observed that the covariance value between the dimensions of the model is high. Additionally, the Cronbach Alpha value was calculated as .91. All items were contributing to the reliability with high item-total correlations.



In this sense, it was observed that the 6-factor model was highly compatible with the data. When the other indices included in the model were examined, it was seen that CFI value was .95, IFI value was .95, and RMSEA value was .041. The values obtained for the specified indices are regarded as indicators of good fit values in model studies (Kline, 2005; Tabachnick and Fidell, 2007).

Table 2: The Goodness of Fit Indices of CFA

Fit Indices	Perfect Fit	Good Fit	The Scale Results
χ2/df	≤ 5	≤ 3	1.61
RMSEA	≤.05	≤.08	.041
SRMR	≤ .05	≤.08	.044
CFI	>.97	>.95	.95
NFI	>.95	>.90	.87

CONCLUSION

Students are more easily educated to become technologically literate than adults through formal education. Therefore, it is logical and necessary for researchers and educators to capture students' perceptions of nature of technology and further develop instruction to equip them with advanced technological capability and to be technologically literate (Liou, 2015). With respect to the human and social aspects of technology we can observe that young people often see technology as something positive. There are not that many pupils and students that show awareness of the negative impacts of technology. Maybe this is because of their strong focus on technology as artifacts. It is their direct experience that these artifacts often make life easier and more comfortable, and the negative impacts of technology are at a different level that they do not yet get to see or that does not yet appeal to them very much (de Vries, 2005:107).

If an average student is asked if (s)he can describe technology, the most probable answer is a list of technological artifacts. And most pupils and students have no problems in mentioning a whole variety of artifacts: radio, television, lasers, robots, and many others. However the list is not as rich as it may seem to be at first sight. The first limitation is the prominent place of the computer in the lists that pupils and students generate. Technology is in the very first place: computers. A second limitation is that technology is primarily 'high tech'. Once in an interview a 13-year-old boy responded to a researcher's question about what technology is by mentioning the steam engine. But he immediately took back his answer by stating that this was not an appropriate example of technology, because it was too old. Clearly something has to be at least a 20th century invention in order to be called technology. 'Technology' then is all these almost magic things that can help the country get to the level of modern, industrialized countries. In general we can see that children reflect what society tells them about technology. Watching television and reading magazines constantly enhances the idea that technology is 'high tech' (de Vries, 2005:106).

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PROBING HIGH SCHOOL STUDENTS' COGNITIVE STRUCTURE ABOUT PHYSICAL AND CHEMICAL CHANGES THROUGH WORD ASSOCIATION TEST

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ABSTRACT: The aim of this study is to investigate high school students' cognitive structures and to identify their learning difficulties in physical and chemical changes through word association test (WAT) and to compare at different students grades. The study was comprised of 167 students who are attending at ninth (88 students) and tenth grades (79 students). The WAT was used as data a collection instrument developed by the researcher. Before WAT is developed, the physical and chemical change topic placed in high school chemistry curriculum was examined to select the stimulus words of WAT. The WAT comprised of eight total stimulus words, among them *chemical reaction, energy, chemical property,* and *physical property,* is used to probe students' cognitive structures. At the end of the study, it was found that differences in the students' cognitive structures at ninth and tenth grades make it clear that instruction affects the cognitive structure. On the other hand, it was also concluded that students from both grades cannot associate with the concept of energy with other concepts of the subject.

Key words: High School Students, Cognitive Structures, Physical and Chemical Changes, WAT

INTRODUCTION

The examination of students' cognitive structure is important for probing what learners know about a topic before their instruction. In addition, visualizing students' cognitive structures is essential for understanding how students understand a previously taught subject. Fisher (2004) has indicated that all learners construct knowledge in their conscious working memory, and store that knowledge in long-term memory. The knowledge students acquire in science classrooms is stored in long-term memory in a hierarchically organized form, and can be represented as a cognitive structure in their memory (Tsai, 2001; Kalyuga, 2006). The cognitive structure comprises learners' existing experiences and knowledge that will lead to their reconstruction and information processing of the incoming stimuli (Nakiboğlu, 2008).

Determining students' cognitive structure is important for assessing what a learner knows about the subject knowledge. Therefore, knowing students' prior knowledge can guide teachers to design appropriate teaching strategies in their classless. There are several techniques that researchers can use to gain insights into students' cognitive structure. A word association test (WAT) is one of the most common methods for mapping cognitive structures (Bahar et al. 1999; Cachapuz and Maskill, 1987; Nakiboğlu, 2008). WAT provides wide-ranging lists of concepts that are associated with the concepts in the students' minds (Gussarsky and Gorodetsky, 1988). The underlying assumption in a WAT is that the order of responses reflects at least a significant part of the structure within the semantic memory, and between concepts (Shavelson, 1972). WAT has been frequently used to observe changes before and after instruction in various science disciplines (Nakiboglu 2008; Shavelson 1973).

Of particular interest to this study are students' understandings about the physical and chemical changes. The subject of the physical and chemical changes is one of the basic and essential issues of high school chemistry curriculum and also is related to daily life. To add, the subject is taught at the middle school level. On the other hand, it is stated that students have learning difficulties and misconceptions concerning the identification of the physical and chemical changes. Although so many studies of specific learning problems and students' misconceptions concerning the physical and chemical changes have been reported, there is not known about students' cognitive structure about the physical and chemical changes. The research question which provided a focus for the research reported in this study is:

How do students' cognitive structures, as related to the physical and chemical changes, change according to students grades?

METHODS

The study was comprised of 167 students who are attending at ninth (88 students) and tenth grades (79 students). The WAT was used as data a collection instrument developed by the researcher. Before WAT is developed, the physical and chemical change topic placed in high school chemistry curriculum was examined to select the stimulus words of WAT and to establish the content validity of the WAT (Gay and Airasion, 2000, p. 163). The WAT comprised of eight stimulus words and they were *chemical change, physical change, chemical reaction, energy, chemical property, physical property, matter,* and *reaction equation*. The students were provided with a booklet, each page containing each page of which contained one of the eight stimulus words. For each stimulus word, students were asked to write down within 30 seconds as many response words as they could think of in association with each stimulus word. To obtain inter-judge reliability of the analysis, after the same WAT was applied, all WATs were analysed and a concept map drawn from the WAT results twice by the author in the different times.

There are several ways of scoring the data provided by a WAT. One way of representing the cognitive structure is by drawing a map. A number of different types of the map of KS can be produced (Preece, 1978) It is possible to draw a map using response frequencies for looking for relations used by Bahar et al. (1999). Researchers have claimed that counting the number of responses to each stimulus word is also one method of summarizing the WAT data (Shavelson, 1974; Bahar et al., 1999). Nakiboğlu (2008) has also suggested another mapping method by using response frequencies. In the present study, two response frequencies' map methods were used for WAT analysis developed by Bahar et al. (1999) and Nakiboğlu (2008). The number of responses to each stimulus word was tabulated for 9th and 10th grades firstly and then maps were drawn taking into account these tables. In Nakiboğlu's method, the thick lines represent the strongest interconnections between both two stimulus words and a stimulus word and a response word, while the thinner line between two stimuli words or a stimuli word and a response word indicates a weaker relation in the graphic representations of the cognitive structures.

RESULTS AND FINDINGS

The maps of students' cognitive structures were drawn from the frequency tables by using both Bahar et al. (1999) and Nakiboğlu (2008) methods. Only the maps which drawn according to Nakiboğlu's method (2008) were presented in Figures 1 and 2 for 9^{th} and 10^{th} grades, respectively. Because the highest frequency range was 41≤ f≤49, this value was selected as the beginning frequency range for mapping. The lowest frequency range was found as 16≤ f≤20 for 9th grade and 13≤ f≤20 for the 10th grade since all stimulus words were appeared in this range for both grades.

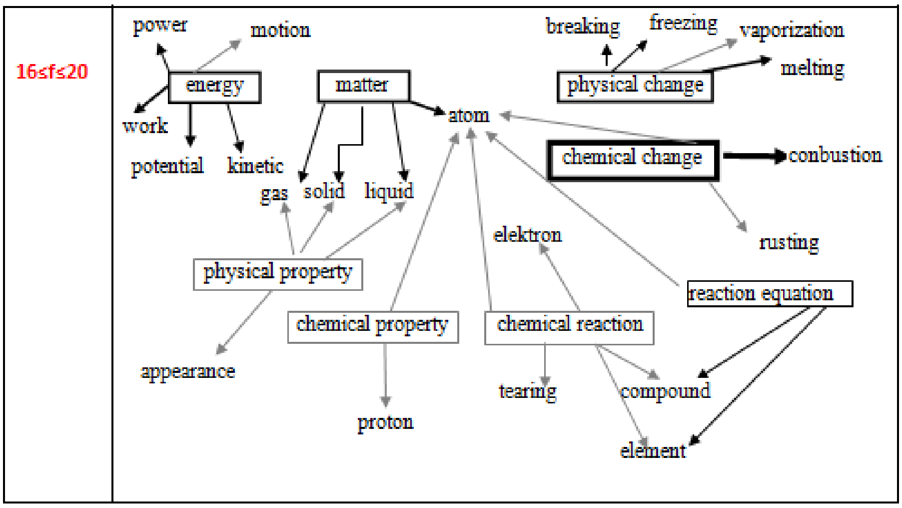

Figure1. The 9^{th} Grade Students' Cognitive Structure

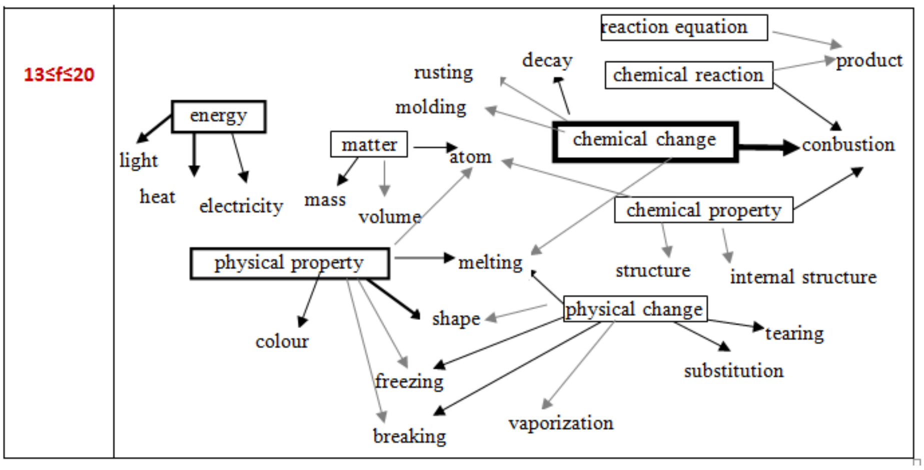

Figure2. The 10th Grade Students' Cognitive Structure

The comparison of 9th and 10th grades students' cognitive structures shows that while all stimulus words appeared and were added to the map at the frequency range 16≤f≤20 and three separate islands in Figure 1, not all stimulus words appeared at the same frequency range in Figure 2. In the case of 9th grade that before teaching the physical and chemical changes topic there were more disconnected ideas in the students' minds. The five stimulus words (*matter, chemical change, reaction equation, chemical reaction, and chemical property*) were connected to each other via only atom concept. While two stimulus words (*matter and physical property)* were connected to each other via three concepts (gas, solid, and liquid), two stimulus words (*reaction equation* and *chemical reaction*) were connected to each other via two concepts (element and compound). In the case of 10th grade, all stimulus words appeared at the frequency range 13≤ f≤20 and two separate islands were placed in Figure 2. There were more connections between stimulus words. While three stimulus words (*matter, chemical property* and *physical property*) were connected to each other via the atom concept, three stimulus words (*chemical change, physical property* and *physical change*) were connected to each other via the melting concept. The stimulus words *physical property* and *physical change* were connected to each other via the concepts shape, freezing and breaking concepts. While three stimulus words (*chemical change, chemical reaction, and chemical property*) were connected to each other via the combustion concept that is very significant connection among these tree stimulus words, the stimulus words *chemical reaction* and *reaction equation* were connected to each other via the concept of product meaningfully.

CONCLUSION

In this study, the word association test (WAT) was applied successfully in identifying conceptual organization of the cognitive structure of two student groups (9th and 10th grades) about the physical and chemical changes. It was concluded that there were differences between these two grades and the instruction did produce a significant difference. It can be said that instruction clearly has an influence on students' cognitive structure about the physical and chemical changes.

The method of analysis developed by Nakiboğlu (2008) was used for atom topic first time and in her study Nakiboğlu found that this method enabled the detection of strongly and weakly related concepts within a conceptional organization. Similarly in this study, the same method was also used to analyze the WATs and found out that strongly and weakly related concepts within the conceptional organization concerning the physical and chemical changes could be identified.

RECOMMENDATIONS

As suggested constructivist theory, meaningful learning can take place only when the learner is able to relate the new knowledge provided by a teacher to their existing knowledge. The examination of students' cognitive structures is important for probing what learners know about a topic before their instruction. Therefore, to gain students' cognitive structures before instruction can guide the design of the teaching process, which may lead to the construction of the desired knowledge. For this reason, the first recommendation of this study is that the teachers should gain information about their students' prior knowledge before the instruction that so they can find to chance to reconsider their teaching strategies. So many techniques can be used for probing students' prior knowledge and the WAT can also be suggested to use before the instruction to gain the students' prior concepts in students' conceptual structure.

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INVESTIGATION OF UNIVERSITY CHEMISTRY STUDENTS' MENTAL MODELS OF METALLIC BONDING AND STRUCTURE OF METAL

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ABSTRACT: This study identifies second-year chemistry students' mental models of metallic bonding and structure of metals by using a phenomenographic analysis. Mental models are real representations of objects, ideas or process which individuals generate during the learning process. Sample group consisted of 64 (43 female and 21 male) chemistry students taught all metallic bonding theories. To obtain an in-depth understanding of chemistry students' mental models, the data were collected by using a written instrument with two open-ended questions. They were asked to explain the bonding in the cupper metallic structure by drawing in the first question. In the second question, they were asked to define what the metallic bonding is. The analysis of the data was conducted on two different dates by using the content analysis method by the author. It was concluded that most of the students' mental models were simple, in contrast with the sophisticated complex models taught. Some of the students have also hybrid models of the bonding theories.
Key words: University Chemistry Students, Mental Models, Metallic Bonding

INTRODUCTION

The metallic bonding is one of the central topics in chemistry and involves the use of a variety of models. Students are expected to progress in an understanding of these models easily. In elementary level (6th -8th grades) students are taught a simple particle model of matter (SPM). According to SPM, metal atoms or particles are regarded as the basic structural constituents and particles/atoms are assumed to be spherical are often represented as circles (Cheng and Gilbert, 2014). The sea of electrons metaphor for the metallic bond is used in teaching metallic bonding commonly in secondary education (9th -12th grades). Chemistry students are taught metallic bonding in general chemistry course by using both sea of electrons metaphor again and also the band theory of metals that is a more sophisticated theory.

Research has shown that students have a poor understanding of the bonding in metals and models for metallic structure and bonding at all level (Coll & Taylor, 2002; Coll & Treagust, 2003; Coll, 2008; Taber, 2003). Cheng and Gilbert (2014) indicated that the students were unable to visualize the metal structure in a scientific way. Taber (2003) investigated learners' mental model for metallic bonding in his interview study and characterized learners' conceptualizations of metallic bonding. He found that while some of the students did not think the metallic substance represented would have any bonding, others thought there was some form of interaction in metals, but this was not proper bonding at the beginning of the study. Some of them suggested there would be ionic or covalent bonding in metals or metallic bonds existed between two metals. The "sea of electrons" metaphor for the metallic bond is used in teaching metallic bonding commonly. Taber (2003) found that students seemed to accept the "sea" metaphor uncritically, and to develop images of cations and/or electrons floating, swimming, etc. in the sea without thinking through the consequences of such a model. Other students seemed to develop the "sea" metaphor in relation to ideas about orbital overlap or electrical forces, to provide both a more meaningful framework for interpreting the metallic bond, and a model that is more coherent with developing understanding about other types of bonding (Taber, 2003). One of the problems that led to students' misconceptions about the metallic bonding is that students at both high school and undergraduate level tend to develop hybrid models. Students can use different model together and integrate them which they treat as coherent and finally they can create their own mental models. Besides, representations of scientific models have placed in textbooks or teachers' explanations while teaching models. Sometimes they might be rather confusing. For this reason, to grasp how students visualize the visual representation of metallic structure is important..

The aim of this study is to identify mental models of the metallic bonding and metallic structure of a group of undergraduate chemistry students after taking general chemistry course and taught metallic bonding theories and models.

METHODS

Research Participants

The participants consisted of 64 (43 female and 21 male) second-year chemistry education students who taught more sophisticated models of metallic bonding in their first academic year as part of general chemistry course.

Data Collection

This is a survey that a written survey enabled to use a sample large enough to reflect the variety of models hold by students. The open-ended response questions were chosen in this study since the metallic bonding can be explained by using a number of different models. Students were asked to provide a drawing of structure and bonding in the copper metal and written explanations of metallic bonding. The drawing task question (1) aimed to probe into their mental visual representations of metallic bonding. In the second question, the main purpose was to obtain students' mental verbal description about metallic bonding.

Data Analysis

This study categorizes the students' descriptions of metallic bonding and bonding in a metallic structure by looking for structurally significant differences that clarify how students describe metallic bonding and draw bonding in the metallic structure. For this reason, analysis of students' answers was based on the phenomenographic method. This method was developed by Marton (1981). He described phenomenography as a "research method for mapping the qualitatively different ways in which people experience, conceptualize, perceive, and understand various aspects of, and phenomena in, the world around them." To determine the reliability of analysis was used intra-judge reliability which would involve a single judge scoring at the same test at two different times (Gay and Airasion, 2000, p.176).

RESULTS AND FINDINGS

From the analyses of students' drawings about the metallic structure of cupper asked in question (1), six types of mental models and two hybrid models were identified. The types of mental models obtained from the first question, and students' frequency/percentage are given in Table 1. From Table 1, it was said that a preferable model was *simple particle model* (SPM) that was thought of the elementary grades. Nearly quarter of students (23.4%) drew *simple particle model* (SPM) to show the structure of cupper metal. the Second and third ones were a *unit cell model* (15.6%) and *electron-sea-model* (9.4%), respectively.

Table 1: The frequency and percentage of students' mental model of the structure of metal

Types of Model	f	%
Simple Particle Model	15	23.4
A Unit cell model	10	15.6
Electron-Sea-Model	6	9.4
Covalent bonding/electron cloud model	4	6.3
Models based on Molecular Orbital Theory	4	6.3
Close-packing model	2	3.1
A Unit cell model and Close-packing model together	2	3.1
A hybrid model of a unit cell and particulte models	1	1.6
A hybrid model of covalent bonding model and a unit cell model	1	1.6
$_{29}Cu{:}1s^2 2s^2 2p^6 3s^2 3p^6 4s^1 3d^{10}$	4	6.3
No answer/I do not know	15	23.4
TOTAL	64	100.1

In the second questions, students were asked to describe what the metallic bonding was. It was found that nearly 40% of students described metallic bonding as "The bonding which is occurred **among metal atoms** is called as metallic bonding".

CONCLUSION

It was concluded that most of the students' mental models were simple, in contrast with the sophisticated complex models taught. While some of the students thought the metallic bonding as the covalent or ionic bonding, some of the students had hybrid models of the metallic bonding theories used during lessons. Justi and Gilbert (1999) proposed that models constituted of elements of different historical models treated as if they constituted a coherent whole be called as a hybrid model.

It was also found that the metallic bonding was also not seen as a real bonding and students thought that there was some form of interaction in metals as indicated in Taber' study (Taber, 2003). It was found that almost quarter of students still used the Simple Particle Model they brought from elementary school science courses. It can be said that the students' prior knowledge influences how new knowledge is constructed from the data of this study.

RECOMMENDATIONS

First of all, the students should be presented fundamental conditions of the bond occasion in generally taking into account electrostatic attraction and energy. The main problem about difficulties concerning the bonding is that students do not make sense why the atoms come together to occur the chemical bonds. It should be avoided that the simple explanations about bonding such as electron sharing or transferring. While using different models to explain the same topic, why these different models used should be clarified.

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THE RELATIONSHIP BETWEEN INFORMATION LEVEL OF INDIVIDUALS REGARDING INFORMATION TECHNOLOGY AND THEIR PERCEPTIONS CONCERNING INFORMATION SECURITY: UNIVERSITY STUDENTS AS EXAMPLE

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ABSTRACT: As a result of the developments experienced in information technology, many such services as bill payment, shopping, e-government transactions, access to libraries and information sources, finding the routes to go are possible to find in virtual worlds. Transferring all these businesses and operations to the IT environments comes along with the security problems. Because the threats, which come to the information shared in these environments, increse rapidly and show great diversifications, the importance of works to be done on the security of information is increasing with each passing day.

Today, especially those information and communication devices having internet access are used extensively by individuals. Every day, many new threats, with which the individuals encounter while they are using these devices, and new measures to be taken against these threats can be added to the present ones. This situation requires users to keep up to date constantly their information on this subject. In this study, the data which is obtained by measuring the relationship between information level of university students concerninig information technologies and their perceptions about information security was shared, and measures which can be taken against information security threats and solution proposals were presented.

Key words: Information security, perception of information security, digital threats.

INTRODUCTION

Information security, sometimes shortened to InfoSec, is the practice of defending information from unauthorized access, use, disclosure, disruption, modification, perusal, inspection, recording or destruction. It is a general term that can be used regardless of the form of the data may take (e.g. electronic, physical). Information security, computer security and information insurance terms, often are used interchangeably. These fields are relevant and can be reached on the protection of the integrity and privacy of the information they share is common objectives with regard to (information security, n.d.).

When examined institutions and individuals, it is seen that the biggest reason why the mentioned ones experience problems related to the information security is that they do not have eduquate information regarding this delicate topic. Nowadays, there are a growing number of individuals who use information technologies. Some of these individuals use the information technology in a number of such ways like the penetration of other digital media , data theft, and therefore threatens the security information to damage. In the past this kind of threat was performed by a small number of professional attackers; today the number of attackers has grown rapidly; attackers profiles are changing and the number of the attacks is also increasing day by day. The software can be easily downloaded via the Internet by hackers to attack and thus more information about the individuals may also be attacked; information on this subject on the internet, as documents and videos would be easy to access by the hackers, so taking serious measures on personal and corporate information security have been essential for those using information security.
In this study, the relationship between university students' information and communications technology(ICT) knowledge on the level of information security perceptions, which can be measured with a questionnaire findings and shared their information security measures to be taken against threats and solutions are presented.

Current Threats

In the Internet environment, our children, our young users and even unconscious users may face a number of unexpected and unwanted threats, dangers and situations. These are;

- Pornographic, hatred, anger and containing violence, illegal content, can be exposed on the internet to the users,

- In the online environment, the address will endanger themselves or their families and their credit card numbers when they share information like telling third parties through email or chat programs who was at house at that moment or how many people were there at home at that time,
- making purchases over the Internet without telling their parents with their parents' credit card (by children)
- They can communicate with issues such as the age of the great and evil people and criminal organizations as may be; in different ways and may also show itself in distress.

All these risks are sufficient to reveal the importance of the issue (Canbek & Sağıroğlu, 2007).

Individuals and organizations that use information technology, all information and document sharing to you move the digital environment, business dealings and transactions made in digital media is increasing, which, naturally, on current threats and hazards associated with data security leads to significant increases cost.

At the beginning of the most experienced areas of current threats and dangers that come mobile platforms and applications are running in a web environment. Web applications are the easiest communication ways for individuals and organizations to have easy access to all information they want, which appears to be the fastest and most effective medium as well. However, this information which is accessed via the web, during storage and sharing, it is necessary to take serious measures in terms of data security. The access to this web application on mobile platforms, reveals much more risky information security threats with it.

Attacks on the information shared on the web, in relation with the growth of the services provided on the web is increasing every day. That the security of web applications are not taken serious enough, secure software development techniques are not used and the individuals and institution have lack of sufficient knowledge about information security can be explained the major reasons for these attacks to increase.

Today, there are many studies related to web application security. One of these works, started to be developed in 2001 by Mark Curphey and still ongoing was OWASP (The Open Web Application Security Project) project. Free tools for improving web application security, standards, making forums regarding web applications security, writing the article are subject works of OWASP's. Another study conducted by Jeremiah Grossman and Robert Auger was founded in 2004 to develop open standards and web applications related to security issues such as dissemination and exploitation of workers and it is called as the Web Application Security Consortium (TheWeb Application Security Consortium-WASC). Determined by OWASP and WASC which are recognized in the world about web application security, the most common attacks on web applications are listed below. This attack methods were included in the list as the basis for current threats and developments (Vural & Sağıroğlu, 2008).

- Authentication
- Authorization Vulnerability
- Cross Site Script
- CommandExecution
- SQL Injection

When looking at this attack methods, it is clear that during the development of web and mobile applications, the necessary measures should be taken. Taking these measures is the responsibility of developers at most. In addition, all web and mobile application service users whom we describe as as end-users, should have to know what these threats are and what kind of measures they shall take. and that's what this is threatened by the need to take measures which are required to know.

The extensive use of information technology has brought new security risks with it. Specifically, with the increasing use of mobile technology it is also seen that there are huge increases in crime in this area. The rapid development of technology and increasing skills of attackers increased the necessity of special staf raised in this area to detect the crime and criminals. In most of the smart phones, without the use of specialized hardware and software, it is almost impossible to detect malicious software. This hardware and software is expensive in terms of cost, and they are also extremely complex and difficult in terms of use. The community should be informed about the threats the mobile devices are facing and thus a sufficient level of awareness should be created, and they should be informed about the measures to be taken as well. In addition, companies using these technologies in their infrastructures, must be provided with the necessary safety measures to take (Ekim, 2013).

Institutions and individuals who are aware of the threats that may occur on mobile devices and environments, should take the necessary protective measures, and they need to educate both their staff and users and raise awareness on this issue (Sağıroğlu & Bulut, 2009).

PURPOSE OF RESEARCH

In this study, to determine the level of awareness of users about information security are conducted with a survey according to individuals' Internet use years and to find their relationships if there were any. Survey on the results, examining the relationship between knowledge level of information security perceptions of university students on the use of information technology is intended to make several observations. The findings are shared, measures can be taken against information security threats and solutions are presented.

Students; the level of knowledge about information technology, access methods to the Internet, Internet usage frequency, internet habits (shopping, e-government, gaming, email, etc.), various survey questions to learn about the security measures they have software and implements they use directed and their answers to these questions on ICT compared with knowledge. Comparison results are examined in detail; mobile and web platforms using intensive information security perceptions of university students were measured, the results were analyzed and solutions were presented not only for students but also for all users who can all apply the online content while using.

Following sections focus on the outcomes obtained from the survey conducted between December 1, 2015 - February 1, 2016 through total of 300 students studying at the University of Süleyman Demirel.

THE METHOD USED IN RESEARCH

The Universe and Sample

The survey was administered to students at Süleyman Demirel University and the universe of research "Süleyman Demirel University Students" was determined due to measurement of the level of knowledge in information security matters based on internet usage. One of the questionnaire of the student was omitted from the evaluation. When taken into consideration of university students who are at the age of 299, it is seen that the demographic data ranges from 17 to 29.

Data Collection Tools

The IT security survey developed for this study was used as data collection tool. Including age and gender, there are two demographic parameters in the survey conducted. Information processes actions of the social networks that most crimes occur, internet banking, desktop software and the browser downloads are made, questions are used to measure the level of awareness on the issues.

Acquisition and Analysis of Data

Datas from Süleyman Demirel University in different sections of the main Information Technologies is collected in courses through students studying 2015-2016 school year and obtained from a survey applied in the fall semester. According to statistical data, it is encoded and transferred to computer environment properties. The data in the same environment analysis using the R package program has been made ready. Analysis are Kruskall Wallis tests, Chi-square and Anova tests.

RESULTS

The data in this study which was obtained by statistical findings was mentioned below. The findings are; gender, year of internet use, social networks are used by individuals, according to internet banking and e-commerce use, it contains results.

Investigation of Students According to Their Ages and Gender

The sample consisted of 300 people and the results of 299 persons were taken into consideration. The data on the gender distribution of the participants is given in Table 1. Accordingly, it is the 136 men and 163 women's research group.

Table 1. Respondents Gender Distributions

Gender	Rate (%)
Male	45.33
Woman	54.67

The age of the audience, min, max, average and standard deviation values are shown in Table 2.

Table 2. Participants Age Distributions

Variable	N.	Min	Max	Average	Standard Deviation
Age	299	17	30	19.3813	1.61633

The age of the participants who were surveyed between 17 and 30, and the average of the 19 can be seen in Table 2. The reliability analysis for the masses; Table 3 is providing 93% reliability and it can be seen.

Table 3. Reliability Statistics

Cronbach's Alpha	N of Items
, 931	98

Investigation of Distribution of Students According to Internet Usage Rates
Distribution of Students According to Internet use rate is shown in Table 4.

Table 4. Descriptive Statistics

Variable	N.	Min	Max	The mean	Std. Deviation
How many years do you use the internet?	300	1.00	18.00	6.7133	2.98455
Valid N (listwise)	300				

6 years the average mass of Internet users can be seen in Table 4. Using the internet at least 1 year to 18 years in mass and it has emerged as the people who use the internet.

Investigation of Use In The Daily Work of The Corporate E-Mail Address

Internet usage frequency of amount in hours per week (Table 5) and relational level between corporate e-mail address in response to those who declare using it in their daily work was measured by cross tabulation methods and results in Table 6 are also shown.

Table 5. DescriptiveStatistics

Variable	N.	Min	Max	The mean	Std. Deviation
Weekly frequency of internet usage?(h)	300	1.00	24.00	.0867	2.10410
Valid N (listwise)	300				

Table 6. Crosstab data

Count		Corporate e-mail address I use in daily business.					Total
		Never	Rarely	Sometimes	Frequently	All The Time	
Weekly frequency of internet usage? (h)	1.00	4	0	2	0	2	8
	2.00	10	0	2	1	0	13
	3.00	2	5	2	2	3	14
	4.00	6	4	7	2	3	22
	5.00	9	3	9	4	7	32
	6.00	2	2	3	1	0	8
	7.00	78	46	34	24	17	199
	8.00	0	1	0	0	0	1
	14.00	0	0	1	0	0	1
	15.00	1	0	0	0	0	1
	24.00	0	1	0	0	0	1
Total		112	62	60	34	32	300

Internet usage frequency of responses to the question when Anova test was done, and the Sig. level 0.123 and 1.83 F value stands out. Results can be seen in Table 7.

Table 7. Anova Test Results

	Sum of Squares	DF	MeanSquare	F	SIGs.
BetweenGroups	32.060	4	8.015	1.830	, 123
WithinGroups	1291.687	295	4.379		
Total	1323.747	299			

In respect to corporate e-mail addresses for use in their daily work of students, it is observed that more data loss suffered conditions such as viruses and has been observed to increase the level of awareness of safe internet use which increases the frequency of corporate e-mail usage. This significantly reduces the probability of encounters with particular file viruses that cause financial losses.

The Investigation of Those According to Their Ages Who Transmit Information Crimes to Relevant Authorities

It is tested that the age groups of those transmitting Information Crimes to the relevant authorities whether they are suitable for the normal distribution. Kolmogorov-Smirnov test in all of the significant level was seen as below 0.05 in the group and that has shown us that the distribution is not normal. Here, some comments were made by using Kruskal-Wallis H test, which is a non-parametric one, as a comparison would be performed among the the groups.

Kruskal-Wallis test included a sample of more than 3 groups and assumptions which are necessary for the single-factor analysis of variance and thus it was applied. Accordingly, the value of the variable age which is observed increases the possibility of transmission to the relevant authorities cyber crimes and it decreased, therefore.

In respect to the test results, it is observed that the significance level is of 0,131. The level of significance appears to show differences between the groups and it is greater than 0.05. It is observed that the more age increases the more likely it is to transmit Information Crimes to the authorities.

Rates of Students Making Internet Shopping

People using Internet banking and e-commerce platforms seem to be more consistent audience about information security and basic IT skills. According to analysis, standard deviation between people in terms of internet usage time is 2.98 including students starting 1 year before the mass use of the Internet and has experienced students that use the Internet is for 18 years. According to internet shopping statistics; while not any shopping is 1 and shopping always is 5 in score; average is 2.67, while the standard deviation of 1.3763. Statistical relationship between Internet usage years with no action on the internet shopping can be explained by the cross-table method. Accordingly, it is increasing the action of making purchases over the Internet by increases in year of Internet usage.

The Relationship Between Age and Internet Banking

According to analysis, the use of internet banking has been seen mostly in 18,19 and 20 years old. In respect to the correlation matrix; it is seen that there is a strong correlation between age and Internet banking. By using social networking sites like Facebook and Twitter, it is seen that accepting invitations sent between applications in social networking has emerged as a strong bond. It has been reached there that there is a relation between age and negative evidence at downloading music over the internet, downloading movies, programs to download and downloading files. The Anova test done; and F value of 5.243 was found. Kuruskal-Wallis test was applied to the siglevel 0.0. According to the test results, the hypothesis which says that ‘’there is a relationship between age and the use of internet banking’’ was rejected.

The Comparability of application invitations, which were sent on social networks, by age

In order to analyze the relationship between age and the adoption of state of the invitation sent applications on social network, it is primarily need to examine the relationship between normality group. The decision to Anova test or Kolmogorov-Smirnov tests were decided to be applied for the application.

While observing the relationship between age groups for normality, Kolmogorov-Smirnov test is able to comment on the significance level. Here, the p-value at the 95% confidence level value in all age groups seems to be under 0.05. In this case, it is determined that one-way Anova, which is not following normal distribution, is given. As the values are not in normal distribution, non-parametric Kruskal-Wallis H test was conducted. The distribution of responses between the two groups was observed in the test results. . As we see the significance level is higher than 0.05 in relation between age and acceptance of invitations through social networks, it is considered that there is a difference. In other words, acceptance of invitations increase by decreasing of the age.

CONCLUSIONS & RECOMMENDATIONS

In the analysis, parameters of year in internet usage and age has significant difference on information levels about informatics security. As increasing of year in internet usage and age, decrease is observed in possibilities of transmitting crimes to relevant authorities. By increase in year of internet usage, knowledge increases in social nets, desktop softwares and digital file sites which are the platforms that crimes are faced mostly. Relevant with increase in age, knowledge in informatics security increases and shopping decreases through internet. As the year in internet usage increases, users become more informative but not sensitive for transmitting the crimes and it is the same for the increase in age parameter as well. Internet banking users are more careful against to troubles in social nets, chat softwares, file share sites. There should be some actions for informing society about informatics security, adding info security courses to elementary, middle , high education and thus there should be urgent action plans for governmental structures to take precautions. All users who use informatics technology should care about precautions against treats and they should be updated.

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PERSPECTIVES OF UNDERGRADUATE STUDENTS ABOUT POSTGRADUATE EDUCATION

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ABSTRACT: Nowadays, demand for postgraduate education is increasing so the necessity to determine undergraduate students' perspectives to postgraduate education is revealed. Thus, the aim of this study is to determine the perspectives of 4th grade mathematics students studying at faculty of arts and sciences and faculty of education about postgraduate education. In the study, qualitative research design was used. 129 undergraduate students participated in the study on fall term of 2015-2016 academic year. 69 students of them were from a faculty of arts and sciences and 60 of them were from a faculty of education. A form including open-ended questions was used to gather the data in the study. Data obtained were analyzed by descriptive and content analysis techniques. At the end of the study, it was found that 50.4% of the students did not want to get a postgraduate education, 41.1% of them wanted to get a postgraduate education, and 8.5% of them did not have an idea about this subject. Also, it was found that students wanted to get a postgraduate education to have much salary, to specialize in the fields, to make academic career, to improve oneself, and since they thought that being appointed as a teacher was more difficult. In addition, the most important reasons for some students who did not have an ambition or attempt to get a postgraduate education were found as they want to be a teacher, they thought they wouldn't have enough time to get postgraduate education, and they would have financial problems. Lastly, it was determined that students were offered to get a postgraduate education by their relatives, friends, and educators and they got information about postgraduate education mostly from their educators, friends, and internet.

Key words: mathematics education, postgraduate education, teaching profession, academic career

INTRODUCTION

Scientific studies, public service, education and training activities are considered primary duties of universities (Erdem, 2005). Moreover, another task of universities is to spend effort to raise their students as qualified and skilled individuals who are capable of exhibiting their interest, skill, and performance and of doing research afterwards of their undergraduate education (Sayan & Aksu, 2005). Postgraduate education is considered as a structure guiding for specialization of individuals awarded their undergraduate degrees in the world and in Turkey on disciplines master and doctorate programs through scientific studies.

According to the Higher Education Law with 2547 serial number, execution of the postgraduate education is the task assigned to institutes; and it was stated that institutes are the frameworks which carry out postgraduate studies, education, scientific research, and practice at universities and faculties (URL 1). Postgraduate education is an activity similar to undergraduate education which applies numerous programs in formal education model and which awards certain degrees (Karakütük, 2001). When individuals complete an undergraduate study, they are entitled to apply postgraduate education programs opened by educational sciences, natural sciences, social sciences, health sciences, and advanced technology institutes (Demirtaşlı, 2002). Postgraduate education enables individuals to gain socio-economic, socio-cultural, and psycho-social developments beside knowledge, skill and attitude in academic process (Schaefer & Lamm, 1995).

Among the prioritized purposes of the postgraduate education, there is one which includes raising scientists who could introduce wise solutions; adjust to society and guide society in their problems (Gömleksiz & Yıldırım, 2013). Purpose of postgraduate programs is to prepare qualified scientists who create information in their fields afterwards of the undergraduate education, who puts them into practice; in other words, who could vitalized the information that they create, who are beneficent to their society and able to make unique researchers (Bozan, 2012; Ergun & Çilingir, 2013; Günay, 2011; İlhan, Öner Sünkür, & Yılmaz, 2012; Karaman & Bakırcı, 2010; Kurnaz & Alev, 2009; Küçükoğlu & Ozan, 2013; Şahin, Calp, Bulut, & Kuşdemir, 2013). Furthermore, the purpose of the postgraduate education is not only making investment in own qualification, but also it is raising individuals who are problem solver, researcher, and questioning and to view those individuals as scientists at universities in the future (Bülbül, 2003). Accordingly, postgraduate education is the program aiming to raise scientists required in education, industry, science, fine arts, and health domains of countries.

If it is taken into consideration that education is positively and directly related with economic development level of countries, postgraduate education programs have great responsibilities in terms of raising qualified labor force and relevant competent scientists (Aslan, 2007). Therefore, postgraduate education programs are required to offer solutions for society's socio-economic, information communication technology, social-psychological, and cultural development (Dilci, 2009). Kilmen (2007) reported that number of applications to postgraduate education programs in Turkey has increased; postgraduate education has been further qualified; undergraduate degree is not sufficient alone therefore having graduate degree brings exclusivity to individuals. Additionally, Karakütük (2009) stated that postgraduate education has gained prominence recently in Turkey; and this development emerged necessity to raise faculty members for the new universities. Since expectations from postgraduate education have increased, it is necessary to pay utmost attention to this process; and to determine appropriate targets related with raising competent scientist; and individuals who would be recruited for the graduate programs are required to be selected sensibly.

There are studies in the relevant literature regarding expectations of teachers from postgraduate education and the issues within this process encountered by them (Alabaş, Kamer, & Polat, 2012; Alhas, 2006; Aslan, 2010; Başer, Narlı, & Günhan, 2010). There are as well studies on opinions of faculty members concerning postgraduate education (Bülbül, 2003; Dilci & Gürol, 2012). However, there are only limited up-to-date studies investigating into opinions of senior university students about participating into postgraduate studies. When the subject viewed from this angle, as the demand for postgraduate education increases in our contemporary period, it is necessary more than ever to determine opinions of university students' inclinations about postgraduate education. Consequently, it is considered that determination of views of senior university students regarding moving their education further with the postgraduate education is important. Therefore, in the present study, it was aimed to reveal point of views of senior students from faculty of arts and sciences and faculty of education regarding postgraduate education.

METHOD

This section includes information on the research method, study group, data collection tool, and data analysis.

Research Method

The study uses qualitative research method. Qualitative research is the method which allows systematical investigation of inferences that arise from the experiences of participant individuals (Ekiz, 2009).

Study Group

The research was conducted on 129 students in the fall semester of the academic year of 2015-2016. Of these students, while 69 were from arts and sciences faculty, 60 were from education faculty. In order to ensure maximum diversity of participant individuals who could be part of the examined issue (McMillan & Schumacher, 2006; Yıldırım & Şimşek, 2008), maximum diversity sampling method was preferred for the study. Some demographic characteristics of the undergraduate students were exhibited in Table 1.

Table 1.Demographic Characteristics of Undergraduate Students

		Faculty of Arts and Sciences		Faculty of Education		Total	
Characteristics	**Categories**	**f**	**%**	**f**	**%**	**f**	**%**
Gender	Male	29	22.5	20	15.5	49	38.0
	Female	40	31.0	40	31.0	80	62.0
Type of High School	Anatolian Teacher High School	-	-	10	7.8	10	7.8
	Anatolian High School	10	7.8	16	12.4	26	20.2
	Regular High School	46	35.7	33	25.6	79	61.1
	Superior High School	13	10.1	-	-	13	10.1
	Health Vocational High School	-	-	1	0.8	1	0.8
Department	Equal Weight	20	15.5	14	10.9	34	26.4
	Quantitative	49	38.0	46	35.7	95	73.6

According to Table 1, 62% of undergraduate students were female, 61.2% were graduated from Regular High School; and 73.6% were graduated from quantitative-based department.

Data Collection Tool

In the present study, a form composed of open-ended questions was utilized as data collection tool. In the beginning of the study, nine questions were determined by the researchers. Researchers submitted to these questions to three different researchers for their review; then, the ultimate form was established based on the received feedbacks. Thus, the final form utilized in this study was created. Afterwards of the pilot practice of this form on 23 students, four questions were combined into one and ultimate number of questions was reduced to six. Then, the survey was implemented in a classroom environment when students are available.

Data Analysis

Data collected through open-end questions were analyzed in terms of descriptive and content aspects. In the content analysis, the relevant codes were structured. Then, these codes were collected under certain categories. After researchers determined codes and categories, their frequencies and percentages were estimated. Since some students indicated opinions about multiple codes in one answer, total number of frequency of codes could be greater than the total number of student included in the study. In order to facilitate readers' job, codes and categories were exhibited in tables. Finally, findings were supported by referring citations of students.

Collected data was transferred into written form by researchers. Two of the data among the one transferred into written form were randomly selected by two researchers and coded by them individually. Consistency between codes prepared by researchers was estimated based on the formula of [Agreement / (Agreement + Disagreement)] (Miles & Huberman, 1994); and the conformity among coders was estimated at 0.91. Based on the ethical considerations, students were coded as S1, S2, S3, … , S129.

FINDINGS

Frequency and percentage values of codes created based on opinions of students regarding meaning of graduate education were exhibited in Table 2:

Table 2.Inferences of Students Regarding to Graduate Education

Categories	Codes	f	%
Academic Inferences	1.Academic career	67	51.9
	2.A better life	5	3.9
	3.Doing research	4	3.1
	4.Creativity	3	2.3
	5.Making friends	2	1.6
	6.Having exclusivity	1	0.8
Personal Inferences	7.Self-improvement	64	49.6
	8.Nothing	12	9.3
	9.Difficulty	7	5.4
	10.Waste of time	5	3.9
	11.Exhaustion	2	1.6
	12.Stress	1	0.8
	13.Self-esteem	1	0.8
	14.Happiness	1	0.8
Professional Inferences	15.Specialization in their fields	21	16.3
	16.Success	9	7.0

According to Table 2, it was observed that undergraduate students' inferences about graduate education were accumulated under three essential categories of "academic inferences", "personal inferences", and "professional inferences". Of these categories, "academic career", "self-improvement", and "specialization" codes have come to prominence basically. Some of the answers given by undergraduate students to the 1st, 7th, and 15th codes were exhibited below:

"I would like to complete my master degree and to continue with doctoral study. Hence, I would like to have a good career. (S86)"
"I consider postgraduate education as a requirement to be a scientist. (S92)"

"Postgraduate education is the decision which always takes me a step further to be specialized in my field... (S118)"

Frequency and percentage values of codes prepared based on opinions of undergraduate students regarding continuing with postgraduate education afterwards of their graduation were exhibited on Table 3:

Table 3.Whether Students Have Desire or Initiative to Continue with Postgraduate Education, or not

Categories	Codes	f	%
Positive	1.Being reluctant to continue with postgraduate education	65	50.4
Negative	2.Being desirous to continue with postgraduate education	53	41.1
Neutral	3.Undetermined about continuing with postgraduate education yet	11	8.5

According to Table 3, it was observed regarding inclination of students to continue with postgraduate education that 50.4% of undergraduate students were reluctant; 41.1% were desirous; and 8.5% were indecisive. Examples of opinions of undergraduate students about these three codes were given below:

"Postgraduate education is waste of time for me because I do not like studying. Indeed, spending time for a laborious job seems boring to me. I am tired of studying courses along my entire studentship. (S20)"
"I am willing to start my postgraduate education as soon as possible. (S12)"
"No any idea. (S49)"

Frequency and percentage values of codes prepared based on opinions of undergraduate students regarding reasons of their willing or initiative for continuing with postgraduate education afterwards of their graduation were exhibited on Table 4:

Table 4.Reasons for Students for Their Willing or Initiative to Continue with Postgraduate Education

Categories	Codes	f	%
Professional Development	1.Better salary	20	15.5
	2.Specialization	16	12.4
	3.Success	6	4.7
	4.Learning new methods	1	0.8
	5.Making difference	1	0.8
Academic Development	6.Academic career	24	18.6
	7.Because it is difficult to be appointed as teacher	16	12.4
Personal Development	8.Self-improvement	22	17.1
	9.Increasing self-esteem	4	3.1
	10.For greater independency	3	2.3
	11.For curiosity	2	1.6
	12.For my future	2	1.6
	13.For better make use of my spare times	1	0.8

According to Table 4, it was observed that reasons of undergraduate students for willing or initiative to continue with postgraduate education were mostly classified under three categories of "professional development", "academic development", and "personal development". It was understood that "better salary", "specialization", "academic career", "difficulty to be appointed as teacher", and "self-improvement" codes have come to prominence ones under these categories. Examples of answers given by undergraduate students to the 1st, 2nd, 6th, 7th, and 8th questions were given below:

"I think postgraduate education provide us opportunity to earn higher salary. (S20)"
"I want to be specialized in a certain subject and to be competent on that field. (S105)"
"If I have graduate degree, I would have a good career. (S98)"
"We study, continue our education. Nevertheless we are not placed at a job. It is very difficult to be appointed as teacher. Therefore, I want to continue with postgraduate education. (S123)"
"I am thinking about continue with postgraduate education because I believe it will be helpful for me to develop myself… (S71)"

Frequency and percentage values of codes prepared based on opinions of undergraduate students regarding reasons of lack of their willing or initiative for continuing with postgraduate education were exhibited on Table 5:

Table 5.Reasons for Undergraduate Students not to Have Willing or Initiative to Continue with Postgraduate Education

Categories	Codes	f	%
Personal Issues	1.Desire to be a teacher	60	46.5
	2.Thinking that there would not be sufficient time	15	11.6
	3.Thinking that postgraduate education would take long time	8	6.2
	4.Thinking that postgraduate education would be difficult	7	5.4
	5.Considering postgraduate education as waste of time	7	5.4
	6.Considering undergraduate degree is sufficient	7	5.4
	7.Unwillingness to study	6	4.7
	8.Finding postgraduate education boring	6	4.7
	9.Having difficulty with foreign language	6	4.7
	10.Overaged	5	3.9
	11.Family issues	4	3.1
	12.Unwillingness to do research	4	3.1
	13.Not feeling ready	4	3.1
	14.Lack of supporting friends	4	3.1
	15.Lack of self-esteem	3	2.3
	16.Unwillingness for academic career	3	2.3
	17.Finding postgraduate education laborious	2	1.6
	18.Experiencing transportation issue	1	0.8
	19.Need for a break after the undergraduate education	1	0.8
Material Issues	20.Expecting material issues	27	20.9
Academic Issues	21.Discrimination in student acceptance process	5	3.9
	22.In sufficient student quotes	5	3.9
	23.Closure of some departments	4	3.1
	24.Exploiting graduate students by faculty members at the university	2	1.6

According to Table 5, it was observed that reasons of undergraduate students not to have willing or initiative for postgraduate education were concentrated under three categories of “personal issues”, “material issues”, and “academic issues”. It was understood that “desire to be teacher”, “thinking that there would not be sufficient time”, “expecting material issues”, and “insufficient student quotas” codes under these categories have been prominent. Examples of answers given by undergraduate students to the 1st, 2nd, 20th, 21st, and 22nd codes were given below:

“Postgraduate education is something good, but since we need to make economic contribution into our family after undergraduate degree, our first target will be chasing opportunity to be appointed as teacher or having a job... (S83)”
“There is no sufficient time. I think there would not be sufficient time for graduate study afterwards of undergraduate education. (S54)”
“I wish I could make graduate study. However, the most important factor hindering this is economic reason. (S3)”
“Since there are discriminations at universities, the reason could be the fact that some students have privileges over others instead of superiority in skills and knowledge. (S77)”
“I am hesitating about not be placed when there is no sufficient quotes for students. (S67)”

Frequency and percentage values of codes prepared based on opinions of undergraduate students regarding the persons suggesting postgraduate education were exhibited on Table 6:

Table 6.Persons Suggesting Postgraduate Education

Categories	Codes	f	%
Other	1.No suggestions	51	39.5
Educators	2.From faculty members at the university	32	24.8
	3.From relatives	15	11.6
Relatives	4.From family members	28	21.7
Friends	5.From friends	17	13.2

According to Table 6, it was observed that the person who suggest postgraduate education to undergraduate students were concentrated under four categories of "other", "educators", "relatives", and "friends". It was understood that "no suggestion", "from faculty members at the university", "from family members", and "from friends" codes under these categories have come to prominence. Examples of answers given by undergraduate students regarding these five codes were given below:

"Nobody suggested. (S42)"
"One of my lecturers at the university whom I respect and like suggested. He thinks that I will be a very good academician. (S123)"
"Some of my relatives suggested that I should definitely continue with postgraduate education. (S45)"
"My family wants me to continue with postgraduate education because they think that person who complete postgraduate education have superior social status within the society. (S16)"
"My friends suggested. They think that I would be successful in this field. (S65)"

Frequency and percentage values of codes prepared based on opinions of undergraduate students regarding the information resources of undergraduate students about postgraduate education were exhibited on Table 7:

Table 7.Information Resources of Undergraduate Students Regarding Postgraduate Education

Categories	Codes	f	%
Educators	1.From faculty members at the university	66	51.2
	2.From administers from senior level	2	1.6
Friends	3.From friends	62	48.1
Internet	4.From internet	54	41.9
Other	5.Not informed	18	14.0
Relatives	6.From relatives	3	2.3
	7.From family members	2	1.6
Academic Resources	8.From books	1	0.8

According to Table 7, it was observed that information resources of undergraduate students regarding postgraduate education were concentrated under six categories of "educators", "friends", "internet", "other", "relatives", and "academic resources". It was understood that "from academicians at the university", "from friends", "from internet", and "not informed" codes under these categories have come to prominence. Examples of answers of undergraduate students given to the 1st, 3rd, 4th, and 5th questions were exhibited below:

"I have investigated experiences and behaviors of my university lecturers only. I have consulted their opinions. (S8)"
"I gathered very positive information from my friends. I realized that they developed themselves with help of the postgraduate education. (S11)"
"I made more research on internet to gain information. (S92)"
"I could not claim that I have gathered information. (S93)"

DISCUSSION & CONCLUSION

As result of the present study which aims to determine point of views of undergraduate students regarding continuing their education process with graduate studies, following conclusions were drawn:

It was understood that undergraduate students' inferences about the postgraduate education were classified under three titles of "academic", "personal", and "professional". It was revealed that while 51.9% of undergraduate students' inferences about postgraduate education were "academic career"; 49.6% were "self-improvement", and 21% were "specialization". In study of İyibil and Akpınar (2013), when opinions of pre-service science teachers who continued with postgraduate education are taken into consideration, it was determined that 36% of them perceived postgraduate education as specialization; 28% as academic career; and 26% as continuance to formal education afterwards of the undergraduate education. As it was seen from the relevant literature, it was understood that undergraduate students attribute different inferences to postgraduate education.

It was determined that 50.4% of undergraduate students were reluctant to continue with postgraduate education; 41.1% were willing to continue with postgraduate education; and 8.5% were indecisive about postgraduate education. İyibil and Akpınar (2013) reported in their study that 60.43% of prospective teachers were reluctant to continue with postgraduate education; 32.37% were inclined to continue with postgraduate education; and 7.2% were indecisive about this issue. Accordingly, it is possible to conclude that the interest among undergraduate students toward postgraduate education has been increased over the time. In the studies of Türer, Balçın, Sevindik, and Er (2013), Bahadır and Özdemir (2014), they revealed that attitudes of undergraduate students toward postgraduate education were positive in general. Majority of teachers either prefer a graduate study in their fields or educational science in their fields; therefore, it is necessary that Ministry of National Education and universities to develop various educational policies supporting efforts of teachers (Ünal & İlter, 2010). As the number of students graduated with undergraduate degree increased, students are obliged to have advanced study degrees and to be equipped with different competencies (Karaman & Bakırcı, 2010).

It was understood that reasons of undergraduate students for continuing with postgraduate education or having initiative for postgraduate education were concentrated under the titles of “professional development”, “academic development”, and “personal development”. Among the reasons of undergraduate students for willing or having initiative for postgraduate education, reasons such as “better salary”, “specialization”, “academic career”, “difficulty to be appointed as a teacher”, and “ self-improvement” have come to prominence. Based on these findings, it was understood that undergraduate students view postgraduate education as an investment made to enhance their salary and social status in the future (Bülbül, 2003). Price incentive for academicians in 2014 could have been influent on this situation. Tavukçu, Özkardaş, Erzurum, Çiftçi, Şahin, and Bilgin (2013) determined in their study that reason of prospective classroom teachers to continue with postgraduate education as specialization in their field and to have professional career. Alabaş, Kamer, and Polat (2012) determined in their study that teachers prefer postgraduate education for personal development, professional career, and academic career. These results exhibit similarities with the findings reported by the present study. Şahin, Demir, and Arcagök (2015) reached a conclusion in their study that prospective teachers consider postgraduate education as a mean for self-improvement at teaching profession and in academic area. Results obtained from these studies indicate that postgraduate education has become an inviting area for university graduates.

It was observed that reasons hindering willing or initiatives of undergraduate students to continue with postgraduate education were “personal issues”, “economic issues”, and “academic issues”. It was understood that there were “desire to be a teacher”, “thinking that there would not be sufficient time”, “think that there would be economic issues”, “thinking that there would be discrimination in student recruitment process”, and “insufficient student quotas” among the reasons indicated by the undergraduate students, which prevent them to continue with postgraduate education. In the study of Gömleksiz and Yıldırım (2013), it was reported that graduate students suffer from economic problems. As it can be understood from their point, some undergraduate students are in pursuit of economic welfare by following chances to be appointed as a teacher. It is known that postgraduate education is rather burdensome process for students without any social and economic security. Moreover, it is an interesting finding that some students think that there is discrimination in recruitment process of students for graduate programs. In this regard, it should not be underestimated that there is significant conscious responsibility for faculty members taking position in recruitment of students for postgraduate education.

It was determined that graduate programs are mostly offered by “educators”, “relatives”, and “friends” to undergraduate students. Furthermore, it was determined that suggestions were mostly coming from “students’ instructors from their universities”, “family members”, and “friends”. Şahin et al. (2015) came to conclusion in their study that prospective teachers think that they will experience problems in this process; and their supporters in this decision were family members, friends, and academicians from their universities. The fact that undergraduate students were given suggestions from their academicians at the university, their families or friends regarding postgraduate education indicates that they were aware about this subject.

Finally, it was understood that the resources from which undergraduate students were collected information about postgraduate education were concentrated under titles of “educators”, “friends”, “internet”, “relatives”, and “academic resources”. Furthermore, it was determined that “instructors from the university”, “friends”, and “internet” under these titles have come to prominence more than others. İyibil and Akpınar (2013) reported in their study that information resources of prospective teachers were academic personnel, internet, and friends. This finding conforms to the results of the present study. In the same study, İyibil and Akpınar (2013) also reported that 40.29% of prospective teachers were not informed about postgraduate education. In this study, only 14% of undergraduate students were not informed. Accordingly, it is possible to state that majority of undergraduate students could have access to the information resources regarding postgraduate education and they are informed about postgraduate education.

RECOMMENDATIONS

Based on results of the present research, following recommendations were made for future researches:

1. Based on the findings of the present research, it was determined that one of the reasons for postgraduate education to be preferred was economic reason. Concerning the academic profession, a perception that it is an education process which enables individuals to realize their scientific ideas rather than giving them prosperous economic conditions. Accordingly, prospective teachers could be given seminars (Demirkol, Doğru, & Demir, 2014) or conferences about postgraduate education for better elucidation.

2. If it is taken into consideration that some students from faculty of arts and sciences and faculty of education are willing for graduate study because they think that their job placement as teacher is rather difficult, various regulations could be introduced to prevent undergraduate students to prefer postgraduate education because of their concern about employment. In this regard, the Ministry of National Education could offer priority in job placement for prospective teachers with graduate degree.

3. It was determined that the most important reasons for reluctance of some students to continue with postgraduate education were their desire to be a teacher, their thoughts that they would not have sufficient time, and experience economic difficulty. These circumstances could be prevented so that undergraduate students could continue their postgraduate education. In this regard, graduate students could be provided convenient job placement opportunity for the educational institution where they continue their graduate study (Gömleksiz & Yıldırım, 2013). Furthermore, number and volume of scholarships provided to graduate students could be increased.

4. Academicians would prefer to inform undergraduate students in their university period about the postgraduate education. Thus, it would be ensured that students could be informed about pros and cons of postgraduate education along their regular education process to prepare them cognitively and sensibly.

5. As expectations from postgraduate education increases, it should not be ignored that the person who would be recruited for this education are required to be selected delicately and fairly.

6. The results of the present study were obtained based on the findings from the opinions of the students at the departments of mathematics and elementary school mathematics teaching. Further studies could be conducted to include students from other faculties (law, engineering, etc.).

7. For more extensive investigation, opinions of persons who incent students for graduate studies could be consulted.

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MIDDLE AND SECONDARY SCHOOL STUDENTS' APPROACHES TO COMPUTER AND INTERNET

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ABSTRACT: The aim of this qualitative study is to determine middle and secondary school students' approaches related to computers and internet. To achieve this aim a form consisted of 8 open-ended questions was used. The implementation was carried out to 322 middle school and 161 secondary school students in Trabzon and Giresun cities on 2015-2016 school year. It was tried to determine understandings of students related to computer and internet, their computer program and internet sites preferences, the difficulties they have in computer and internet usage, and their suggestions regarding effective usage of computer and internet. The qualitative data obtained were analyzed by content analysis and descriptive analysis methods. Data obtained showed that students saw computer mostly as a tool for amusement and a tool which helped to lessons and they saw internet as the fastest way to reach information and a communication way, they used office programs in computers and preferred communication sites. Also, it was determined that students had some problems in computer and internet usage arising from themselves, others, computers, and internet. Thus, they thought that there had to be in-service training courses related to these problems. Some suggestions were given to students, families, and institutions to make students benefit from computer and internet more effectively.

Key words: Computer usage, internet usage, middle school students, secondary school students

INTRODUCTION

Computer and internet technologies are extensively utilized by almost all industries in our contemporary world. It has been observed that utilization areas of technologies have expanded dramatically; and mean user age has decreased remarkably. Additionally, utilization of these technologies in learning field has increased as well (McDonald & Hannafin, 2003; Polat & Güzel, 2011). Furthermore, it is expected that computer and internet would more extensively be used in education by both students and teachers than ever (Martinovic & Zhang, 2012).

According to the "Household Information Technologies Usage" statistics published by the Turkish Statistical Institute (TSI) in 2015, it was determined that 54.8% of individuals aged 16-74 were household computer users; and 69.5% have internet access at home. Concerning type of access device of users, it was observed that 25.2% was using desktop computer, 43.2% were using laptops, and 96.8% were using cell phone. On the basis of these results, whereas computer usage rate of males aged 16-74 was determined as 64%; this rate was 45.6% for females. Furthermore, internet usage rate of males aged 16-74 was determined as 65.8%, it was 46.1% for females. The largest computer user group rate was 70% exhibited by the group aged 16-24. The highest internet usage rate was 77% exhibited again by the group aged 16-24 (TSI, 2015). When these findings were compared with data from the previous years, it could be realized that house hold computer and internet technology usage has increased with increasing pace.

In parallel to the technology services, volume of information created in virtual environments has significantly increased (Lyman & Varian, 2000). Substantially increasing information volume has also introduced some problems. Regarding technology usage, some difficulties such as accessing Turkish characters; necessity to use keywords in foreign languages; deficiency in infrastructure; and technical problems; internet connection problems; poor computer education; and negative impact of computer on socialization have arisen (Çuhadar & Battal, 2010; Karaman & Açıkyıldız, 2006). These problems have adverse effect on effective usage of technologies. Therefore, it is important to determine processes accurately, in which students could acquire the information that they need; and to reveal the problems that they encounter in this process (Nesset, 2008). Additionally, the need for maintaining capability of middle and secondary school students to access the information along their further ages in the information technology environment which is evolving with a great pace necessitates design of solid policies and review of education contents in teaching programs (Şerefoğlu Henkoğlu, Mahiroğlu, & Keser, 2015). Moreover, it is evident that students, parents and institutions such as the Ministry of Youth and Sport are required to undertake joint roles and certain responsibilities regarding the risks associated with computer and internet, and solution of problems (Gökçearslan & Seferoğlu, 2016).

Studies concerning cognitive and social contributions of computer and internet have increased in the literature (Deniz, 2008; Greenfield & Yan, 2006; Johnson, 2010). Besides basic functions of computer and internet such as communication and accessing information, there are benefits such as contribution into social capital, strengthening social unity and awareness, coordination among groups and enhancing communication (Akbulut, 2013). These benefits have transformed computer and internet into new born babies for families (Akbulut, 2011). According to the relevant literature, it was observed that studies on computer and internet were concentrated on students' computer and internet usage areas, experiences, purposes, reasons (Batmaz, 2012; Deniz & Coşkun, 2004; Demir, 2006; Doruk, 2007; Dursun, 2004; Ersoy & Yaşar, 2003; Gökçearslan, 2005; Tuti, 2005); and on effects of computer and internet on students' success (Dönmez Usta, Karslı, & Durukan, 2016; Hacısalihoğlu Karadeniz & Akar, 2014; Kaya, 2010), and attitudes (Bahar, Uludağ, & Kaplan, 2009; Deniz & Köse, 2003; Köse, Gencer, & Gezer, 2007; Usta, 2011). However, unlike the existing literature, in the name of preparing students as stronger individuals for their future, it is necessary to determine inferences attributed to these new concepts by students; computer programs used by them; internet websites visited by them; encountered problems; and relevant suggestions for solution. Therefore, it could be seen that there is certain need for a study to determine computer and internet usage approaches of middle and secondary school students since it has been seen that computer and internet usage rate among students have substantially increased recently; and the highest rate was measured with the group aged 16-24 (TSI, 2015). From this point of view, the purpose of the present study is to expose approaches of middle and secondary school students toward computer and internet. Accordingly, following questions were tried to be answered along the purpose stated:

1. What computer and internet infer for students?
2. What are the most frequently used computer programs and internet websites by students?
3. Which problems are encountered by students during usage of computer and internet?
4. What are the suggestions of students for effective usage of computer and internet?

METHOD

This section includes information on the research method, study group, data collection tool, and data analysis.

Research Method

The present research is a qualitative study to explore approaches of middle and secondary school students toward computer and internet. Qualitative study could be described as a process of effort spent by individuals to resolve and comprehend problems experienced by both themselves and by others in their proximity through unique methods (Creswell, 2014). In the present study, findings resulted from personal experiences of individuals who were evaluated through qualitative research approach were investigated systematically (Lincoln & Guba, 1985; **Strauss & Corbin, 1998**).

Study Group

In order to reflect diversity of participants who could be stakeholder of the issue oriented as much as possible (McMillan & Schumacher, 2006; Yıldırım & Şimşek, 2008), maximum diversity sampling, one of the purposeful sampling methods, was employed in the study. Participants of the study were 483 (322 middle and 161 secondary) middle and secondary school students from Trabzon and Giresun cities in the fall semester of the academic year of 2015-2016. The participants were applied "Computer and Internet Approach Form". Some demographical characteristics of participants, determined through this form, were summarized in Table 1 below:

Table 1.Various Demographical Characteristics of Students

Demographical Characteristics		Male		Female		Total	
		f	%	f	%	f	%
Age Groups	10-12	78	16.1	96	19.9	174	36.0
	13-15	81	16.8	73	15.1	154	31.9
	16-18	39	8.1	109	22.6	148	30.6
	19 and above	3	0.6	4	0.8	7	1.5

Grades	5^{th}	36	7.5	39	8.1	75	15.5
	6^{th}	48	9.9	60	12.4	108	22.4
	7^{th}	42	8.7	40	8.3	82	17.0
	8^{th}	34	7.0	23	4.8	57	11.8
	9^{th}	2	0.4	13	2.7	15	3.1
	10^{th}	2	0.4	4	0.8	6	1.2
	11^{th}	3	0.6	52	10.8	55	11.4
	12^{th}	34	7.0	51	10.6	85	17.6

Whereas 41.6% of participants were male (201); 58.4% were female (282); distribution of age groups of 10-12, 13-15, 16-18, and 19 and above were 36.0%, 31.9%, 30.6%, and 1.5%, respectively. Distribution their grades 5^{th}, 6^{th}, 7^{th}, 8^{th}, 9^{th}, 10^{th}, 11^{th}, and 12^{th} were 22.4%, 17.0%, 11.8%, 3.1%, 1.2%, 11.4%, and 17.6%, respectively.

Data Collection Tool

The researchers prepared a form consisted of eight open-ended questions in order to collect data from students along the purpose of the study. In this form, there are the meanings assigned to computer and internet by the students, their computer program and internet website preferences, problems they encounter in computer and internet usage, and questions regarding effective usage of computer and internet. During preparation of this form, the studies on computer and internet usage patterns of middle and secondary school students were reviewed first. The form prepared according to the purpose of the study was submitted to two experts from the relevant major and a Turkish teacher for their opinions. The experts from the major were asked to review the form in terms of whether the questions in the form serve the purpose of the study; and the Turkish teacher was asked to review the question sentences to determine whether they are clear and comprehensible, or not. Moreover, a pilot study was conducted on 30 students for the prepared form. At the end of the pilot study, necessary amendments were made on the form along the views of experts and the teacher; and the ultimate form used during data collection process was created. During data collection process, students were informed about the purpose of the study first. Then, the form prepared by the researchers was applied on students in the classroom environment under surveillance of teachers in conventional written form. The participant students were asked to answer the questions in detailed way that they represent their personal views.

Data Analysis

Data collected within the scope of the present study was analyzed through descriptive and content analysis methods. Firstly, collected data was transformed into MS Word format. As the MS Word files were being prepared, it was paid attention to transfer answers of students in their original form. Secondly, data in these MS Word files incurred descriptive analysis individually. Furthermore, codes and categories were prepared by means of the content analysis. Afterwards of the descriptive and the content analyses, the researchers made required changes by comparing codes and categories that they created. Upon the researchers determined the codes and categories, frequencies and percentages of codes were estimated. Since some students displayed their views about multiple questions at once while they were answering open-ended questions, total frequency of codes could sometimes be greater than number of total participant students. Finally, collected data was organized in tables to be exhibited to the reader and direct citations from answers of students were displayed as well. For consistency evaluation among codes, "Reliability = [Agreement / (Agreement + Disagreement)]" formula was used (Miles & Huberman, 1994). According to the estimation based on this formula, conformity among coders was estimated at 84.1%.

FINDINGS

Based on analysis of answers of students to open-ended questions, their approaches toward computer and internet were exhibited under four titles:

Meanings Attached to Computer and Internet by Students

Frequency and percentage values of codes created based on answers given by students to the questions concerning meaning of computer to the students were summarized in Table 2 below:

Table 2.Meaning of Computer to the Students

	Codes	f	%
1	Tool for entertainment	171	35.4
2	An auxiliary tool for courses	118	24.4
3	Nothing	45	9.3
4	A tool which makes life easier	28	5.8
5	Device for watching film / video	20	4.1
6	An unhealthy device	10	2.1
7	Everything	10	2.1
8	Device to watch movie episodes	8	1.7
9	Device for listening music	8	1.7
10	An addictive tool	6	1.2
11	A tool which harms social connections of people	6	1.2
12	A mean enabling us to be happy	4	0.8
13	Miracle technology device	4	0.8
14	Lover	2	0.4
15	Family	1	0.2
16	Information storage tool	1	0.2
17	The most significant invention of this age	1	0.2
18	A tool enabling us to download files	1	0.2
19	A window opening to the world	1	0.2

According to Table 2, it could be seen that students view computer mostly as an entertainment tool and assistance for their course work. Examples of students' answers given to the first four codes were displayed below:

"It stands for entertainment because there are lots of games. (Student 2)"
"Computer is an assistant tool for my course work. (Student 13)"
"It means nothing. (Student 89)"
"It makes my life easier. (Student 53)"

Frequency and percentage values of codes created based on answers given by students to the questions concerning meaning of internet to the students were summarized in Table 3 below:

Table 3.Meaning of Internet to the Students

	Codes	f	%
1	It is the fastest way to reach information	176	36.4
2	Establishing communication	121	25.1
3	Doing research	74	15.3
4	Assistance to courses	66	13.7
5	Social media	51	10.6
6	Makin life easier	44	9.1
7	Playing game	40	8.3
8	Life itself	29	6.0
9	Being happy	26	5.4
10	Nothing	14	2.9
11	News	12	2.5
12	A world makes me feel free	10	2.1
13	Making people sociopath	7	1.4
14	Listening to music	5	1.0
15	An invention miracle of technology	5	1.0
16	Addiction	5	1.0
17	Watching film / video	3	0.6
18	Resource of inspiration	1	0.2

According to Table 3, it could be realized that students view internet as the fastest way of reaching abundant information and as a tool for establishing communication. Some of the expressions indicated by students to the first codes were displayed below:

"Since internet includes all sorts of information inside, I can reach information very fast. (Student 18)"

"The best way to communicate with other people. (Student 57)"
"Computer has significant place for me with respect to doing research. (Student 35)"
"It is a tool that I get help for my homework. I use it for my homework. (Student 3)"
"It means social media for me. (Student 27)"

Students' Computer Program and Internet Website Preferences

Frequency and percentage values of codes created based on answers given by students to the questions concerning the most frequently used programs in computer were summarized in Table 4 below:

Table 4.The Most Frequently Used Programs by Students in Computer

	Codes	f	%
1	MS Office programs (Word, PowerPoint, Excel)	255	52.8
2	Web Browser programs (Google Chrome, Yandex)	132	27.3
3	Photograph / image editing programs (Adobe Photoshop, Retrica, Paint)	25	5.2
4	Game programs (PlayStation Games, Minecraft, League of Legends, Grand Theft Auto, Shadow Fight, Counter Strike, Dragon City, Live for Speed, Point Blank, Stardoll, Wolfteam)	22	4.6
5	Other programs (FrontPage, Winamp, Adobe Acrobat Reader, Keylogger, Winrar, WordPad)	10	2.1
6	Antivirus programs (Eset Nod32, CCleaner, ComboFix, Deep Freeze)	8	1.7
7	Downloading programs (Internet Download Manager, Utorrent)	8	1.7
8	Video maker programs (Windows Movie Maker, Camtasia Studio, Bandicam)	5	1.0
9	Video / film / game players (Adobe Flash Player, Vlc, Gom, and Windows Media Player)	4	0.8
10	Design programs (CorelDraw, AutoCAD)	3	0.6

According to Table 4, it was determined that the most frequently used programs by students were MS Office programs such as Word, PowerPoint, and Excel. Example expressions indicated by students with respect to the 10 codes were given below:

"It is PowerPoint because I like to do things in there. (Student 36)"
"It is Google Chrome because I could do everything on the internet. (Student 38)"
"I use mostly Paint because. It is quite fun to draw image. (Student 15)"
"I like soccer games. I play Pro Evolution Soccer 2015. (Student 18)"
"I could download and open some documents by means of the Adobe Reader. (Student 16)"
"I use Eset antivirus program. (Student 25)"
"I download some stuff by means of the Internet Download Manager. (Student 54)"
"It is Camtasia Studio. I make various videos because I enjoy it; I cut and edit videos. (Student 22)"
"It is Vlc Media Player. I watch videos. I spend time. (Student 61)"
"It is CorelDraw. I could do anything in graphic and design areas. (Student 63)"

Frequency and percentage values of codes created based on answers given by students to the questions concerning the most frequently accessed websites on the internet were summarized in Table 5 below:

Table 5.The Most Frequently Accessed Websites on the Internet by Students

	Codes	f	%
1	Communication websites (facebook, instagram, youtube, whatsapp, twitter, ask.fm, tumblr, google+, messenger, snapchat, wattpad, connected2, hotmail, vine, weheartit)	333	68.9
2	Education websites (e-okul, morpa kampus, onedio, eodev, meb vitamin, sanal okulumuz, wikipedia, your learning place, matematikciler, okulistik, teknofem)	63	13.0
3	Game websites (oyuncini, stardoll, habbo, kraloyun, pottermore, moviestar planet, trackmania forever, twitch)	35	7.2
4	Shopping websites (markafoni, morhipo, gittigidiyor, hepsiburada, trendyol)	25	5.2
5	Film episodes websites (dizipub, koreanturk)	7	1.4

According to Table 5, it was determined that students mostly accessed into the communication related websites. Furthermore, it was observed that students accessed in websites related with education, game, shopping, and film episode watching. Examples of expressions indicated by students regarding the five codes were given below:

"I access in Facebook to catch up with the agenda. (Student 66)"
"Eodev because I do my research on homework from here. (Student 11)"
"Pottermore. Because I like playing game on Pottermore. (Student 18)"
"Markafoni. I make shopping. (Student 31)"
"Dizipub. I watch the episodes of my favourite movies. (Student 67)"

Difficulties Encountered by Students while They Use Computer and Internet

Frequency and percentage values of codes created based on answers given by students to the questions concerning the difficulties encountered by students during usage of computer were summarized in Table 6 below:

Table 6.Difficulties Encountered by Students during Usage of Computer

	Codes	f	%
1	Illiteracy about usage of some programs	28	5.8
2	Frequent formatting necessity of computers	25	5.2
3	Slow operation of computers	13	2.7
4	Illiteracy about computer usage	11	2.3
5	Poor keyboard usage skill	9	1.9
6	Headache or eye pain caused by computer usage	7	1.4
7	Difficulty on program downloading	5	1.0
8	Foreign words in some programs	5	1.0
9	Charging problems with laptops	2	0.4
10	Failure in formatting process	1	0.2

According to Table 6, it was determined that students encounter commonly with difficulties such as illiteracy about usage of some programs and frequent formatting needs of computers. Examples of students' expressions regarding the first four codes were given below:

"Since I do not know some programs, I experience difficulties. Especially with MS Office programs. (Student 48)"
"When the computer freezes, I could not do anything. I need to format the computer. (Student 10)"
"Slow operation of computer and frequent hang up. (Student 45)"
"I am literate on computer usage. (Student 11)"

Frequency and percentage values of codes created based on answers given by students to the questions concerning the difficulties encountered by students during usage of internet were summarized in Table 7 below:

Table 7.Difficulties Encountered by Students with Internet

	Codes	f	%
1	Malware infection from internet	47	9.7
2	Slow internet speed	39	8.1
3	Lack of internet connection	22	4.6
4	Experiencing loss of connection to internet	20	4.1
5	Illiteracy about internet usage	15	3.1
6	Existence of harmful / forbidden website	8	1.7
7	Loss of internet access time to time	3	0.6
8	Hacker attacks	1	0.2

According to Table 7, it was observed that the most common difficulty encountered by students with respect to internet usage was internet-born virus. Examples of students' expressions given regarding he first four codes were given below:

"I experience difficulty when virus comes from internet to my computer. (Student 46)"
"Sometimes internet speed is quite low. (Student 40)"
"Lack of internet connection at home. (Student 62)"
"There are times that I cannot connect to the internet. (Student 34)"

Suggestions of Students Regarding Effective Usage of Computer and Internet

Frequency and percentage values of codes created based on answers given by students to the questions concerning their suggestions regarding effective usage of computer were summarized in Table 8 below:

Table 8.Students' Suggestions Regarding Effective Usage of Computer

	Codes	f	%
1	People could develop their conscious through computer training courses.	171	35.4
2	All students could be provided computer.	62	12.8
3	Computer prices could be reduced.	59	12.2
4	Computers may not be used due to their adverse impact on health.	25	5.2
5	Superior computers could be manufactured.	23	4.8
6	Educational and instructional programs could be developed.	16	3.3
7	Advertisements could be published.	14	2.9
8	Computer courses could be given at schools.	13	2.7
9	Computer course hours could be increased.	12	2.5
10	Computer-generated homework could be assigned.	11	2.3
11	Number of computers could be increased at schools.	8	1.7
12	Internet laboratories could be established at schools.	7	1.4
13	Posters could be prepared.	7	1.4
14	Computers could be used under parents' supervision.	6	1.2
15	Relevant conferences could be organized.	5	1.0
16	Antivirus programs could be used.	3	0.6
17	Mottos could be prepared.	3	0.6
18	Brochures could be printed.	3	0.6
19	Seminars could be organized.	2	0.4
20	Educational and instructional websites could be published.	2	0.4
21	Students could be allowed to access into computer labs at schools at all the time.	2	0.4
22	Movement of Enhancing Opportunities and Improving Technology Project could be supported.	2	0.4
23	Practical computer courses could be provided.	2	0.4
24	Public announcements could be increased.	1	0.2
25	Turkish versions of computer programs could be introduced.	1	0.2
26	Free computer centres could be established.	1	0.2
27	Computer support hotline could be established.	1	0.2

According to Table 8, it was determined that the most frequently expressed suggestion by students regarding effective usage of computer was "Establishing computer courses for public to develop their conscious about computer usage". Examples of expressions indicated by students regarding the first five codes were displayed below:

"There is necessity to open more computer courses. Programs to enhance conscious of individuals are required to be extended because especially parents are illiterate about this subject. (Student 10)"
"All individuals could be provided computer. (Student 15)"
"I wish I could lower computer prices so that everyone could get one. (Student 24)"
"They should not be used to often because many people could get some diseases. (Student 18)"
"Superior computers are required to be developed. (Student 54)"

Frequency and percentage values of codes created based on answers given by students to the questions concerning their suggestions regarding effective usage of internet were summarized in Table 9 below:

Table 9.Students' Suggestions Regarding Effective Internet Usage

	Codes	f	%
1	Training sessions could be introduced.	89	18.4
2	Internet usage tariffs could be reduced.	86	17.8
3	Access to the harmful / inappropriate websites could be limited.	80	16.6
4	Internet access could be provided to all houses.	58	12.0
5	Students could be assigned research studies.	47	9.7
6	Internet speed could be developed.	29	6.0
7	Advertisements could be published.	28	5.8

8	Unlimited internet service could be provided.	18	3.7
9	Internet service could be free of charge.	15	3.1
10	Posters could be prepared.	11	2.3
11	Internet packages could be enlarged.	6	1.2
12	Seminars could be introduced.	6	1.2
13	Internet could be made available in everywhere.	4	0.8
14	Conferences could be organized.	3	0.6

According to Table 9, it was observed that students commonly suggested that "internet courses are required to be provided for improving conscious of people about internet usage", "lowering internet fees", and "prevention access into harmful / inappropriate websites". Examples of expressions given by students regarding the first five codes were indicated below:

"I would train people about effective usage of internet through public courses. (Student 25)"
"Internet fees could be less. (Student 40)"
"The Ministry of National Education could ban unfavourable websites so that psychology of students could not be influence adversely. (Student 10)"
"The government should provide free internet to all homes. (Student 22)"
"The research assignments should be given. Thus, we use internet more effectively. (Student 28)"

DISCUSSION & CONCLUSION

In the present study, it was aimed to determine approaches of middle and secondary students toward computer and internet.

It was determined that students views computer more like as an entertainment tool and as an auxiliary tool for their courses. This situation suggests that students consider computer as an entertainment and education tool. These findings exhibit similar direction with studies of Batmaz (2012), Ersoy and Yaşar (2003). Computers have been one of the irrevocable elements of our lives in every aspect (Akbulut, 2013) because individuals own computers to catch up with novelties introduced by technology, to access information conveniently and quickly and to make their lives easier (Özkan, 2010).

It was determined that students view internet as the fastest way of accessing information and as a communication tool. Therefore, it was understood that students consider internet as a tool for accessing information and establishing communication. Şerefoğlu Henkoğlu et al. (2015) reported that students embrace advantageous aspects of internet; and that students perceive internet as an environment in which they could find all information conveniently and quickly. According to other studies with similar purpose, I was observed that internet is used mostly for having information about daily news, listening to music, watching movies and videos, sending e-mail, playing game, chatting, entertainment, downloading music, film or file (Batmaz, 2012; Bayraktar & Gün, 2007; Ceyhan & Ceyhan, 2011; Deniz & Coşkun, 2004; Ersoy & Yaşar, 2003; Kraut, Patterson, Lundmark, Kiesler, Mukopadhyay, & Scherlis, 1998; Kuzu et al., 2008; Tsai & Lin, 2003; Yang & Tung, 2007). In this regard, in addition to the fact that students use internet as an entertainment, game and social media, and communication purpose, they use it for educational purposes and their criterions are required to be paid attention.

It was revealed that students use MS Office programs most. MS Office programs are followed by web browser and image/photograph editing programs. The least used programs were the ones used for designs. In this regard, it is realized that students view computer as a programming tool that could be utilized for multiple purposes. Köse et al. (2007) determined that students use MS Office programs intensively. Gökçearslan and Seferoğlu (2005) determined in their study that students are dispose to computer software with game content rather than educative programs; and reported that game programs are significantly important in purchasing of a household computer and that 79% of household computers were composed of game programs. Therefore, necessary emphasis is required to be placed on issues of utilization degree of students from computer programs and their positive or negative impacts on students.

It was determined that students most frequently visited websites related with communication. In terms of establishing communication means, it is possible to state that internet usage is rather common among students (Özkan, 2010). Communication websites were followed by education, game, shopping, and film episode websites. In this regard, it was observed that students use internet websites first of all for communication than for many other purposes. In the research conducted by Batmaz (2012), it was stated that students establish their communication over Facebook. Dursun (2004) emphasized that student stake advantage of electronic mail services communication for establishing communication. In a study conducted by Yıldız and Abdüsselam (2016), it was determined that males and females prefer Facebook more with respect to other social media tools; additionally, males use Facebook more than females; and females use Instagram and Twitter more than males. On the other hand, it should not be underestimated that the internet perceived as communication opportunity could be turned into a threat over the time "because parents lack sufficient technology literacy (Akbulut, 2013)".

It was observed that some students experience various problems such as lack of skills to use programs, frequent formatting necessity of computers, virus infection from internet and poor internet speed. In this regard, it was understood that the problems encountered by students while they were using computer and internet were in cognitive and technical dimensions. It is known that some students do not utilize from computer and internet because they do not know how to use them, experiencing difficulty in accessing computer and internet, and getting infected by internet-borne viruses (Abdüsselam & Yıldız, 2015; Akgün & Topal, 2015; Canbek & Sağıroğlu, 2007; Yıldız & Abdüsselam, 2016). These difficulties cause hard time for students in effective and quality usage of computer and internet. Accordingly, students are required to be informed about cognitive (Akbulut, 2013) and technical (Canbek & Sağıroğlu, 2007) results of computer and internet usage. In this regard, the Ministry of Youth and Sport has been conducting a study aiming to cover 100 thousand youth, referred as "safe internet and social media" (Gökçearslan & Seferoğlu, 2016). Number of such studies could be increased.

It was revealed that the most frequently drawn suggestion by students concerning effective usage of computer and internet was that computer and internet courses should be established. Therefore, it was understood that awareness of students are required to be developed regarding effective computer and internet usage through training courses. In the study of Korkmaz (2010), it was determined that utilizing from peer education in internet usage would provide significant advantages to students regarding internet usage. Dursun (2004), in his study conducted on university students, reported that students developed their computer and internet usage skills by themselves; and the environments specific to computer and internet usage at higher education were not sufficient. Ersoy and Yaşar (2003) reported in their study that students were not capable of using especially internet effectively and productively; they were able to find sufficient support regarding internet usage from their parents and teachers. In this regard, it was considered that establishing courses on effective usage of computer and internet could be beneficent for individuals.

There are two limitations with the present study. The first one is its limitation since 10^{th} grade students were not sufficiently included in the study in which the relevant data was collected from the students by means of the form containing open-ended questions. Only 1.2% of students (n=6) in the study group were from the 10^{th} grade. The second limitation of the study was that research data was collected only by means of a form; and no any interview or observation data was included in the considerations.

RECOMMENDATIONS

On the basis of research results, following recommendations were drawn:

1. Since students view internet as the fastest way of accessing information in general, it could be beneficent that awareness of students regarding paying attention to ethical codes during doing research on internet.

2. Students could use filter software such as "Internet Family Protection Package" and "Safe Internet" against viruses and malware / inappropriate websites.

3. Parents need to inspect computer and internet usage of their children time to time since it is important for children to use computer and internet under supervision of their parents.

4. It should not be underestimated that children are required to be informed about usage of computer and internet effectively and safely. This process could be accomplished either by means of educational activities such as training courses at schools, seminars, and conferences. Moreover, advertisements could be published about effective and safe usage of computer and internet, public announcements could be made, mottos could be communicated, posters and brochures could be prepared.

5. Students could be encouraged to visit internet websites that could assist them in terms of academic point of view; computer programs and applications could be taught. Furthermore, educational and instructional new programs and websites could be prepared for students so that they could utilize these technologies in a qualified and desirable way.

6. Effective usage of computer and internet could be covered more extensively in courses of “Information and Communication Technologies” and “Information Technologies and Software” at school.

7. It could be beneficent for students to increase their awareness about software and hardware problems that they could encounter about computer and internet. Ministry of National Education could establish a support hotline to provide assistance to students in this regard.

8. Students’ awareness could be raised about health problems such as headache and eye pain, associated with long-term computer usage.

9. The form to determine “Students’ Approach toward Computer and Internet” developed under the scope of the present study could be applied in all middle and secondary schools under the roof of the Ministry of National Education.

10. Approaches of prospective teachers, teachers, and academicians toward computer and internet could be investigated.

11. Observation activities could be conducted to investigate approaches of students toward computer and internet usage and to determine the difficulties that they encountered.

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THE EXAMINATION OF 7TH GRADE STUDENTS' ACHIEVEMENTS IN MATHEMATICAL PATTERNS

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ABSTRACT: The aim of this study is to determine the 7th grade students' achievements in mathematical patterns presented by figures, tables, number sequences, and word problems. This research is a situation determination study where quantitative methodology is used. The sample of the study consisted of 47 female and 50 male students, totally 97 students from 7th grades in Giresun city on 2015-2016 academic year. Pattern topic oriented 7 questions were used as the data gathering tool. The questions which focused on the attainments of pattern topic were prepared by the researcher. It was determined that students could perform specialization in figural patterns but they couldn't reach a generalization. In other words, it was observed that students could find the required steps according to a given rule and so they could easily reach the situation which involved operational knowledge. Also, it was seen that although students found the number of figures in the next step of the pattern, they couldn't find the general rule that represented the pattern. Another result of the study was that students could recognize patterns of number sequences but they couldn't find the general term of the pattern. Lastly, it was determined that students couldn't understand patterns which were represented as word problems and they failed at these kind of pattern questions but they had success in pattern questions represented by tables. In this context, it can be offered to give much place to representation forms of patterns by figures, tables, number sequences, and word problems while students are given experiences of patterns.

Key words: elementary school mathematics curriculum, numbers and operations learning domain, algebra learning domain, pattern representation forms, 7th grade students

INTRODUCTION

Mathematics, as the leading discipline aiming at what is learnt in real life, is a field that has an application for sciences like engineering and technology and in the real world (Hacısalihoğlu Karadeniz, Aydın Güç, & Tülek, 2014). It can be said that "mathematical patterns exist in nature (Devlin, 1998)" as there are patterns in sunflowers, cabbages, and the flow of water. Mathematical patterns are an important subject which are often encountered in daily life and allow connections to be made with other disciplines. For this reason the study of patterns has been included in the mathematics curricula of many countries (Australian Education Council, 1994; Ministry of National Education (MoNE), 2005, 2009a, 2009b, 2013b; National Council of Teachers of Mathematics, 2000).

The pattern, which is a regular order of mathematical objects such as numbers, figures, etc., has been defined in various ways by mathematics educators (Tanışlı & Özdaş, 2009). For example, the pattern can be described as a repeating regularly arrayed combination of elements such as geometrical figures, symbols, signs, actions or mathematical objects (Burns, 2000; Fox, 2005; Souviney, 1994; Waters, 2004). According to Guerrero and Rivera (2002) the pattern is the rule functioning between the elements of structured mathematical objects (numbers, figures, etc.). According to Olkun and Toluk-Uçar (2006) the pattern is like a poem which is composed of regularly arrayed repeating objects or figures. Papic and Mulligan (2007) have defined the pattern as spatial or numeric regularity.

The patterns used in the school curricula are divided into four categories: a figure (visual), a table or graphic, a number sequence, and a word problem (Yaman & Umay, 2013). *Patterns given as a figure (visual)* may be either an increasing series of points or may be composed of figures made from matchsticks, counting rods, unit squares, unit spheres, blocks, and tiles (Ley, 2005). In *patterns given as a table or graphic*, the students record the outcomes in each line systematically and look for a pattern among the resulting outcomes (Schliemann, Carraher, & Brizuella, 2001). In *patterns given as number sequences*, the students are expected to determine the connections between the given terms of the pattern, to write the unknown one in the sequence (Yaman & Umay, 2013), and to express the pattern rule using the connection that they have found (Ley, 2005). Moreover, the patterns may also be represented as a word problem (Yaman & Umay, 2013).

When the curricula are examined, it can be seen that the topic of patterns may be highlighted from the pre-school period. In the renewed and updated pre-school curricula, the attainment, "*He/she forms a pattern with the objects*", is given with regard to the cognitive domain (MoNE, 2006, 2013a).

In the primary school mathematics curriculum (1st-5th grade), which was renewed in 2005, patterns are given in the learning domains "*geometry*" and "*numbers*". The topic was given in the form, "*He/she determines the pattern of connection. He/she determines the elements which are missing in a pattern*", in the sub-learning domain "*pattern and tessellation*" in the learning domain "*geometry*" for the 1st grade. Patterns were discussed under the heading, "*He/she forms number patterns*", in the sub-learning domain "*natural numbers*" in the learning domain "*numbers*" in the 2nd grade. The topic of patterns was given as, "*He/she determines the connection in a pattern and extends the pattern*", in the sub-learning domain "*natural numbers*" in the learning domain "*numbers*" in the 3rd grade curriculum. Patterns were expressed through the idea that, "*He/she associates a pattern with numbers and completes the missing part*", in the sub-learning domain "*natural numbers*" of the learning domain "*numbers*" in the 4th grade. Finally, an attainment related to patterns given is observed as, *"He/she forms the pattern, using the rule and procedure; he/she determines the number or numbers which are not given in a pattern*", in the sub-learning domain "*natural numbers*" in the learning domain "*numbers*" in the 5th grade (MoNE, 2005, 2009a).

In the elementary school mathematics curriculum (6th-8th grade), which was renewed in 2005, it is seen that the topic of patterns is also given in the learning domain "*geometry*". The topic of patterns was given in two attainments as "*He/she forms patterns using polygons and identical and similar ones of the polygonal areas*" and "*He/she creates tessellations by translation*", in the sub-learning domain "*pattern and tessellations*" of the learning domain "*geometry*" in the 6th grade. Similarly, the topic was introduced as "*He/she makes a tessellation by tessellating an area with polygonal models*", "*He/she determines the codes of the tessellations created with uniform polygonal models*" and "*He/she makes tessellations by reflecting, translational, and rotational motions*" in the sub-learning domain "*pattern and tessellations*" of the learning domain "*geometry*" in the 7th grade. There after patterns were represented in *"He/she builds patterns from linear, polygonal, and circular models and determines the fractal ones from among these patterns*" in the 8th grade (MoNE, 2009b).

The elementary school mathematics curriculum was updated in 2013 and grades 5, 6, 7, and 8 were renamed the "Middle School Mathematics Curriculum". There are two attainments which explicitly contain the topic of patterns in the updated middle school mathematics curriculum. The attainment "*He/she produces the desired sequence number and figural patterns, the rule for which is given*", the first one of these attainments, belongs to the sub-learning domain "*natural numbers*" within the learning domain "*numbers and procedures*". The attainment "*He/she express the rule of the arithmetic sequence using a letter; he/she finds the desired term for the sequence, the rule of which is expressed with a letter*", the second attainment, belongs to the sub-learning domain "*algebraic expression*" in the learning domain "*algebra*" of the 6th grade (MoNE, 2013b).

Grades 1, 2, 3, and 4 of the elementary school mathematic curriculum were renamed the "Primary School Mathematics Curriculum". In this curriculum, the topic of patterns was given with the attainments "*He/she recognizes the single-rule number pattern, he/she finds the pattern rule*" and "*He/she completes the pattern by finding the missing element in a number pattern*" in the learning domain "*introduction to algebra*" in the 1st grade. The attainments for the learning domain "*geometric patterns*" at the same grade were given as "*He/she finds the rule in a pattern consisting of geometric objects or figures and he/she completes the pattern by finding the missing element of the pattern*" and "*He/she creates a single-rule geometric object or figural pattern of maximum three-element*". The attainment in the learning domain "*introduction to algebra*" in the 2nd grade of the pattern curriculum was given as "*He/she extends the number pattern, the rule of which requires one procedure*". The attainments for the learning domain "*geometric patterns*" in the same grade were given as "*He/she determines the missing elements in a repeating geometric pattern and completes the pattern*" and "*He/she creates new patterns having the same connection with different materials using the connection in a geometric pattern*". The attainment for the learning domain "*introduction to algebra*" in the 3rd grade of the curriculum was given as "*He/she creates a number pattern. He/she creates a pattern, with one procedure as the rule*". The attainments of the learning domain "*geometric patterns*" of the same grade were given as "*He/she makes a design using the figure models. He/she draws the pattern on dotted or squared paper*". In the 4th grade of curriculum the learning domain "*introduction to algebra*" is further extended with the attainments "*He/she determines the rules of a number pattern containing a maximum of two different procedures and extends the pattern*" and "*He/she creates and describes repeating, increasing, and decreasing number patterns*" (MoNE, 2015).

When the curricula in which the new approaches have begun to be implemented in Turkey since 2005 are examined, it can be understood that the topic of pattern has been given a place in every curriculum. According to MoNE (2009a, 2009b) the main objectives for placing patterns to be in mathematics curricula are to reveal the students' situations in their cognitive schemes, to enhance the psychomotor skills of the students, and to explain mathematics to the students, moving from the abstract to the concrete, using their daily activities.

This study is needed because there are few studies related to patterns conducted with primary school and middle school students in Turkey. Thus, this study will likely make a contribution to this gap in the literature. Accordingly, this study aims to reveal 7th grade students' perceptions of mathematical patterns represented as figures, tables, number sequences, and word problems.

METHOD

This section includes information on the research method, study group, data collection tool, and data analysis.

Research Method

This study is a case determination study using quantitative methodology. Considering the study participants and the subject of the study; this research is a case study method. Because case study method pave the way for profoundly examining the subject, investigating the relations of data and explaining the cause and effect relations (Çepni, 2014).

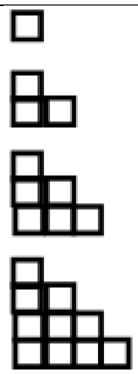
Study Group

The study group comprised of 97 7th grade students consisting of 47 female and 50 male students being educated in a middle school in the center of Giresun during 2015-2016 school year. The names of the students were kept confidential due to ethical reasons and the students were coded as follows: "S1, S2, S3, … , S97".

Data Collection Tool

In this study, totally 7 questions regarding pattern presentation forms were used in order to collect data. The questions were prepared by focusing on two attainments related to patterns in the middle school mathematics curriculum which was updated in 2013 and they were practiced by the students in classroom environment during a single class period individually. The questions used in the study and the attainments on which the questions were focused are provided in Table 1:

Table 1.The Questions Used in the Study and the Attainments on Which these Questions Were Focused

Attainments	Questions
A1. He/she produces the desired sequence in number and figural patterns, the rule of which is given.	**Q1.**Find the sum of the first 7 terms of the pattern, the rule of which is 3a+1.
	 **Q2.**How many squares are there in the next step according to the figure above? Find the general rule of the pattern?
A2. He/she express the rule of an arithmetic sequence with a letter; he/she finds the desired term of the sequence, the rule of which is expressed with a letter.	<table><tr><td>n</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr><tr><td>4n+2</td><td>6</td><td>▲</td><td>14</td><td>18</td><td>○</td></tr></table> **Q3.**What is the sum of ▲+ ○ using the pattern, the rule for which is given in the table?

Q4.A model of a pattern which is created by circles is given above. Fill in the table below by determining the pattern used for each step in the model.

Sequence number of the number in the pattern	The number of circles used for the number
1	2
2	4
3	6
4	8
5	…
6	…
…	…
n	…

Q5. Cem, who is a mason, builds a wall by working for 3 hours on the first day and for 4 hours more on the second day than the first day and by repeating the same rule on all subsequent days. What is the general rule and pattern of this activity?

Q6. An entrance fee for a car park is 5 Turkish Liras and is 2 Turkish Liras for every hour thereafter. Find the general rule of this pattern.

Q7. Find the algebraic expression corresponding to the number pattern 0-8-16-24-32-40-…

The 1st and 7th questions are the questions given as a number sequence. The 2nd question is given for determining the next step of a pattern represented as a figure and for finding the general rule of the pattern. The 3rd question includes the determination of the desired sequence of a pattern given in a table. The 4th question which was represented as a figure and a table requires specialization of a figural pattern primarily and than a generalization of it. The 5th and 6th questions are represented as word problems and require finding the general rule of a pattern.

Data Analysis

While analyzing the data, the questions answered by the students were categorized as; correct (answers containing all aspects of the valid answer), partially correct (answers containing one aspect of the valid answer, but not all aspects thereof), incorrect (scientifically incorrect answers), and blank (leaving blank, giving meaningless answers, answers such as “I do not know” or “I did not understand”) and the frequencies (f) and percentages (%) were calculated.

FINDINGS & COMMENTS

The frequencies (f) and percentages (%) calculated according to the answers of the students which are correct, partially correct, and incorrect, or left empty are provided in Table 2:

Table 2.The Answers of the Students Given to the Questions

Attainments	Questions	Representation Forms of the Patterns	Answers							
			Correct		Partially Correct		Incorrect		Blank	
			f	%	f	%	f	%	f	%
A1	Q1	Number sequence	30	30.9	2	2.1	43	44.3	22	22.7
	Q2	Figure	3	3.1	36	37.1	19	19.6	39	40.2
A2	Q3	Table	81	83.5	7	7.2	3	3.1	6	6.2
	Q4	Figure and table	45	46.4	43	44.3	8	8.3	1	1.0
	Q5	Word problem	5	5.1	25	25.8	39	40.2	28	28.9
	Q6	Word problem	4	4.1	6	6.2	59	60.8	28	28.9
	Q7	Number sequence	35	36.1	6	6.2	29	29.9	27	27.8

The findings and comments related to the questions are provided below.

Findings and Comments related to Q1

When the findings for the first question are examined it is seen that 44.3% of the students gave incorrect answers, 30.9% of them gave correct answers, 22.7% of them left the question blank, and 2.1% of them gave partially correct answers. Examples of correct, partially correct, and incorrect answers given to the 1st question by the students are provided in Figures 1, 2, and 3:

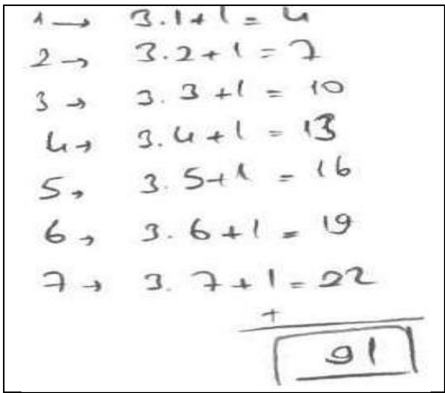


Figure 1. The Correct Answer Given To the 1st Question By S26

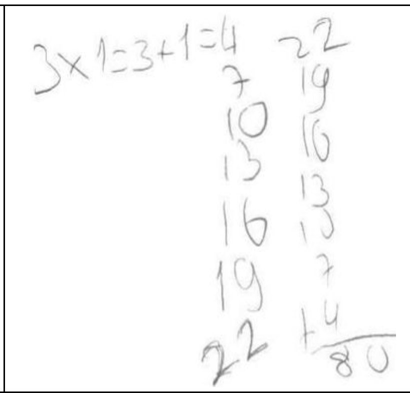


Figure 2. The Partially Correct Answer Given To the 1st Question By S47

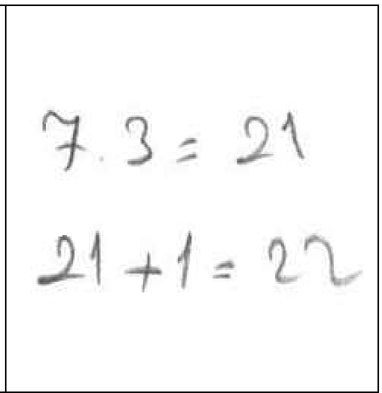


Figure 3. The Incorrect Answer Given To the 1st Question By S34

In this question the students were asked to find the sum of the first 7 terms of a number pattern, the rule of which was given and the expected answer was "4+7+10+13+16+19+22=91". When we examine Figure 2, it is seen that students found all the required terms but they made a mistake in the process of addition. When Figure 3 is examined it was determined that S34 found only the 7th term, not the sum of the first seven terms of the pattern like the majority of the students.

Findings and Comments related to Q2

When the answers given to the 2nd question are examined it is seen that 40.2% of the students left the question blank, 37.1% of them gave partially correct answers, 19.6% of them gave incorrect answers, and 3.1% of them gave correct answers. It was determined that although 37.1% of the students found how many squares would be in the next step of the pattern, they could not obtain the general rule expressing the pattern. Examples of correct, partially correct, and incorrect answers given to 2nd question by the students are provided in Figures 4, 5, and 6:

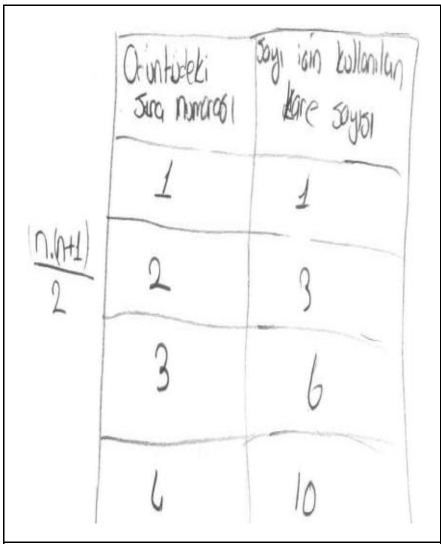


Figure 4. The Correct Answer Given To the 2nd Question By S76

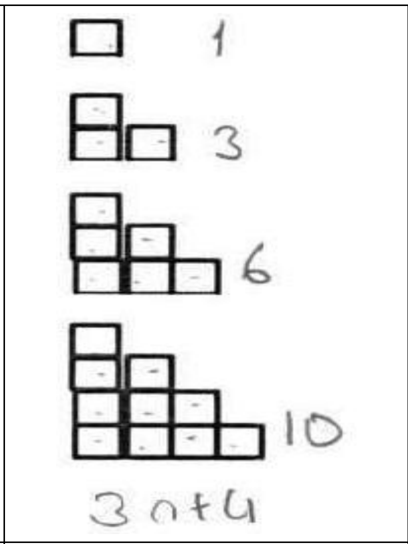


Figure 5. The Partially Correct Answer Given To the 2nd Question By S61

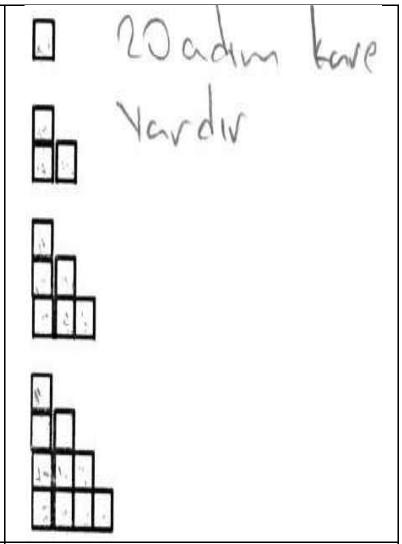


Figure 6. The Incorrect Answer Given To the 2nd Question By S19

What is expected from the students is that they reach the rule "n.(n+1)/2". When Figure 4 is examined it is seen that S76 used the table for solving the 2nd question represented as a figure and solved the problem correctly. "Making a table, i.e. arranging the data during solving some problems, or knowledge obtained during problem-solving into a table, facilitates seeing the connection between data or the obtained knowledge. Thus, the rule used for obtaining the results is found and the problem is solved" (Altun, 2015, p.76 and 123). When Figure 5 is examined it is seen that although the student correctly found the number of the squares, he/she got the rule of the pattern wrong.

Findings and Comments related to Q3

When the findings for the 3rd question are examined it is seen that 83.5% of the students gave correct answers, 7.2% of them gave partially correct answers, 6.2% of them left the question blank, and 3.1% of them gave incorrect answers. Examples of correct, partially correct, and incorrect answers given to the 3rd question by the students are provided in Figures 7, 8, and 9:

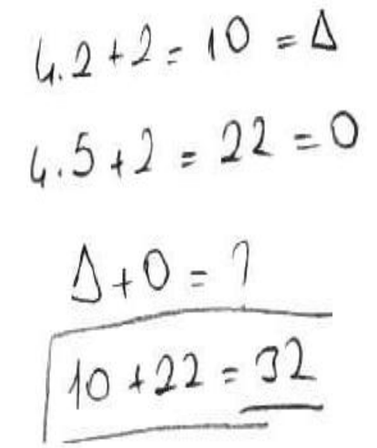


Figure 7. The Correct Answer Given To the 3rd Question By S73

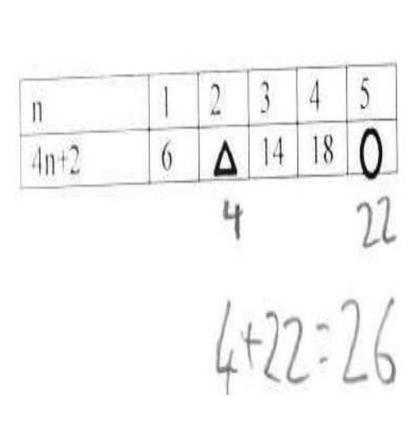


Figure 8. The Partially Correct Answer Given To the 3rd Question By S71

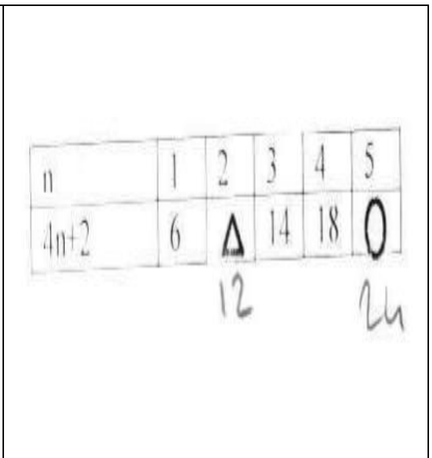


Figure 9. The Incorrect Answer Given To the 3rd Question By S72

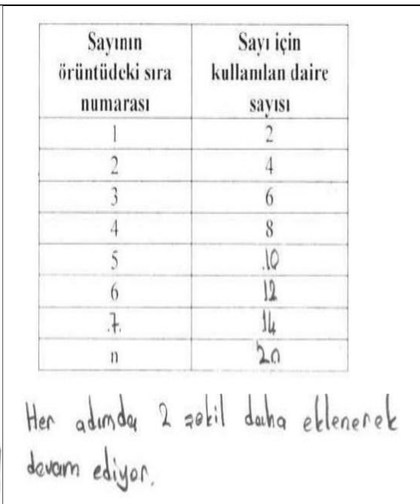
In this question, which was represented as a table, what is expected from the students is that they obtain a result which reveals the procedure to be "10+22=32". It is seen that the majority of the students did not have any difficulty answering this question which requires the skill of procedural knowledge. The students who gave a partially correct answer to the question could not get the result as they found a value belonging only to one of the terms, as in Figure 8. "The primary school mathematics curriculum aims to make connections between concepts and procedures and to teach conceptual learning rather than procedural learning. Moreover, the curriculum expects the students to use mathematical terminology correctly and develop their communication skills via concepts, terms, and numbers" (MoNE, 2015, p.4).

Findings and Comments related to Q4

When the findings for the 4th question are examined it is seen that 46.4% of the students gave correct answers, 44.3% of them gave partially correct answers, 8.3% of them gave incorrect answers, and 1.0% of them left the question blank. The 4th question which was represented as a figure and a table, is a question which requires students first to specialize a figural pattern and then to reach a generalization. Specialization means to choose particular or systematic examples in order to understand and give a meaning to a problem, and to examine these examples with the problem (Keskin, Akbaba Dağ, & Altun, 2013). During specialization there are a number of actions such as choosing one or more example, giving examples, identifying, displaying, explaining, and drawing an example (Arslan & Yıldız, 2010). While 46.4% of the students in the study group gave correct answers for this question, 44.3% of them could make a specialization but could not reach a generalization. Examples of correct, partially correct, and incorrect answers given to the 4th question by the students are provided in Figures 10, 11, and 12:

Sayının örüntüdeki sıra numarası	Sayı için kullanılan daire sayısı
1	2
2	4
3	6
4	8
5	10
6	12
...	...
n	2n

Figure 10. The Correct Answer Given To the 4th Question By S36



Sayının örüntüdeki sıra numarası	Sayı için kullanılan daire sayısı
1	2
2	4
3	6
4	8
5	10
6	12
7	14
n	2n

Figure 11. The Partially Correct Answer Given To the 4th Question By S61

Sayının örüntüdeki sıra numarası	Sayı için kullanılan daire sayısı
1	2
2	4
3	6
4	8
5	9
6	8
4	6
n	1

Figure 12. The Incorrect Answer Given To the 4th Question By S31

In this question, represented as a figure and table, what is expected from the students is that they obtain the general rule "2.1, 2.2, 2.3,…,2n". With reference to Figure 11 it is understood that the majority of the students who gave a partially correct answer filled in the table by expressing the sequence number of the number which represents the variable "n" in the table as a number rather than writing the general rule.

Findings and Comments related to Q5

When the findings for the 5th question are examined it is seen that 40.2% of the students gave incorrect answers, 28.9% of them left the question blank, 25.8% of them gave partially correct answer, and 5.1% of them gave correct answers. Examples of correct, partially correct, and incorrect answers given to the 5th question by the students are provided in Figures 13, 14, and 15:

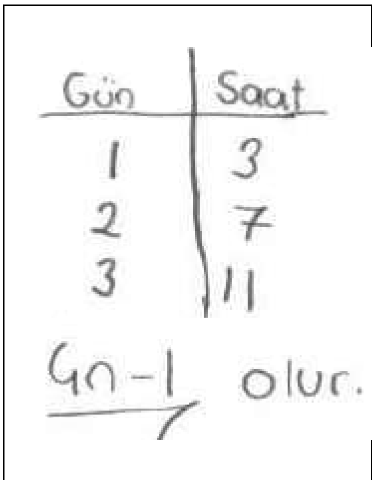


Figure 13. The Correct Answer Given To the 5th Question By S75

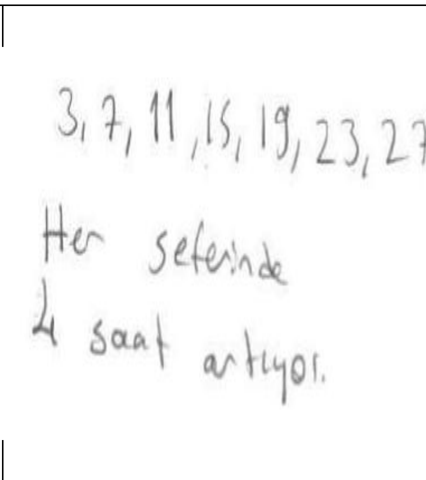


Figure 14. The Partially Correct Answer Given To the 5th Question By S12

Figure 15. The Incorrect Answer Given To the 5th Question By S59

In this question, represented as a word problem, what is expected from the students is that they obtain the general rule "4n-1". When Figure 13 is examined it is seen that S75 solved the question by making a table. When Figure 14 is examined it is seen that S12 continued the number pattern correctly in order to find the general rule but got the general rule incorrect. It can be understood from Figure 15 that the student tried to find the correct answer using the figural pattern but failed.

Findings and Comments related to Q6

When the findings for the 6th question are examined it is seen that 60.8% of the students gave incorrect answers, 28.9% of them left the question blank, 6.2% of them gave partially correct answers, and 4.1% of them gave correct answers. Examples of correct, partially correct, and incorrect answers given by the students to the 6th question are provided in Figures 16, 17, and 18:

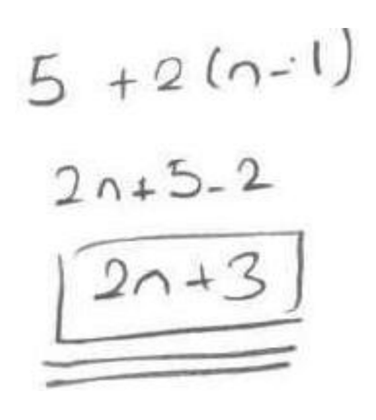


Figure 16. The Correct Answer Given To the 6th Question By S15

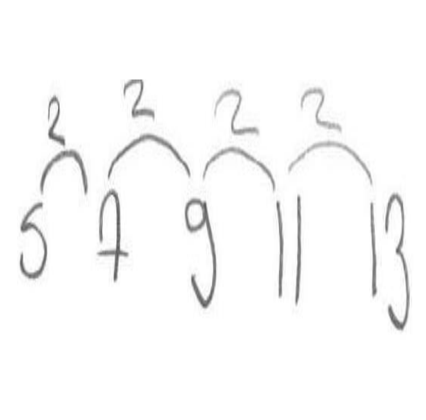


Figure 17. The Partially Correct Answer Given To the 6th Question By S44

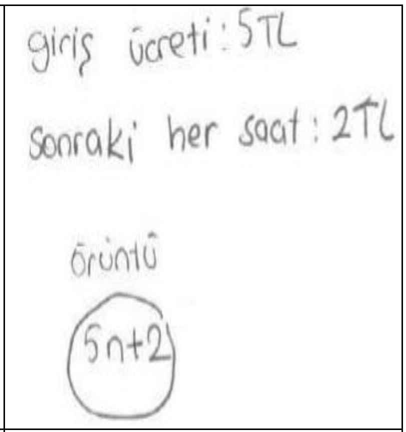


Figure 18. The Incorrect Answer Given To the 6th Question By S37

In this question, represented as a word problem, what is expected from the students is that they reach a generalization as “2n+3”. When Figure 17 is examined it is seen that S44 determined the number pattern expressing the pattern but could not obtain the general term in the 6th question represented as a word problem.

Findings and Comments related to Q7

When the findings for the 7th question are examined it is seen that 36.1% of the students gave correct answers, 29.9% of them gave incorrect answers, 27.8% of them left the question blank, and 6.2% gave partially correct answers. Examples of correct, partially correct, and incorrect answers given to the 7th question by the students are provided in Figures 19, 20, and 21:

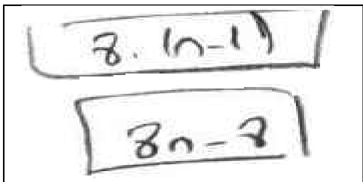


Figure 19. The Correct Answer Given To the 7th Question By S18

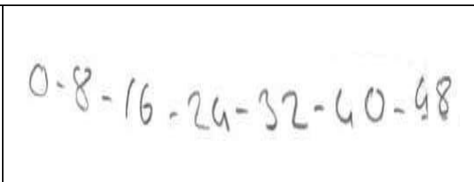


Figure 20. The Partially Correct Answer Given To the 7th Question By S20

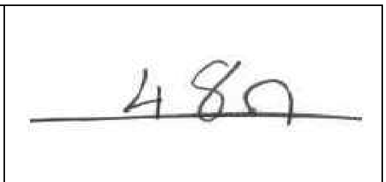


Figure 21. The Incorrect Answer Given To the 7th Question By S25

In this question, given as a word problem, what is expected from the students is that they obtain the general rule “8.(n-1)”. When Figure 20 is examined it is seen that S20 found the number pattern but could not make a generalization. Generalization is defined as extending the effect of the results obtained by the students using mathematical thinking and problem-solving, or restating the results using some examples in a more general and broader way (Mullis, Martin, & Foy, 2005; Stacey, Burton, & Mason, 1985). Students have to perform the following steps to make generalizations: determining connections, preparing examples to test hypotheses, finding a number of different examples, classifying the examples systematically, determining which exercises have the same results, carrying out similar tests and making assumptions (Bell, 1976; cited by Pilten, 2008).

CONCLUSIONS & RECOMMENDATIONS

At the end of the study, it was seen that the students could make specializations but could not reach a generalization for the patterns given as figures. It was concluded from the answers given to the questions by the students that although the students could find out how many figures would be present in the next step of the figural pattern, they could not find the general rule expressing the pattern. In addition to this, it was determined that the students were able to find the desired steps according to a given rule, and thus they easily attained procedural knowledge. This situation indicates that the students had memorized the procedures performed on the concept and its definition. Attention must be paid to conceptual learning to overcome this difficulty (Hacısalihoğlu Karadeniz, Bozkuş, Gündüz, & Baran, 2015). In procedural knowledge, while the idea is to know how to use a concept or procedure without necessarily knowing the reason for it, in conceptual knowledge the process of understanding becomes prominent (Baki, 1997). Conceptual knowledge encompasses the core meanings of the rules, generalizations, and the connection between them and procedures (Bekdemir, Okur, & Gelen, 2010).

In the studies of Soylu and Aydın (2006), it was determined that procedural and conceptual learning could not be balanced in the mathematics teaching process and that subjects could not be learned at a conceptual level as the procedural and conceptual learning could not be balanced. In the studies of Kaya and Keşan (2012), it was determined that the students were more successful in questions which required procedural knowledge and that they better understood these questions. Palabıyık and İspir (2011) specified in their studies that pattern-based algebra teaching increased the success in conceptual algebra of students in the experimental group and did not cause any difference in success in procedural algebra in the experimental and control groups. Similarly, as a result of the study carried by Bekdemir et al. (2010) it was revealed that score average of the students related to procedural knowledge was higher than the score average related to conceptual knowledge. Having difficulties in making connections between the problem and the subject and not correlating and reading what is given in the graphics indicated that the students had inadequate knowledge and could not internalize or learn the subject (Baki & Kartal, 2004). These findings from the study support the findings of this study. Every science field has its own teaching methods in accordance with its objects (Soylu & Aydın, 2006). A teaching process suitable for the structure of mathematics should be planned such that the students are able to understand both conceptual and procedural knowledge in mathematics and to make connections between them (Van De Wella, 2004).

As concepts in mathematics are the connections structured within the cognitions of individuals, these concepts cannot be learned and the next stage of the learning process becomes difficult if mathematical connections are not created in the mind of the student (Soylu & Aydın, 2006). The updated middle school mathematics curriculum (MoNE, 2013b) intends that the use of informal knowledge obtained from concrete experiences, feelings, and the daily life of the students support conceptual learning. When this situation is considered what is expected from the teachers is that they create environments in which the students can make connections between their past knowledge and new knowledge (Hacısalihoğlu Karadeniz et al., 2015).

It was concluded in the study that the students could reproduce a pattern related to the number sequences but could not find the general rule containing the pattern. As another result, it was determined that the students did not understand the questions represented as a word problem, thereby they were not successful in solving these kinds of questions. However it was seen that the students were successful in the pattern questions given as a table. In this context, activities involving the figure, table, number sequence, and word problem forms of patterns should play a greater part in the lessons.

In order to eliminate the difficulties related to the patterns encountered by the students, various examples should be given from environments closely related to these concepts; students' attentions should be attracted by using appropriate materials or models in the class; and the students should be allowed to better understand the subject using different methods and techniques such as games or drama. Similarly, the topic of pattern should be correlated with daily life by using concrete materials, enriched activities, and different models for the process of teaching patterns. Thus, "students will be able to understand the concepts, make connections between concepts and procedures (MoNE, 2013b)" and achieve the *general purposes of mathematics education* by coordinating these with daily life and the other disciplines.

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EXEMPLARY TECHNOLOGY INCORPORATED CONTEMPORARY ACTIVE LEARNING ENVIRONMENTS FOR STEM COURSES

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ABSTRACT: Unprecedented innovations have been experienced since the second half of the twentieth century although there have not been fundamental changes in learning environments throughout the history. The reasons of these changes can be grouped mainly into two categories: 1) The development of new learning-teaching approaches such as constructivism, active learning, lifelong learning, etc. 2) The fast incorporation of technology into education like in every part of our life. More developments in learning environments will not be surprising in the near future.

This study aims to present and analyze contemporary active learning classrooms (ALCs) which are technology incorporated, large enrolled, student-centered, and highly interactive. For this aim, literature review has been carried out about technology incorporated ALCs, which are being innovated continually and designed especially for STEM courses, and prominent contemporary classrooms have been compiled. Then, some ALCs such as SCALE-UP, TEAL, TILE and Next-Gen ALC v2.0 have been deeply analyzed in terms of their physical environment, pedagogical approach, teaching and learning processes, etc. Moreover, traditional classrooms and technology incorporated contemporary ALCs have been compared. It is concluded that the use of these ALCs should be disseminated and instructors should be prepared to guide and facilitate learning in these classrooms.

Keywords: Active learning, contemporary classrooms, technology incorporated, STEM courses, SCALE-UP

INTRODUCTION

For long years, governments have been allocating a large portion of their budgets in education in order to increase the quality of learning and teaching in schools. For this purpose, new schools are being constructed, educational and curricular reforms are taking place, and teacher education programs are being updated. However, the results show that the outcomes are not consonant with the efforts (Gonzalez & Kuenzi, 2012).

There are many reasons of this failure and learning environments may be one of these. While curriculum is constructivist and classrooms are modern and equipped with some technological devices like smart boards and computers, classroom design is still traditional in many schools, in which desks are located one after another and the teacher is in front of the classroom. This design also negatively effects especially the implementation of the constructivist curriculum which is student-centered and supports active learning in its nature. Park & Choi (2014) specify "educational spaces convey an image of educational philosophy about teaching and learning". They indicate that traditional classrooms may be a representation of educational philosophy of essentialism which focuses more on "injecting content into students' brain" rather than having them active and enabling them construct the knowledge. Therefore, it is possible to say that students cannot really be active in these traditional classrooms.

The idea of classroom dates back to ancient Greek where students surrounded their teachers during Socratic dialogues. There was not a regular classroom space, teachers and students came together in an irregular shape. Medieval universities were first to use structured spaces for education, there were two vertical lines of desks facing each other. Then linear rows of desks started to emerge where the teacher stood at the front center of the space. The term lecture, *lectus* in Latin, as a means of delivering the original knowledge through instructor's reading to students was important in those days because paper and books were rare. With the industrial revolution, a need for bigger classrooms arises due to the increase in the number of the students to be educated, and the traditionally designed classrooms were shaped (Park & Choi, 2014). This traditional layout is still used in a widespread manner in many classrooms today (Parsons, 2015, p. 18).

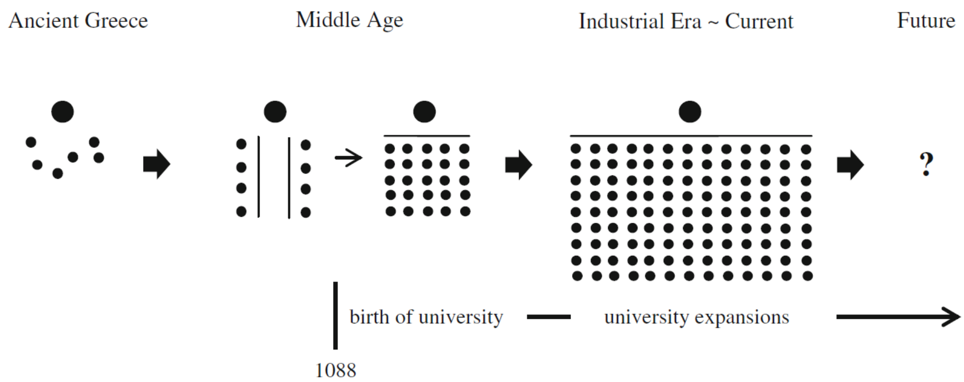

Figure 1. Historical changes in classroom design (Park & Choi, 2014)

Strange & Banning (2001, p. 12) states that physical environment effects learning and development processes. Even if it is a technology incorporated classroom, the design of the classroom will hinder active learning in a traditional one because academic architecture has its own hidden curriculum, and the design and construction of the classrooms effect learning (Orr, 1993). In order for retention and achievement, students should involve actively in peer and student-faculty interaction (Astin, 1993) and this can be done thanks to active learning classrooms (ALCs).

ALCs are technology incorporated collaborative learning environments which support constructivist educational paradigms (Charles, Whittaker & Lasry, 2014). In ALCs, teachers' role of relaying information shifts to learning coach and facilitator. These classrooms also promote collaborative learning and teamwork, active discussion and encourage students to talk and participate more (Alexander et. al., 2009). Therefore, in order to achieve these goals, ALC furnishings and architecture are designed intentionally in a different way shifting the focus toward students' collaboration and reshaping the traditional authority structures (Charles, Whittaker & Lasry, 2014). They also consist many technological devices to provide an active learning opportunity (Erol, Ozcan & Luft, 2016) and visualization, connectivity, sharing and artifact creation (Charles, Whittaker & Lasry, 2014). A current ALC may be depicted as in Figure 2 to replace the question mark in Figure 1.

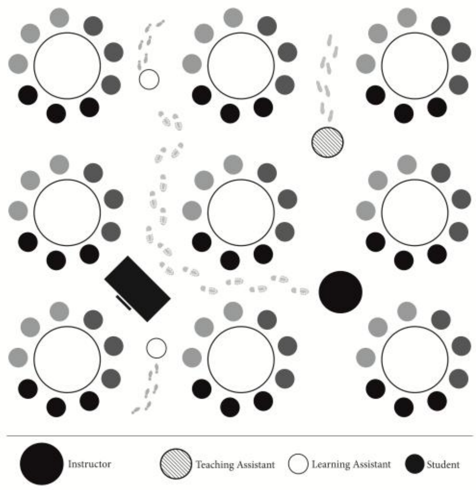

Figure 2. Contemporary active learning classroom design

As shown in Figure 2, the traditional idea of instruction, in which teacher is the resource of the knowledge and s/he teaches by "lecturing" and students learn by sitting on their desks, is flipped in ALCs. In these flipped classrooms, the teacher is not the authoritative figure in front of the students; instead s/he is the facilitator and coach of the learning. The teacher walks around the classroom, works with the students on the tasks and guides and discusses with them. In some ALCs, there may be some teaching and learning assistants who help both students and teachers during the activities. In these classes, students sit in groups and face to face rather than one after another.

Before the construction of contemporary ALCs, there have been some initiatives such as Workshop Physics, Open Laboratory, and Peer Instruction.

Initiatives of ALC Implementations

In a *workshop* physics classroom, which was firstly implemented by Dickinson College, all lectures are taught in a laboratory with new computer technology. Students preferred workshop courses (Singer, Nielsen & Schweingruber, 2012, p. 127) and their success was better on the conceptual exams, but not in problem solving (Laws 1991, 2004). *Peer Instruction* approach (a Harvard University initiation) has been shown to boost conceptual understanding and problem-solving abilities and to provide instructors with valuable feedback on their teaching (Mintzes & Leonard, 2006). *Open Laboratory* allows students flexibility in scheduling laboratory attendance and permits students to spend more time if necessary to complete lab. The system also encourages the students use of visual media which is less personnel dependent instruction (Godbey, Otieno & Tofan, 2006). *Interactive Lecture Demonstrations* (initiated in University of Colorado) are designed to enhance conceptual learning through active engagement of students in learning process. Students observe real physics demonstrations, make predictions about the outcomes on a prediction sheet, and collaborate with fellow students by discussing their predictions in small groups, and then examine the results of the live demonstration (Sokoloff & Thornton, 2004).

Active learning has been reported to increase academic performance in Science, Technology, Engineering and Mathematics (STEM) courses (Freeman et. al., 2014), therefore, ALCs are widely used in STEM education. In an educational view STEM education involves more inquiry and project-based approach than traditional lecture-based teaching activities (Breiner et. al., 2012). STEM contains educational practices both in formal and informal settings across all levels from pre-school to post-doctorate (Gonzalez & Kuenzi, 2012). These are generally active learning practices that promote student engagement in learning process, increase academic performance and facilitate interaction between the students and instructors (Erol, Ozcan & Luft, 2016).

Aforementioned ALC initiatives fall under *studio* style classroom. In these classrooms, physical design of the room is different; students sit together and look at each other (Perkins, 2005) and the environment is quite interactive (Gottfried, 2007). Although it covers small number of topics in the course book, it enables students to comprehend the concepts deeply and supplies a higher order thinking skills because lab and lecture are combined and no major problems were reported by the researchers who studied in it (Perkins, 2005). The pedagogy of this classroom is based on peer instruction (Kohl, 2012) learning cycles, active learning, scientific research, and cooperative learning (Gottfried et. al., 2007). The research show that studio teaching promotes better learning, improve student attitudes, and result in better grades (Beichner & Saul, 2003; Perkins, 2005), gains in problem-solving skills and exam performance (Kohl & Kuo, 2012).

Aim

Among the studio type classrooms, some are commonly and successfully implemented, especially in STEM courses, such as SCALE-UP (Student Centered Active Learning Environments Upside Down Pedagogies, initiated in North Caroline State University), TEAL (Technology Enabled Active Learning, initiated in Massachusetts Institute of Technology),TILE (Transform, Interact, Learn, Engage, initiated in University of Iowa), and Next-Gen ALC v2.0 (Next Generation Active Learning Classroom, initiated in Dawson College). These ALCs have very similar characteristics with each other. They are technology-enhanced and contemporary environments that promote active and engaged learning. The students are grouped in these classrooms; they sit around tables and have laptops on them. There are projectors, smart boards and screens on the walls; also each group has their own boards. These ALCs are student-centered in their nature, students work actively and collaboratively; and the instructor guides and facilitates students' learning (Benson et. al., 2007; Beichner, Dori & Belcher, 2006; Florman, 2014) Therefore, they enable flipped instruction, hands-on activities, and collaborative learning.

This literature review aims to analyze these ALCs in terms of some aspects such as class design, technology incorporation, teaching and learning processes, and challenges. For the examination of these classrooms, an extensive research has been carried out on active learning classrooms and technology incorporated educational environments. Then, contemporary ALCs used in STEM courses have been compiled. The ALCs analyzed in this study are SCALE-UP, TEAL, TILE and Next-Gen ALC v2.0. These ALCs have been deeply investigated in terms of their physical medium, pedagogical approach, grouping and assessment procedures, teaching and learning processes, and challenges. At the end of the study a comparison between traditional classrooms and ALCs are made.

Undoubtedly, there may exist a great number of ALCs around the world and they can have significant differences from each other. This study is limited with prominent ALCs mentioned above. However, it gives a general perspective about the characteristics of ALCs, especially to use in STEM courses. Beichner, Dori & Belcher (2006) state STEM instructors should follow the contemporary approaches. This study will help STEM instructors and educational authorities to learn the characteristics of and to be aware of contemporary ALCs. It is also hoped that this study will contribute to the implementation and dissemination of ALCs.

Exemplary Active Learning Classrooms

Some of the exemplary technology incorporated contemporary ALCs successfully implemented in STEM instruction are SCALE-UP, TEAL, TILE, and Next-Gen ALC v2.0. All these classrooms are similar to each other and they have distinctive properties from the traditional classrooms in many aspects. The characteristics of these ALCs have been analyzed under several themes such as class design and technology incorporation, pedagogical approach, lectures and curriculum coverage, teaching and teaching staff, learning and students, hands-on activities and experimenting, assessment, and challenges.

Class design and technology incorporation

The main aim of these ALCs design is to engage the students in active learning. Lecture time is spent in a special technology incorporated medium (Beichner et al., 2007; Gaffney et al., 2008). Based on the enrollment, the room may involve small or large number of students (eg. 36-99, or even more) sitting on round tables. Each table accommodates 9 students in 3 groups having their own laptops with internet. There are whiteboards, multiple projectors and screens on the walls so that every student has a view (Singer, Nielsen & Schweingruber, 2012). The instructor has a sympodium with interactive digital pen display, linked to projectors (Benson et. al., 2007). The students are exposed to a mixture of desktop experiments, cooperative activities, presentations, and web-based assignments. The desktop experiments and computer-aided analysis of experimental data allow the students have direct experience of various phenomena (Dori et. al., 2003). The Next Generation ALC v2.0 of Dawson College was based on providing a dedicated multi-touch interactive white board to each student group, and an asymmetrical truncated circle table design born while trying to promote peer collaboration. A “horseshoe” arrangement was developed to have larger space for activities (Charles, Whittaker & Lasry, 2014).

Pedagogical approach

Active learning is the way of instruction that rooted in constructivist and social constructivist learning theories (Charles, Whittaker & Lasry, 2014). Effective implementation of authentic learning centering upon daily life experience is the pedagogical approach of ALCs. They emphasis on learning by guided inquiry rather than sitting and listening the instructor. Team based active learning (Johnson, 1991) and in-class learning by guided inquiry (Lee, 2004) approaches are used in ALCs (Benson et. al., 2007). The ALCs help students concretize the content with the desktop laboratory experience in a media-rich classroom and use collaborative and active learning (Dori et. al., 2003). In ALCs, the teams are constituted to be heterogeneous within groups, but homogeneous across groups (Beichner, Dori & Belcher, 2006). They focus to increase student-faculty interaction and engagement (Van Horne et. al., 2014).

Lectures and curriculum coverage

In these ALCs mini-lectures are replaced with full period lectures (Benson et. al., 2008). During the class, lecture time is reduced to about 15-20 minutes (Benson et al., 2009; Oliver-Hoyo and Beichner, 2004; Perkins, 2005) at the beginning of the class period. The reduced lecture continues with group learning activities, and the students are generally more motivated than the ones in other sections (Benson et. al., 2007). Many studies support the notion that "less is more," meaning that exposing students to less information can result in better learning (Tobias, 1990; Dempster, 1993; Nelson, 2001; Fratt, 2002; D'Avanzo, 2003; cited in Perkins, 2005).The content covered is less than traditional class but the learning is greater (Perkins, 2005).

Teaching and teaching staff

ALCs have not only one instructor, but also some teaching and learning assistants. The instructor and teaching assistant(s) roam the facility and asks questions (Beichner, Dori & Belcher, 2006). Modules of the content should be relevant to daily life experience and be prepared as activities do be carried out in the classroom. The instructor assigns activities and then visits each table, engages students in conversations about their work

(Beichner, Dori & Belcher, 2006). Learning assistants, upper-grade undergraduates, may serve as coaches asking leading questions, answering questions, and formatively assessing student work for the benefit of students and to inform instruction (Benson et. al., 2007).

Learning and students

ALCs have specialized active learning format that relies largely upon social interaction among students, instructor, and learning assistants (Benson et. al., 2008). In some studies, this format has resulted in an improved retention rate (Benson et. al., 2007) and it has increased the learning gains significantly (DeBeck & Demaree, 2012; Dori et. al., 2003). Student have also favored the teaching methods and the course activities and had positive comments after the course (Benson et. al., 2007). Carefully planned high engagement learning activities take place in ALCs like discovery learning and inquiry-based learning (Benson et. al., 2008), they shift learning process from a teacher-centered to a student-centered one (Beichner et al., 2007; Gaffney et al., 2008).

Hands-on activities and experimenting

In ALCs, students engage in hands-on activities and they have experience with computer simulations, work cooperatively on problems, and conduct hypothesis-driven experiments. (Singer, Nielsen & Schweingruber, 2012). They introduce a laboratory component into the courses (Dori & Belcher, 2005; Beichner, Dori & Belcher, 2006). The virtual experiment can be performed by the students (Beichner, Dori & Belcher, 2006).

Assessment

Monitoring the real time assessment of students by the teaching staff is central to these ALCs. Formative assessments are carried out during the learning activities (Benson et. al., 2008) and instructors can easily assess the conceptual understanding of students (Beichner, Dori & Belcher, 2006). Grades in the ALCs are not curved. Because collaboration is an element, it is important the class not be graded on a curve to encourage students with stronger backgrounds to help students with weaker backgrounds (Beichner, Dori & Belcher, 2006).

Some Challenges

In addition to success of the ALCs, there are some challenges regarding to shift from a traditional class to a contemporary technology incorporated active learning classes: (1) All course materials, like lecture notes, projects, exams may need a redesign (Perkins, 2005). (2) Preparation of the instructors takes lots of time and planning must be well done (Van Horne et. al., 2014; Perkins, 2005). (3) The classes are student focused; it sometimes requires giving up an uncomfortable amount of control (Perkins, 2005). (4) Planning class time to cover all the necessary topics are not easy, instructors reminds the deadline of the activities (Van Horne et. al., 2014). (5) The instructional team (instructor, teaching and learning assistants) needs extra skills. (6) A better professional development program is required for instructional team. (DeBeck & Demaree, 2012). (7) Some teaching strategies (eg. whole class discussion) may not fit ALCs (Van Horne et al., 2014). (8) Staff reluctance and lack of experienced personnel may be encountered. (9) Scarce of the financial resources may be a problem.

Active Learning Classrooms vs. Traditional Classrooms

While the ALCs analyzed in this study have similar features with each other, they distinct from traditional classroom environments significantly in many aspects. Therefore, a comparison between the ALCs and traditional classroom is needed to show their differences. Table 1 compares the characteristics of traditional classrooms with ALCs, with reference to the literature. As traditional classrooms are common and well-known, their features have not been referenced.

Table 1. Traditional classrooms versus technology incorporated active learning classrooms (ALCs)

Dimensions	Traditional Classrooms	Technology Incorporated ALCs
Physical environment	Classical classroom design enabling only instructor-student interaction	Large enrolled (Beichner et. al. 2000; Beichner & Saul, 2003; Benson et. al., 2007; Rogers et. al., 2015), comfortable (Beichner & Saul, 2003), round tables with nametags (Gaffney et. al., 2008), interactive environment (Van Horne et. al., 2012; Florman, 2014) visualized (Beichner,1999; Dori et. al., 2003)
Lectures	Lecturing through the 50-90 minute classes	Lecturing reduced to about 10-20 minutes (Benson et al., 2009; Oliver-Hoyo & Beichner, 2004; Perkins, 2005)
Technology incorporation	Supportive tools like smart boards, projectors etc.	Ultimate level of technology incorporation (team or student laptops, instructors station, projectors, video and document cameras, TVs,

		clickers, software, etc.)(Beichner at. al., 2000; Oliver-Hoyo & Beichner, 2004)
Activities	Individual and group activities, question-answer, problem solving	Out-of-class readings, group discussions, hands-on activities, internet search, Socratic dialogues (Beichner, Dori & Belcher, 2006; Benson et.al., 2007)
Laboratory activities	Separate laboratory hours, individual or group works in lab.	Laboratory works integrated to the lectures (Gaffney et. al., 2008; Perkins, 2005), team work (Beichner,1999)
Curriculum coverage	More topics can be covered	Essential topics can be covered in great depth (Perkins, 2005)
Grouping	Rare or none	Students work in groups (Gaffney et al., 2008).
Responsibility	Teachers are responsible for students' learning	Students take learning responsibility (Beichner et. al., 2000; Gaffney et al., 2008)
Instruction	Teacher – centered	Minimized lecturing, peer instructions, student-centered (Benson et al., 2007)
Learning	Passive learning	Active learning (Beichner, 1999), peer review, critique (Perkins, 2005), research environment (Kohl & Kuo, 2012), team based (Benson et al., 2007), group learning activities (Gottfried et. al., 2007), inquiry learning (Oliver-Hoyo & Beichner, 2004), collaborative learning (DeBeck & Demaree, 2012),
Instructor	Lecturer, authoritarian, active through the class	Mentor, acts as learning guides, provides materials (Perkins, 2005), assigns activities, walks from table to table, engages students (Beichner, Dori & Belcher, 2006)
Teaching assistant	Separate lab or recitation role	Roam the facility, asks questions (Beichner, Dori & Belcher, 2006), provides materials (aid instructor) (Perkins, 2005)
Learning assistant	No LA	Serves as coach, answers questions, asks leading questions, and formatively assesses student work (Benson et al., 2007)
Student	Passive learner, no interactions with peers, motivation is difficult	Active learner, group member (Perkins, 2005), generally more motivated (Benson et al., 2007)
Assessment	Classical exams: quizzes, mid-term exams, final exam	Formative assessment, real time assessment (Benson et al., 2008)
Basic challenges	Teacher-centered, generally monotony medium, boring for students	No lecture notes (Beichner et al., 2000), preparation of instructors takes lots of time, planning must be well done, sometimes uncomfortable amount of control (Perkins, 2005), classroom management needs extra qualification, the efficacy is limited by the skill of the instructional team, professional development program is desired (DeBeck & Demaree, 2012).
Benefits	Economic space, no need for extra qualifications for the staff	Team work ability (Beichner & Saul, 2003), higher cognitive skills (Oliver-Hoyo & Beichner, 2004), communication skills (Erol, Özcan & Luft, 2016), critical thinking (Beichner,1999), scientist students (Handelsman et al., 2004), presentation skills (Beichner et al., 2000)

CONCLUSION

In the last years, an extensive change has been occurring regarding to educational environments. This change is seen especially in STEM courses with the emergence of approaches like active learning, collaborative learning, flipped instruction, etc. Therefore, educational authorities, teacher trainers and STEM instructors must be aware of these approaches and classrooms.

Technology incorporated contemporary ALCs held in this study are technology-rich environments that may be large-enrolled and enable a great number of students become active at the same time. These ALCs adopt a constructivist approach and students have daily life experiences by doing experiments, research and hands-on activities. Lecture in the ALCs is generally minimized; however they result in better student performance and more learning. There may be more than one staff (the instructor) in these ALCs such as teaching and learning assistants. They do not teach; rather, they guide students' activities and facilitate their learning. Formative assessment takes place in ALCs and students' collaboration and engagement in activities and group works have also importance for grading. Compared to traditional classrooms, ALCs have been proved to yield better results in terms of learning, retention and affective dimensions.

Besides the advantages above, ALCs have some challenges. It may be hard for both instructors and students to adopt an ALC who are accustomed to traditional learning environment. Although they are student-centered and may seem easy to handle for instructors, they require substantial time and effort to prepare for the courses and to instruct them. Moreover, curricular and instructional materials should be adopted for these ALCs, and they will need more financial resource.

In order to overcome the challenges, teacher education programs should be revised and in-service training activities should be carried out. Additionally, the authorities should invest in comfortable classrooms and contemporary technological tools. Also, continuous faculty encouragement programs should be an academic culture to introduce and use ALCs.

STEM instructors may use the ALCs analyzed in this study. They may also be suitable for other courses rather than STEM with minor changes, even for social sciences. Change may be a challenging and slow process, especially for the ones who are accustomed to traditional; however, it is a prerequisite in this age where rapid changes are emerging. When the educational stakeholders take a decision for change, the success will likely to come.

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REVIEW ANALYSES OF THE USE OF TECHNOLOGY ENHANCED EDUCATION IN TEACHING IN SCHOOLS IN MACEDONIA IN ALBANIAN LANGUAGE

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ABSTRACT: The research focus in on reviewing and analyzing the current usage of ICT in teaching in schools in Macedonia in Albanian language. Despite the fact that schools are currently undergoing a rapid development technological some have already completed, are equipped with cabinets and computer labs are supplied with internet, created the platform for teaching electronics, some schools have created web sites their were part of the pilot projects: e-school, e-learning, are supplied with cabinets and contemporary laboratories of many other developments that will impact on achieving the best possible, but teaching by using the benefits that technology provides in most cases is not the desired level, so it is efficient but followed the traditional form despite reforms that are being made. Technology opportunities and resources that schools have available, not rationally utilized and maximized by teachers who should lead these processes. Therefore this research provides insights into most used technologies for teaching that could be beneficial also for other regions as well. The insights and recommendations have been provided and discussed.

Key words: instructional technologies, technology enhanced education, review of technological opportunities

INTRODUCTION

New technologies are constantly arising and they influence the way how people interact and learn. Recent developments in digital technologies, especially web 2.0 tools such as blogs, wikis and social media, and mobile devices such as smartphones and tablets, have given the end user, the learner, much more control over access to and the creation and sharing of knowledge. This empowers learners, and innovative instructors are finding ways to leverage this learner control to increase motivation and relevance for learners.

Information and communication technology represents one of the main areas in contemporary human life and especially in teaching, is an integral part of his daily activity and aim readiness to deal with the problems of the present and future . Information technology and communication is a continuation and extension of previous knowledge in this field and has to do with the acquisition of knowledge and skills necessary for successful use and independent hardware information technology and communication (ICT), use respective programs can be edited, created, designed and published web pages with various data via internet (Brooker, 2003)

Through this web-pages aim to provide examples of different learning and that these examples and help teachers explanation as students learning through practical examples and easier to understand and become familiar with many more subjects.

In higher education, information and communication technology, has enabled the lectures, seminars and various presentations, exams etc., Held in the form of so-called "online" despite the remoteness of the facility ie there is no reason to justify ourselves in this long-distance educational institutions, so the only condition to be fulfilled is to have communication infrastructure that is appropriate for internet and communication programs.

Use of websites being implemented in all the vital processes as a vital necessity for the development of knowledge worldwide. Even in the sphere of education, as in every area of life, the use of websites has brought about a radical turn in the development of a culture of learning, making knowledge more advanced and more accessible, increase skills conceptual and perceptual students during class, facilitating learning.

All this it enables progress independent development, brings dynamism in teaching / learning, promotes and develops training as communication, mathematics, foreign languages, social studies, programming, design, critical thinking and finding election problems of different nature, use multiple sources etc., for all students.

New Demands of a Knowledge-Based Society

There are several separate factors at work here. The first is the continuing development of new knowledge, making it difficult to compress all that learners need to know within the limited time span of a post-secondary course or program. This means helping learners to manage knowledge - how to find, analyze, evaluate, and apply knowledge as it constantly shifts and grows.

The second factor is the increased emphasis on skills or applying knowledge to meet the demands of 21st century society, skills such as critical thinking, independent learning, knowing how to use relevant information technology, software, and data within a field of discipline, and entrepreneurialism. The development of such skills requires active learning in rich and complex environments, with plenty of opportunities to develop, apply and practice such skills. Lastly, it means developing students with the skills to manage their own learning throughout life, so they can continue to learn after graduation.

Analyses of Web Quests

A Web quest, "according to Bernie Dodge, author of the WebQuest concept," is an activity-oriented in which most or all of the information used by learners is drawn from the web. Web quest are designed for use in leisure, focus on using information rather than looking for it, and to support students in thinking at the levels of analysis, synthesis and evaluation (Condie, et al 2007).

Web Questa are simple websites, where they can be built with any software that allows to create websites. Users of information and communication technology can develop code in Notepad or Notepad ++ is the most advanced, while the used templates that offer p.sh Microsoft platform or OpenOffice. More advanced developing Web software, they are numerous and by combining, but are recognized as Dreamweaver, FrontPage, etc.

There are pages of various websites that are geared specifically to enable the creation of web Questa, as Questgarden, Zunal, Teacherweb, etc., All these allow the teacher to create and modify those for the student to be more understood. These web sites offer less control over the design, but they make the creation process more simple and direct.

Methods for creating web Questa are easier than thought, so always looking to make a web quest but not sure where to start. Therefore, the use of information technology and communication has concrete answers and can make the process easier for the activity in question. Web quest are probably the most talked about activities and widely used web-based nowadays, which are used for constructive approach to learning and a deeper knowledge of specific topics. Through the use of web Questa students are not limited to learning to take only from books, brochures, magazines, etc., From which students would benefit and also used their imagination to solve various problems being detected or established method of easy to use. So, the creation and completion of a quest-Web is a very effective way that students can use the computer. This includes strengthening the two forms and more powerful electronic tools that have recently it is: the Internet and related programs. Web quest is a demanding task for which material should be used that are online and other materials also. Each student has one or more roles and have to use language constantly during operation of the task (Mazrek, 2015).

Communication, teamwork, problem solving, and critical skills and creative thinking are becoming more important in today's world than having students who learn by heart the default content. Web Questa allow students to seek and find what there is in the subject and enrich any elements to it that topic and that will be to the benefit, to do more than learning information by heart, but meaningful . Here, teachers can express their ability to make changes in the curriculum to accommodate different needs that students understand and remember for a long time.
Distinctive features - web Questa distinguished from others based on the Internet site of three features, such as:

• Web questi is based class
• Web questi emphasizes their thinking (such as analysis, criticism kreativitete or different)

• The teacher selects the appropriate resources, emphasizing the use of information

The purpose of the web Questa group work is accomplished by dividing the roles and tasks. Questa web structure - composed of five essential parts, such as:
• Introduction
• task
• process
• sources
• Evaluation and conclusion

Questa web tasks - their duty is to be a description of what will introduce a web quest.
Process - shows the steps of the processes through which has passed to achieve successful introduction of adequate material and examples.
Resources - in order to provide a better presentation of the web Questa should take into account other relevant sources.
Evaluation - ways of presenting web Questa students for specific projects will be evaluated, their preparation and presentation must be fair, clear, consistent, comprehensive specifications for certain tasks adequately.

Questa uses the web in education - teachers use web Questa for:
• Keep children active at a certain time using the Internet (student activities organized by Questia web and they can stay focused on the use of information rather than find it)
• Makes students to think in a higher level of analysis, synthesis and evaluation,
• Critical thinking and problem solving through authentic assessment, learning group,
• Motivating students to learn independently,
• Familiarity with technological components,
• Provision of guidance, through which solved problems and ideas arise for the use of other resources to better understanding,
• Increasing the skills and the development of thinking, etc.

Blogs

BLOG is the acronym of "WEB" and "LOG". Blog is a website which is maintained by a person who continually enriches with different information on the subject which elaborates. Information that can be edited are different formats like text, pictures, audio, video, etc., Where the content of the information displayed in chronological order form. Information Technology, blog made one of the most common forms for the preparation of web-websites nowadays, relying on methods of creating BLOG's and maintenance, maintenance is easy and does not It requires a deep knowledge of ICT. Viewed from a practical perspective, Blogs is a personal online diary where teachers can write on topics that have to be explained to students and bloggers threads (teachers) can be varied and rich with examples. Web journals dealing with one or more subjects in which visitors can write commentaries or ask questions. Each can in a simple way and without any special technical knowledge to show their opinion. The contents change frequently and this makes the web more popular journals (Duhaney, 2001). In addition BLOG can be seen in the format micro blogging by posting on social networks: Facebook, Twitter, Video Blogging etc.

RESEARCH METHODOLOGY

The research methodology used is quantitative research. Primary quantitative data has been mainly collected from questionnaires particularly designed for this research which has been distributed to the management and administration of school institution.

The target group were teachers of different subjects and school levels, schools, urban and rural, high school, vocational school, art school and special school (school for children with special needs).

The research methodology is based on the questionnaire instrument which has been distributed to educational institutions in the municipality of Mitrovica. The questionnaire consisted of 32 questions, where: 9 questions – consisting basic information and other questions have been distributed for assesing the specific impacting factors.

35 Questionnaires have been distributed to school Principles and recived 34 of responses from them. 550 electronic questionnaires have been sent through e-mail to teachers and recived only 115 responses and waited approximately 3 months for the responses.

RESULTS AND FINDINGS

Access to computers - Based on the results presented from the survey results that all schools are equipped with computers, which is an indication of very important on the one hand and a disturbing indicator on the other hand, since the level of use their very low.

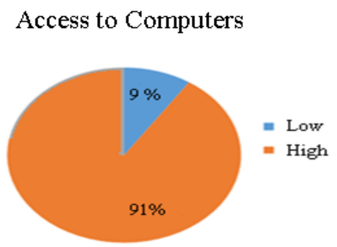

Figure 5. Analyses of Access to Computers

Long experience as Director, Computer possession, following some training in technology is inconsistent with the level of full use of technology for the management and creation of climate use in schools.

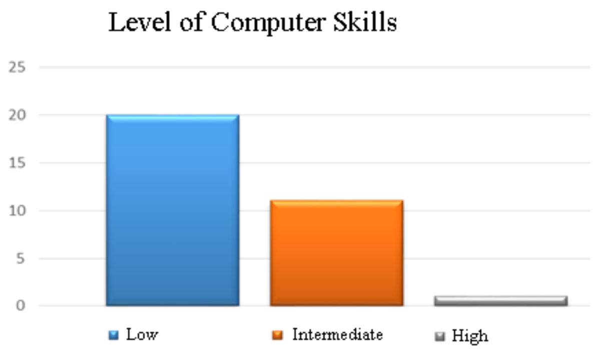

Figure 6. Analyses of Computer Skills level

Computer skills - from 63% of directors have little knowledge in the use of technology, despite the fact that all possessed a computer, 34% and 3% average knowledge of enjoyable knowledge. The following image is reflected in the rate of computer ownership by directors.

Website - figure 50% of those who are beginners in the use of the Internet is alarming, because all communication nowadays is oriented towards and through Internet technologies. Everything in the world of technology today is preceded by communication via the Internet. Development and advancement of all processes that occur in school is dependent primarily by communication through internet technologies.

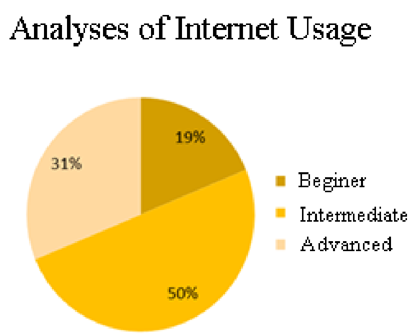

Figure 12. Analyses of Internet usage

Reports - Measure the percentage of 91% electronic reporting is inconsistent with the computer skills of directors. To this percentage is due to staff-subordinate directors engage others to prepare reports on electronically.

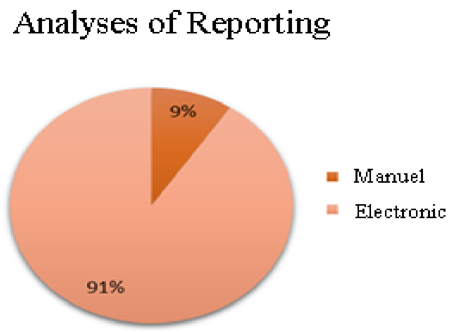

Figure 13. Analyses of Reporting

Compiler reports - greatly principals hire teachers for the preparation of reports. This result gives us realize even one of the reasons why the level of technology use is low, so they are upheld to their subordinates and this did not make them to engage and commit themselves more in the use of technology, given the fact that they have the legal obligations which sets out the duties of school principals, as p.sh management database to school, reporting through EMIS 1 -s, statistical reports, descriptive, analytical etc. The figure shown on the next page, seen rates makers electronic medical reports.

Delays reports - Clearly not the best approach to technology affects the delayed reports. These delays cause reporting problems because they know that these reports have their hierarchy of school - education director - Minister.

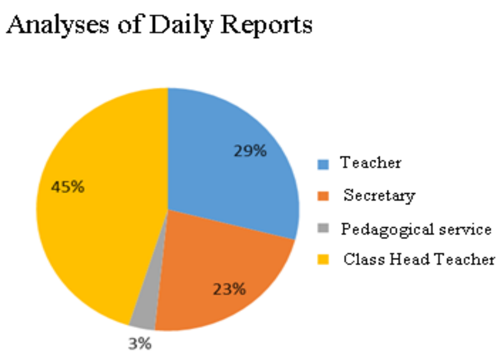

Figure 14. Analyses of Daily Reports

Communication - The tabular overview of this communication appears that the directors of subsidiaries engage in most cases teachers stand out because the result that 44% of the media use that is inconsistent with the level of use of technology by the directors.

Table. 1. Coverage of exploitation technologies of communication directors expressed in numbers and percentages

Coverage of exploitation technologies of communication directors expressed in numbers and percentages		
Communication technologies	Nr.	%
Phone	2	6
Phone & Hard Copy	3	10
Phone, mail Hard Copy &	11	34
Phone, mail & Social Networks	2	6
Phone, Hard Copy, mail & Social Networks	14	44

The outlook for technology - indicators that give positive signs for the use of technology and its integration in school is the fact that all the directors in question "Will the use of technology to help management" responded positively. This gives with the understanding that they are aware of the role that the use of technology to facilitate the performance and management duties in their schools. In relation to the degree of knowledge and experience in their results that only an opinion declared not a necessity in which you should invest continuously in this direction. Directors have the opportunity to invest in knowledge for technology to do without can be large, since all possess computer, are all the time in school, have teaching technology from whose experience can benefit, provided various trainings can cooperate with each - other.

Table. 2. Coverage of exploitation technologies of communication directors expressed in numbers and percentages

Blogs	Description
http://informatikabizz.blogspot.com/	different information about informatics
http://www.networkedblogs.com/blog/itshqip	different information about computers and ICT in general
http://it-albania.blogspot.com/	different information about information technologies
http://bloguipare.blogspot.com/	informacione të ndryshme rreth informatikës
http://unitedcolorsofaulona.blogspot.com/2013/03/une-jam-nje-bloggere-shqiptare.html	different information about blogs usage
http://www.kuzhinashqiptare.com/blog/	different information about kitchen
http://kulturashqiptare.blogspot.com/	Informations about culture
http://keshilla-shqip.blogspot.com/	Informations regarding different advices
http://blogshqip.blogspot.com/	Blogs in alabnaina language
http://mesoni-anglisht.blogspot.com/2014/06/follow-me.html	Learning English language for Albanians
http://k-morina.blogspot.com/	Learning German language for Albanian

Blogging is a great way to share what is happening in the classroom to the wider world and to engage students in authentic communication. With good use of the tags and categories, it is also a great way to organize web-based resources. The graph below gives the countries that use edublogs education, this survey has been conducted in the period 2014/2015 (Mazrek, 2015), in which it is clear that the US dominates in popularity and use of blogs in education for treatment of topics various educational.

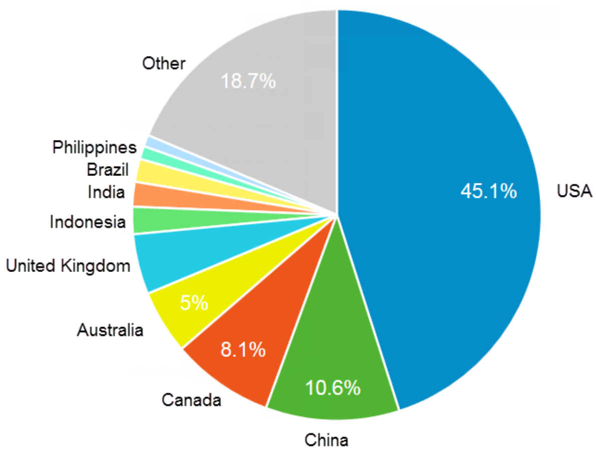

Figure 1. Analyses use of blogs in the world level

CONCLUSIONS & RECOMMENDATIONS

Information and communication technology knows no tradition but innovation and innovation. Therefore, the use of the benefits offered by technology in teaching, will affect students will learn and achieve more objectives of the course and quickly through attractive examples that teacher will be presented on various subjects, compared with traditional methods and tools.

With the use of technology which is understood as the implementation of equipment and various tools in the learning processes not only students will benefit more and prepare better for the future but it is welcome and makes it easier for themselves teachers in communication, critical thinking and problem solving as well as organizing various working groups that are essential nowadays, this will achieve more than just reading or writing.

The necessity of the use of technology in all aspects and levels of education starting from the fact of the generations before preparing to become familiar with the technology and to achieve success in all walks of life day by day which is being led by the information.

The need and reason of the application of ICT in education starting from the fact of preparing young people to become leaders and be successful in this society led by information. Communication skills, processing, critical thinking and problem solving and group work are essential to society and socio-economic technology of the 21st Century Education in this sophisticated environment will do more than just reading, writing or acquisition of skills arithmetic. It should also provide job skills that will help young people achieve their human potential.

Therefore, information and communication technology in education will address the changes and effects in primary education are: emphasis on the need, in the way of more effective integration of ICT in teaching methods change from traditional to interactive, hours with the evolution of the ICT application, electronic data processing and data interpretation. ICT integration is not only an opportunity but also a necessity to make the educational process more attractive. (Mazrek, 2015).

The main goal is to use the benefits offered by technology to optimize their use by various categories of potential participants as teachers, students, etc., Which represents a step very challenging, especially in the cycle low in primary where learning content must have elements that students will be reasonable and enforceable. Each school precedes development using technology and communication in all areas and communities. Using the opportunities offered by communication technology are multi-dimensional and more efficient. The possibility of cooperation between schools, whether urban or rural, regional, or global by using the technology would bring more good schools and various processes to advance in school. Using the opportunities that technology will help give the report parental school-community, business community, etc. Using the opportunities that technology offers, the school division will bring experience, professional development through online courses, video conferences, project management school, school timetables efficient management, monitoring and effective supervision, various development activities educational, creativity and innovation, problem solving, communication and mutual cooperation teachers - students, etc.

Relying on technology developments downturn, education should be a vital aspect in the learning process. Technology can affect learning in education in different ways:
• Changing the orientation of the education system, teachers as a source of knowledge for students,
• The choice of many valuable resources and usable by students,
• The possibility of distance learning (e-learning / e-learning)
• The standardization of quality in education,
• The need to better understand and implement lifelong education, etc.

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DEVISING AND ANALYZING NEW IT LEARNING MODEL MULTILEVEL ASSISTED INSTRUCTIONS- (MAI) IN DISTANCE EDUCATION

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ABSTRACT: The research focus is into proposing a new IT learning pedagogy Multilevel Assisted Instructions- (MAI) to be used in Distance Education. The aim of the new devised pedagogy MAI model is to transform today's outmoded education system, teaching and learning, to a vibrant learning ecosystem that puts learners at the center, especially in the distance education. The research study will investigate and integrate all of the following research questions: What triggers in the new pedagogy? What are the new demands of a Knowledge-Based Society? What are the new student expectations? What new technologies impose into teaching and learning? What are the advantages and pitfalls of new technologies? Can combinations of learning resources, experiences, and supports to help each learner succeed? Insights and recommendations are stated, augmented and discussed.

Key words: instructional technologies, new pedagogical model, distance education

INTRODUCTION

New technologies are constantly arising and they influence the way how people interact and learn. Recent developments in digital technologies, especially web 2.0 tools such as blogs, wikis and social media, and mobile devices such as smartphones and tablets, have given the end user, the learner, much more control over access to and the creation and sharing of knowledge. This empowers learners, and innovative instructors are finding ways to leverage this learner control to increase motivation and relevance for learners.

How nw pedagogies are transforming teaching and learning

These new developments are not emerging as neatly as the above analysis suggests, with many initiatives combining the methods listed above. Professors and teaching and learning specialists in post-secondary institutions, have been re-thinking pedagogy and designing resources, courses, and programs that benefit from new approaches to teaching and learning.

What triggers in new pedadogy

What drives the development of this new pedagogy? Changes in society, student expectations, and technology are motivating innovative university and college faculty and instructors to re-think pedagogy and teaching methods.

Three emerging Pedagogical trends

Underlying these developments are some common factors or trends:
1.A move to opening up learning, making it more accessible and flexible. The classroom is no longer the unique centre of learning, based on information delivery through a lecture.
2. An increased sharing of power between the professor and the learner. This is manifest as a changing professorial role, towards more support and negotiation over content and methods, and a focus on developing and supporting learner autonomy. On the student side, this can mean an emphasis on learners supporting each other through new social media, peer assessment, discussion groups, even online study groups but with guidance, support and feedback from content experts.

3. An increased use of technology not only to deliver teaching, but also to support and assist students and to provide new forms of student assessment.
It is important to emphasize that these are emerging pedagogical trends. More experimentation, evaluation, and research are needed to identify those that will have lasting value and a permanent effect on the system.

New Demands of a Knowledge-Based Society

There are several separate factors at work here. The first is the continuing development of new knowledge, making it difficult to compress all that learners need to know within the limited time span of a post-secondary course or program. This means helping learners to manage knowledge - how to find, analyze, evaluate, and apply knowledge as it constantly shifts and grows.
The second factor is the increased emphasis on skills or applying knowledge to meet the demands of 21st century society, skills such as critical thinking, independent learning, knowing how to use relevant information technology, software, and data within a field of discipline, and entrepreneurialism. The development of such skills requires active learning in rich and complex environments, with plenty of opportunities to develop, apply and practice such skills.
Lastly, it means developing students with the skills to manage their own learning throughout life, so they can continue to learn after graduation.

New Student Expectations

Even the most idealistic students expect to find a good job after several years of study, a job where they can apply their learning and which will also provide a reasonable income. This is especially true as tuition increases. Students expect to be actively engaged and see the relevance of their learning to the real world.
Today's students have grown up in a world where technology is a natural part of their environment. Their expectation is that technology will be used where appropriate to help them learn, develop essential information and technology literacy skills, and master the technology fluency necessary in their specific subject domain.

SURVEY ANALYSES OF LEARNING MODELLING APPROACHES

In Software Engineering mobile learning software there is evidently a lack of support for instructional techniques and pedagogical learning models, as well as procedures or guidelines how, when and for what particular situation each pedagogical learning model should be supported in the software development process and its conjunction and correlation with the instructional strategies (Fetaji et al, 2008). Instructional strategy is a very important concept that needs to be addressed because the main purpose of any learning activity should be clear to the learner (Fetaji et al, 2008). Instructional design models typically specify a method in using the technology that if followed will facilitation of the transfer of knowledge, skills and learning process (Fetaji et al, 2008). This learning dimension should provide the context of instruction and desirable outcome. The learning environments require high level of self-organization and metacognitive abilities from the learners engaged in the process of learning that should be captured by the instructional techniques. There are several instructional strategies that are currently considered: Problem Based, Project based, Inquiry-based Learning, Task based and Game based learning and (Marjanovic, 2005).

Problem based learning represents the learning that results from working with problems that needs solving. The entire learning process is set around a problem introduced and the knowledge is developed as a consequence of trying to solve the problem. Official description offered by (Lin & Tallman, 2006) generally describe it as "an instructional strategy in which learners confront contextualized, ill structured problems and strive to find meaningful solutions and learn in the process of doing it". Problem-based learning is a general approach of learning focusing primarily on solving a problem and acquiring knowledge; with project based learning students creating an end-product (Roschelle, et al 2003). Many research studies have focused on aspects of problem-posing and problem-solving as a way to motivate and teach students about science and math. Problem-based learning (PBL) is collaborative where students work in small groups learning through solving problems and reflecting on their experience.

The approach is also inquiry-based when learners are active in creating the problem. The learners are elevated to the position of analyst and problem-solver and have specific objectives and deadlines to meet. According to (Lin & Tallman, 2006) there are two critical issues involved in presenting the problem. First, if the learners are to engage in authentic problem solving, then they must own the problem. A second critical issue in presenting the problem is to be certain that the data presented does not highlight critical factors in the case. Either the problem must be richly presented or presented only as a basic question. Learning should be synthesized and organized in the context of the problem.

Project-based learning (PBL) is a model that organizes learning around projects. Definitions of "project-based instruction" include features relating to the use of an authentic ("driving") question, a community of inquiry, and the use of cognitive (technology-based) tools (Powe et al, 2009). Project-based learning is a student-centered approach to instruction in which students work in teams to complete an open-ended project. It is ideally suited to the teaching of analysis, design and implementation, especially when using object-oriented analysis and design methods (Fernandez & Williamson, 2003), but not to e-learning that provides instructional material for multiple diverse courses of a University study program which needs to be conducted via small pocket mobile devices. It is a student-centered approach of instruction in which students work in teams to complete an open-ended project. It is closely related to problem-based learning (Fernandez & Williamson, 2003). It promotes higher-order thinking skills which is not appropriate for classes of students with different knowledge and skill levels that is common for university environments. Project-based instruction is an authentic instructional model or strategy in which learners plan, implement, and evaluate projects that have real-world applications beyond the classroom (Helic et al, 2005). Projects sometimes go off track, with teachers and students pursuing questions that are peripheral to the subject matter of interest. The solution, according to (Helic et al, 2005) is to find ways for projects to centre on "learning appropriate goals."

In University environment, with class groups of vast variability and diversity of cognitive abilities, literacy level, skills and educational background of students, in order to complete the project the active students will work versus passive once will just stay without engaging themselves in the project and wait for the active once to do it. In Problem based learning, the same will occur. Passive students will just passively wait to end class without doing anything and loosing the time.

Project Based learning is instructional method that motivates learning and provides learning experiences; but, it is not appropriate for learning system accessed from a mobile device with many physical constraints to support University education.

Inquiry-based Learning according to (Lin & Tallman, 2006) represents an instructional strategy were involvement in learning implies processing skills and metacognitive abilities in order to seek answers to questions and issues while at the same time constructing new knowledge. "Inquiry" is defined as seeking information by questioning. According to (Lin & Tallman, 2006) it usually begins with posing a problem or question, followed by generating and pursuing strategies for investigating, collaborating, reflecting, and justifying the solutions of the problem or answers to the question, and communicating the conclusions.

Task-based learning is an educationally sound, effective and efficient instructional strategy for learning focusing the learning activities around tasks (Harden et al, 1996). The term "task-based learning" originated primarily from the work done in language education. The traditional way that teachers have used tasks is as a follow-up to a series of structure/function or vocabulary based lessons (Harden et al, 1996). Tasks have been 'extension' activities as part of a graded and structured course [13-what is task base]. Tasks are defined as activities that are meaning-focused and outcome-evaluated and have some real-world relationship (Venkatesh et al, 2005). Tasks can be considerate as a curricula unit so TBL perfectly suits to a university study program learning method. TBL facilitates vertical integration of the curriculum (Marjanovic et al, 2005). Tasks can be used to model activities in a subsequent work. As (Venkatesh et al, 2005) states that 'task' has generally been used not as the organizing principle of courses but as a methodological device for implementing the final step of a well-established methodological sequence. In TB learning, the learning activity is task-centered. Originally developed by (Venkatesh et al, 2005) in Bangladore, southern India (cited in Knight,), it is based on the belief that students may learn more effectively when their minds are focused on the task. TBL is learner centered where learners can work through their needs and interests and selecting materials, activities and tasks accordingly.

According to (Helic et al, 2005) the learning tasks play a fundamental role in determining the learning outcomes. According to (Venkatesh et al, 2005) it has three advantages:

1. TBL is learning built round tasks is more *effective* than traditional didactic memory-based or purely apprenticeship-type learning;
2. TBL is learning structured round the tasks is an *efficient* approach to learning;
3. TBL is likely to lead to more *relevant* and appropriate education;
4. TBL links theory with practice. The practical task becomes the starting point for the theory: in turn, theory informs and leads to a better understanding of the task (suits to curricula study program);

5. TBL provides an appropriate framework for planned education (curricula driven) where it makes explicit what is to be achieved and how the learner should do this (efficient learning);
6. A TBL approach is likely to result in greater relevance of curriculum content (appropriate for curricula learning).

TBL offers a focused and structured approach to learning and increases the learners' satisfaction and motivation, and at the other side is consonant with current theories of education (Helic et al, 2005). This is the reason we decided to implement a task-based model for the prototype.

Task-based learning offers action and reflection, while in contrast, rote learning is low in action and in reflection. According to (Helic et al, 2005) incidental learning, such as occurs in on-the-job learning, is rich in action but may be low in reflection. Classroom, or formal, learning is frequently high in reflection but low in action.

Game based learning or also lately referred to as digital game-based learning (Marjanovic, 2005) goal based scenarios and instructional games and simulations are alternatively used to describe the instructional strategy were learning activities are organized around a game or simulation. The academic community regarded game based learning as part of problem based learning using simulations and did not give much of attention in its research, and still today there are a lot of opinions in this regard (Marjanovic, 2005). Educational games and simulations are defined as activities that have rules and constraints, a goal, and an emphasis on competition and also has the additional feature of having a primary objective of enabling a student to learn either facts, skills, attitudes, or all three. (Marjanovic, 2005) suggests that transfer of knowledge is aided when students actively construct explanations for events. Perhaps the biggest benefit for game -based learning is the fact that it involves students who need to learn complex skills and need to transfer these skills to real life.

The design and development of m-learning cannot be based only in the existing practice of technology, it is necessary to understand the relation between theory and practice to ensure that the design of practice is founded on the learning theory. This concept is given in the figure below:

It describes that the different learning activities that are driven in the learning environment are supported by the m-learning instructional technologies stated above. The learning principles are formed by the learning activities to be done to produce the learning outcome. The learning activities are crucial to define the features and abilities the learning environment has to support and are supported by the technology.

Proposed Model Multilevel Assisted Instructions- (MAI)

The proposed Multilevel assisted Instructions (MAI) Model should incorporate the following attributes and is provided as Template to incorporate within the online courses.

Teaching /Learning Activity	**Instructions**
Engaging Opening / Writing	Has that something that compels attention.
The Task	Clear Question and Task. These naturally flow from the introduction and signal a direction for sophisticated learning.
Background	Clearly calls attention to the need for a common foundation of knowledge and provides needed (Web?) resources.
Roles / Expertise	Roles match the issues and resources. The roles provide multiple perspectives from which to view the topic.
Use of the Web	Uses the Web to access at least some of the following: interactivity, multiple perspectives, multimedia, current information, etc.
Transformative Thinking	Higher level thinking is required to construct new meaning. Scaffolding is provided to support student achievement.
Real World Feedback	A feedback loop connecting learners to the Real world is included in the Web page and an evaluation rubric is probably provided (early on!).
Conclusion	Clear tie-in to the intro. Makes the students' cognitive tasks overt and suggests how this learning could transfer to other domains/issues. Probably calls attention to the assumptions

CONCLUSION

In this study, the research focus was into proposing a new IT learning pedagogy Multilevel Assisted Instructions- (MAI) to be used in Distance Education. The aim of the new devised pedagogy MAI model is to transform today's outmoded education system, teaching and learning, to a vibrant learning ecosystem that puts learners at the center, especially in the distance education. The research study investigated and integrated all of the following research questions: What triggers in the new pedagogy? What are the new demands of a Knowledge-Based Society? What are the new student expectations? What new technologies impose into teaching and learning? What are the advantages and pitfalls of new technologies? Can combinations of learning resources, experiences, and supports to help each learner succeed? It is known that motivation has an important role in learning and science instruction. And also Personal beliefs affect from various fact. Research shows that designed systems used in science laboratories don't influence students' motivation toward science learning. New research design should be considered to thoroughly investigate the time of MAI multilevel assisted instructions in classroom, and teachers' strategies using the system, and students' preferences. Additionally, a well-designed instrument should be implemented to precisely measure even the minuscule effects.

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UNIVERSITY STUDENTS' UNDERSTANDING OF DENSITY AND CONCENTRATION: A CROSS-LEVEL INVESTIGATION

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ABSTRACT: In this study, it was aimed to explore all level university chemistry students, from freshmen to the students who graduated from the university chemistry departments, how students define the concepts of density, concentration, and solvation which are the fundamental and basic concepts of chemistry. Qualitative data were gathered in a test composed of 3 open-ended questions distributed to 135 university students comprising two different academic institutions: Education faculty and science and art faculty. Students were asked to provide a written description of three concepts. The data were analyzed by using both content analysis method and a concept-evaluation scheme. It was found that students had different understanding levels concerning three concepts and problems to the description of them. To add, students had the problem concerning the concept of mass which is a pre-requisite concept for density. The reason for the students' difficulties with density and concentration can be related to nature of these concepts that involve proportional reasoning.

Keywords: University students, understanding, density, concentration, solvation

INTRODUCTION

The chemistry education literature contains a large number of studies about students' conceptions about chemical phenomena and concepts. The students' understanding of the density has been thoroughly investigated at all level (Kohn and Landau 1987; Yeend, Loverude, and Gonzales 2001; Hashweh, 2016). Although density is seen a simple concept, Hashweh (2016) has indicated that it is a difficult concept to understand by middle school children and efforts to foster students' understanding are not very successful. He has investigated the reasons for the difficulties and the specific difficulties that students encounter when learning about density at the middle school level. In his study, firstly he has presented a historical account of the development of the density concept in order to show the difficulties in its development within the scientific community. Hashweh (2016) has concluded three points from this brief historical summary of the development of the scientific concept of density. One of them was that the concept itself was part of the conceptual system included many interconnected concepts. These interconnected concepts were the concepts of mass, weight, volume, and the relations between mass and motion. Yeend, Loverude and Gonzalez (2001) also found that middle school, high school, and college students harboured numerous alternate conceptions, particularly a tendency to associate mass, volume, and density with size.

The concepts of density and concentration are the fundamental concepts that occur at all levels of chemistry education from middle school to university levels. On the other hand, both concepts and difference between them are not easily grasped by the students. Density is a characteristic property of a pure substance and directly related to mass. Concentration is defined as the amount of one component in a matter which contains more than one component. There are several types of concentrations defined. However, density is often confused with concentration. When university students are asked to define the density, it can be seen that they can define the concentration instead of density. In this study, it was aimed to explore all level university chemistry students, from freshmen to the students who graduated from the university chemistry departments, how students define the concepts of density, concentration, and solvation.

METHODS

Participants

Qualitative data were gathered in a test composed of 3 open-ended questions distributed to 135 university students comprising two different academic institutions: Education faculty and science and art faculty. Students were asked to provide a written description of three concepts that is density, concentration, and solvation.

Analysis of Data

In analyzing the three questions of the test, a concept-evaluation scheme developed in previous research was used (Abraham et al., 1994; Haidar, 1997; Nakiboğlu, 2003). This scheme enables the researcher to look into the data from two points. The students' responses can be separated into different levels of understanding and misconceptions can analyze into different patterns (Haidar, 1997; Nakiboğlu, 2003). The concept-evaluation scheme used in this study is comprised of five categories listed and defined in Table 1. During these analyses misconception statements were identified using a coding system.

Table 1. The Scheme with Five Categories Used in this Study and Description of Each Category

Degree of understanding	Criteria for scoring
Sound understanding (SU)	Responses that include all components of the validated response
Partial understanding (PU)	Responses that include at least one of the components of the validated response, but not all the components
No understanding (NU)	Irrelevant responses
Misconception (MC)	Responses about concept which do not correspond to currently held scientific theory
No answer (NA)	Blank

RESULTS AND FINDINGS

Students' Understanding about Solvation

The first question was about the description of solvation concept. The solvation concept is one of the important pre-requisite concepts for learning both density and concentration. For this reason to find out the patterns of students' understandings and misconceptions of the solvation concept is important. The complete list of students' thoughts for their first question was coded and presented below in Table 2 according to the degree of students' understanding levels about solvation.

Table 2. Degree of Students' Understanding about Solvation

Degree of understanding	1st Grade (N=19) f (%)	2nd Grade (N=19) f (%)	3rd Grade (N=34) f (%)	4th -5th Grade (N=43) f (%)	Graduated (N=20) f (%)	Total (N=135) f (%)
SU	1 (5,3)	1 (5,3)	2 (5,9)	3 (7,0)	4 (20,0)	11 (8,1)
PU	13 (68,4)	11 (57,9)	20 (58,8)	33 (76,7)	12 (60,0)	89 (65,9)
NU	4 (21,0)	1 (5,3)	8 (23,5)	5 (11,6)	2 (10,0)	20 (14,8)
MC	1 (5,3)	0	1 (2,9)	1 (2,3)	1 (5,0)	4 (3,0)
NA	0	6 (31,5)	3 (8,8)	1 (2,3)	1 (5,0)	11 (8,1)

According to Table 2, 8.1 % of all students showed a SU for the solvation concept that the solvation describes as solvation is the process that a substance dissociates to ion or molecules in solvent/liquid by surrounding with solvent molecules. 65.9% of the students suggested that the solvation is changing / disintegration / dissolution / separation/ the separation of particles/ of a substance until disappearing in another substance / in a solvent/ which was considered as PU. About 3% of the students showed misconception and only one misconception statement was identified through analysis of this question. This misconception is "solvation is an amount of matter which solves in a liquid solution" and it can be said that students confuse solvation with concentration.

Students' Understanding about Density

The second question was about a description of density concept. The main goal of this question is to find out the patterns of students' understandings and misconceptions about density. The complete list of students' thoughts for the second question was coded and presented below in Table 3 according to the degree of students' understanding levels about density.

Table 3. Degree of Students' Understanding about Density

Degree of understanding	1st Grade (N=19) f (%)	2nd Grade (N=19) f (%)	3rd Grade (N=34) f (%)	4th -5th Grade (N=43) f (%)	Graduated (N=20) f (%)	Total (N=135) f (%)
SU	11 (57,9)	3 (15,8)	4 (11,8)	6 (14,0)	0	24 (17,8)
PU	1 (5,3)	4 (21,0)	13 (38,2)	8 (18,6)	7(,0)	33 (24,4)
NU	1 (5,3)	8	5 (14,7)	4 (9,3)	4 (20,0)	22 (16,3)
MS	6 (31,6)	4 (21)	7 (20,6)	25 (58,1)	9 (45,0)	51 (37,8)
NA	0	0	5 (14,7)	0	0	5 (3,7)

According to Table 3, only 17,8 % of all students showed sound understanding for this question that they described density as "density is a mass of a substance per its unit volume". While none of the graduated students described the density correctly, 57,9 % of the first-grade students showed sound understanding. In partial understanding, the students have given mathematical expression instead of definition for density such as mass to volume ratio or the mass divided by volume or d=m/V.

It can be seen from Table3, all levels students had a misconception about density. It was found that those students presented the definition of concentration instead of density. They described density with the expression of concentration such as "density is the amount of substance in per unit volume or the amount of substance in per liter".

Students' Understanding about Concentration

The third question was about the description of concentration concept. The main goal of this question is to find out the patterns of students' understandings and misconceptions about concentration. The complete list of students' thoughts for the second question was coded and presented below in Table 4 according to the degree of students' understanding levels of concentration.

Table 4. Degree of Students' Understanding about Concentration

Degree of understanding	1st Grade (N=19) f (%)	2nd Grade (N=19) f (%)	3rd Grade (N=34) f (%)	4th -5th Grade (N=43) f (%)	Graduated (N=20) f (%)	Total (N=135) f (%)
SU	12 (15,8)	10 **(52,6)**	9 (26,5)	13 (30,2)	3 (15,0)	47 (34,8)
PU	1 (5,3)	3 (15,8)	9 (26,5)	24 (55,8)	12 (60,0)	49 (36,3)
NU	2 (10,5)	3 (15,8)	5 (14,7)	5 (11,6)	2 (10,0)	17 (12,6)
MS	3 (15,8)	1 (5,3)	4 (11,8)	1 (2,3)	0	9 (6,7)
NA	1 (5,3)	2 (10,5)	7 (20,6)	0	3 (15,0)	13 (9,6)

According to Table 3, 34,8 % of all students showed sound understanding for this question. 9% of students had the misconception that one of them was "concentration is the case that the components of a substance are dense".

Comparison of Students' Understanding about Density and Concentration

The results of comparison of the students' understanding level about density and concentration are presented in Table 5.

Table 5. Frequencies of Students' Understanding about Density (D) and Concentration (C)

Degree of understanding	1st Grade D/C	2nd Grade D/C	3rd Grade D/C	4th -5th Grade D/C	Graduated D/C	Total D/C (%)
SU	11/12	3/10	4/9	6/13	0/3	24/47 (17,8/34,8)
PU	1/1	4/3	13/9	8/24	7/12	33/49 (24,4/36,3)
NU	1/2	8/3	5/5	4/5	4/2	22/17 (16,3/12,6)
MS	6 /3	4/1	7/4	25/1	9/0	51/9 (37,8/6,7)
NA	0/1	0/2	5/7	0/0	0/3	5/13 (3,7/9,6)

According to Table 5, both SU and PU levels of concentration concept were higher than density concepts'.
Most of the students confused density with concentration.

CONCLUSION

It was concluded that all level of students' understanding about concentration were higher than the degree of understanding about density. When the students asked to define the density it was determined that most of the students defined the concentration instead of density. Smith, Carey, and Wiser (1985) indicated that the difficulty with density arises mainly from undifferentiated conceptions that become differentiated within a new conceptual system. It was also found that all students had the misconception about density. Most common misconception identified in this study was that "density was the amount of a matter in the unit volume". Besides, most of the students' responses about density indicated NU contains irrelevant answers.

RECOMMENDATIONS

Before teaching density and concentration to students, students' pre-requisite knowledge about these concepts (solvation, mass, volume and mole, mole number) was examined and corrected. Density and concentration concepts which are used together in some calculations should be kept on the agenda and repeated in all level. Differences between concentration and density should be clarified.

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TEACHING FRACTIONAL ORDER CONTROL SYSTEMS USING INTERACTIVE TOOLS

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ABSTRACT: Much of subjects being taught in a first course on control theory in Electrical and Electronics Engineering appears to have changed little. Although the basic theories, methods and applications on classical control in textbooks remain unchanged, there have been many new developments in the field of control theory in recent years. One of such topic is fractional order control systems which is based on fractional order calculus and can be used to model physical system more exactly than integer order systems. The purpose of this paper is to show how fractional order control methods can be introduced into a first course on classical control using interactive tools such as Matlab and LabView.

Key words: Education, Control Theory, Fractional Order System, Iteractivity, LabVIEW

INTRODUCTION

The subjects being taught to undergraduate students on automatic control, despite advances in the field of control theory, seem to have changed little over last many years. However, developments in computer technology now allow us to use new and high-quality educational methods such as interactive tools, virtual and remote laboratories to make use of World Wide Web etc. (Dormido, 2002). Today's computer software programs such as Matlab and LabVIEW can be used effectively to teach some advanced subjects to the students without going into details of mathematical derivations. Although the fundamental control theory concepts known as classical control theory are necessary for control theory education and because of its many advantages we think this must continue in the future, it will be important that any developments in control theory which can be linked to classical control are good candidates for consideration in basic feedback control education by using interactive tools. The interactive tools are extremely useful and they enable students to explore changes in system performance as parameters are varied, and to do so looking at several diagrams simultaneously. This can be done without any programming by just using a mouse to adjust any parameters and the effects can be immediately seen. Matlab, LabVIEW and Simulink provide an excellent environment for such studies to teach additional topics besides subjects of classical control theory.

One such topic is the recent development in methods to analyse systems using fractional order calculus (Das, 2008; Podlubny, 1999a). This is an important topic since most real physical system can be modeled more adequately by fractional order differential equations. The applications of fractional order differential equations to the problems in the control theory have been increased in recent years and promising results have been obtained (Xue et al., 2007; Monje et al., 2010). It has been shown that there is a strong link between classical control methods and fractional order approaches. Therefore, from educational point of view, it is important to teach developed results based on fractional order calculus to see the effects of fractional order integrator and derivative on control system performance. The purpose of this paper is to show how the results based on fractional order concepts can be introduced into a basic classical feedback control theory course given for undergraduate students and the teaching can be supported by software tools.

The layout of the paper is as follows. In the next section the concept of fractional order system is introduced and examples are given. Section 3 discusses the teaching of fractional order control systems using Matlab and LabVIEW with application examples. Finally some conclusions are given in Section 4.

FRACTIONAL ORDER CONTROL SYSTEMS

Fractional order derivative and integrator can be considered as an extension of integer order derivative and integrator operators to the case of non-integer orders and it is defined in general form as the following (Chen et al., 2009),

$$ {}_aD_t^\alpha = \begin{cases} \dfrac{d^\alpha}{dt^\alpha} & \alpha > 0 \\ 1 & \alpha = 0 \\ \int_a^t (d\tau)^{(-\alpha)} & \alpha < 0 \end{cases} $$
(1)

where, ${}_aD_t^\alpha$ represents fundamental non-integer order operator of fractional calculus. Parameters a and t are the lower and upper bounds of integration, and $\alpha \in R$ denotes the fractional-order (Oustaloup et al., 2000). Two definitions used for the general fractional derivative and integrator are the Riemann-Liouville definition and the Caputo definition (Chen et al., 2009). The Riemann–Liouville definition for the fractional-order derivative of order $\alpha \in R$ has the following form

$$ {}_aD_t^\alpha f(t) = \frac{1}{\Gamma(n-\alpha)} \frac{d^n}{dt^n} \int_a^t \frac{f(\tau)d\tau}{(t-\tau)^{\alpha-n+1}} \tag{2} $$

where $\Gamma(.)$ is Euler's gamma function and $n-1<\alpha<n,\ n \in \mathbb{N}$. An alternative definition for the fractional-order derivative was given by Caputo as

$$ {}_aD_t^\alpha = \frac{1}{\Gamma(n-\alpha)} \int_a^t \frac{f^n(\tau)}{(t-\tau)^{\alpha-n+1}} d\tau \tag{3} $$

where $n-1<\alpha<n,\ n \in \mathbb{N}$. The Laplace transform of the Caputo fractional order derivative has the following result that is particularly significant for fractional order system modeling (Monje et al, 2010):

$$ \int_0^\infty e^{-st}\, {}_0D_t^\alpha f(t)dt = s^\alpha F(s) - \sum_{k=0}^{n-1} s^{\alpha-k-1} f^{(k)}(0) $$
(4)

When $f(0) = f^{(1)}(0) = f^{(2)}(0) = f^{(3)}(0) =,.., f^{(n-1)}(0) = 0$ is considered, a basic property facilitating for design and analysis of fractional order systems is expressed for Laplace transform of fractional order derivative as $L\left\{D^\alpha f(t)\right\} = s^\alpha F(s)$.

In general, fractional order LTI systems were described by the following fractional order differential equation form as (Monje et al, 2010):

$$ v_n D^{\alpha_q} y(t) + v_{n-1} D^{\alpha_{q-1}} y(t) + ... + v_1 D^{\alpha_1} y(t) + v_0 y(t) = u_p D^{\beta_p} r(t) + u_{p-1} D^{\beta_{p-1}} r(t) + ... + u_1 D^{\beta_1} r(t) + u_0 r(t) \tag{5} $$

By applying $L\left\{D^\alpha f(t)\right\} = s^\alpha F(s)$, a general form of transfer function of fractional order LTI systems were expressed as,

$$ G(s) = \frac{Y(s)}{R(s)} = \frac{\sum_{j=0}^{p} u_j s^{\beta_j}}{\sum_{i=0}^{q} v_i s^{\alpha_i}} \tag{6} $$

where, denominator polynomial coefficients v_i and numerator polynomial coefficients u_j are polynomial coefficients and fractional orders of the LTI system are denoted by $\alpha_i \in R$ ($i = 0,1,2,3...,q$) and $\beta_j \in R$ ($j = 0,1,2,3...,p$).

Fractional Order PID Controller

Fractional order PID controller ($PI^\lambda D^\mu$) which has five tuning controller parameters including an integrator of order λ and an differentiator of order μ provides a better response than the integer order PID controller when used both for the integer-order systems and fractional-order systems (Chen et al., 2009). $PI^\lambda D^\mu$ is described in time domain in (Podlubny, 1999b) as follows;

$$ u(t) = k_p e(t) + T_i D^{-\lambda} e(t) + T_d D^{\mu} e(t) \tag{7} $$

where k_p is the proportional gain, T_i the integration constant, T_d the differentiation constant; λ and μ are positive real numbers. The frequency domain formula is given in (Petras, 1999).

$$ C(s) = \frac{U(s)}{E(s)} = k_p + \frac{k_i}{s^\lambda} + k_d s^\mu \tag{8} $$

In Equation (8), classical PID controller can be obtained for $\lambda = 1$ and $\mu = 1$.

Integer Order Approximation Methods for Fractional Order Systems

Fractional order functions are infinite dimensional functions and hence it is very difficult to implement them practically or simulate them numerically (Vinagre et al. ,2000). Therefore, several integer order approximation methods were proposed for realization of fractional order systems by replacing them with integer order approximations. Oustaloup presented an approximation method based on recursive distribution of poles and zeros in a limited frequency (Oustaloup et al, 2000). Another approximation method using the gain of the fractional order transfer functions at certain frequencies was suggested by Matsuda, (Matsuda et al., 1993). Recently, SBL fitting approximation method has been presented for fractional order derivative and integrator operators (Deniz et al., 2016). The integer order approximations model obtained by SBL fitting method is given in Table 1 (Deniz et al., 2016).

Table 1. Lists of fractional order derivative operator approximations determined using proposed method for $\omega \in [0.01, 1.2]$.

s^{α}	Fractional Order Derivative Approximations by SBL fitting
$s^{0.1}$	$\dfrac{5532s^4 + 1.338\times10^4 s^3 + 4147s^2 + 191.5s + 1}{4392s^4 + 1.353\times10^4 s^3 + 5063s^2 + 284.5s + 1.894}$
$s^{0.2}$	$\dfrac{7718s^4 + 1.714\times10^4 s^3 + 4974s^2 + 214.2s + 1}{4810s^4 + 1.743\times10^4 s^3 + 7372s^2 + 470.2s + 3.587}$
$s^{0.3}$	$\dfrac{1.087\times10^4 s^4 + 2.227\times10^4 s^3 + 6052s^2 + 242.6s + 1}{5224s^4 + 2.263\times10^4 s^3 + 1.083\times10^4 s^2 + 783.7s + 6.829}$
$s^{0.4}$	$\dfrac{1.553\times10^4 s^4 + 2.949\times10^4 s^3 + 7507s^2 + 279.8s + 1}{5622s^4 + 2.972\times10^4 s^3 + 1.615\times10^4 s^2 + 1324s + 13.16}$
$s^{0.5}$	$\dfrac{2.271\times10^4 s^4 + 4.012\times10^4 s^3 + 9566s^2 + 330.7s + 1}{5987s^4 + 3.978\times10^4 s^3 + 2.46\times10^4 s^2 + 2283s + 25.87}$
$s^{0.6}$	$\dfrac{3.447\times10^4 s^4 + 5.677\times10^4 s^3 + 1.268\times10^4 s^2 + 405.6s + 1}{6300s^4 + 5.493\times10^4 s^3 + 3.88\times10^4 s^2 + 4074s + 52.66}$
$s^{0.7}$	$\dfrac{5.564\times10^4 s^4 + 8.562\times10^4 s^3 + 1.791\times10^4 s^2 + 528.2s + 1}{6537s^4 + 8.007\times10^4 s^3 + 6.487\times10^4 s^2 + 7704s + 113.8}$
$s^{0.8}$	$\dfrac{1.008\times10^5 s^4 + 1.452\times10^5 s^3 + 2.844\times10^4 s^2 + 770.1s + 1}{6666s^4 + 1.298\times10^5 s^3 + 1.213\times10^5 s^2 + 1.628\times10^4 s + 275.5}$
$s^{0.9}$	$\dfrac{2.428\times10^5 s^4 + 3.28\times10^5 s^3 + 6.012\times10^4 s^2 + 1488s + 1}{6648s^4 + 2.773\times10^5 s^3 + 3.006\times10^5 s^2 + 4.561\times10^4 s + 887.3}$

An example is provided below relating to SBL fitting method. For this case, the values in Table 1 are used to obtain integer order approximation model of fractional order derivative operator. Also, these values can be used as $1/s^{\alpha}$ for integer order approximation model of fractional order integrator operator.

Example 1: Consider the fractional order transfer function

$$G(s) = \frac{1}{s^{1.2} + 1} \tag{9}$$

For the fractional order derivative $s^{0.2}$, SBL fitting method, Matsuda's method and Oustaloup's method provide the integer order approximation model in Table 2. Also, equivalent integer order transfer function $G_T(s)$ of fractional order transfer function $G(s)$ can be seen in Table 2.

Table 2. Equivalent integer order transfer function $G_T(s)$ of fractional order transfer function $G(s)$

Method	Integer order approximation models for $G(s)=\dfrac{1}{s^{1.2}+1}$
SBL	$s^{0.2}=\dfrac{7718s^4+1.714\times10^4s^3+4974s^2+214.2s+1}{4810s^4+1.743\times10^4s^3+7372s^2+470.2s+3.587}$ $G_T(s)=\dfrac{4810s^4+1.743\times10^4s^3+7372s^2+470.2s+3.587}{7718s^5+2.195\times10^4s^4+2.241\times10^4s^3+7586s^2+471.2s+3.587}$
Matsuda	$s^{0.2}=\dfrac{3.357s^4+161s^3+453.9s^2+95s+1}{s^4+95s^3+453.9s^2+161s+3.357}$ $G_T(s)=\dfrac{s^4+95s^3+453.9s^2+161s+3.357}{3.357s^5+162s^4+548.9s^3+548.9s^2+162s+3.357}$
Oustaloup	$s^{0.2}=\dfrac{2.512s^5+98.83s^4+531.7s^3+442.3s^2+56.87s+1}{s^5+56.87s^4+442.3s^3+531.7s^2+98.83s+2.512}$ $G_T(s)=\dfrac{s^5+56.87s^4+442.3s^3+531.7s^2+98.83s+2.512}{2.512s^6+99.83s^5+588.6s^4+884.5s^3+588.6s^2+99.83s+2.512}$

Figure 5 shows a comparison of the amplitude and phase responses. Here, the exact solution for $G(s)=\dfrac{1}{s^{1.2}+1}$ was obtained by calculating phase and amplitude of $\dfrac{1}{(j\omega)^{1.2}+1}$ considering $(j\omega)^{\alpha}=\omega^{\alpha}(\cos(\frac{\pi}{2}\alpha)+j\sin(\frac{\pi}{2}\alpha))$.

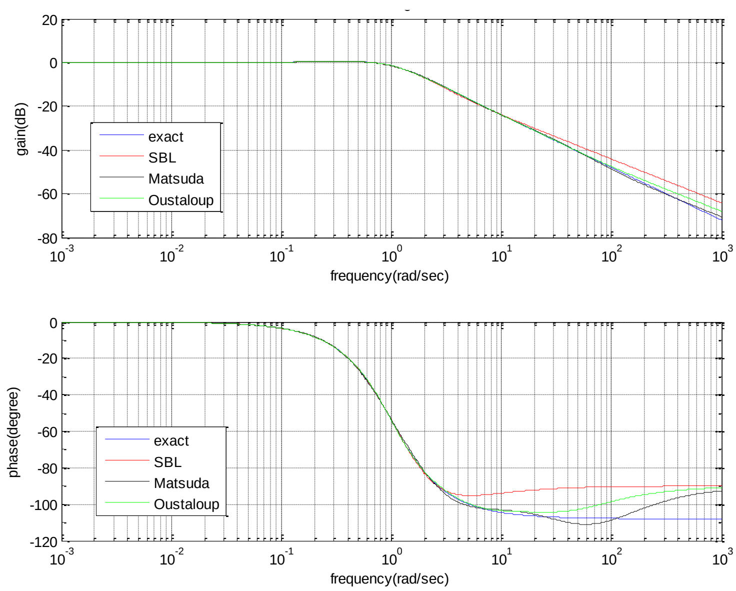


Figure 1. Amplitude and phase responses of $G(s)$ and approximate integer order models, SBL fitting method, Matsuda's method and Oustaloup's method

Example 2: In this example, SBL fitting method is used to simulate the closed loop control system with PI$^{\lambda}$ controller as shown in Figure 2 in MATLAB. Consider the fractional order PI controller

$$C(s)=k_p+\frac{k_i}{s^{\lambda}}$$

(10)

To use fractional order controller $C(s)$ for simulation of the closed loop control system in MATLAB, an integer order approximation method has to be applied for fractional operator s^{λ}. When an equivalent integer order approximation model of $C(s)$ is determined using an integer order approximation method, the closed loop control system as shown in Figure 2 can be simulated to obtain the closed loop response. For this, fractional order operator is replaced with its equivalent integer order model in closed loop control system.

An illustrative example which contains SBL fitting approximation method is given to clarify this strategy. Assuming that the plant transfer function is given by $G(s)=\dfrac{1}{s^2+3s+1}$ and PI^{λ} controller is formed as $C(s)=k_p+\dfrac{k_i}{s^{0.9}}$ in Figure 2, one can found stability region of the closed loop control system using SBL analysis (Hamamci, 2008). Then, the controller parameters k_p and k_i can be selected in stability region to obtain the step response of configuration in Figure 2.

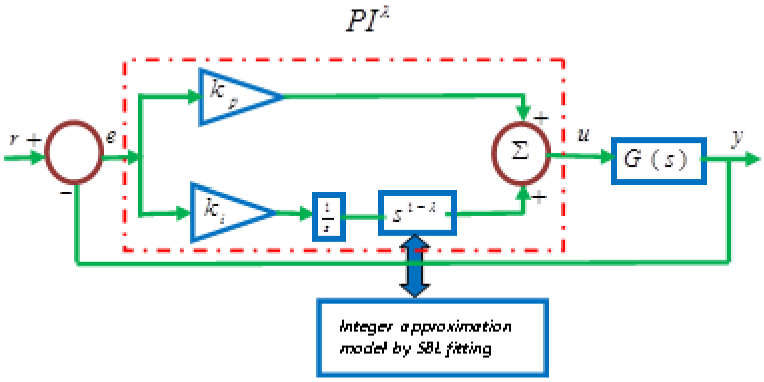


Figure 2. The closed loop control system with PI$^{\lambda}$ simulated in MATLAB

Figure 3 shows different step responses obtained for different controller parameters (k_p,k_i) with $\lambda=0.9$ selected from stability region as (0.2604, 2.2281), (0.6843, 4.7544) and (0.1129, 1.2807). Better closed loop step responses can be obtained for different controller parameters (k_p,k_i,λ) selected from stability region.

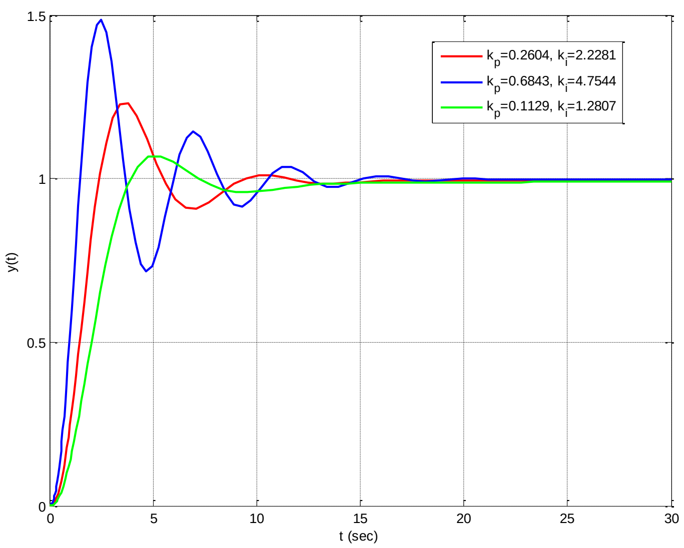


Figure 3. Step responses of the closed loop control system with PI$^{\lambda}$ for different values k_p and k_i

Teaching Fractional Order Control Systems Using Matlab And Labview

MATLAB is a high-performance language for technical computing. It integrates computation, visualization, and programming in an easy-to-use environment where problems and solutions are expressed in familiar mathematical notation. Simulink can easy analyze model and simulate control systems (MathWorks, http://www.mathworks.com/). Simulink can work with the MathWorks Real-Time Workshop. Real-Time Workshop generates and executes stand-alone C code for developing and testing algorithms modeled in

Simulink. The resulting code can be used for many real-time and non-real-time applications, including simulation acceleration, rapid prototyping, and hardware-in-the-loop testing (Rodriguez, et al. 2005). So Simulink is also widely used in simulation of all kind of systems. However, Simulink lack the imitation of physical instruments or equipment in appearance and operation. That's why, it is a good idea to combine LabVIEW and MATLAB in simulation of control system (Xuejun et al, 2007).

The LabVIEW (Laboratory Virtual Instrument Engineering Workbench) software is a graphical programming language and used to develop a virtual instrument (vi) that includes a front panel and a functional block diagram. User enters input from the front panel of the vi. LabVIEW has become a vital tool for engineers and scientists in research throughout academia, industry, and government labs. LabVIEW is taught at many universities in Europe and USA. LabVIEW has been used in the classroom for teaching of difficult subjects. For example, the graphical programming approach of LabVIEW has been used to teach computer science concepts. The graphics make the concepts more intuitive and easier to understand.

LabVIEW is used to teach control systems. The graphical programming approach is based on dataflow theory which is an ideal platform for learning how signals flow from one function to another such as from an acquisition function through a filter to a spectrum analysis and finally to a graph. Each function is an icon that is wired to other icons as in the example given in Figure 4. The wires are the signals flowing from one icon to the next. Research and industry use LabVIEW for automated test (ATE), medicine, chemistry, process control, simulation, calibration, and general-purpose data acquisition and analysis (Vento, 1988).

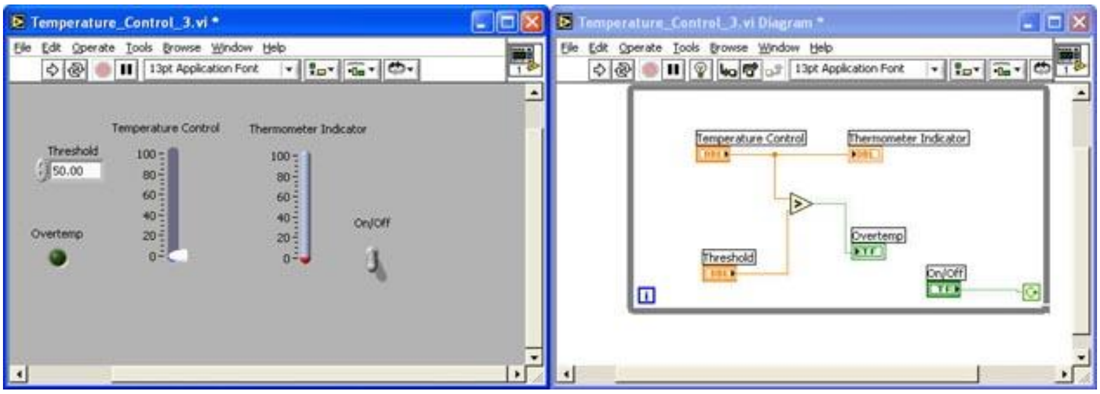


Figure 4. The Front and Block Diagram Panel Image of LabVIEW

The temperature control system given in Figure 4 performs on LabVIEW environment. The application includes two windows. The first window is front panel and second is block diagram panel of the program. The front panel is developed as a graphical interface and it is performed interactively. The block diagram panel is that provided wire connection and data flow.

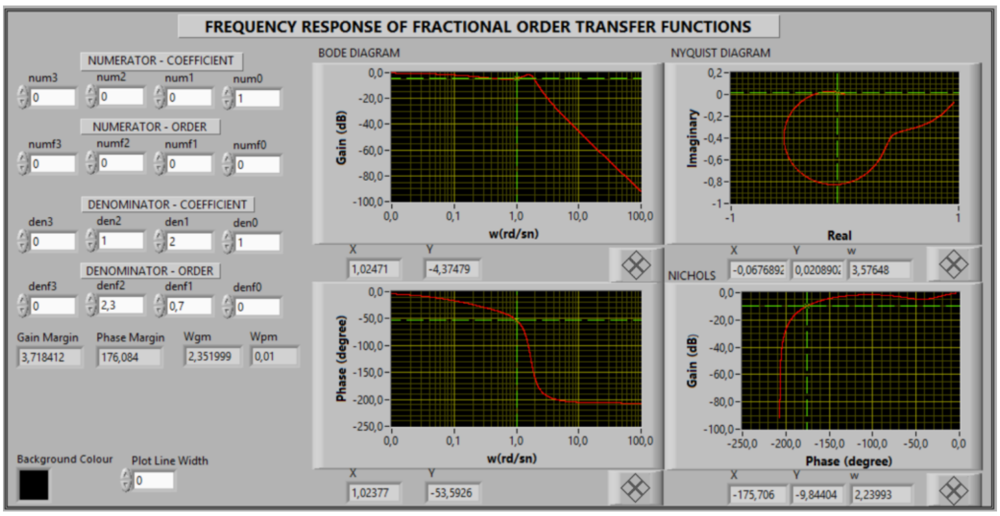


Figure 5. The Front Panel Image of Frequency Response Application of FOTF using LabVIEW

The application given in Figure 5 has been developed in the LabVIEW environment for the frequency domain analysis of fractional order control systems. The Bode, Nyquist and Nichols diagrams for any fractional order transfer function can be plotted by using the program. The program with this properties helps to design suitable controller for a given control system. The program is especially suitable for use in the field of education since it has interactive features.

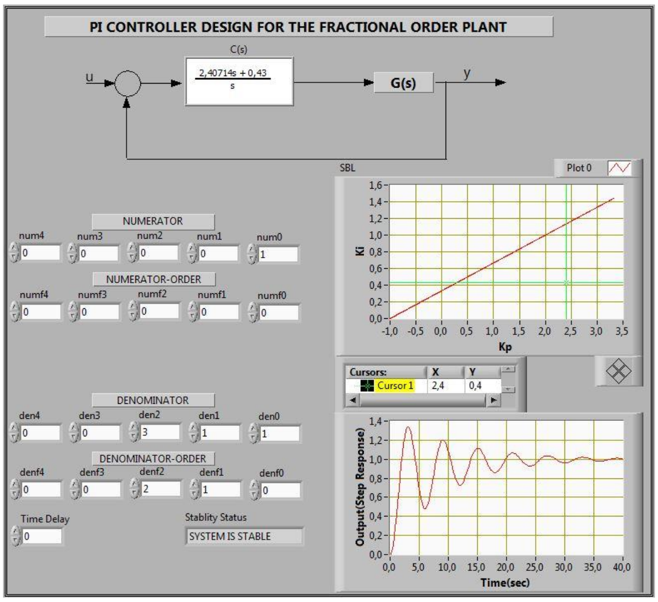


Figure 6. The Front Panel Image of PI Controller Design Application for the Fractional Order Plant using LabVIEW

The application given in Figure 6 runs the stability boundary locus (SBL) method to find all stabilizing PI controllers in a stability region for closed loop control systems with fractional order plant transfer function using LabVIEW application. Effect of the parameters of controllers selected from the stability region can be immediately observed and step response of the system can be immediately plotted. Thus, the controller which gives the best results can be designed based on proposed interactive approach.

Example 3: Consider the transfer function as below,

$$G(s) = \frac{5}{s^{2.2} + 7s^{0.9} + 2} \tag{11}$$

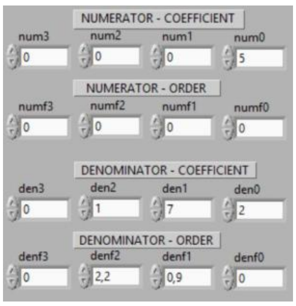


Figure 7. Transfer Function Input Panel for Frequency Response Application

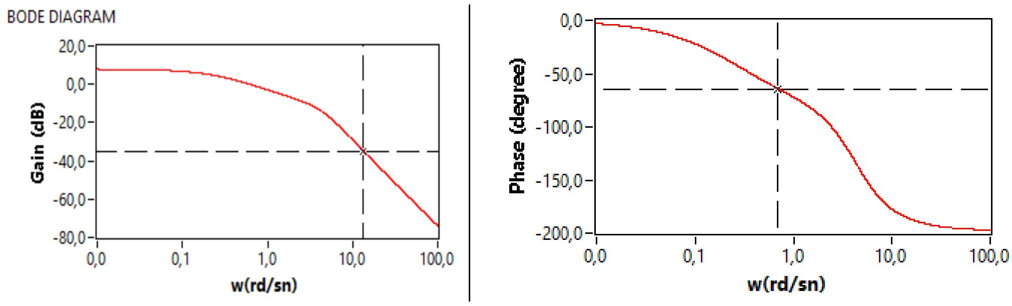


Figure 8. Bode Diagram

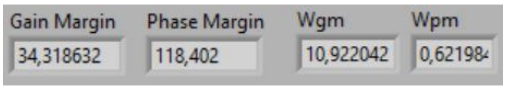
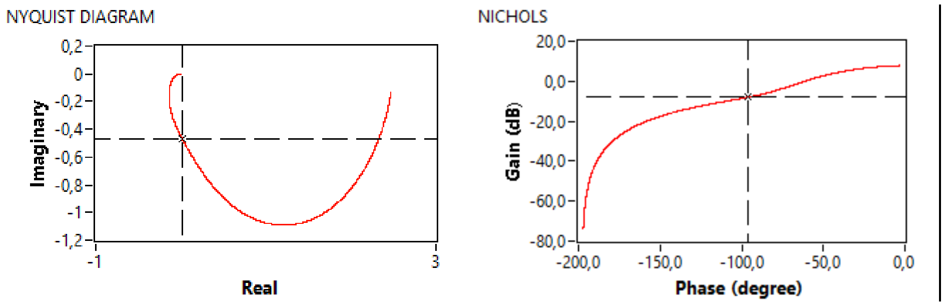


Figure 9. Gain and Phase Margin Panel

In this example, frequency response application of fractional order transfer functions is examined. Transfer function given in Eq. (11) is entered to panel as shown in Figure 7. Bode, Nyquist Nichols diagrams are simultaneously plotted as shown in Figure 8 and 9. Also, the application computes gain and phase margin values which are shown in Figure 9. The application has interactive features, thus user can try different values, while the application is performing.



a) **b)**

Figure 10. a) Nyquist Diagram b) Nichols Diagram

Example 4: Consider the transfer function with time delay as below,

$$G(s) = \frac{2}{s^{2.4} + 2.5s^{1.2} + s^{0.4}} e^{-2s} \tag{12}$$

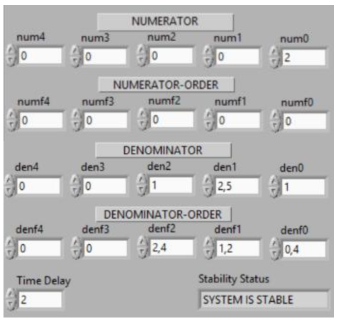
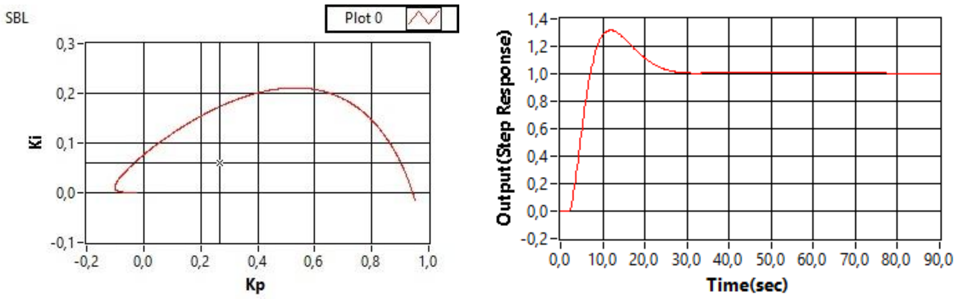


Figure 11. Transfer Function Input Panel for PI Controller Design Application



a) b)

Figure 12. a) Selected Point in Stability Region b) Stable Step Response for Closed Loop System

In this example, PI controller design for fractional order transfer functions is examined. Transfer function given in Eq. (12) is entered to panel as shown in Figure 11. SBL graph is first plotted when the program is run. Then, user can select any points in the controller parameter plane which is shown in Figure 12 (a) by moving mouse on the opened SBL plot window. As seen in Figure 12 (a), selected point is $K_p = 0.262545$, $K_i = 0.06$ and this point is in stability region. Thus, the closed loop system is stable and step response of the system is plotted for the selected point and the result is given in Figure 12 (b). According to selected point, the PI controller is designed as shown in Figure 13.

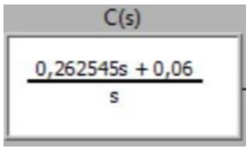
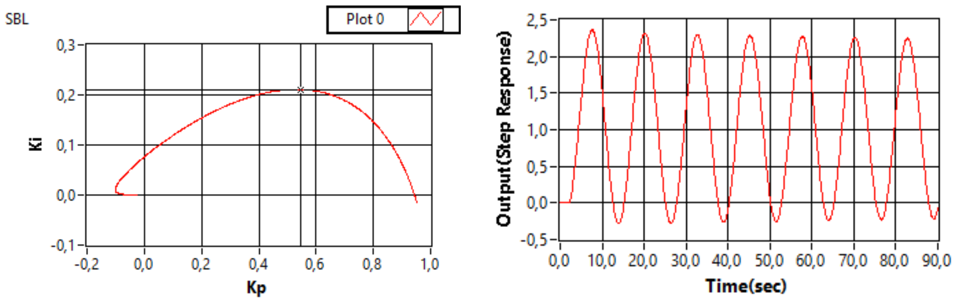


Figure 13. Designed PI Controller According to Selected Point



a) b)

Figure 14. a) Selected Point on Stability Curve b) Critical Step Response for Closed Loop System

Now, consider another point as seen in Figure 14 (a), where selected point is $K_p = 0.546182$, $K_i = 0.21$ and this point is exactly on SBL curve. Thus, the closed loop system is critically stable and step response of the system is plotted for the selected point and the result is given in Figure 12 (b). According to selected point, the PI controller is designed as shown in Figure 15.

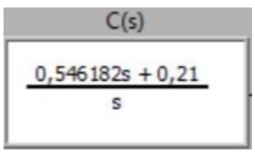


Figure 15. Designed PI Controller According to Selected Point

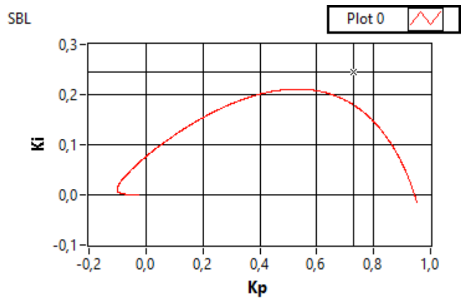


Figure 16. Selected Point Outside Stability Region

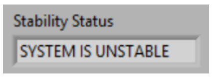


Figure 17. Stability Status Panel

Consider another point as seen in Figure 16, where selected point is outside the SBL curve. Thus, the closed loop system is unstable and step response is not plotted, because the apllication uses Inverse Fourier Transform Method (IFTM) for plotting the time response and IFTM method is defined in stable condition (Atherton et al, 2015). Thus, the application writes ‘SYSTEM IS UNSTABLE’ on stability status panel.

CONCLUSION

The objective of this paper has been to draw attention to the new developments in the field of control systems with fractional order derivative and integrator and to show how these ideas can be introduced into a first course on classical control theory. The methods are based on fractional order calculus and allow students to think more practically in terms of representation of real systems with fractional order differential equations. It has also been shown that with suitable software, the theoretical results obtained in the field of fractional order control can be used for the analysis and design of systems.

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AN INVESTIGATION OF UNIVERSTY CHEMISTRY STUDENTS' UNDERSTANDING OF PRECIPITATION TITRATIONS AND RELATED CONCEPTS THOROUGH VEE-DIAGRAMS

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ABSTRACT: In this study, second-year chemistry students' understanding of essential concepts related to precipitation titration was investigated by using Vee-diagrams which are completed during the analytical laboratory course. Three Vee-diagrams concerning three argentometric titration methods were constructed prior to the laboratory study by taking into laboratory manual by the researchers. Vee- diagrams delivered to the students after completing each experiment one by one in the laboratory. Sixteen analytic chemistry students from two faculties participated in the study. It was found that the students were insufficient to define some concepts such as argentometry, precipitation, back titration and indicator. It was also concluded that the students had the calculation difficulties, especially for the back titration.

Keywords: Precipitation titrations, Vee-diagram, analytical chemistry laboratory, university students

INTRODUCTION

Laboratory work is one of the fundamental components of undergraduate chemistry courses. If the experiments are conducted in a meaningful way, the laboratory study can provide students with opportunities to engage in a process of constructing knowledge. The Vee-diagram was developed by Gowin to enable students to understand the structure of knowledge and the process of knowledge construction (Novak & Gowin, 1984). The conceptual side of Vee diagram includes philosophy, theory, principles/conceptual systems, and concepts all of which are related to each other and to the topic which is studied in the experiment. Thus, it can provide to explore students' knowledge structure and be used as an assessment tool at the same time. V-diagrams were also used an easement tool by several researchers to gain information about students' understanding of a special topic (Ault, Novak ve Gowin, 1984; Passmore, 1998; Nakiboğlu, Benlikaya ve Kalın, 2002; Nakiboğlu ve Arık, 2005; Nakiboğlu ve Erdem, 2009).

Titrations are the one of the essential topics in all level chemistry classes from high school to general chemistry courses. It was also taught in analytical courses again. Application of volumetric titrimetry contains acid-base titrations, which an acidic or basic titrant reacts with a titrand that is a base or an acid; complexometric titrations based on metal–ligand complexation; redox titrations, in which the titrant is an oxidizing or reducing agent; and precipitation titrations, in which the titrand and titrant form a precipitate (Harvey, 2000). Precipitation titrations are an important part of analytical chemistry classes and common experiments carried out by students in analytical chemistry laboratories. The fundamentals of precipitation titrations are generally explained by selecting argentometry which is a volumetric titrimetry technique used known amount of silver nitrate solution as a titrant or reagent. Mohr, Fajans and Volhard methods are three common argentometric methods.

Although there are limited number studies about students' understanding of acid-base titrations in the literature, it has not been encountered with a detailed study about students' understanding level of precipitation titrations. Therefore, it was aimed to investigate the second-year chemistry students' understanding of essential concepts related to precipitation titration by using Vee-diagrams in this study.

METHODS

In this qualitative study, students' understanding of essential concepts related to precipitation titration was investigated by using Vee-diagrams which are completed during the analytical laboratory course.

Participants

Participants in the present study were drawn from two faculties of Balikesir University in Turkey: the Science and Art Faculty, which has 4 year chemistry program, and the Education Faculty, which has pre-service chemistry teacher training program. A total of 16 analytic chemistry students from two faculties participated in the study. While 7 of students (5 female and 2 male, and assigned as C) come from the Science and Art Faculty, 9 of students (6 female and 3 male, and assigned as CE) attend to the Education Faculty. Subjects ranged in ages between 19-22 years. All of the participants studied General chemistry courses1 and 2 in their first year at university.

Instruments

In order to determine students' understanding levels about concepts of precipitation titration, three V-diagrams were used. The Vee-diagrams concerning three argentometric titration methods were constructed prior to the laboratory study by taking into laboratory manual by the researchers. Vee- diagrams delivered to the students after completing each experiment one by one in the laboratory.

Analysis of Data

In analyzing the V-diagrams, a concept-evaluation scheme developed in previous research was used (Abraham et al., 1994; Nakiboğlu, 2003). The students' responses can be separated into different levels of understanding and misconceptions can analyze into different patterns (Nakiboğlu, 2003). The concept-evaluation scheme used in this study is comprised of five categories: Sound understanding (SU), Partial understanding (PU), No understanding (NU), Misconception (MC), No answer (NA).

RESULTS AND FINDINGS

Students' Understanding Levels about fundamental concepts of precipitation titration

The primary goal of the conceptual side of vee diagrams was to find out the patterns of students' understandings and misconceptions of the the fundamental concepts concerning precipitation titration such as *precipitation, precipitation titration, argentometry, back titration and adsorption*. These concepts are the most important concepts to comprehend the precipitation titrations meaningfully. The data about students' understanding levels about the fundamental concepts of precipitation titration are presented in Table 1 according to the degree of understanding.

Table 1. Degree of Students' Understanding about fundamental concepts of precipitation titration

Degree of understanding	Precipitation	Precipitation Titration	Argentometry	Back Titration	Adsorption
SU			CE3,CE10, CE11, C1,C4,C7 (f=6) %35,3	CE7,CE12, C1,C2 (f=5) %31,3	CE3,CE12, C2, C7 (f=5) %31,3
PU	CE3,CE5,CE6,CE7, CE9,CE10,CE11, C1,C3, C4,C7 (f=11) %68,8	CE2,CE3,CE6, CE7,CE10, CE11, CE12, C1, C3, C4, C6, C7 (f=12) %75	CE2,CE6,CE7, CE12, C2,C6 (f=6) %35.3	CE2,CE3,CE5CE6 (f=4) %25	CE2,CE6, CE11,C1 (f=4) %25
NU		CE1, CE5, CE9, C2, C5 (f=5) %31,3	CE1, CE5, CE9, C3 (f=4) %25	CE1, CE9, CE10,CE11, C3, C6, C7 (f=7) %43,8	CE1,CE5, CE9,CE10,C3 (f=5) %31,3
MC	CE1, CE2, CE12, C5, C6 (f=5) %31,3	-	-	-	C4,C5,C6 (f=3) %18,8

According to Table 1, none of students showed a SU for the *precipitation* and the *precipitation titration* concepts. 11 of students showed a PU. 5 of students had misconceptions about precipitation and two misconception statements were identified. One of them is concerning "thinking the precipitation as saturated/excess saturated solution" and one example expression about this thought is:

"Precipitation is addition excess amount of substance to a solvent that it can be solve (CE2)"

Secondly it was found that students associated the precipitation with concentration and one example expression about this thought is:

"Precipitation occurs when the concentrations of two liquids increase in to one another (C5)"

Although there were not identified any misconception concerning the *precipitation titration*, 5 of students showed the NU. One of the students (C5) suggested that *the precipitation titration was general name of the substances which are determined.* While none of students had misconception about concepts of *back titration* and *argentometry*, it was seen that 3 of the students had misconceptions about the concept of *adsorption* that these misconceptions based on students' confusion adsorption with absorption.

Students' Understanding Levels about procedural knowledge of precipitation titration

Another goal of the conceptual side of vee diagrams was to explore the students' understandings and misconceptions of the procedural knowledge concerning precipitation titration. For this purpose three questions were asked to students. They were a) Which specifications are needed to use a precipitation reaction in volumetric analysis? b) Are there any pH limitations in Mohr method? If there are, please explain. c) What are the general working principles of indicators used in volumetric analysis? The data about students' understanding concerning the procedural knowledge about precipitation titration that obtained from anaysis of three questions were given in Table 2.

Table 2. Degree of Students' Understanding about Procedural Knowledge of Precipitation Titration

Degree of Understanding	Specifications used for precipitation reaction in volumetric analysis	pH limitations in Mohr method	Working principles of indicators
SU	-	CE2, CE6, CE7 (f=3) %18,8	CE9, CE10 (f=2) %12,5
PU	CE2, CE3, CE6, CE7, C7 (f=5) %31,3	CE10, CE11 (f=2) %12,5	CE2, CE3, CE6, CE11, CE12, C1, C2, C4, C6, C7 (f=10) %62,5
NU	CE1, CE5, CE9, CE10, CE11, CE12, C5 (f=7) %43,8	CE1, CE3, CE5, CE9, CE12, C2, C3, C6 (f=8) %50	CE1, CE5, C3, C5 (f=4) %25
MC	-	-	
NA	CE4, C1, C2, C3, C4, C6 (f=6) %37,5	C1, C4, C5, C7 (f=4) %25	-

According to Table 2, none of students showed a SU about specifications used for precipitation reaction in volumetric analysis**,** but degree of students' understanding about pH limitations in Mohr method and working principles of indicators are very low. %62.5 of the students showed a PU about working principles of indicators.

Any misconception about procedural knowledge of precipitation titration was not determined for all of the students, while a NA in 6 of the students about specifications used for precipitation reaction in volumetric analysis for and in 4 of the students about pH limitations in Mohr method was observed.

Students' Understanding Levels about calculation skills concerning precipitation titration

The experimental side of Vee diagram includes *data recording* part that the students record data during the experiment and transform them to a table, graph or make calculation by using chemical equation in the *data transforming* part. It can be obtained students' understanding levels about calculation skills from the analysis of the *data transforming* part of Vee diagram. The development of students' calculation skills is the fundamental for participation titrations. In this study, since three V-diagrams for each argentometric methods that is Mohr, Fajans and Volhard methods were used, the data obtained from the *data transforming* parts of Vee diagrams. The findings about these analyses were presented in Table 3.

Table 3. Degree of Students' Understanding about Calculation Skills Concerning Precipitation Titration

Degree of Understanding	Mohr Method	Fajans Method	Volhard Method
SU	CE1, CE2, CE5, CE6, CE7,CE12 **f=6 %35,3**	CE6, C7 **f=2 %11.8**	-
PU	CE11, C1, C2, C6, C7 **f=5 %29.43**	CE1, CE2, CE3, CE5, CE12, C2, C4, C5, C6 **f=9 %52.9**	C1, C2, C6, C7 **f=4 %23.55**
NU	CE3, C4, C5 **f=3 %17.6**	CE9, CE10, CE11, C1 **f=4 %23.5**	CE1, CE2, CE3, CE5, CE6, CE7, CE9, CE11, CE12, C4, C5 **f=11 %64.7**
MC	CE9, CE10, C3 **f=3 %17.6**	CE7, C3 **f=2 %11.8**	CE10, C3 **f=2 %11.8**

According to Table 3, while none of students showed a SU about calculation skills in Volhard method, 6 of students had SU level of calculation skills in Mohr Method and also 2 of the students showed a SU about calculation skills in Fajans Method.

CONCLUSION

In this study, the students' understanding levels about participation reactions, fundamental concepts and procedural knowledge about participation reaction, and calculation skills of students were investigated by using Vee-diagrams. It was concluded that the degree of the students' understandings of precipitation and precipitation titration concepts were on a level with partial understanding and students had the misconception about precipitation. Another conclusion is about students' calculation skills. Some of the students have gained skills about calculation in SU and PU levels, while none of the students have understood the calculations about back titration in Volhard method.

RECOMMENDATIONS

Recommendations can be divided into two groups. One of them is about learning and teaching precipitation and precipitation titrations and the calculation skills. The teachers should gain information about their students' prior knowledge and pre-requisite knowledge about precipitation and precipitation titration and related concepts concerning them before the laboratory instruction. Besides students' calculation skills and if they construct stoichiometric relationships should be reconsidered before instruction. If they have deficiency about them, these deficiencies should be eliminated. The second recommendation is about usage Vee diagrams in analytical chemistry laboratory as an assessment tool. In this study, the Vee diagrams were applied successfully in assessing both students' conceptual and procedural understandings, and also calculation skills. So, it can be suggested that Vee diagrams are used in analytical chemistry laboratories as an assessment tool and for different purposes.

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THE DESIGN OF A SECURE QUIZ EXTENSION FOR MOODBILE

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ABSTRACT: E-learning has been adopted broadly by various institutions all over the world. However, the expansion of mobile devices creates a new form of E-learning, called m-learning. M-learning encompasses all learning delivered via mobile devices. It helps to make the learning process learner-centered by promoting "Bring Your Own Device" (BYOD) model of learning technology. Despite ever increasing demand for it among students, m-learning lacks teachers and/or institutions confidence who are accustomed to use e-learning systems such as LMSs. Moodbile project was the first attempt to find a moderate solution between the two parties by the integration of m-learning initiatives with LMSs. On the other hand, M-learning has unique security requirements especially for conducting exams. For that, we have designed a Secure Exam Management System (SEMS) as a service extension to Moodbile. SEMS enables mobile exams to be conducted securely (as cheat-free as possible). This paper discusses the design principles of SEMS. It also presents the results of a survey about students/teachers acceptance and confidence to adopt such exam systems.

Key words: Learning Management System (LMS), M-Learning, E-Learning, Exam Engine, Access Control

INTRODUCTION

The LMS has become a centerpiece of the digital strategy of most educational institutions. In addition to offering a virtual space for the classroom and the usual set of tools (noticeboards, forums, assignments, wikis, quizzes, SCORM, PDF and other contents), the LMS has articulated the digitalization management of studies and curriculums. With support for advanced gradebooks, groups within courses, meta-courses, competences, roles and integration via web services, the LMS has a lot of information about what is going on in the educational institution, and is often a key part of the business processes that take place inside it. With the transition to new ways of using technology for learning, such as mobile devices and MOOCS, one could suppose that the established LMSs (Blackboard, Moodle, Sakai and the one: Canvas) have long been ripe to be replaced by new ones that are more tuned to the new trends in the field.

However, in the last 15 years the educational institutions have invested heavily in technology, information systems integration, training and reorganization around the LMS. And, it is hard, if not impossible, to find a big organization considering replacing a large LMS system for a new one [1, 2]. Thus the established LMS is the starting point towards the new trends of technology in education. Particularly in the field of mobile-learning, we can see how all platforms are moving towards it. There are two main approaches. One is to enable mobile friendly web interfaces. In the Polytechnic University of Catalonia, the Moodle installation experienced an increase in usage from mobile devices from 7% to 28% of the total accesses, just by changing the CSS templates. The other one is to develop mobile apps. The Moodle community published a mobile Moodle connected to the web services, as proposed by the Moodbile project back in 2010 [3].

Nevertheless, as Moodle founder Martin Dougiamas admitted, when receiving his Honoris Causa doctorate in Catalonia in Spring 2016, going mobile means to rethink deeply the workflows of the LMS tools, and it will mean a heavy redesign and recoding. Quizzes are not an exception. Moodbile project never addresses the security and privacy issues related to conducting exams in m-learning environment, and neither does the Moodle Quiz Engine which emphasizes only on the learning process not on securing the examination process. Other e-exam systems developed based on mobile platforms with wireless access [4], [5] lack proper security considerations and exam management functions as well.

This paper aims to briefly discuss the design principles of SEMS [6]. SEMS is designed to meet the distinct security requirements of m-learning environments and to be integratable with Moodbile. The paper is organized as follows: Section 2 presents SEMS Exam Engine. Section 3 discusses how SEMS enforces exam security and controls network communication during an exam. Finally, Section 4 presents a survey conducted about SEMS.

Sems Exam Engine

The Quiz Engine in Moodle can only be accessed through standard web browsers that are slow on mobile devices and that cannot address m-learning exam security issues. Thus, we need to develop a new Quiz Engine integratable with Moodle/Moodbile in order to have a complete LMS whose services can be consumed by mobile applications, to cater m-learning specific security requirements. The core features of the proposed Exam Engine are discussed below.

Secure and Random Distribution of Exam Questions

The following functionalities are provided in this context:

- Enabling the teacher to define a bank of exam questions and linking them to his/her subject.
- Enabling the teacher to specify subjects' exam properties such as: Date and Time, Duration, Percentage of questions at various difficulty levels, etc.
- Securely authenticating and enrolling students, using any of the well-known secure and multifactor authentication mechanisms, into the exam at the predefined date and time.
- Creating exam instances by random distribution of exam questions and multi-choices of answers to the enrolled students' mobile devices according to the predefined exam properties such as percentage of each question level.
- Allowing students to answer the exam questions through the Exam Client and then submitting the answers to the Exam Server.
- Allowing students to request interaction with the teacher during an exam. If a student has a doubt about one of the questions, he/she can click a button that causes the teacher version of the software to raise an alert about the question, the student who is asking, and the room that he/she is attending the exam from. The teacher will be further able to edit the question in case he/she finds a mistake or an ambiguity in it. Students who have got the same question will be alerted with the change.
- Processing students' answers to determine their grades.
- Generating a set of reports to enrich the assessment process, by providing statistical information about a particular exam, a student, or a teacher.

The Quiz Engine proposed herein also includes a Turbo-mode Assessment Service for conducting arbitrary quizzes during class time rapidly. According to the student's answers it increases or decreases the difficulty level of the questions in a reactive manner. As a result, student's level can be determined using fewer questions and in a shorter time. Also the software has to be supported with a special theme for students with special needs (for example, a theme with a big font for students with short vision).

Following the Widely Accepted Industrial Standards

SEMS Exam Engine must conform to a well-known and widely-adopted set of standards and specifications developed by IMS Global Learning Consortium (IMS-GLC) [7]. IMS-GLC is a specification authoring organization comprised of distributed computer learning system vendors, publishers, digital content vendors, government agencies, universities, training organizations, and other interested parties. It is a global and non-profit member organization supported by over 190 of the world's leaders in educational and learning technology. It has approved and published some 20 standards that are the most widely used learning technology standards in higher education around the globe. These include meta-data, content packaging, enterprise services, question & test, competencies, tools interoperability, sharable state persistence, vocabulary definition, and learning design. All IMS-GLC standards are available free of charge via the IMS GLC web site and can be used without royalty. The IMS Question & Test Interoperability (QTI) specification enables the exchange of item, test and results data between authoring tools, item banks, test constructional tools, learning systems and assessment delivery systems. QTI specification is defined in XML to promote the widest possible adoption.

Enforcing Exam Security

In m-learning environments, students' tablet/mobile devices are connected to a Wi-Fi network through which they can exchange information during an exam. Applying simple policies, such as turning the network down, does not work out as students from different classes do not have their exams simultaneously. We have to introduce an appropriate mechanism to address this point in a practical manner.

In such an environment, a dynamic network access policy has to be generated and applied on each student's tablet according to predefined conditions. For example, if the student has no exam, then all the intranet communication, including the Bluetooth communications, are allowed. However, during exam time, Bluetooth and all other network communications have to be blocked except the main connection to the Exam Server through which the student is going to download the questions and submit their answers.

To enforce such policies, we introduce SEMS **Security Agent**. It is an agent software installed on students' mobile devices and is responsible for downloading the dynamic network access policies from the Exam Server and enforcing them on each student device respectively. This agent is connected to the Exam Server via a predefined secure channel through which it is going to download the dynamic access policy. To ensure that students are not going to shut this agent down in order to break the access control policy, the Security Agent will keep sending a periodic heart-beat signal through the same secure channel to the Exam Server as illustrated in Figure 1. In case the Exam Server stops receiving this signal for a predefined period, it has to log this event and send an immediate alert to the proctor's device who is associated with the running exam to investigate the issue.

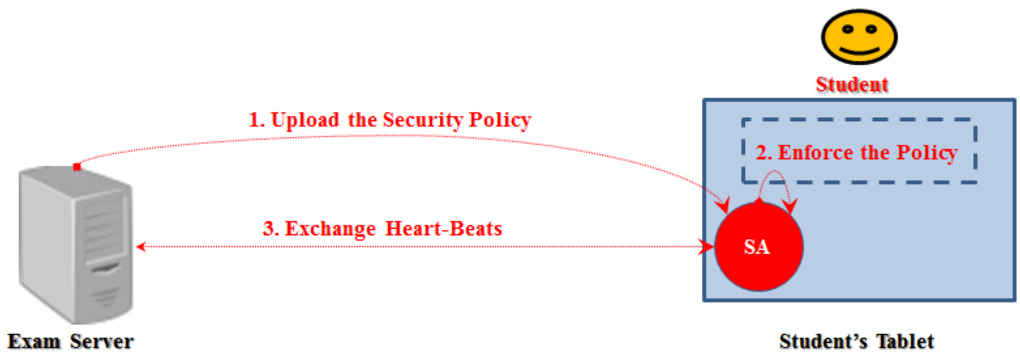

Figure 1: Student Monitor Agent

In case of an open-book exam, teacher has to upload a set of exam eBooks to the Server. The dynamic access policy allows students to browse the eBooks associated with their open exam. This mechanism controls the access to materials rather than opening the entire network resources which can be misused by the students. SEMS design also adopts a mechanism for anti-impersonation. Students' mobile devices' cameras can be used for a biometric-based login to the Exam Server by implementing any well-known face-recognition algorithm. In a Wi-Fi based connection, we cannot guarantee that each student is going to attend the exam from the dedicated class room. A student can simply sit in a nearby room, log in to the Exam Server through the Wi-Fi network, illegally open a textbook, and use it to answer the questions. To encounter this issue, SEMS design offers three strategies: the Proctor Approval based Strategy, the QR-Code based Strategy, and the NFC based Strategy. Each strategy suits a particular scenario.

Students might still attempt to cheat by simply exchanging their mobile/tablet devices after they get authenticated by the Exam Server. To prevent this issue, SA may re-authenticate the students biometrically by asking them to represent their faces in front of the mobile camera on a random basis. Moreover, SEMS design handles various network issues such as: network overload and occasional failures, the use of alternative mobile devices to exchange information during an exam, and the use of a Wi-Fi jammer to bring the Wi-Fi network down. On the other hand, the Security Agent has an optional auditing service that helps to monitor students' activities on their tablet/mobile devices such as: Internet browsing, playing games, reading course electronic materials, etc. This can help to analyze the efforts being done by the students and give suggestions to their parents in order to encourage them to improve their efforts so they can accomplish better results.

RESULTS

The proposed Secure Exam Management System design principles were validated by conducting a survey at three different universities. The number of students participated in the survey was 322. The opinions of a total of 72 lecturers were also taken. Two of the institutions are private universities, the other is a state university, and the success levels of students at the entrance exam are almost the same. The lecturers were presented 7 questions related to adaptation of SEMS system in their exam evaluation process (Table 1). On the other hand, the students were asked to answer 5 question to expose their attitudes towards SEMS system (Table 2). Both of the surveys were prepared using a 5 point Likert-type scale i.e. (1) strongly disagree – (5) strongly agree.

The feedback from the both surveys shows that the attitudes of the students and the teachers towards adopting SEMS in conducting exam process are positive. The response from students shows that they 51.6% either “strongly agree” or “agree” on this statement. On the other hand, responses of the lecturers show positive and neutral tendencies. Out of 72 lecturers, 38.9% of them either “strongly agree” or “agree” on this statement, 36.1% are neutral while the minority of 25% disagree with the statement. The results show that the stake-holders’ attitude towards SEMS is acceptable. The exposure of the students to new high-tech devices is the main reason why the students’ feedback is more positive compared to the lecturers’.

In general, the confidence level among the lecturers of using the system and getting benefit out of it is extremely high as seen in Figure 2; for Q2, 66.7% of the lecturers and for Q3, 58.3% of lecturers either “strongly agree” or “agree” on this statement, respectively. A similar tendency among students is evident on being comfortable with using SEMS (Figure 3). 64.6% of the students either “strongly agree” or “agree” on this statement regarding Q2 in the students’ survey. They also believe that SEMS would be fairer in grading. The opinion for the respective question is 49.1% being either “strongly agree” or “agree” on this statement. Although 22.9% of students either “strongly disagree” or “disagree” on this statement, the general attitude is comparably positive. Only %18.7 of the students did not think that SEMS would help to improve the teaching process via instant quizzes. The results are indicative of highly positive general view of the stake-holders on using SEMS in m-learning environments.

Table 1. Questions to Teachers

Q1 SEMS is more preferable over a paper-based exam.
Q2. Exams would be conducted easily and effectively using SEMS.
Q3. An enhanced evaluation process would be obtained using SEMS.
Q4. The user-friendly interfaces of SEMS design would help adaptation of new technologies in classrooms.
Q5. I don’t expect to have any difficulties in conducting exam using SEMS once it is implemented.
Q6. Students’ attitudes towards SEMS system would be definitely positive.
Q7. Face recognition as an extra security-check would increase the confidence.

Table 2. Questions to Students

Q1. SEMS is more preferable over classic type paper-based exam.
Q2. As a generation acquainted with high-tech devices we would be more comfortable with using SEMS.
Q3. SEMS would be more fair and unbiased in grading my knowledge.
Q4. As a system with latest technology SEMS would prevent cheating more efficiently.
Q5. Instant quizzes help to increase our success and to identify our levels quickly and regularly.

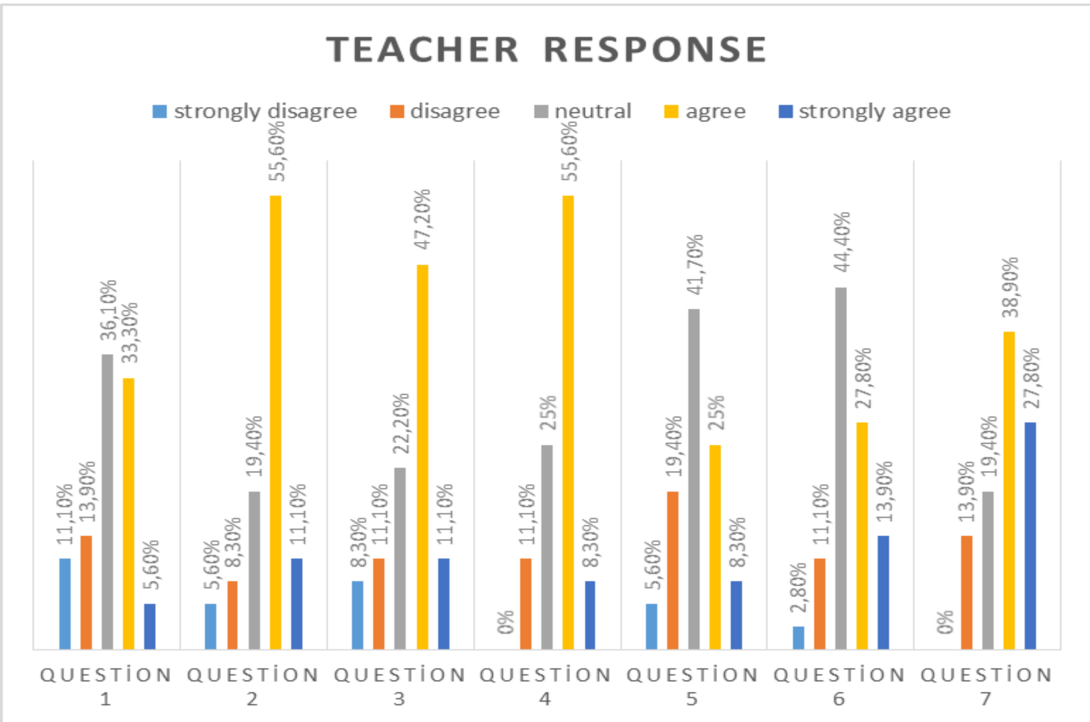

Figure 2: Teachers’ Responses

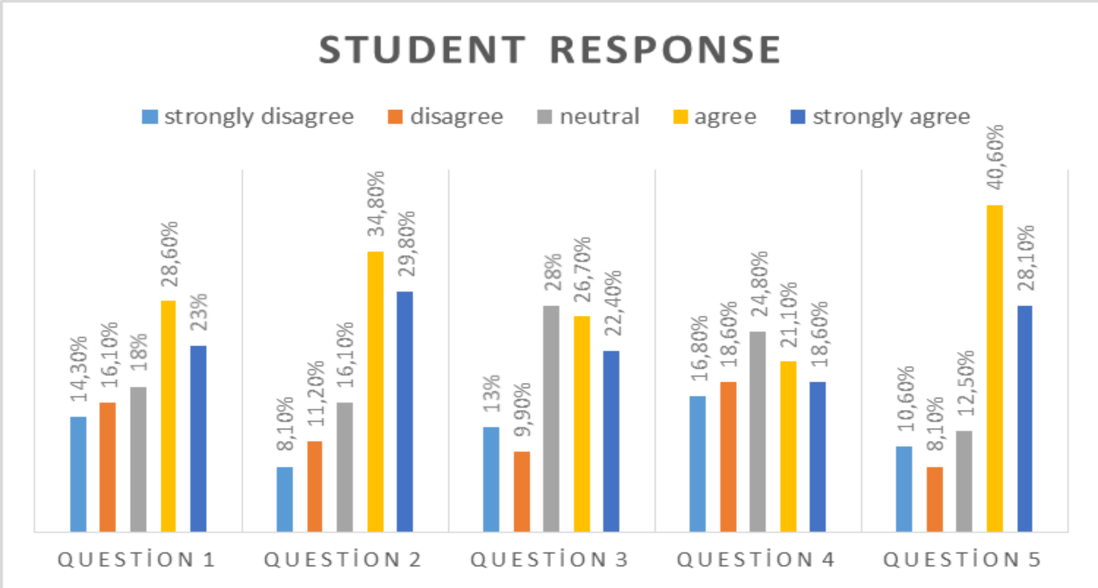

Figure 3: Students' Responses

CONCLUSION

This paper proposes the design of Secure Exam Management System (SEMS) to mitigate exam security threats that exist in m-learning environments. SEMS offers many efficient exam services such as: secure and random distribution of exam questions, biometric based authentication mechanism for anti-impersonation, conducting exams securely, and auditing services. SEMS is integratable with Moodle and its service extension Moodbile. The resulted design is a complete LMS with secure exam services that can be consumed by legacy systems through web browsers and by m-learning systems.

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PRESERVICE CLASSROOM TEACHERS' BIOETHICAL PERCEPTIONS

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ABSTRACT: Recent developments in biology and biotechnology have raised ethical issues. In order to live in more ethical world, it is most important to improve preservice teachers' capacity to make ethical decisions. The purpose of this research was to determine preservice classroom teachers' perceptions about bioethical issues. The research was conducted with 40 preservice class teachers (35 females, 5 males) from Yildiz Technical University, Faculty of Education, Department of Classroom Education in 2015-2016 academic year. In this study qualitative research method was used. For this purpose four bioethics scenarios was developed by the researchers and applied. The participants wrote their decisions about each scenario that included bioethical issues. The data was treated by qualitative data analysis - open coding. As a consequence of this research, it has been revealed that classroom teachers have decided mostly by their beliefs such as religious rather than bioethical perspective. At the end of the research, some suggestions were made concerning to have bioethics subjects in lessons, and to arrange preservice education for classroom teachers.

Key words: bioethics, bioethical issues, biotechnology, preservice teachers

INTRODUCTION

Bioethics is the double sided relationship between biology and ethics. It includes everything from well-known debates such as the use of stem cells in medicine, to the impact of terrorism and war on Earth's environment, to how human populations alter the landscapes around them, to how research into these questions is conducted and results are shared (Dybas, 2003).

Advances in medical technology and biotechnology have caused the emergence of comprehensive new bioethical issues globally. Nowadays the ethical topics in science and biology have become increasingly important in education as a bridge for improving students' perspective. That's why ethics training has gained importance.

Ethics education has a positive effect on students' ability to make decisions about ethical issues (Hosmer, 1998). Bioethics education enables students' awareness of ethical disagreements and dilemmas and fosters good ethical decision making (Choe, Park & Yoo, 2014).

When examining the literature there is not much work in science education about bioethic issues (e.g. Keskin-Samanci, Özer-Keskin & Arslan, 2013; Dawson, 2007; Sadler et al., 2006; Larazowitz & Bloch, 2005; Sadler & Zeidler, 2004; Bryant & Baggott la Velle, 2003; Dawson & Taylor, 2000; Tsuzuki et al., 1998; Asada et al., 1996). In these studies with respect to bioethical issues deal with use of animals in experiments, prenatal genetic diagnosis and abortion, determining the gender or physical appearance of unborn babies, genetically modified organisms, genetic screening tests and therapeutic cloning, gene therapy and cloning, sociological, philosophical and ethical background; interactions of humans with the 'natural' world; biomedical topics; aspects of biotechnology, ethical concerns about animal experiments, environmental issues. In this study we will discuss donors, organ transplant, euthanasia, human milk bank topics with dilemmas.

Incorporating ethical dilemmas into the classroom is one strategy for increasing student motivation and engagement with science content in bioethics education. Students notice the greatest changes in their own awareness of ethical issues and in understanding the connection between science and society (Chowning et al., 2012).

In order to help teachers appropriately manage and resolve ethical dilemmas and conflicts, it is of greatest importance to improve the bioethics education they receive while they are still pre-service teachers. If preservice teachers provide the awareness in bioethics, they will also enable effective education.

The purpose of this research was to determine preservice classroom teachers' perceptions about bioethical issues. Considering these issues, our future teachers have responsibilities as citizens and as teachers to prepare the next generation to be component in the consideration of bioethical issues and help their students discuss ethical implications of these issues.

This study was designed to answer the following research question: What are the preservice classroom teachers' perceptions about bioethics?

METHODS

Design of the Research

A qualitative approach was adopted. This approach helps the researchers to better understand the process of constructing meaning and describe them (Bogdan & Biklen, 1998). In this study, four bioethics scenarios was developed by the researchers and applied. The participants wrote their decisions about each scenario that included bioethical issues. In the analysis of the open-ended questions in the scenarios, the students' responses were first defined thematically. Decriptive content analysis of the data was performed by two researchers.

Sampling

The research was conducted with 40 preservice class teachers (35 females, 5 males) from Yildiz Technical University, Faculty of Education, Department of Classroom Education in 2015-2016 academic year.

In all students (40 preservice classroom teachers), scenarios were administered. The entire questions of response time was 45 minutes.

Data Collection

Scenarios that were prepared on the subjects of bioethics were developed to define the students' perceptions. In developing these scenarios, questions were prepared by researchers at the basis of the common issues among people. The scenarios were reviewed by two faculty members specialized in science instruction. After they examined questions, the questionnaire was given final form which contains 4 questions. Also, before before being presented to students, a pilot run was implemented with 5 students to see whether there was anything the students could not understand.

As part of the reliability study for the scenarios, two researchers analyzed students' answers. There was 95% agreement between the two analyses.

Four scenarios were prepared about bioethical issues as donors, organ transplant, euthanasia, human milk bank. The question below is an example from the scenarios (Figure 1).

Scenario 3. Esra has cancer disease which is too late to treat. Now she has unbeareble pain. Esra has not decision making ability lost yet. She says to doctors that she is going to die and wants to end the her pain. She know to die, thus she wants to doctors end her life. What do you think about the decision of Esra who wants to end to life of her own accord?

Figure 1. Example of the Bioethics Scenario

Data Analysis Procedure

In a study conducted with Keskin-Samanci, Özer-Keskin and Arslan (2013), in determining suprathemes, they benefited from Principles of Biomedical Ethics (i.e. usefulness, harmlessness, respect for autonomy, and justice) (Beauchamp & Childress, 1994) and the Basic Ethical Approaches (i.e. utilitarian, rights, justice, goodness of all, virtue) used in ethical decision-making processes and in ethical standard-setting (Velasquez et al., 2009). The classification of categories set forth by Keskin-Samanci, Özer-Keskin and Arslan (2013), given below were used to analyze the data obtained from scenarios.

- *The Utilitarian Approach* is concerned with doing the most good and causing the least harm for all those concerned–customers, employees, shareholders, the community, and the environment. It tries both to increase the good done and to reduce the harm caused.
- *The Rights Approach* is concerned with the duty to respect others' rights.
- *The Justice Approach* is concerned with the idea that all equals should be treated equally.
- *The Virtue Approach:* Honesty, courage, compassion, generosity, tolerance, love, fidelity, self-control, and prudence are all examples of virtue. The virtue approach asks of any action "What kind of person will I become if I do this?" or "Is this action consistent with my acting at my best?"
- *The Normative Approach* sets forth specific conditions that label actions as ethical or unethical.
- *The Theological Approach* deals with actions motivated by religious rules.
- *Preference for the Natural:* In this approach, people prefer natural things. The important issue is not to pose a risk for the environment or the order of the nature.
- *The Science and Technology Based Approach* deals with scientific developments. According to this approach, science and technology contribute to human life.
- *Belief in Humans' Superiority to Other Living Beings:* This anthropocentric approach assumes that human beings are superior to other living beings which are merely at the service of humans.

The classification of the responses to all scenarios in according to these nine subthemes was made by two researchers. The thematic classification of the reponses for the scenarios is given Results and Findings Section.

RESULTS AND FINDINGS

To find out students' views about donor, we asked to this scenario. Scenario 1 is included a dilemma about a girl in need of donor and her sister does not want to be donor. The percentages of preservice classroom teachers' responding to this dilemma are presented in Table 1.

Table 1. Participants' Approaches about Donors

Bioethics Approach	f
The Utilitarian Approach	7
The Rights Approach	4
The Justice Approach	4
The Virtue Approach	5
The Normative Approach	8
The Theological Approach	7
Preference for the Natural	3
The Science and Technology Based Approach	-
Belief in Humans' Superiority to Other Living Beings	-

Majority of preservice classroom teachers have the utilitarian approach, normative approach and theological approach. Two students have no response this scenario. Some of the participants' statements given below (Numbers in the paranthesis used instead of students' name):

- *We should not be angry to a sister who do not want to be donor. We also shoulld respect her decision. (12)*
- *I think sister who do not want to be a donor should be discarded. It is a disrespectful behavior to her sister. (25)*
- *If she don't want be a donor, she can commit a great sin. According to our religion it is not acceptable. (32)*

The students were asked to opinion of giving organ if the brain death has occurred. Participants' approaches are given in Table 2.

Table 2. Participants' Approaches about Organ Transplant

Bioethics Approach	f
The Utilitarian Approach	8
The Rights Approach	7
The Justice Approach	4
The Virtue Approach	5
The Normative Approach	5
The Theological Approach	7
Preference for the Natural	3
The Science and Technology Based Approach	1
Belief in Humans' Superiority to Other Living Beings	-

Table 2 shows that in the participants generally have utilitarian approach, rights approach and theological approach. Some of the participants' statements given below:

- *According to our religion organ donate acquires merit. (3)*
- *Even if brain dead is occured, I can not donate my relatives' and my friends' organs. Because it is very sad to think falling to pieces of him/her. Something will always missing. (16)*
- *I can allow. Because organ donate save the life. Maybe in this way someone can survive. (21)*

The preservice classroom teachers were asked to opinion of euthanasia. Scenario 3 is given as an example in a Methods Section. Participants' approaches are presented in Table 3.

Table 3. Participants' Approaches about Euthanasia

Bioethics Approach	f
The Utilitarian Approach	5
The Rights Approach	9
The Justice Approach	1
The Virtue Approach	-
The Normative Approach	7
The Theological Approach	13
Preference for the Natural	5
The Science and Technology Based Approach	-
Belief in Humans' Superiority to Other Living Beings	-

As seen in Table 3, most of the participants have theological approach about euthanasia. Some of the teacher candidates' responses given below:

- *I can say that as a religious, I do not make a decision about birth and I can not make a decision about death. Suffering will return to us as prize in other world. (8)*
- *Individuals can make a decision about death by themself. He/she should also be consulted to close friends and relatives. (18)*
- *If there is no possibility about living and he/she will die, we should be respected he/she decision. (19)*

A human milk bank, or breast milk bank is a service which collects, screens, processes, and dispenses by prescription human milk donated by nursing mothers who are not biologically related to the recipient infant. Scenario 4 is asked to participants: Would you prefer milk bank? Table 4 reveals that preservice classroom teachers' approaches about human milk bank.

Table 4. Participants' Approaches about Human Milk Bank

Bioethics Approach	f
The Utilitarian Approach	8
The Rights Approach	-
The Justice Approach	-
The Virtue Approach	1
The Normative Approach	5
The Theological Approach	16
Preference for the Natural	2
The Science and Technology Based Approach	8
Belief in Humans' Superiority to Other Living Beings	-

As seen in Table 4, most of the participants have theological approach about human milk bank. The utilitarian approach and the science and technology based approach are also prefered mostly. Some of the participants' answers given below:

- *I think that this situation have the useful effect more that the risk, thus the milk ban can be preferred. (6)*
- *I think science will solve the disadvantage sides of this milk banks. Because science and technology so advanced it will be positive for our future. (29)*
- *I do not want to give someone's milk to my child though one of my family members. That's why I can not give milk of someone who I have never met before. (39)*

CONCLUSION

This study aims to show preservice classroom teachers' values in their decision-making on ethical problems resulting from biological sciences within the perspective of 'bioethics' and 'bioethics education'.

In looking at the percentages of the preservice classroom teachers' responses it can be said that most of the participants are prefered the theological approach about bioethical issues. In that, their decisions deals with religious rules. Many teachers also have responded as The Utilitarian Approach. They can be tried both to increase the good done and to reduce the harm caused. It can be said that cultural and religious values affected their decisions.

A few teachers are adopting a scientific approach. Perhaps this frequency could be higher if they were science teachers. In the future bioethical scenarios may be attempted at various academic levels and on in science/biology education.

In a study conducted by Dawson and Taylor (2000), science students in two schools in Australia were taught biotechnology courses that introduced them to bioethics. At the end of the course, students completed a survey in which they made a decision about three bioethical dilemmas. The students' answers and reasons were compared with those of three experts. Researchers found that the majority of students tended to resolve and justify their decisions in a way that was naive, idealistic, and rights based.

Another study investigated Sadler and Zeidler's (2004) study examined the extent to which college students construe genetic engineering issues with dilemmas. The study specifically addressed gene therapy and cloning. It was found that students' responses were influenced by affective features such as emotion and intuition. In addition to moral considerations, a series of other factors emerged as important dimensions of socio-scientific decision-making. These factors consisted personal experiences, family biases, background knowledge, and the impact of popular culture.

As a consequence, it can be said that the character of individuals is the most important factor in improving the quality of bioethics thinking (Pauly et al., 2009). Bioethics education primarily aims to enable individuals to discover their own values regarding existing ethical problems, to question and evaluate with universal ethical values, and to gain decision-making skills in problem-solving processes (Keskin-Samanci, Özer-Keskin & Arslan, 2013). It is important that to improve awareness of individuals priorities and values.

RECOMMENDATIONS

The results of this study provide some perspective in terms of preservice science teachers' perceptions of bioethical issues. In the light of this study, the following recommendations can be given.

1. It can be recommended that teachers can do the 'bioethics education' through the scenarios.
2. The study were that the sample was very small. New studies can be made large number of participants.
3. In this study, no quantitative comparison had been made between the group in which students had the bioethical education and the group in which they did not. In the future experimental researches can be designed.
4. It is recommended that further studies comparing the two groups or more groups (different departments) can be designed.
5. Bioethical scenarios may be attempted at various academic levels and on in science/biology education.

The main limitation of the study were that the number of scenarios which were prepared was very small. For this reason, this study can only be regarded as restricted. For the future research, it can be arranged that new scenarios about another common bioethical issues.

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BIOETHICS IN SCIENCE EDUCATION

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ABSTRACT: Recent developments in science will impact the practice of teachers who teach bioethics in schools. There is a growing awareness of bioethical issues amongst the public and in the media, and an increasing level of debate about them. It is important that teachers and those who teach biology are aware of the ethical and social implications of their work. This paper reviews and critiques the existing research on a bioethics, which deals with ethics in the context of science instruction. First, bioethics and bioethical issues are described. This is followed by an importance of bioethics education. Then the existing studies (on bioethics) are reviewed and evaluated. Because of the gaps with the existing research in the literature, recommendations are made describing the need for more and better designed research.

Key words: bioethics, bioethical issues, biology, biotechnology, science education

INTRODUCTION

In the last decades technological developments have accelerated studies in biology and have enabled great improvements in genetics. It is important that biologists and those who teach science are aware of the bioethical and social implications of their work.

Today science curricula involve science and technology together with social, cultural, environmental, political, and ethical elements. It shows that importance of individual awareness of his/her own values and to explain them in a conscious way. Thus, today science education curricula highlight on the elements conducive to society-wide science literacy rather than conveying pure scientific knowledge to students. (Keskin-Samanci, Özer-Keskin & Arslan, 2013).

Bioethical education among students and people is crucial that a necessity of contemporary moral education because of responsible for the future of humanity. In this article, we will describe the results of published literature on importance of bioethical education. The main aim of this study to review and critique the existing research on a bioethics, which deals with ethics in the context of science instruction.

What is bioethics?

Ethics has long been an integral component of medical and nursing degree programmes (Downie & Clarkeburn, 2005). It is clear that moral laws should embedded with biological, medical, agronomical laws and this is how bioethical education contributes to educating students. Ethics education has been espoused by a number of professions in an effort to raise awareness of social and ethical issues and to enable the ethical decisionmaking skills required of people (Lysaght, Rosenberger III & Kerridge, 2006).

Although the term bioethics has multiple origins, it has generally been taken to mean medical ethics (Bryant & Baggott la Velle, 2003). Bioethics, which can be classified as a branch of the ethics plays a key role in the development and implementation of the respective means (Urker, Yildiz & Cobanoglu, 2012). Bioethics combines biological knowledge and knowledge about life with knowledge on the human, moral and ethical values.

Why bioethics education is important?

Bioethics education enables lots of benefits to humanity. Bioethics education makes it possible for individuals to accept the value conflicts caused by biological sciences and to develop decision-making skills based on ethical theories and principles (Reich, 1995).

Bioethical education enables to students to make the ‘right’ decision in a given situation, beside this bioethics education concerns itself with allowing them to have the scientific background necessary for ethical discussions and to improve their reasoning and decision-making skills (Sadler & Donnelly, 2006). Individuals can use these skills while interpreting scientific knowledge thus bioethics is important science education.

Review of the Research on Bioethics Education

We searched Web of Science using the search term bioethics education. This search resulted in the retrieval of over 750 studies. Later we marked education and educational research area, article document types and English language. This search resulted in a total of 48 research articles that met our criteria. We went through each of these studies, selecting those that relevant to our review. Specifically, our criteria for inclusion included any study that had implemented bioethics education in science. In the literature there were many studies that described bioethics education (e.g. Bradbury-Jones & Alcock, 2010; Howard, McKneally & Levin, 2010; Pinch & Graves, 2000; Mills, 2015). These studies were in many fields such as medicine, biochemical, law, nurse education. However, the goal of this research was to determine studies in science education disciplines. Our review of the research includes nine research articles.

Critique of the Research on Bioethics Education

According to findings of articles reported here do indicate that it can be difficult to appropriately assess students' socio–scientific discourse. Bioethics arguments can be useful for improvement of students' cognitive ability, and topics such as genetic engineering provide useful ways to stimulate this (Lucassen, 1995). Larazowitz and Bloch (2005) highlighted the need for the implementation of discussions on societal issues related to science, technology, and environment.

Studies were performed in many counties (e.g., Turkey, US States, UK, Australia, Japan, New Zealand). It was generally found that individuals' responses were influenced by affective features such as emotion, attitude and intuition (e.g. Dawson & Taylor, 2000, Sadler & Zeidler, 2004). Although individuals' opinions also differ according to their country, generally the explanations of them supplied to support their decisions suggested that they did not consider long term consequences. Thus, it can be said that teachers need more teaching materials to discuss the bioethics values and ideas on further ways to teach biology and use animals in school (Tsuzuki et al., 1998). In this way they can put into practice a more effective ethic teaching.

The sample of studies was examined during the review. Keskin-Samanci, Özer-Keskin and Arslan (2013) study with secondary school students. Dawson's (2007) sample is 12-13 years old and older children. Bryant and Baggott la Velle (2003) emphasize the importance of awareness among biology science and biology education students of the ethical and social implications of their work. Dawson and Taylor (2000) worked with also science students. In Sadler and Zeidler's (2004) study college students were used as a sample. Sadler (2006), Larazowitz and Bloch (2005), Asada et al (1996) and Tsuzuki et al. (1998) worked with teachers. When the literature examined, It has not been found to study at primary level. Therefore, it can be said that, studying with students at this level should be increased.

In these studies data collection method generally was interviews (e.g. Dawson, 2007; Sadler et al, 2006; Sadler & Zeidler, 2004) and some of the studies used the surveys (e.g. Dawson & Taylor, 2000; Tsuzuki et al., 1998). The bioethics education is also important as well as determining indivuduals' views on bioethics.

RECOMMENDATIONS

The results of this study provide some perspective in terms of bioethical issues. Students should be given more opportunities to discuss bioethical issues. That is, bioethics should be a subject for study in science education. Science curricula at all levels of education should incorporate ethical issues of science.

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ROLE OF EXCURSIONS AND EVENTS ON ECO-FRIENDLY BEHAVIOR FORMATION AND EFFECTS ON STUDENT INFORMATION AND ATTITUDES

Sinan Erten

INTRODUCTION

The environmental problem is global rather than local. Environmental issues affect everyone without looking to ethnicity, language, gender or other discriminations. Especially, during last years it threats the globe by "Global warming" that reported in the 5th report of IPCC. Environmental issues threat human beings existence and they make the world a hard place to live. Besides technological developments individual responsibilities are also important to overcome these issues. That might be possible with environmental education. The purpose of environmental education is to prepare responsible individuals that are environmentally friend. People can overcome environmental problems by being aware of the problems and by being responsible individuals for environmental issues. This study has been taken into consideration with those ideas. The aim of the current research is search for the effect of environmental activities and trips during the environmental course and to check if attitudes toward environment have changed or not.

METHODOLOGY

This study is qualitative and quantitative. In qualitative part of the study an attitude and knowledge survey was given to students before and after instruction. The survey has been applied in many researches before and it has been adapted by the researcher. The cronbachs alpha of the survey is 0.84 Students were given a cardboard in the first lecture and asked to draw picture that describes environmental issues of the world in 2050. Students were requested to write a nickname on the cardboard and they also wanted to write down pessimistic or optimistic on the cardboard. The same procedure followed in the last lecture of the semester. The pessimist and optimist ratios have been determined. The first and last pictures were analyzed based on the content. Seven students participated in the qualitative part of the study. Students were interviewed and recorded. After that the data were transcribed.

RESULTS

The results showed that the attitude of students' environmental views and their environmental knowledge has statistically increased. Moreover, qualitative analysis of the data supported that the students' eco-friendly behavior seemed to be also increased indicating that the environmental activities and eco-tours had positively increased students' environmental views. At the end of the course period students had drawn 460 pictures. According to the results, 267 of them (59%) gave up on pessimistic views and started thinking positively. 193 (41%) students had drawn pictures indicating that in the next 30 years, environment will get worse.

Interviews conducted with randomly selected 7 students. These meetings have provided more information about students' pictures and their responses were recorded. Then the data categorized and analyzed in detail to obtain detailed results. The finding indicated that environmental education and eco-friendly views supported and developed mostly by eco-tours and activities. Hence these type of activities should be designed and can influence students' behavioral changes positively.

COMMENTS

Here, it seems that the effect of outdoor activities should be integrated and supported more often to develop and increase students' eco-friendly behaviors. Environmental education courses should be designed accordingly to support and gain positive environmental views among students.

ICT APPLICATIONS IN ENGLISH TEACHING: A LITERATURE REVIEW

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ABSTRACT: Language teaching and learning are becoming more sophisticated day by day thanks to application of technological innovations in classroom practice. In recent past, the number of applications of ICT in English teaching and learning have been increased. The researches over English teaching with information and communication technology (ICT) suggest some evidence as to positive effects of the use of information and communication technology (ICT) on students' learning (Mumtaz, 2000).English language teachers have a tendency to use ICT as a tool to practice structural purposes, teaching unknown words, speaking and pronunciation, reading comprehension ,writing, listening. The aim of the review is to provide an insight on which ICT applications are used in English teaching in practice and categorize ICT applications in relation to language skills and knowledge such as speaking, writing, listening, pronunciation and vocabulary and to examine effects of ICT applications on student achievement by investigating the literature involving ICT applications in other countries. It was determined that 12 doctoral dissertations and 25 papers, 7 master theses related to ICT applications and English skills and impact on students' achievements in ICT applications of English were included. In this research, the researchers assessed theses and papers including ICT applications in English teaching, impact of ICT on achievement in English lesson and technologies which applied in ICT. To investigate doctoral dissertations, master theses and papers from 2004 to 2016, document review was used. The findings suggested that ICT applications for vocabulary teaching was the most widespread English teachers and researchers used "Mobile Learning" based applications mostly; as to impact of ICT on students' achievement in English teaching, it was found that engagement and facilitiate English learning statements were frequently stated between 2004 and 2016.

Key words: English teaching, ICT applications, Language skills, Educational technology

INTRODUCTION

Educational technology dates back to early sixties. Until the present, new technological innovations have triggered and assisted teaching and learning. The development of educational technologies recently has tended to be mobilized, portable, and personalized. These trends have led to learning forms changing from traditional classroom learning to electronic learning (e-learning),mobile learning (m-learning) or ubiquitous learning (U-learning) (Chen &Chung, 2008, s. 6259).ICT in English teaching decrease teacher-centered instruction, conversely increases student centered instruction. The main purpose of the education is to enable students take part in meaningful learning. To achieve the aim, the students should construct the knowledge by the help of the teachers or the technology.

The technology has a critical role as a partner to enhance students' learning process. That's the teachers get help from information and computer technology to support students by forming meaningful learning environment. In language teaching (ET) with the integration of ICT, language games, text reconstruction, cloze texts, puzzles and reading and writing practice were included in the computer programs (Chen, 2006, p. 20).

To improve four language skills, the integration of ICT in English teaching has been concern for years. With integration of the computer technologies, the way of English teaching has been differentiated recently. English teacher has been using ICT applications to improve English level of students and facilitate English learning by providing opportunities with retention and removing time and place problem because students practice everywhere and whenever. For successful English teaching, English teacher (EFL) should be eclectic and not strict. To overcome learning problems thanks to ICT which enables students study at their own pace via different activities. Karaca (2007, s. 8) reported Ahmad and others' opinions about English teaching as like this:" Language teaching tends in practice to be eclectic: there are languages not only exceptionally many paths and educational means for arriving at a given educational goal, but there are also very many types of educational materials which can be used to achieve that goal". To be eclectic and richen learning environment, and draw attention of the students, the numerousness ICT applications have been utilized by the EFL teachers to richen students' English skills reading, writing, speaking and listening.

These applications affected English instruction. To illustrate; Dinçer (2014) used social media site" Facebook" to investigate its effect on vocabulary learning. The result of the study suggested the social media had a favorable impact on vocabulary acquisition. The result of the study suggested the social media had a favorable impact on vocabulary acquisition. Dalton (2016) conducted a study for investigating three dimension virtual environment which based on practice for meaningful and authentic language use. Chen and Chang (2011) utilized augmented reality (AR) technology to apply an AR-learning system for English vocabulary learning. The researchers stated that AR-learning system was a potential learning tool for learners. The 3D virtual object had a critical role to draw attraction of the students and for enhancing learning effectiveness. On reviewing literature, M-learning, computer-based technologies, Web, AR (Augmented Reality), Video based technologies and Social media like facebook, twitter and e-mail have been used mostly for ICT applications in English teaching.

In literature review, it is notable that ICT in English teaching improves collaborative learning and student-centered learning and increases students' self-regulation and help teachers make students' learning easier. In literature review, it is notable that ICT in English teaching improve collaborative learning and student-centered learning and increase students' self-regulation and help teachers make students' learning easier.

The study aims at reviewing the literature on ICT applications and form a framework into applications used for English language skills, applied technologies and their common findings, in other words, keywords researchers offered in the end of their studies about the impact of ICT on English teaching. The research questions to guide the study were developed from an initial review of the literature. The review of related literature focuses on three major topics:

1. What is the distribution of types of technologies used in the teaching of specific language skills and areas?
2. What is the distribution of English language skills (writing, speaking, listening...etc.) used in ICT applications?
3. Which keywords are stated commonly in studies impact of applications of ICT on students' achievement?

METHODS

To investigate theses and papers from 2004 to 2016, document review was implemented. Papers and theses were researched from 'ProQuest" and "Some journals on language and technology' by using key words "ICT", "ICT and English teaching", "EFL and Technology", ICT and English teachers".

Table 1. The Distribution of Sources

	f	%
Doctoral dissertation	12	% 27
Master Theses	7	%16
Papers	25	%57

All the sources searched and reached were filtered then some of them were eliminated, in conclusion, 25 papers and 12 doctoral dissertations and 7 master theses published between 2004 and 2016 were determined for the review.

Data Analysis

To analyze the data, SPSS 18 was used for frequency and mean of the items revealed in questions of the study. For the data analysis, descriptive statistical analysis was applied for frequency and mean of collected sources.

RESULTS AND FINDINGS

The results include "Language Skills", "Kind of ICT" and "Common effects of ICT applications on students' achievement and attitudes in English teaching. For distribution of types of technologies used in the teaching of specific language skills and areas, When the frequency was viewed, it was seen that m-learning % 31,25 (f=8), wap site %6,25 (f=1), AR 18,75 (f=5), Web %12,5 (f=3), Cmc Technologies %12,5 (f=2) and Call %6,25 (f= 1), video based %6,25 (f=1) and VR %6,25 (f=1). For the last decade, Mobile learning and AR was utilized in design of ICT applications mostly, conversely; Wap, Video based and VR was used at least. For the distribution of English language skills (writing, speaking, listening...etc.) used in ICT applications, Listening % 20, Speaking % 15, Writing % 15, Reading % 5 and Pronunciation % 5 is the distribution of ICT applications for over 10 years. Of the most widespread is vocabulary "Word teaching process" with % 40. Pronunciation and Reading skills were performed just once (*f*=1) in the literature reviewed by researchers. The frequency of writing and speaking is 3 (*f*=3). Listening (*f* = 4) and vocabulary (*f*= 8). As to keywords stated commonly in studies impact of applications of ICT on students' achievement, the findings indicate that the most influential outcome is make English learning easier with % 26. The frequency of "Facilitate learning" is 8. "Interaction" is %10 (*f* =3); "Motivation %20 (*f*=5), "Thinking skills" %13 (*f* = 4), "Engagement" %20, (*f* =6), "Attention" % 10 (*f* =3).

CONCLUSION

In the study, the aim was to review ICT applications used in English teaching by examining theses and papers from 2005 to 2016.A number of sources were reviewed and technologies applied in English teaching were categorized and distribution of technologies was shown with percentage. The other aim was to investigate distribution of English skills in ICT applications. It was understood that vocabulary teaching in ICT applications was the most widespread. Karaca (2007, p. 35) stated vocabulary knowledge is an indispensable part of language learning, vocabulary can be a useful supplementary aid for language learning. For the first question, the findings show that m-learning is the most significant technological applications performed by EFL teachers for the last decade. When tle literature was viewed for getting information on impact of ICT on students' achievement in English teaching, it was found that engagement and facilitiate English learning statements were frequently stated.It is clear that the use of ICT by EFL teachers in English teaching is increasing year by year.

RECOMMENDATIONS

The number of the studies can be expanded by including more theses and papers to review the literature. The studies can be categorized according to different variables such as level of students' level and their grades.

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EXAMINATION OF ADOLESCENTS' COPING WAYS WITH CYBERBULLYING

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ABSTRACT: With the rapid development in information and communication technologies, increase in quality and quantity of various tools that are compatible with Internet also augments interpersonal communication and interaction opportunities on the Internet. This increase in interpersonal communication and interaction on virtual platforms, however, brings a set of problems along, too. One of these problems is the use of the virtual platform technologies by the young to bully (cyberbullying) their peers. Considering 12 to 20 years of adolescents, being the most engaged people with virtual platforms, and who are called the digital natives; ascertaining adolescents' coping ways with cyberbullying is thought to be important. The purpose of this study is to examine 9th, 10th, 11th and 12th grades high-school adolescents' coping ways with cyberbullying on the basis of gender, high-school type and Facebook membership variables. Survey model was used as the research method. The study was conducted with 301 adolescents from two different high-schools in a city in the centre of Turkey. "Coping with Cyberbullying Scale towards Adolescents" consisting of 17 items and 4 subscales was used to obtain research data. Findings obtained from the research show that adolescents' coping ways with cyberbullying are generally elevated. Additionally, while there is a significant difference in favour of female adolescents in coping ways with cyberbullying in terms of gender; there is, on the other hand, a significant difference in favour of adolescents studying from public high-schools in terms of school type. Finally, coping ways with cyberbullying according to whether the adolescents are members of Facebook, differentiated on a significant level in favour of the ones that are not members of Facebook.

Key Words: Coping with cyberbullying, Adolescents, Gender, Facebook membership.

INTRODUCTION

Nowadays information and communication technologies rapidly develop and therefore gradually increasing occurred in the quantities and qualities of different tools which are compatible with Internet causes to an increase in interpersonal communication and interaction possibilities in Internet environment as well. Based on the results of the research conducted by Turkish Statistical Institute (TUIK) in April 2015, it is determined that while 54.8% of individuals in the 16-74 age range in Turkey uses computer, 55.9% of them uses Internet (TUIK, 2015). However, the use of social media with a rate of 80.9% takes place on the top among intended uses of Internet in the first three months of same year (TUIK, 2015). The Internet usage rate in the world has reached 46.1% for the first five months of 2016 (Internet Live Stats, 2016). Such an increase and acceleration occurred in use of communication tools nearly turns the world into a small city and even if there are distances among people and people don't know each other, they take the opportunity to establish communicate each other. The most popular technological tools of this era in which we live are mobile tools and these tools have an important place in the life of the young ones (Saran, Seferoglu & Cagiltay, 2009). The mobile tools rapidly become widespread in our country and accordingly they are no doubt used by adolescents in the best way.

Adolescence period covers 12-24 age range and adolescence term refers to the individuals whose childhood period ends upon their attainment to puberty and it continues to young adulthood period (between aged 25-30) and differs from childhood period in terms of biological and psychological and society expects them to take responsibility and they win their economic freedoms at the end of this period (Kulaksızoğlu, 2004). Adolescents consist of individuals who can more closely follow technological advances compared to their parents and learn faster the changes in their environment than their parents and act more flexible in the interpretation of the information learned. As each learning will cause to behavioral changes and also as adolescents have more advantage in learning the innovations and in turning them into behavior, they exhibit more different behaviors than their parents. These behavior differences can lead adolescents to experience conflicts and problems with their parents (Kulaksızoğlu, 1989). As adolescents use more and better the technological means and their parents don't know to benefit from the technological means as required, Prensky (2001) defines the adolescents as "digital natives" and their parents as "digital immigrants".

Today, group who are more willing to use the Internet considered as the most basic component of information and communication technologies are digital natives (Tonta, 2009). Digital natives means individuals who are born inside modern technology and communication world and place online media and new technologies in the center of their lives and have natural skills to use them (Prensky, 2001). Digital natives adapt newly emerging technological innovations in a short time and naturally turn them into a part of their lives. Speed and accessibility has become the passion of digital natives and as a sequence they get used to it and consume it quickly. Digital immigrants are such a generation that they were not born with the tools engendered by the rapidly evolving information and communication technologies and tools such as mobile phones, computers and so on have entered in their lives later. This generation can be forced in using technological tools, resist them and even refuse them; but they are obliged to benefit from these tools in order to keep up with the times. There are some differences between digital natives and digital immigrants in terms of using of technology as well as there are some differences in their general behaviors. Generally digital natives have an extremely nervous person; they anger easily and tend to exaggerate their some behaviors. But digital immigrants, contrary to digital natives, get pleasure out of a quite life and generally exhibit a calmer attitude than digital natives (Prensky, 2001). Some negative features of digital natives bring alone some problems in the digital age. Due to especially using of Internet in many types of devices, the number of communication channels in cyber environments has increased and as a consequence cyberbullying named as a new type of bullying has become popular among adolescents.

Belsey (2007) defines the cyberbullying that has many definitions in literature as behaviors aiming to harm to other people by means of using of information and communication technologies by an individual or a group and repeating intentionally and made hostilely. However, Hinduja and Patchin (2008) has stated that adolescents have harassed each other by using technological tools such as mobile telephones and computers together with modern technology with the impact of the interest in technology and accordingly that they have exhibited bullying behavior against each other. There are similarities between cyberbullying and bullying in terms of bad faith, violence, repetition and remarkable power difference (Patchin & Hinduja, 2006). Willard (2006) expresses that there are seven cyberbullying activities such as anger (angry, to send rude and abusive messages), harassment (to transmit continuous offensive messages), cyber harassment (to forward repeatedly harmful and extremely frightening threat messages), defamation (to send untrue or cruel expressions), imitation (to act like someone which is under bad and difficult conditions), navigation and deception (to send the sensitive and proprietary information belonging to someone else to other people and to deal with spreading of this information to more people) and removal from membership (to remove a member intentionally from a online group). He has stated that these activities consist of text, picture, graphic, video and audio files.

According to the data of research performed by TUIK in Turkey in concern with individuals taking place among aged 16-74, the age group where computer use is at the highest level is composed of individuals taking place among aged 16-24 with a ratio of 70% (TUIK, 2015). It has been determined that group where Internet use is at the highest level is composed of individuals taking place among aged 16-24 with a ratio of 77% (TUIK, 2015). In light of these data and when it is taken into consideration that most interested group on the Internet are adolescents, it may be said that exposing of adolescents to cyberbullying is potentially a higher probability. For example, in Turkey it has been determined in the scope of a research conducted together with high school students that 30.2% of adolescents have shared their passwords in the Internet and it has been revealed that 13.4% of boys and 10.4% of girls have been exposed to cyberbullying (Aricak, Siyahhan, Uzunhasanoglu, Saribeyoglu, Ciplak, Yilmaz, & Memmedov, 2008). Some negative emotions have occurred in individuals exposed to bullying and their daily activities have been adversely affected from this situation (Willard, 2007).

In a study conducted by Anderson (2012) about what individuals exposed to cyberbullying feel, it has been observed that individuals in question face with emotions such as sadness, self-accusation, lack of self-confidence, insecurity, anger, discomfort, depression, isolated from environment and shame. It is possible to see many studies carried out abroad that what kind of strategies is required to cope with cyberbullying. Parris, Varjas, Meyers and Cutts (2012) have divided into three sections activities aiming to cope with cyberbullying in their studies. In other words they are composed of sections such as reactive coping, preventive coping and not to use any method to prevent. The methods used in reactive coping consist of avoidance, acceptance, defense and social support seeking behaviors. The methods used in preventive coping are to tell someone, to raise safety and awareness. Similarly, Baştürk-Akca, Sayımer, Balaban-Salı and Başak (2014) state that it is essential to take the preventive measures and to provide the correct use of technological means by creating the awareness of cyberbullying in order to protect individuals from cyberbullying. Sezer, Sahin and Akturk (2013) conducted a study on middle school students for the ways they use to prevent themselves from cyberbullying. The results of their study show that students; complain cyberbullying to the site administrator, contact to the experts, inactivated their own accounts, answering back or counterattack to cyberbullying. As a consequence, importance of determination of levels of coping with cyberbullying is emphasized in studies fulfilled in order to minimize the effects of cyberbullying on individuals and to take preventive measures. With this study, we have aimed to examine the levels of coping with cyberbullying of adolescents dealing with exceedingly technological tools and therefore exposed to cyberbullying.

Purpose of this Research

The purpose of this study is to examine the levels of coping with cyberbullying of students studying at 9^{th}, 10^{th}, 11^{th} and 12^{th} grades of high schools. In accordance with this general purpose, we have tried to find answers for questions indicated below in the scope of this research:

1. What are the levels of coping with cyberbullying of adolescents?
2. Do the levels of coping with cyberbullying of adolescents show differentiation according to the variables specified below?
    a. Gender,
    b. High school type,
    c. Facebook membership

METHOD

Research Model

Survey model has been used as research design in this study. Survey model is a kind of research that describes an ongoing situation in the past or at the present time without changing (Karasar, 2014).

Study Group

301 high school students studying in a province in the central part of Turkey have participated in this research on a voluntarily. Descriptive statistics regarding the study group is provided in Table 1.

Table 3. Demographic Characteristics of Adolescents

Variable	Option	n	f (%)
Gender	Female	115	38.2
	Male	186	61.8
High school type	Vocational and Technical High School	112	37.2
	Public High School	189	62.8
Facebook Membership	Yes	217	72.1
	No	84	27.9
Grade Level	9^{th} Grade	79	26.3
	10^{th} Grade	110	36.5
	11^{th} Grade	71	23.6
	12^{th} Grade	41	13.6

As shown in Table 1; while 115 of adolescents participated in the study is composed of girls, 186 of adolescents participated in the study is composed of boys. 112 of adolescents were studying at Vocational and Technical High School while 189 of them were studying at Public High School. When looking at the Facebook membership of adolescents in Table 1, it shows 72.1% of adolescents are a member of Facebook, while 27.9% of them are not a member of Facebook. In addition, information related to grade levels of the participants is as follow: 79, 110, 71 and 41 of participants consist of 9^{th}, 10^{th}, 11^{th} and 12^{th} grades students respectively.

Data Collection Tools

"Coping with Cyberbullying Scale towards Adolescents" and "Personal Information Form" is used to collect data from adolescents in the scope of the research.

Coping with Cyberbullying Scale towards Adolescents

In this research, "Coping with Cyberbullying Scale towards Adolescents" is used developed by Peker, Özhan and Eroğlu (2015) and carried out a validity and reliability study together with 318 secondary school students in order to determine the levels of coping with cyberbullying of adolescents. The scale consists of 4 subscales. There are 3 items in subscale called as "Social Support Seeking", 5 items in subscale called as "Help Seeking", 4 items in subscale called as “Struggling” and finally 4 items in subscale called as “Online Security", in other words 17 items in total take place in the scale. In the coping with cyberbullying scale towards adolescents, a 4-point Likert type scale, participant is requested to mark one of “Never”, “Sometimes”, “Often” or “Always” options. These options are given 1, 2, 3 and 4 scores respectively. There is no item for which reverse point is given in the scale. Instead of achieving a total score in the scale, achieving a total score for each subscale and evaluating the levels of coping with cyberbullying in the subscales is recommended. When total score increases in each subscale, it is highlighted that the levels of coping with cyberbullying will be in a high level. In the scale, Cronbach α internal consistency coefficient is .80 for social support seeking subscale; .86 for help seeking; .70 for struggling and .77 for online security.

Personal Information Form

In this research, personal information form prepared by researchers is used in order to determine the gender, high school type, class levels of adolescents and whether they are Facebook membership or not. In the Personal Information Form, closed-ended questions related to variables specified above have been asked and adolescents participated in the research have been requested to mark the most appropriate option for them.

Analysis and Interpretation of Data

The reliability of the scale used in the research has been calculated again in the scope of this study. As a result of the calculation, Cronbach α internal consistency coefficient as .76 for social support seeking subscale, as .83 for help seeking, as .70 for struggling and as .70 for online security has been found in the scale. Calculation of Cronbach α internal consistency coefficient as .70 and above indicates that measuring tool used is reliable (Büyüköztürk, 2016). The kurtosis and skewness coefficients of subscales have been calculated with purpose of determining the appropriate statistical techniques to reach the results being the scientific validity through data obtained from the scale. The values obtained according to results of the calculation are given in Table 2.

Table 4. Skewness and Kurtosis Coefficients of the Subscales

	Social Support Seeking	Help Seeking	Struggling	Online Security
Kurtosis	-.240	.146	-.103	.904
Skewness	-.598	-.881	-.677	.573

When the values given in Table 2 are considered, the skewness and kurtosis coefficients calculated for each subscale take place within the limits of -1 and +1 and this shows that scores obtained from subscales exhibit a normal distribution (Huck, 2012). As a consequence, it has been decided to use the parametric tests on the data obtained from the scale. Based on this, descriptive statistics was used in the analytical procedures and independent sample t-test was used in the comparison of the pairs (gender, high school type, Facebook membership).

Scale items are in 4-point Likert type and adolescents have been requested to give scores between 1 and 4 to items taking place in the scale. The scale intervals were calculated by interval = range width / group number formula and is given in Table 3.

Table 5. Scale Intervals

Scales	Option	Intervals
1	Never	1.00 – 1.74
2	Sometimes	1.75 – 2.49
3	Generally	2.50 – 3.24
4	Always	3.25 – 4.00

FINDINGS

The Levels of Coping with Cyberbullying of Adolescents

In this research, the levels of coping with cyberbullying of adolescents have firstly been examined. When the levels of coping with cyberbullying of adolescents are determined, total scores obtained from subscales have been calculated and evaluated instead of total coping with cyberbullying score as is indicated by Peker, Özhan and Eroğlu (2015). It has been specified that the conditions of coping with cyberbullying of adolescents who totally obtain high scores in subscales are at a higher level. The analysis results obtained in accordance with this situation are given in Table 4.

Table 4. The Conditions of Coping with Cyberbullying of Adolescents

The Levels of Coping with Cyberbullying	N	Min.	Mak.	$\overline{X}$	SD
Social Support Seeking	301	3	12	8.42	2.22
Help Seeking	301	5	20	11.65	3.95
Struggling	301	4	16	11.13	2.99
Online Security	301	5	20	16.03	3.29

When average scores obtained by adolescents in subscales of the coping with cyberbullying scale are examined, it is seen that average scores obtained from Help Seeking subscale take place in “Sometimes” range, while average scores obtained from all other subscales take place in “Generally” range. Accordingly, it can be said that the levels of coping with cyberbullying of adolescents are generally high.

Examination of the Levels of Coping with Cyberbullying of Adolescents According to Gender

According to gender of adolescents, differentiation levels between scores taken by adolescents in the coping with cyberbullying scale towards adolescents is examined through independent sample t-test and analysis results are given in Table 5.

Table 5. Examination of the Levels of Coping with Cyberbullying of Adolescents According to Gender

Scale	Subscale	Gender	N	$\overline{X}$	SS	t	p
Coping with Cyberbullying towards Adolescents	Social Support Seeking	Female	115	9.01	2.046	3.679	.000
		Male	186	8.06	2.252		
	Help Seeking	Female	115	12.87	3.833	4.344	.000
		Male	186	10.89	3.839		
	Struggling	Female	115	12.06	2.826	4.383	.000
		Male	186	10.55	2.943		
	Online Security	Female	115	17.75	2.255	8.541	.000
		Male	186	14.97	3.388		

When the values given in Table 5 are considered, it is seen that there is a significant difference in favor of female adolescents among scores obtained from all subscales of coping with cyberbullying scale towards adolescents (Social support seeking [t = 3.679, p <0.01], help seeking [t = 4,344; p <0.01], struggling [t = 4,383, p <0.01] and online security [t = 8,541, p <0.01]). These results suggest that female adolescents can achieve to cope with cyberbullying in the best way in social support seeking, help seeking, struggling and online security subscales compared to male adolescents.

Examination of the Levels of Coping with Cyberbullying of Adolescents According to High School Type

According to high school types of adolescents, differentiation levels between scores taken by adolescents in the coping with cyberbullying scale towards adolescents is examined through independent sample t-test and analysis results are given in Table 6.

Table 6. Examination of the Levels of Coping with Cyberbullying of Adolescents According to High School Type

Scale	Subscale	High School Type	N	$\overline{X}$	SS	t	p
Coping with Cyberbullying towards Adolescents	Social Support Seeking	VTHS[1]	112	7.84	2.463	-3.385	.001
		Public High School	189	8.77	1.992		
	Help Seeking	VTHS [1]	112	11.34	3.871	-1.044	.297
		Public High School	189	11.83	3.994		
	Struggling	VTHS [1]	112	10.50	3.013	-2.850	.005
		Public High School	189	11.50	2.913		
	Online Security	VTHS [1]	112	14.33	3.692	-6.850	.000
		Public High School	189	17.04	2.552		

[1] VTHS: Vocational and Technical High School

When the values given in Table 6 are considered, it is seen that there is a significant difference in favor of adolescents who studying in a public high school among scores obtained from social support seeking, struggling and online security subscales of coping with cyberbullying scale towards adolescents (Social support seeking [t

= -3.385; *p* <0.01], struggling [t = -2 850; *p* <0.01] and online security [t = -6.850; *p* <0.01]). But there is not a significant difference among scores obtained from help seeking [t = -1.044; *p* <0.01] subscale in terms of high school type from where they received education. These results suggest that adolescents studying at a public high school can achieve to cope with cyberbullying in the best way in social support seeking, struggling and online security subscales compared to adolescents studying in the vocational and technical high school.

Examination of the Levels of Coping with Cyberbullying of Adolescents According to Facebook Membership

According to Facebook membership of adolescents, differentiation levels between scores taken by adolescents in the coping with cyberbullying scale towards adolescents is examined through independent sample t-test and analysis results are given in Table 7.

Table 6. Examination of the Levels of Coping with Cyberbullying of Adolescents according to Facebook Membership

Scale	Subscale	Facebook Membership	N	$\bar{X}$	SS	t	p
Coping with Cyberbullying towards Adolescents	Social Support Seeking	Yes	84	9.18	1.989	3.757	.000
		No	217	8.13	2.241		
	Help Seeking	Yes	84	12.89	4.081	3.465	.001
		No	217	11.17	3.798		
	Struggling	Yes	84	11.96	3.164	3.060	.002
		No	217	10.81	2.856		
	Online Security	Yes	84	17.06	3.205	3.435	.001
		No	217	15.63	3.246		

When the values given in Table 7 are considered, it is seen that there is a significant difference in favor of adolescents who are not a member of Facebook among scores obtained from all subscales of coping with cyberbullying scale towards adolescents (Social support seeking [t = 3.757; *p* <0.01], help seeking [t = 3.465; *p* <0.01], struggling [t = 3.060; *p* <0.01] and online security [t = 3.435; *p* <0.01]). These results suggest that adolescents who are not a member of Facebook can achieve to cope with cyberbullying in the best way in social support seeking, help seeking, struggling and online security subscales compared to adolescents who are a member of Facebook.

DISCUSSION AND CONCLUSION

Cyberbullying events increase rapidly among adolescents, it affects adversely especially the adolescents and individuals who closely follow and use all technological developments (Ayas & Horzum, 2012). In this study in which we determine the levels of coping with cyberbullying of adolescents and to examine whether the levels of coping with cyberbullying of adolescents become different according to some variables or not, we firstly have set forth that the levels of coping with cyberbullying of adolescents are high. Aricak et al. (2008), in a manner similar to our study, have determined in their studies that adolescents have optimistic opinions about coping with cyberbullying. In another study by Akturk (2015), cyberbullying sensibility levels of high school students were examined and it was reported that cyberbullying sensibility levels of the students were high.

Secondly, we have determined that female adolescents can achieve to cope with cyberbullying in the best way in social support seeking, help seeking, struggling and online security subscales compared to boy adolescents. In a study conducted by Peker (2014) together with 314 high school students receiving education in 9th, 10th, 10th and 11th classes, participants were applied an questionnaire related to coping with cyberbullying consisting of helplessness, help seeking, coping technically, struggling, aggression and prevention subscales. According to results of this research, it has seen that girls exhibit a significant difference in help seeking, struggling, prevention and coping technically subscales compared to boys, while boys exhibit a significant difference in aggression subscale compared to girls. Price and Dalgleish (2010) have determined two different the coping strategies with cyberbullying as offline and online strategies. They conducted their study with 548 adolescent aging below 25, they found a significant difference in favor of females for strategies such as confronted bully, told a friend, stayed offline, stopped looking, told parent or carer, told teacher or principal, told kids helpline and told another adult among offline strategies. They also found that a significant difference in favor of males for strategies such as did nothing, retaliated and told a sibling among offline strategies. While there is a significant difference in favor of females in strategies such as blocked bully and changed own avatar or mobile number among offline coping strategies, there is a significant difference in favor of males in strategies like removed from friend list.

Thirdly, we have determined that adolescents who studying at a public high school can achieve to cope with cyberbullying in the best way in social support seeking, struggling and online security subscales compared to adolescents studying at a vocational and technical high school. In the literature there is no study where the levels of coping with cyberbullying are examined according school type, but studies are carried out on exposing cyberbullying as well as showing cyberbullying behaviors are examined according to school type. In a study where exposing cyberbullying are examined, it is seen that students studying at a public high school are exposed to further sexual bullying behaviors in the virtual environment compared to students studying at a vocational high school (Horzum & Ayas, 2011). In another study, it is seen that students studying at public schools are exposed to further cyberbullying compared to students studying at private schools (Topçu, Erdur-Baker, & Çapa-Aydin, 2008). In another study where conditions of cyberbullying behavior showing by students are examined according to school type, it is found that students studying at public high schools show further cyberbullying behavior compared to students studying at science high schools (Şahin, Aydın, & Sarı, 2012).

Fourth and finally, we have determined that adolescents who are not a member of Facebook can achieve to cope with cyberbullying in the best way in social support seeking, help seeking, struggling and online security subscales compared to adolescents who are a member of Facebook. When it is considered that students are frequently exposed to cyberbullying in chat rooms and social networks (Ayas & Horzum, 2012), it can be interpreted that adolescents who are not a member of Facebook can achieve to cope with cyberbullying compared to adolescents who are a member of Facebook. Özdemir and Akar (2011) have determined in a study conducted by them that the participants are further exposed to cyberbullying in the Facebook. Baştürk-Akca, Sayımer and Ergül (2015) have determined in a study conducted by them that more than half of students (60%) meet with someone through social media, especially on Facebook, also they have determined in same study that 44% of students makes positive return when they find acceptable the message of someone they don't recognize. It can be said that social media, especially Facebook make people to trust strangers, so it can increase the likelihood of exposuring to cyberbullying.

RECOMMENDATIONS

In this study where the levels of coping with cyberbullying of adolescents are examined, it is seen that the levels of coping with cyberbullying of adolescents are generally high and they become different according to the gender, school type and Facebook membership. At the end of this research, the following suggestions may bring forward in concern with practice: Informing meetings and awareness education may be made about cyberbullying in schools in order to ensure that adolescents can achieve to cope with cyberbullying. Awareness of adolescents related to online security that will cause adolescents to expose to cyberbullying, that will enfeeble the adolescents in coping with cyberbullying can be increased. Adolescents' families who are ready to help to adolescents as their relatives in coping with cyberbullying should be informed about cyberbullying and the ways of coping with cyberbullying and social supports to be provided for them should be increased. Necessary information about institutions, organizations and individuals may be given to adolescents so that they can receive the help when they are exposed to cyberbullying. In addition, researching of conditions of coping with cyberbullying may be suggested for studies to be carried in the future through different variables on different samples.

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FUZZY LOGIC BASED MCCARTHY LEARNING STYLE INFERENCE SYSTEM

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ABSTRACT: In this study, a learning style inference system which is based on fuzzy logic technique and McCarthy learning style is developed to improve student success and learning in education field. McCarthy learning style classifies learners as Innovative, Analytic,Common Sense and Dynamic. In this study, a software system is developed and an interface which includes some questions in relation with McCarthy learning style is designed. Answers of the students are rated and given as an input to the proposed fuzzy logic engine which has four inputs namely Innovative, Analytic,Commen Sense, Dynamic and an output namely EducationStyle. The proposed software system inferences Education Style, Learning Status and the Level of Learning Style of the student. By this way, the instructor will be able to match his teaching style with student's learning style which contributes to student's success in education field.

Key words: McCarthy Learning Style, Fuzzy Logic, Inference System

INTRODUCTION

Learning is the act of acquiring new or transforming and reinforcing, existing knowledge, behaviors, abilities,or preferences and may involve synthesizing different types of information. Each person prefers different learning styles and techniques. By noticing and understanding learning types and abilities, people can use techniques better suited to them. Thus they improve the speed and quality of their learning. For these reasons experts develop different types of learning styles. Education is very important to produce well qualified studies and to contribute to daily life and work. If people know their dominant styles, they can focus on using their abilities. On the other side, if people know their less styles, they can develop some learning strategies too. In this study, fuzzy logic technique is used to inference which learning style is more suitable to the student's learning skils. [1-5] are some of the studies that use Fuzzy logic technique in education field. McCarthy's Learning Style is chosen for implementing and analyzing the developed system. In the following sections, background that includes fuzzy logic technique and McCarthy learning style are described briefly. After that, the proposed system which is composed of interface and fuzzy logic parts is explained in detail. Lastly, simulation results are given and evaluated.

BACKGROUND

In this section, background subjects of the system such as McCarthy learning style and Fuzzy Logic Technique are described briefly.

McCarthy Learning Style

This learning style is based on cerebral hemispheres and takes into other learning styles. Bernice McCarthy classifies learners into four groups:

Type 1: Innovative Learners are interested in personal meaning and need to have reasons for learning. Abilities of this learner types are mostly on cooperative learning, brainstorming, and integration of content areas [6].

Type 2: Analytic Learners are interested in acquiring facts in order to deepen their understanding of concepts and processes. They are capable of learning effectively from lectures, and enjoy independent research, analysis of data [6].

Type 3: Common Sense Learners are interested in how things work. They want to get in work and try it. Concrete, experiential learning activities work best for them [6].

Type 4: Dynamic Learners are interested in self-directed discovery. They rely heavily on their own intuition, and seek to teach both themselves and others. Any type of independent study is effective for these learners [6].

Fuzzy Logic Technique

Fuzzy logic deals with reasoning that is approximate rather than fixed and exact. Compared to traditional logic, fuzzy logic variables may have a truth value that ranges in degree between 0 and 1. Fuzzy logic has been extended to handle the concept of partial truth, where the truth value may range between completely true and completely false [7]. Fuzzification, Fuzzy Rules, Membership Functions, Inference and Defuzzification are basic concepts of the fuzzy logic technique. The aim of fuzzification step is to determine the mapping degree of crisp inputs to fuzzy sets by using membership functions. Fuzzy rules are applied to the fuzzified inputs. Outputs of all rules are aggregated to obtain unificated output. From the fuzzy rules, probability fuzzy output variable can be obtained. The higher probability means that the node has more chance to be selected. Defuzzification is the process of transforming probability fuzzy output variable into a single crisp output [8].

The Proposed System

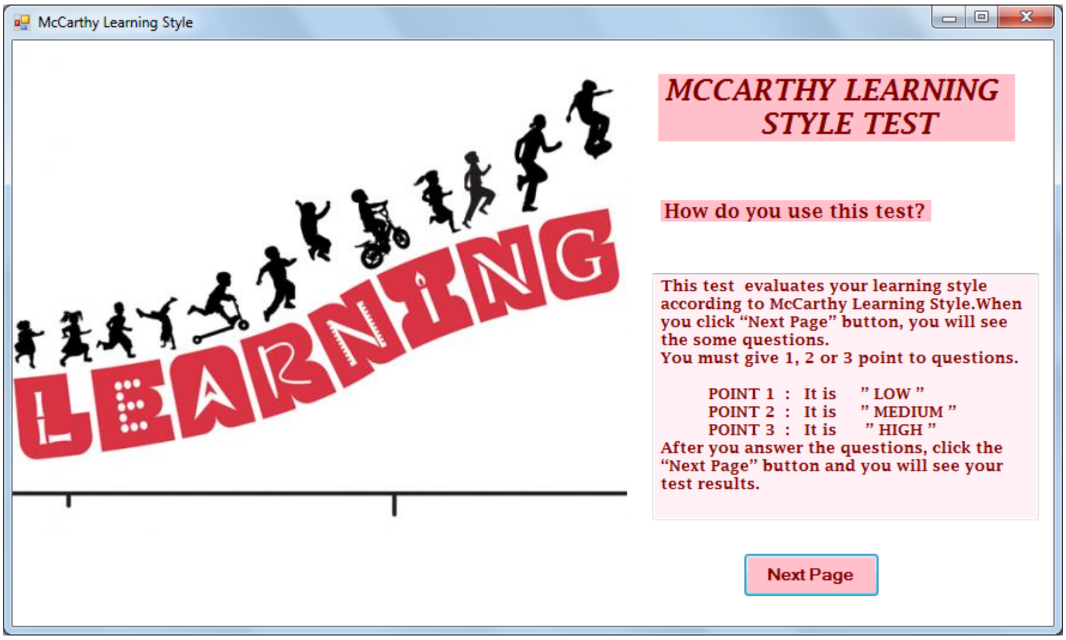
In this study a learning style inference system which is based on fuzzy logic technique and McCarthy Learning Style is proposed to increase the success of students in education. In order to achieve this, a software which provides an interface including 20 questions in accordance with the McCarthy Learning model is developed. Fuzzy logic technique is used to preference which learning style is suitable for the student's education based on the answer's of the students to the questions. We prepared the questionnaire using questions at [9].

Interface

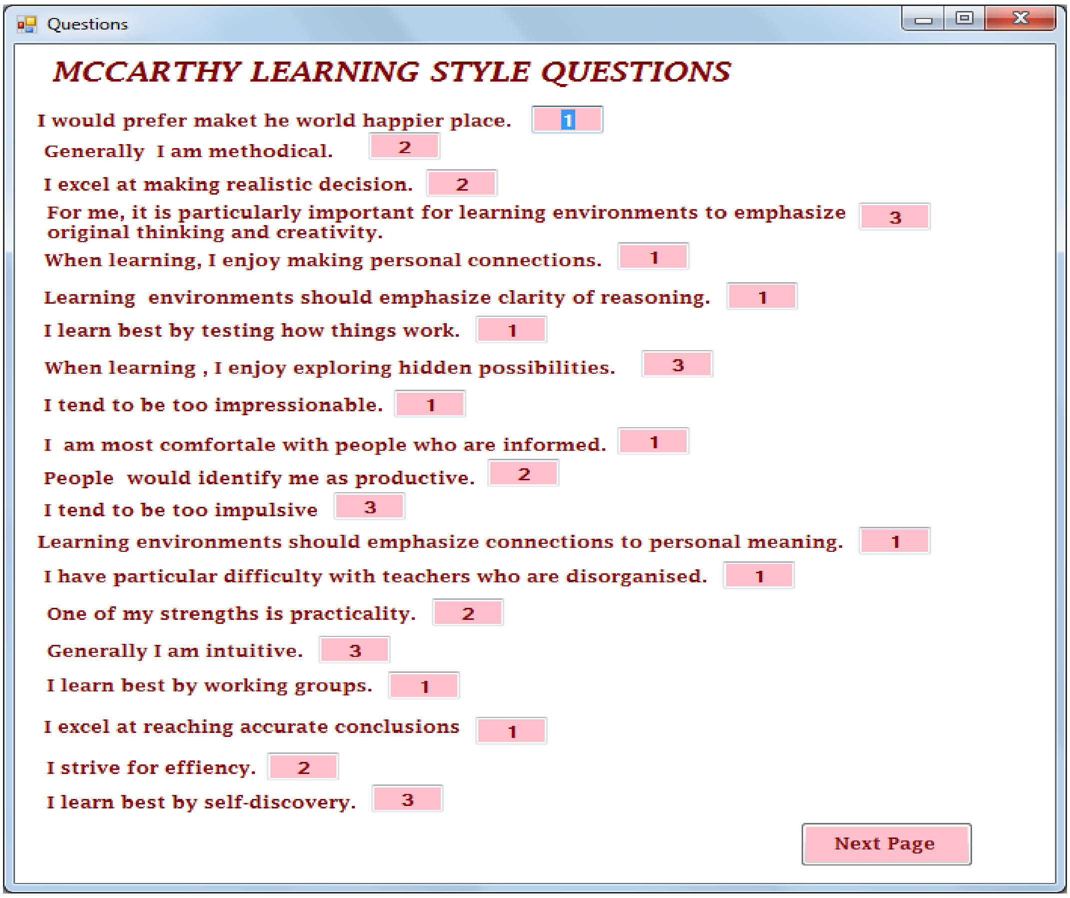
Interface shown in Figure 1 is developed by using C# programming language and includes 20 questions. A student who participates this survey gives 1, 2 or 3 point to each question. Point 1 corresponds to LOW, Point 2 corresponds to MEDIUM and Point 3 corresponds to HIGH.
1-5-9-13-17 questions' total points are for I**NNOVATIVE**,
2-6-10-14-18 questions' total points are for **ANALYTIC**
3-7-11-15-19 questions' total points are for **COMMON SENSE**,
4-8-12-16-20 questions'total points are for **DYNAMIC**,

Table 1. Linguistic variables and their fuzzy value range

Question System Value	Linguistic variables	Fuzzy value
5-6-7	LOW	0.00<= x < 0.3
8-9-10-11-12	MEDIUM	0.03<= x < 0.7
13-14-15	HIGH	0.7 <= x <= 0.1



(a)



(b)

Figure 1. Interface of McCarthy Learning Style

Education style is inferenced via Fuzzy Logic Technicque in accordance with the total points which are obtained from the answers of questions. Figure 2 shows the interface of McCarthy Learning Style Test Result.

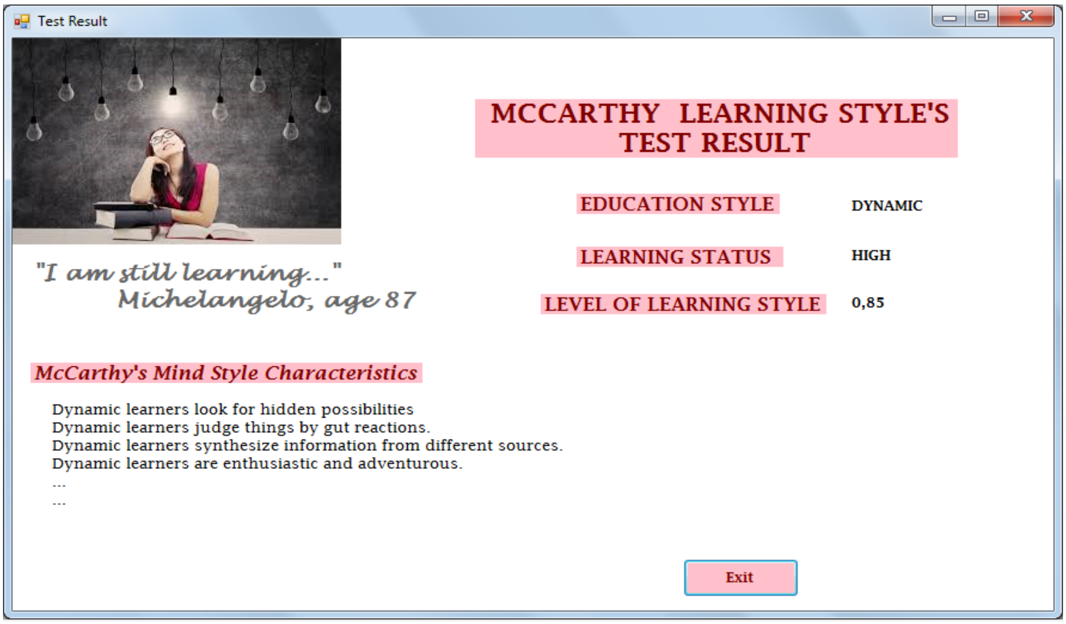


Figure 2. Interface of McCarthy Learning Style Test Result

Fuzzy Logic Based Inference System

Four input parameters namely INNOVATIVE, ANALYTIC, COMMENSENSE, DYNAMIC and one output namely Education Style (EDUSTYLE) are determined in the proposed fuzzy logic based system which is shown in Figure 3.

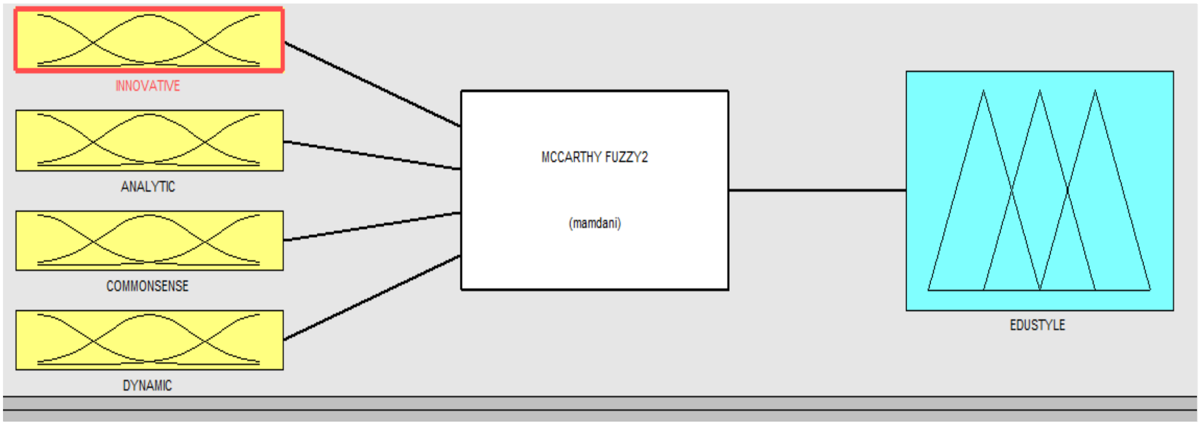
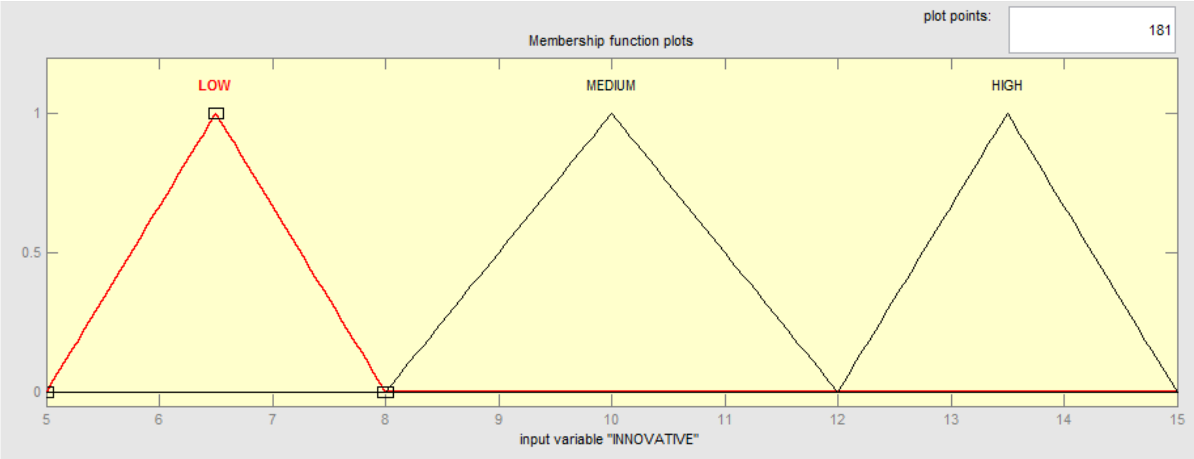
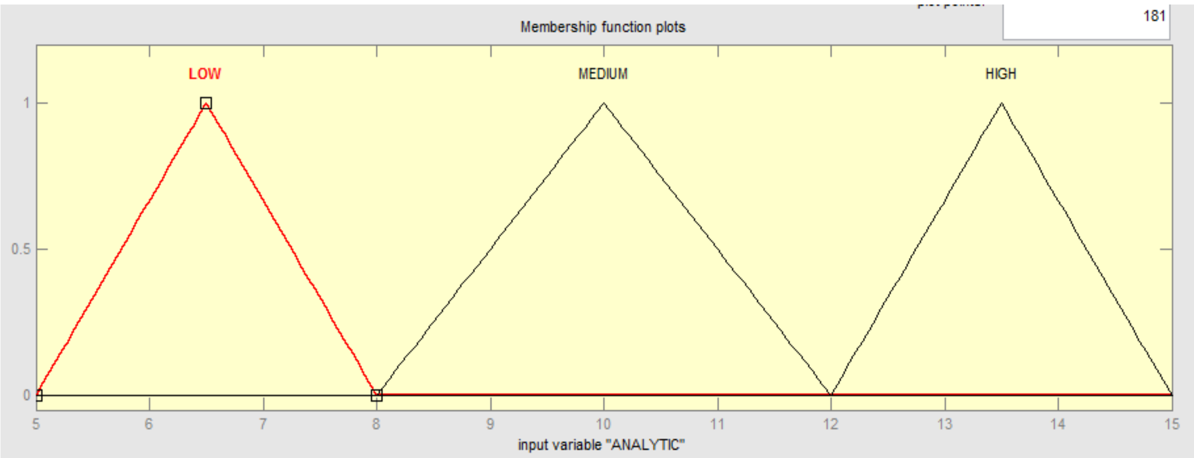


Figure 3. The Proposed Fuzzy Logic Based Inferency System

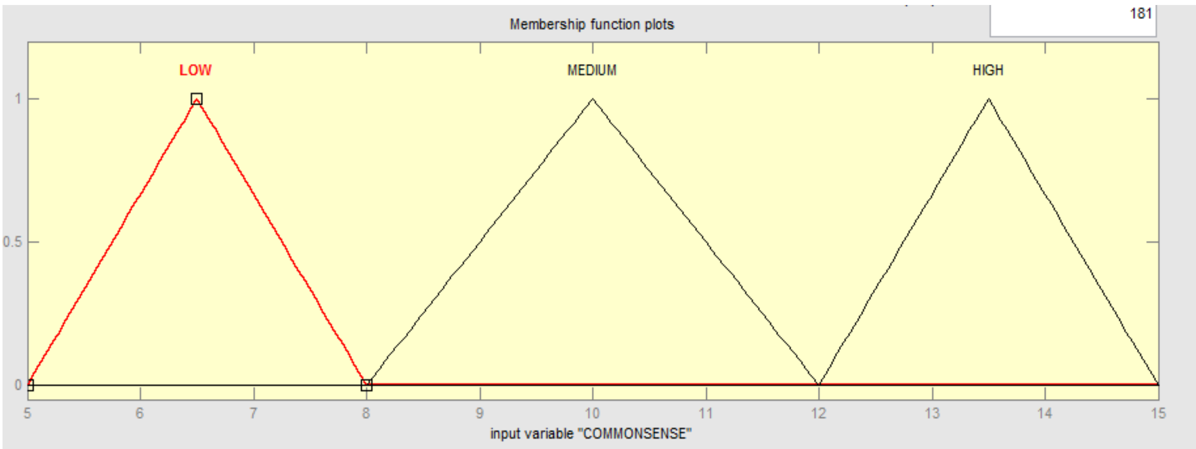
The fuzzification method involves the transformation of raw input variables and evaluation of the linguistic variables by using the triangular Membership Functions as shown in Figure 4.



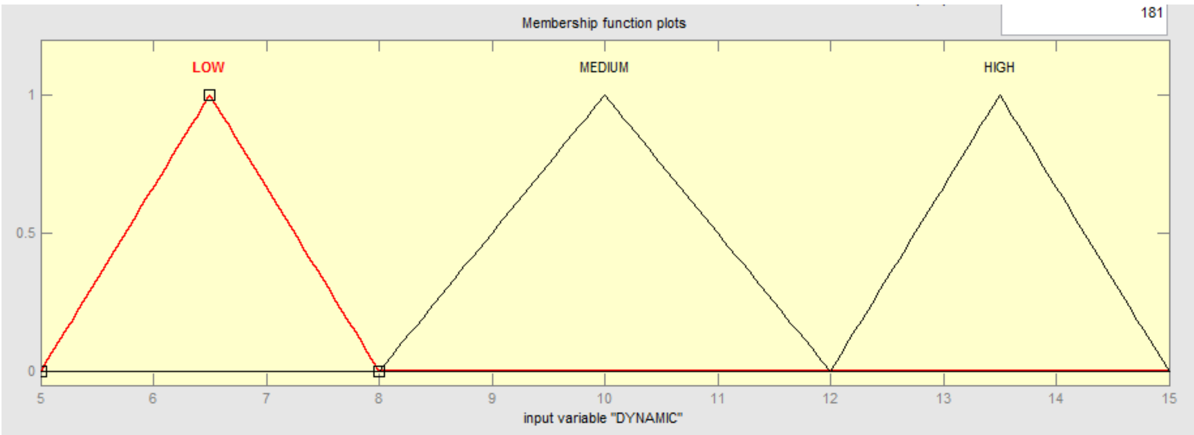
(a) Input for INNOVATIVE



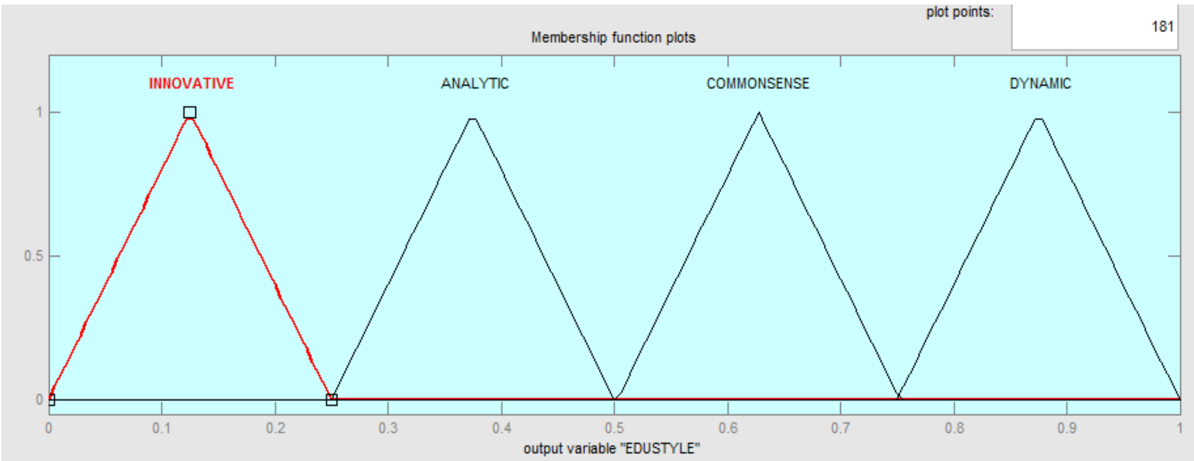
(b)Input for ANALYTIC



(c)Input for COMMEN SENSE



(d)Input for DYNAMIC



(e)Output

Figure 4. Membership Functions of The Proposed System

The rule base of McCarthy Learning styles testing is characterized by a set of IF THEN rules in which the antecedents (IF parts) and the consequents(THEN parts) involve linguistic variables. An example of rule determined in the system is shown in Figure 5. Lastly Centroid of Area (CoA) method is used for the defuzzification step.

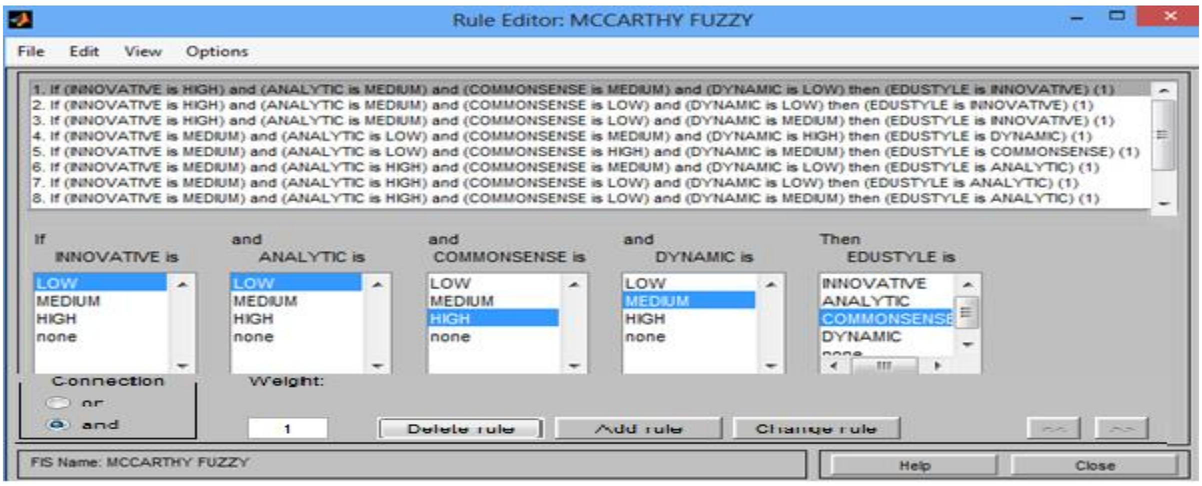


Figure 5. An Example Rule of The Proposed System

RESULTS AND FINDINGS

Figure 6 shows an example operation of our system for the input parameters of values: INNOVATIVE: 6.44, ANALYTIC: 6.92, COMMENSENSE: 10.5 DYNAMIC: 13.5 correspond to LOW, LOW, MEDIUM and HIGH fuzzy degrees respectively. According to the fuzzy rule *"If (INNOVATIVE is LOW) and (* ANALYTIC *is LOW) (COMMENSENSE is MEDIUM) and (* DYNAMIC *is HIGH) then (LEARNING STYLE is DYNAMIC)*". The proposed system inferences that, these input values correspond to the value of 0.875 for the learning style crisp output. The Surface Screen Interface of the Proposed Fuzzy Logic Model is shown in Figure 7.

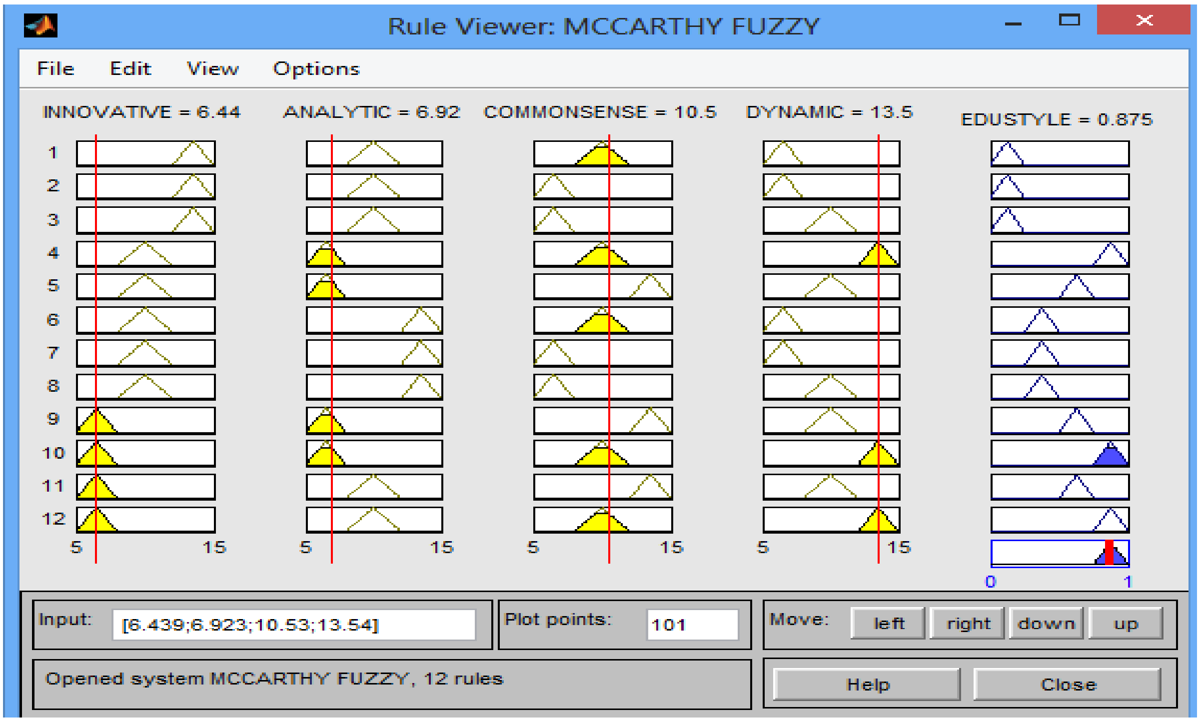


Figure6. An Example Output of the Proposed System

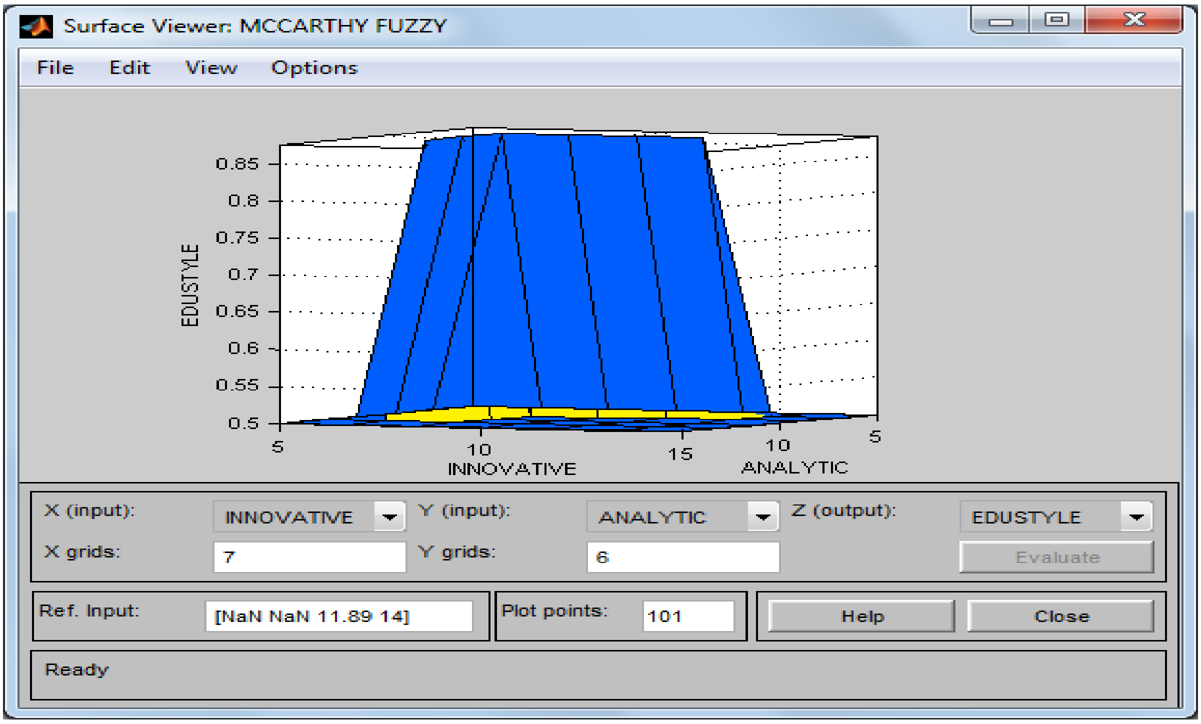


Figure7. The Surface Screen Interface of the Proposed System

CONCLUSION

In this study, fuzzy logic based McCarthy learning system is proposed to characterize learning styles of the students who have various own learning skills, intelligence levels and learning styles. In order to achieve this, a software which provides an interface including 20 questions in accordance with the McCarthy model is developed. Fuzzy logic technique is used to preference which learning style is suitable for the student’s education based on the answer’s of the students to the questions. By categorizing students learning style, instructor will be able to match his teaching style with student's learning style. By this way, it is aimed to increase students success in education considerably.

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A LEARNING STYLE INFERENCE SYSTEM BASED ON FUZZY LOGIC TECHNIQUE

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ABSTRACT:
There are many reasons why education is very important in daily life and business. Such that learning will continue every time parallel to the rapid developments and changes in innovation and the technology. In this study, fuzzy logic based dunn learning style inference system is developed to measure student's success in learning. Dunn learning style identifies five important factors on which student learning style differs; namely environmental, emotional, sociological, physiological, and psychological. In this study, a software system is developed and an interface which includes some questions in relation with Dunn learning style is designed. Answers of the students are rated and given as an input to the proposed fuzzy logic engine. The proposed software system inferences Education Style, Learning Status and the Level of Learning Style of the student. By this way, the instructor will be able to match his teaching style with student's learning style which contributes to student's success in education field.

Key words: Dunn Learning Style, Fuzzy Logic, Inference System

INTRODUCTION

Because of the differences in abilities, personalities, identities and characteristic features of the people, each person prefers different learning styles and techniques. In order to learn easily ve rapidly, people use the most convenient learning style. Recognizing learning style is very useful to students because it allows students to have a better chance of overcoming any difficult situation, to be successful on their education programme, to effectively target areas where an improvement is required and to enjoy their learning process[1].
In this study, fuzzy logic technique is used to inference which learning style is more suitable to the student's learning skils. [2-6] are some of the studies that use Fuzzy logic technique in education field. Dunn Learning Style is chosen for implementing and analyzing the developed system. In the following sections, background that includes fuzzy logic technique and Dunn learning style are described briefly. After that, the proposed system which is composed of interface and fuzzy logic parts is explained in detail. Lastly, simulation results are given and evaluated.

BACKGROUND

In this section, Dunn learning style and Fuzzy Logic Technique are described briefly.

Dunn Learning Style

According to Dunn, environmental, emotional sociological, physiological, and psychological are the five key factors that effect the efficiency of student learning style [7].

Environmental: Ideal place to learn can differ in accordance with the students characteristic features. While some of the students can learn better i a warm, bright place with many people, some of them can prefer cooler and quite places [7].

Emotional: While some students can achive a long-term project and monitor and pace themselves until completing the job, the others may need considerable support [7].

Sociological: Reaction to peer interaction can also differ student to student. While some students prefer to learn by themselves, the others can prefer to work with a group [7].

Physiological: Learning modality, mobility and time are important elements related to individual differences in terms of physiological preferences [7]

Psychological: While students attack to learn problems, some of them can approach globally and look at big Picture, some of them prefer to address individual elements of a problem separately [7].

Fuzzy Logic Technique

Fuzzy logic deals with reasoning that is approximate rather than fixed and exact. Fuzzification, Fuzzy Rules, Membership Functions, Inference and Defuzzification are basic concepts of the fuzzy logic technique. The aim of fuzzification step is to determine the mapping degree of crisp inputs to fuzzy sets by using membership functions. Fuzzy rules are applied to the fuzzified inputs. Outputs of all rules are aggregated to obtain unificated output. From the fuzzy rules, probability fuzzy output variable can be obtained. The higher probability means that the node has more chance to be selected. Defuzzification is the process of transforming probability fuzzy output variable into a single crisp output [8].

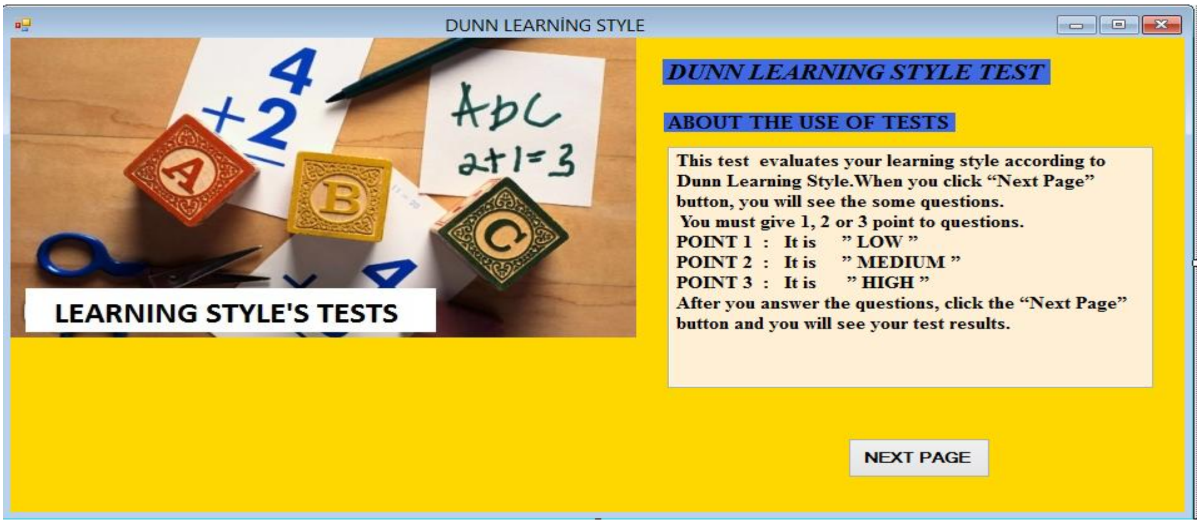
The Proposed System

In this study a learning style inference system which is based on fuzzy logic technique and Dunn Learning Style is proposed to increase the success of students in education. In order to achieve this, a software which provides an interface including 20 questions in accordance with the Dunn Learning model is developed. Fuzzy logic technique is used to preference which learning style is suitable for the student's education based on the answer's of the students to the questions. A student who participates this survey gives 1, 2 or 3 point to each question. Point 1 corresponds to LOW, Point 2 corresponds to MEDIUM and Point 3 corresponds to HIGH.

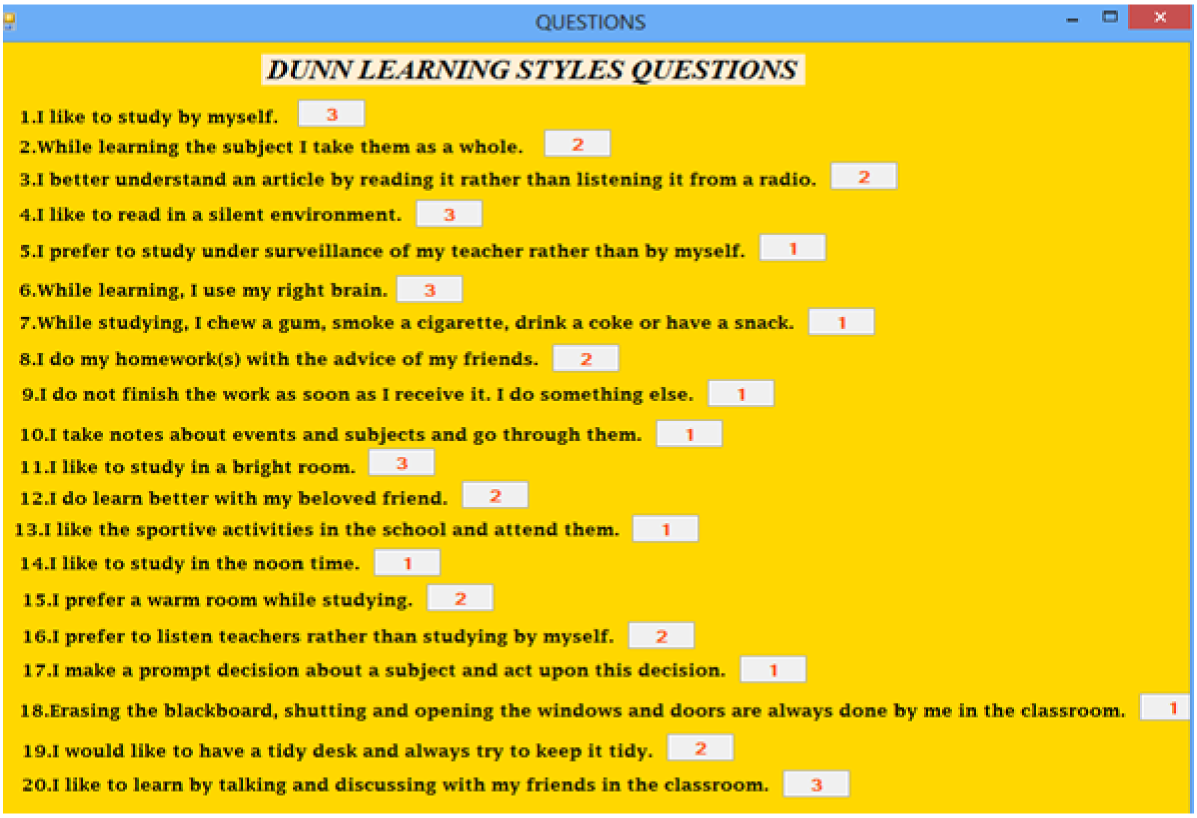
1-5-9-13 questions' total points are for **ENVIRONMENTAL**
2-6-10-17 questions' total points are for **EMOTIONAL**,
3-7-14-18 questions' total points are for **PHYSIOLOGICAL**,
4-11-15-19 questions' total points are for **ENVIRONMENTAL**,
8-12-16-20 questions' total points are for **SOCIOLOGICAL**

Table 1. Linguistic variables and their fuzzy value range

Question System Value	Linguistic variables	Fuzzy value
4-5-6	LOW	0.00<= x < 0.3
7-8-9-10	MEDIUM	0.03<= x < 0.7
11-12	HIGH	0.7 <= x <= 0.1



(a)



(b)

Figure 1. Interface of McCarthy Learning Style

Education style is inferenced via Fuzzy Logic Technique in accordance with the total points which are obtained from the answers of questions. Figure 2 shows the interface of Dunn Learning Style Test Result.

Figure 2. Interface of McCarthy Learning Style Test Result

Fuzzy Logic Based Inference System

Four input parameters namely ENVIRONMENTAL, EMOTIONAL, PHYSIOLOGICAL, SOCIOLOGICAL and one output namely Learning Style are determined in the proposed fuzzy logic based system which is shown in Figure 3.

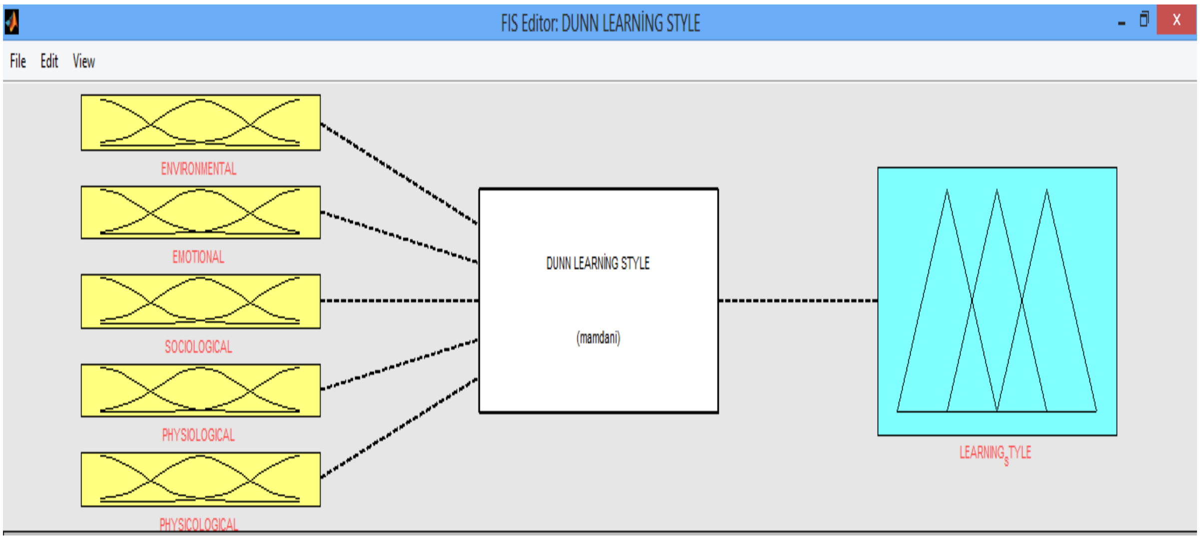
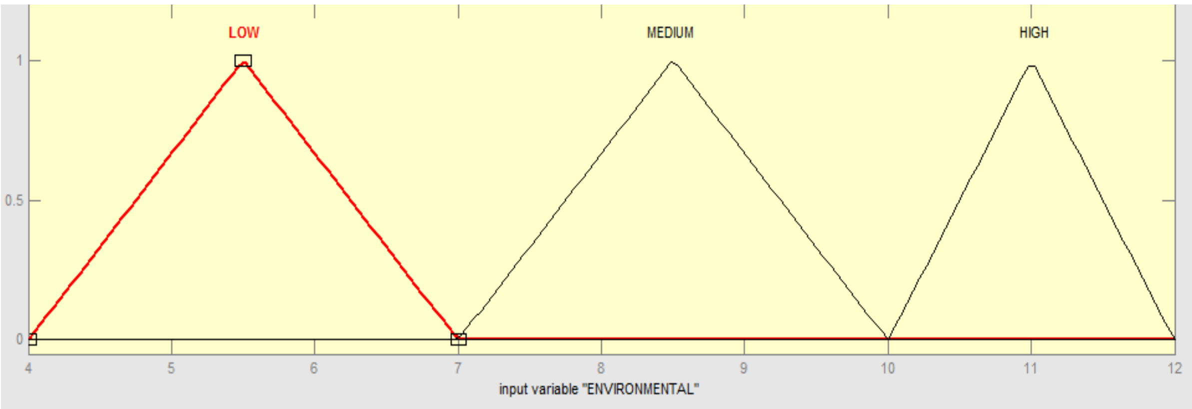
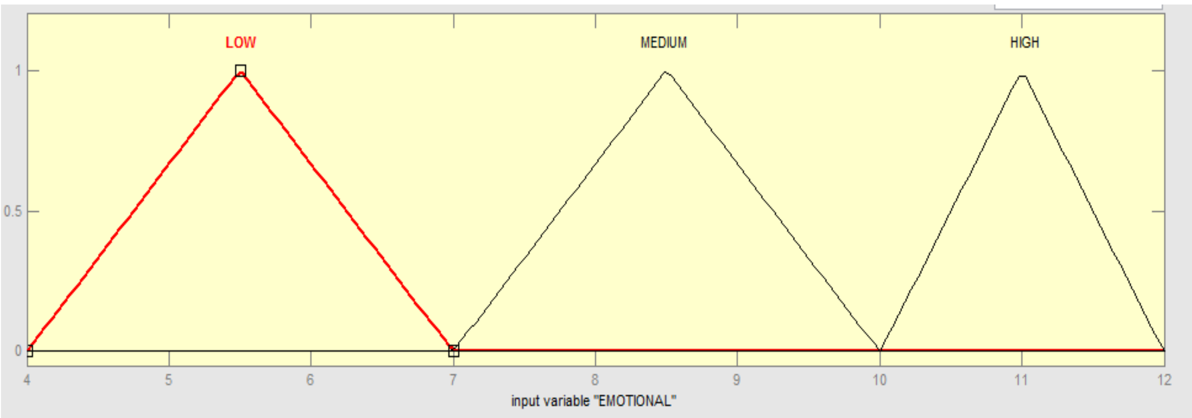


Figure 3. The Proposed Fuzzy Logic Based Inference System

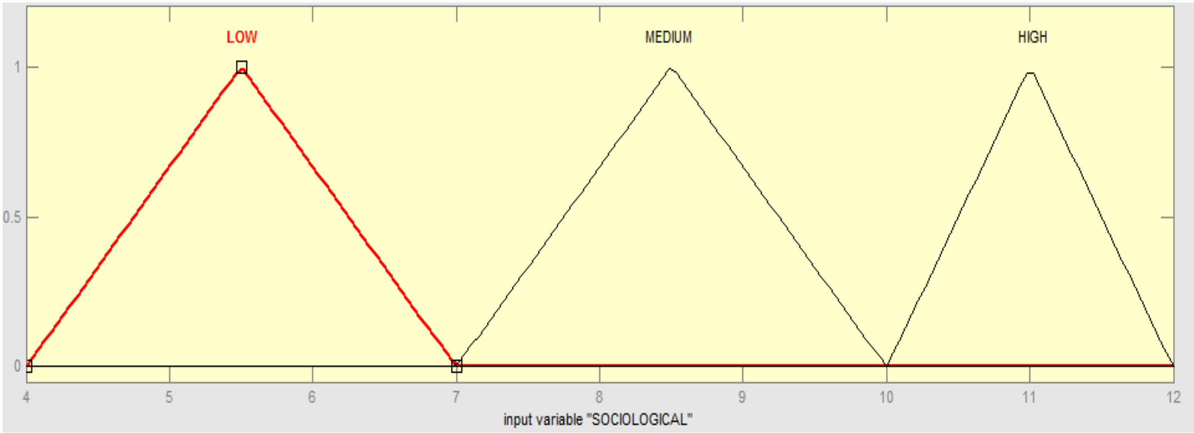
The fuzzification method involves the transformation of raw input variables and evaluation of the linguistic variables by using the triangular Membership Functions as shown in Figure 4.



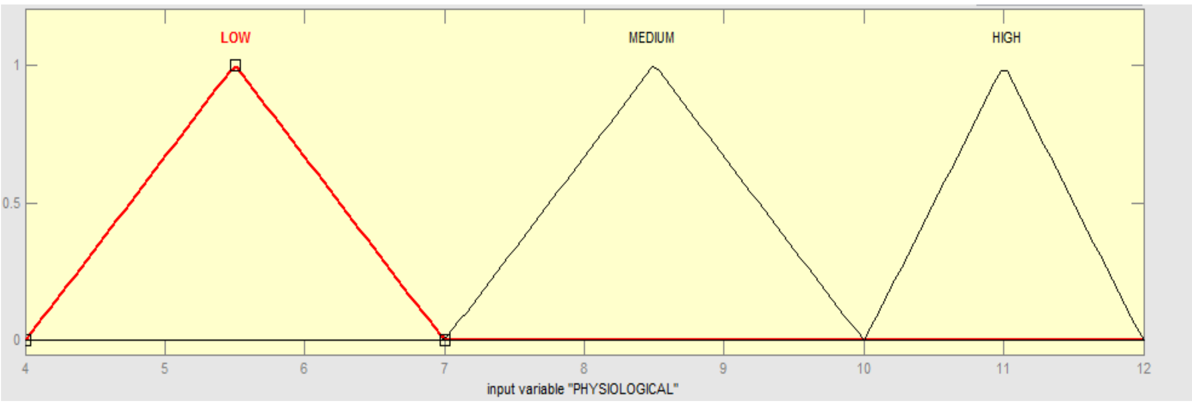
(a)Input for ENVIRONMENTAL



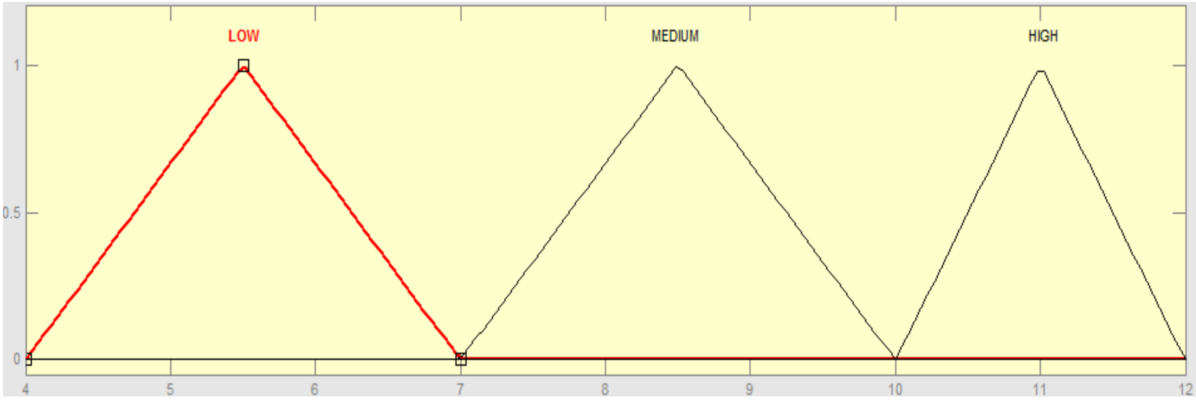
(b)Input for EMOTIONAL



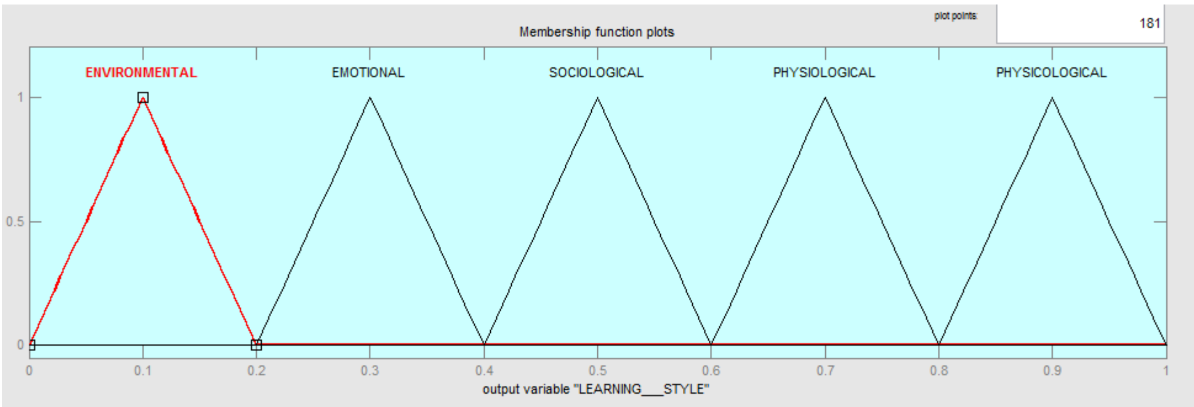
(c)Input for SOCIOLOGICAL



(d)Input for PHYSIOLOGICAL



(e) Input for PSYCHOLOGICAL



(f) Output for LEARNING STYLE

Figure 4. Membership Functions of The Proposed System

The rule base of McCarthy Learning style testing is characterized by a set of IF THEN rules in which the antecedents (IF parts) and the consequents(THEN parts) involve linguistic variables. An example of rule determined in the system is given below.

IF ENVIRONMENTAL is LOW **AND** EMOTIONAL is HIGH **AND** SOCIOLOGICAL is LOW **AND** PHYSIOLOGICAL is MED AND PSYCHOLOGICAL is MED **THEN** LEARNING STYLES is EMOTIONAL.

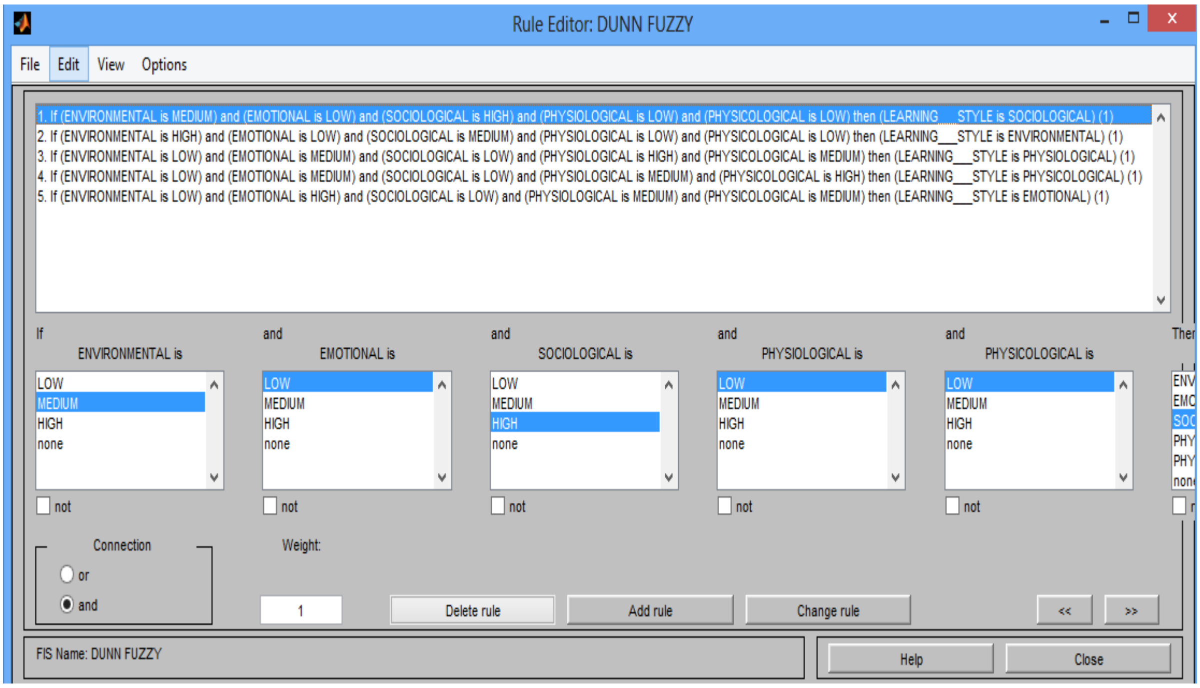


Figure 5. An Example Rule of The Proposed System

Lastly Centroid of Area (CoA) method is used for the defuzzification step.

RESULTS AND FINDINGS

Figure 6 shows an example operation of our system for the input parameters of values: ENVIRONMENTAL: 5 EMOTIONAL: 11, SOCIOLOGICAL: 6 PHYSIOLOGICAL: 9 PSYCHOLOGICAL: 8 correspond to LOW, HIGH, LOW, MED and MED fuzzy degrees respectively. According to the fuzzy rule "***IF*** *ENVIRONMENTAL is LOW* ***AND*** *EMOTIONAL is HIGH* ***AND*** *SOCIOLOGICAL is LOW* ***AND*** *PHYSIOLOGICAL is MED AND PSYCHOLOGICAL is MED* ***THEN*** *LEARNING STYLES is EMOTIONAL".* The proposed system inferences that, these input values correspond to the value of 0.875 for the learning style crisp output. The Surface Screen Interface of the Proposed Fuzzy Logic Model is shown in Figure 7.

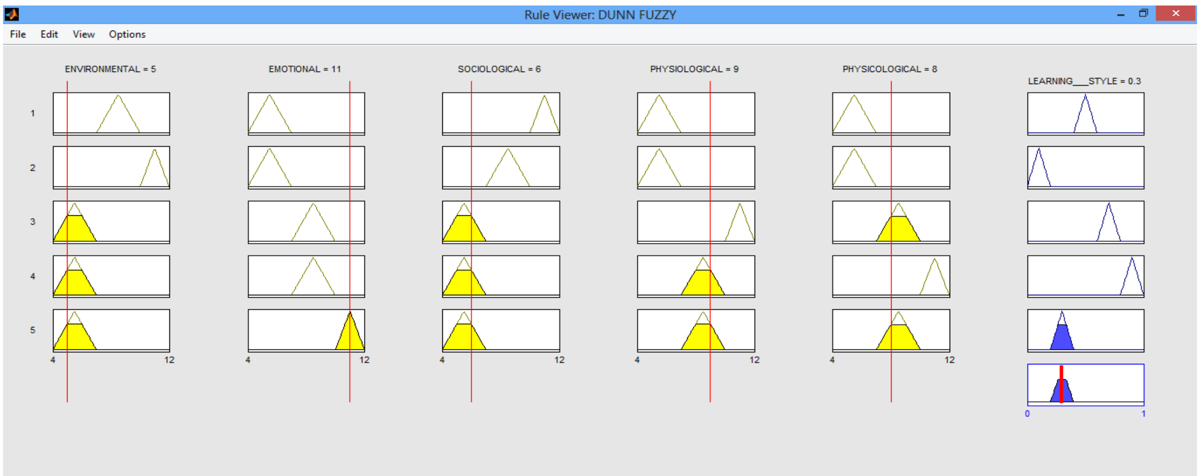


Figure6. An Example Output of the Proposed System

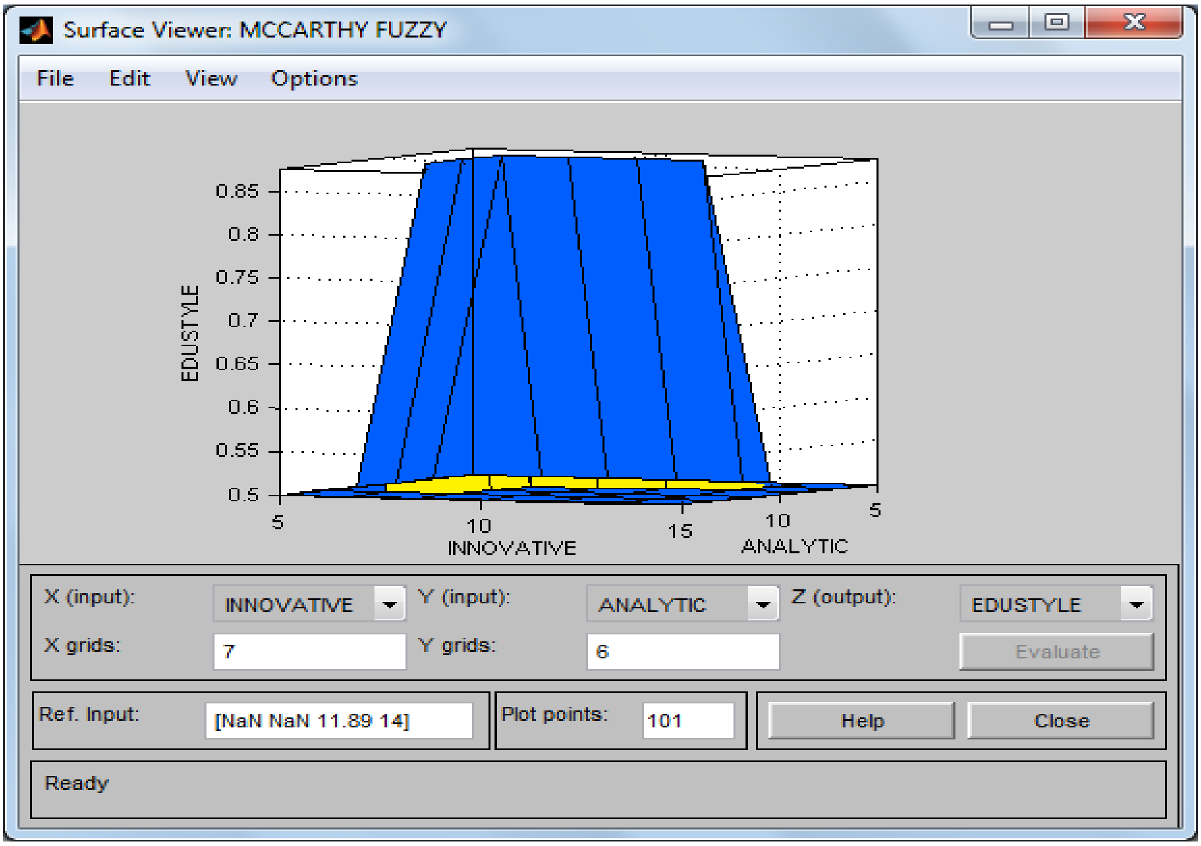


Figure7. The Surface Screen Interface of the Proposed System

CONCLUSION

In this study, fuzzy logic based dunn learning style inference system is developed to measure student's success in learning. The proposed system inferences Education Style, Learning Status and the Level of Learning Style of the student in accordance with the student's answers to the questions which are presented via software interface. In this study, it is aimed to increase students success in education by deciding most convenient Education style.

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IMPROVING THE LEARNING BEHAVIOR BY DESIGNING PROTOTYPE METHOD AT GEOTECHNICAL ENGINEERING EDUCATION

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ABSTRACT: Civil engineers deal with planning, designing and construction steps of all structures such as building, highway, railway, dam, retaining wall and etc. Therefore, civil engineering education in bachelor degree includes geotechnics, hydraulics, material science, mechanics, structure, construction management and transportation engineering educations. Geotechnical engineering is interested in design, analyze and application of soil structures such as foundations, retaining walls, slopes and deep excavations as well as determination of soil properties. Students have to prepare a bachelor degree thesis for graduation in Anadolu University, Department of Civil Engineering. Students are asked to develop a prototype model about their subjects in geotechnical division. In this study, effects of developing prototype models in the geotechnical engineering education are researched. End of the study; observed improvements on the learning behavior are presented.

Key words: civil engineering, geotechnical engineering, improving the learning

GEOTEKNİK MÜHENDİSLİĞİ EĞİTİMİNDE PROTOTİP TASARIMI METODU İLE ÖĞRENME DAVRANIŞININ GELİŞTİRİLMESİ

ÖZET: İnşaat mühendisleri bina, karayolu, demiryolu, baraj, istinat duvarı, vb. tüm yapıların planlama, tasarım ve inşa adımları ile uğraşırlar. Bu sebeple lisans seviyesinde inşaat mühendisliği eğitimi geoteknik, hidrolik, malzeme bilimi, mekanik, yapı, yapı yönetimi ve ulaştırma mühendisliği eğitimini kapsamaktadır. Geoteknik mühendisliği ise; temeller, istinat duvarları, şevler, derin kazılar gibi zemin yapılarının tasarım, analiz ve uygulamalarının yanı sıra zemin özelliklerinin belirlenmesi ile ilgilenmektedir. Anadolu Üniversitesi İnşaat Mühendisliği Bölümünde öğrenciler mezuniyet için bir lisans bitirme tezi hazırlamak zorundadır. Geoteknik anabilim dalında bitirme tezi hazırlayan öğrencilerden konuları ile ilgili bir prototip model geliştirmeleri istenmiştir. Bu çalışmada, prototip model geliştirmenin geoteknik mühendisliği eğitimi üzerindeki etkileri araştırılmıştır. Çalışma sonucunda öğrenme davranışında gözlemlenen iyileşmeler sunulmuştur.

Anahtar sözcükler: inşaat mühendisliği, geoteknik mühendisliği, öğrenmenin geliştirilmesi

GİRİŞ

İnşaat mühendisleri barajlar, yollar, köprüler, tüneller ve gökdelenler gibi yeryüzündeki tüm yapıları planlar, tasarlar ve inşa ederler. Dolayısıyla inşaat mühendisleri medeniyetin gelişimine katkıda bulunurken, birden fazla alanda faaliyet gösterirler. Bu faaliyet alanlarına bağlı olarak inşaat mühendisliği 7 anabilim dalına ayrılmıştır. Bunlar yapı, yapı malzemeleri, yapı yönetimi, mekanik, ulaştırma, hidrolik ve geoteknik anabilim dalıdır. İnşaat mühendisliği eğitimi ise lisans seviyesinde bu anabilim dallarına uygun olarak tasarlanmaktadır (Gündüz ve Dağdeviren, 2009). Yapı anabilim dalında; tüm yapıların statik ve betonarme hesapları ile yapısal elamanlara etkiyen kuvvetler ve kesit hesaplarını içeren teorilerin anlatıldığı dersler verilmektedir. Çelik, beton ve ahşap gibi yapı elemanlarının özellikleri ve davranışları yapı malzemeleri anabilim dalında anlatılırken yapının maliyet analizi, iş planı ve yönetimi yapı yönetimi anabilim dalı derslerinde işlenmektedir. Mekanik anabilim dalı ise yük altındaki cisim davranışını incelemektedir. Karayolları ve demiryollarının tasarım aşamaları ulaştırma anabilim dalı, baraj hidroelektrik santrali vb su yapıları su ve kanalizasyon sistemlerinin tasarımını hidrolik anabilim dalı derslerinde anlatılmaktadır. Geoteknik anabilim dalı tarafından verilen dersler ise her türlü yapının üzerine inşa edildiği zeminlerin özellikleri ile zemin yapılarının tasarımı ile ilgili konuları içermektedir.

İnşaat mühendisliği eğitiminin geliştirilmesi amacıyla literatürde eğitim stratejileri ve iyileştirme yöntemleri ile ilgili birçok çalışma bulunmaktadır. Gunhan (2015) teknik gezi ve saha ziyaretlerinin inşaat mühendisliği öğrencileri üzerindeki etkilerini araştırmıştır. Lopez-Ouerol vd. (2015) geoteknik ve ulaştırma anabilim dalı eğitimi için yeni bir metodoloji önermiştir. Fenner vd. (2014) inşaat mühendisliği eğitiminde sürdürülebilirlik için neler yapılabileceğini incelemişlerdir. Perdoma ve Pando (2014) inşaat mühendisliği eğitimi için bilgi teknolojilerinin kullanımını önermiştir. Castro vd. (2013) ise proje tabanlı eğitimin faydalarından bahsetmişlerdir. Moussai (2012) geoteknik mühendisliği eğitimi ile gerçek dünya uygulamaları arasındaki farklılıkları belirtmiştir. Wang vd. (2012) geoteknik anabilim dalı eğitimi için teknoloji kullanımının yollarını araştırmışlardır. Slizyte vd. (2008) Vilnus Teknik Üniversitesinde yapı ve geoteknik anabilim dalları eğitimlerinde ki yöntem farklılıklarını rapor etmişlerdir. Dundulis vd (2008) ise geoteknik anabilim dalı eğitiminde yenilikçi stratejileri araştırmışlardır. Çokça (2008) Ortadoğu Teknik Üniversitende geoteknik anabilim dalı derslerine bilgisayar kullanımının etkilerini değerlendirmiştir. Qui (2008) Çin'de inşaat mühendisliği eğitiminin geçmişten günümüze tarihsel gelişimini incelemiştir. Arslan ve Huber (2008) geoteknik mühendisliği eğitimini Almanya örneği ile anlatmışlardır. Pantazidou vd (2008) Yunanistan için geoteknik mühendisliği eğitimini diğer ülkeler ile karşılaştırmışlardır. Caprez vd. (2008) İsviçre' de geoteknik mühendisliği eğitimi için yeni yöntemler önermişlerdir.

Günümüz inşaat sektörü ve geçmiş bilimsel çalışmalar detaylı olarak incelendiğinde inşaat mühendisleri için en büyük problemlerden birinin teorilerin pratiğe dönüştürülmesi olduğu anlaşılmaktadır. Problemin çözümü için öğrenilen teorilerin pratiğe dönüştürebilme ve üç boyutlu düşünebilme yeteneğinin kazandırılması olduğu açıktır. Dolayısıyla eğitim stratejilerinin de bu yönde iyileştirilmesi gerekmektedir. Bu çalışmada inşaat mühendisliği öğrencilerine geoteknik anabilim dalı bitirme tez çalışmaları kapsamında prototip hazırlamaları istenmiş ve bu yöntemin öğrencilerin öğrenme davranışları üzerindeki etkileri incelenmiştir.

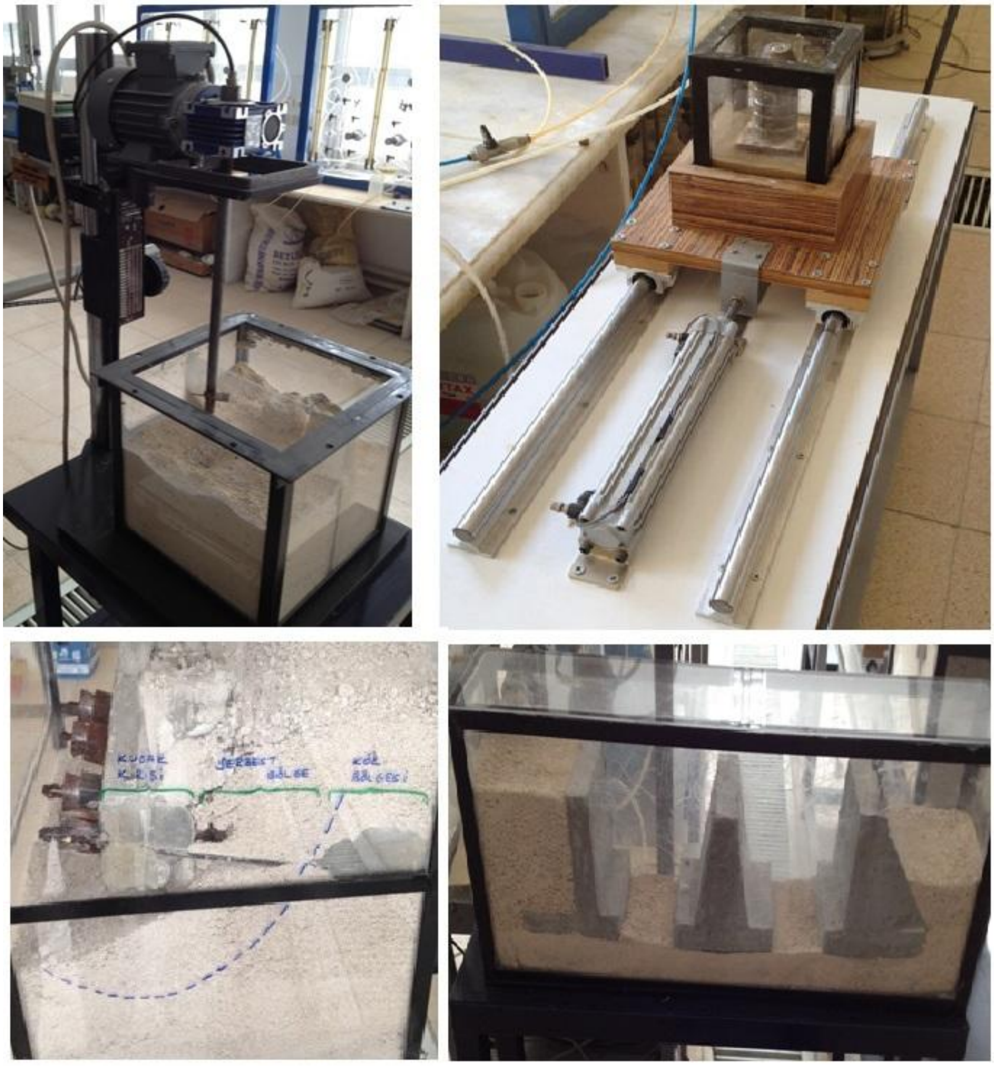
YÖNTEM

Anadolu Üniversitesi İnşaat Mühendisliği Bölümü 1998 yılında kurulmuştur. 2 Eylül kampüsünde dört yıllık inşaat mühendisliği eğitim programı sürdürülmektedir. Eğitim programında ilk yılında matematik, fizik kimya gibi mühendislik temel dersler, ikinci yıldan itibaren de branş dersleri verilmektedir. Özellikle son sınıfta öğrenciler inşaat mühendisliğinin alt disiplinleri olan geoteknik, hidrolik, mekanik, ulaştırma, yapı, yapı malzemesi ve yapı yönetimi anabilim dallarından birisinden bitirme tezi hazırlamaktadır. Ayrıca birçok ders laboratuvar çalışması ile desteklenmektedir.

Geoteknik Anabilim dalı ders programı temeller, istinad duvarları, kazı destek sistemleri gibi zemin yapılarının tasarım analiz ve uygulama detaylarını gösteren teorik bilgiler ile zeminlerin tanımlanmalarında kullanılan laboratuvar ve arazi deneylerini içermektedir. Ayrıca zemin iyileştirme yöntemleri, çöp depolama alanı tasarımı ve dinamik etkiler altında zemin davranışı konularını içeren mesleki seçmeli dersler bulunmaktadır. Laboratuvar çalışmalarının yanında birçok paket program ile analiz yapabilme becerisi de kazandırılmaktadır. İlave olarak bölüm alt yapısında bulunan sondaj makinesi, jet-grout makinesi ve kazık temel makinesi ile uygulamalı eğitimde yapılmaktadır.

Modelleme Çalışması

Bölümde geoteknik anabilim dalı tarafından verilen zorunlu dersler zemin mekaniği I, temel inşaat I, inşaat mühendisliği dizaynı ve inşaat mühendisliğinde tasarım uygulamalarıdır. Ayrıca mesleki seçmeli dersler ise geteknik tasarım, zemin mekaniği II, temel inşaat II, zemin iyileştirme, zemin dinamiğine giriş, temel mühendisliği ve bilgisayar uygulamalarıdır. İnşaat mühendisliğinde tasarım uygulamaları dersi öğrencilerin son sınıfta bitirme tezlerini hazırlamak için kayıt oldukları derstir. Öğrenciler ders kapsamında verilen konu ile ilgili yaptıkları akademik araştırma, analiz ve tasarımların yanı sıra 2012-2013 eğitim döneminden bu yana prototip hazırlamaktadırlar. Onur vd. (2015) prototip hazırlanması ve bu prototiplerin sergilenmesinin öğrencilerin öğrenme istekleri ve motivasyonları üzerinde olumlu etkisi olduğunu rapor etmiştir. Özellikle 2013-2014 öğretim yılında öğrenciler tarafından hazırlanan ankrajlı derin kazı destek sistemi prototipi, derin zemin karıştırma prototipi ve sarsma tablası prototipi hem çeşitli sergi yarışmalarında derece kazınmış hem de alt sınıflar üzerinde olumlu etki yapmıştır. Prototiplerin genel görüntüsü Şekil 1'de verilmiştir.



Şekil 1. 2013-2014 Öğretim Yılında Hazırlanan Prototipler

Olumlu dönütler nedeniyle 2014-2015 öğretim yılında geoteknik anabilim dalında bitirme tezi hazırlayan öğrencilerden konuları ile ilgili prototip geliştirmeleri istenmiştir. Öğrencilere bitirme tezi olarak kazıklı temel ve donatılı zemin konuları verilmiştir. Kazık temeller; üstyapı yükleri karşısında zemin taşıma gücünün yetersiz kaldığı durumlarda uygulanan derin temel sistemidir. Üst yapı yükleri zemin içerisinde oluşturulan betonarme kazık elemanlar ile derinlerdeki sağlam zeminlere aktarılır. Donatılı zemin ise özellikle yanal toprak basınçlarını karşılamak amacıyla istinat yapılarının metal vb. yapıdaki şeritler ile güçlendirilmesini içermektedir. Donatılı zemin yapıları yol kenarlarında, şevlerde sıkça tercih edilmektedir.

Geoteknik Anabilim dalında bitirme tezi hazırlayan öğrencilerden Yusuf Nazlıoğlu öncelikle bir kazık temel projesi hazırlamış, gerekli teorik hesaplamaları tamamladıktan sonra yaptığı çalışmanın prototipini hazırlamıştır. Hazırlanan prototipin görüntüsü Şekil 2' de verilmiştir (Nazlıoglu, 2015). Diğer öğrencilerden Bertan Özdemir isimli öğrenci ise donatılı zemin projesi olarak bitirme tezini tamamlamıştır. Gerekli hesaplamalar sonrasında çalışmasının örnek protoripini hazırlamıştır. Donatılı zemin prototipi Şekil 3' de verilmiştir (Ozdemir, 2015).

Şekil 2. Kazıklı Temel Prototipi

Şekil 3. Donatılı Zemin Prototipi

BULGULAR

Hazırlanan tüm prototipler temel inşaat I ve II ile zemin mekaniği II derslerinde teorik derslerin anlatımı sırasında görsel objeler olarak kullanılmaya başlanmıştır. Öğrenciler bu derslerde gerekli teorik hesaplama yöntemlerini öğrenirken, aynı zamanda prototipleri incele imkânı bulmuştur. Bu durumun öğrenme davranışları üzerinde olumlu etki gösterdiği ve derslere olan ilginin arttığı gözlemlenmiştir. Derslerde yapılan sınavlarda ise sınav ortalamaları geçmiş yıllarda 35,0 civarında iken prototiplerin kullanılmaya başlanmadı ile arttığı ve 45,0 değerinin üzerine çıktığı tespit edilmiştir.

Ayrıca öğrencilerin Geoteknik Anabilim dalına olan ilgileri artmıştır, özellikle son üç yıldır prototiplerin sergilenmesiyle bitirme tezi yapmak isteyen öğrenci sayılarında büyük artış gözlemlenmiştir. Geçmiş yıllarda bu sayı dört civarında iken son yılda on beş sayısına ulaşmıştır.

Diğer yandan Anadolu Üniversitesi Mühendislik Fakültesi tarafından her yıl geleneksel olarak düzenlenen Proje Fuarı ve yarışmasında prototipler sergilenmiştir. Yarışmaya katılan 53 farklı tez çalışması uzman mühendislerin oluşturduğu jüri tarafından incelenmiştir. Donatılı zemin tezi ve prototipi 2015 yılı birincisi seçilmiştir. Yarışma birincisi ayrıca 1000 TL ödüle layık görülmüştür.

SONUÇ

İnşaat mühendisleri gerekli teorileri kullanmalarının yanı sıra pratik uygulamada da başarı göstermelidirler. Bu amaçla öğrencilerin pratik uygulama becerilerini artırmaya yönelik çeşitli prototipler geliştirmeleri istenilmiştir. Bu çalışmada geliştirilen prototiplerin öğrencilerin öğrenme davranışları üzerine etkileri araştırılmıştır. Görselliğin öğrenciler üzerinde olumlu etkileri olduğu tespit edilmiş ve derslere karşı ilginin ve öğrenme isteğinin arttığı gözlemlenmiştir.

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APPLICATION OF ACTIVITIES INTENDED TO PERCEIVE NATURE OF SCIENCE FOR 5TH AND 6TH GRADE STUDENTS

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ABSTRACT: The purpose of this study is to introduce two different activities in which students can understand nature of science fundamentally and to discuss the results of applied activities. The study is applied with the 5th and 6th grade students. 32 students in the 5th grade, 27 students in the 6th grade, 59 students in total have been participated in the study. There are 14 female students and 18 male students in the 5th grade, 14 female students and 13 male students in the 6th grade. In this study, there are two activities called "Scientific Knowledge" and "Direct and Indirect Observation" which are intended to perceive nature of science and to comprehend the importance of observation with the difference of objectives in science curriculum. While the students are thinking about nature of science with the activity called Scientific Knowledge, they realize that science has a dynamic structure based on application and science may change as knowledge changes. Students have taken an opportunity to improve observation and scientific inquiry abilities and also defend their own arguments with the activity of Direct and Indirect Observation. This study has been the first step for our students to study scientifically enabling to think scientifically, to reach scientific knowledge and realize its importance.

Key words: nature of science, scientific knowledge, direct observation, indirect observation

BİLİMİN DOĞASINI ALGILAMAYA YÖNELİK ETKİNLİKLERİN 5 VE 6. SINIF ÖĞRENCİLERİ ÜZERİNDEKİ UYGULAMASI

ÖZET: Bu çalışmanın amacı, öğrencilerin bilimin doğasını temel olarak anlayabilecekleri iki farklı etkinliği tanıtmak ve uygulanan etkinliklerin sonuçlarını tartışmaktır. Çalışma ortaokul 5 ve 6. Sınıf öğrencileri ile gerçekleştirilmiştir. Çalışmaya 32'si 5. sınıf, 27'si 6. sınıf toplam 59 öğrenci katılmıştır. 5. Sınıf öğrencilerinin 14'ü kız, 18'i erkek; 6. Sınıf öğrencilerinin 14'ü kız, 13'ü erkek öğrencilerdir. Çalışmada fen bilimleri müfredatında yer alan kazanımlardan farklı olarak, bilimin doğasını algılamaya ve gözlem yapmanın önemini kavramaya yönelik "Bilimsel Bilgi" ve "Doğrudan-Dolaylı Gözlem" başlıklı etkinliklere yer verilmiştir. Bilimsel Bilgi adlı etkinlik ile öğrenciler bilimin doğası hakkında düşünerek bilimin uygulamaya dayalı dinamik bir yapıya sahip olduğunu ve değişen bilgi ile bilimin değişebileceğini fark ettiler. Doğrudan-Dolaylı Gözlem etkinliği ile de öğrenciler gözlem yapma, bilimsel sorgulamayı geliştirme ve ortaya atılan iddiaları savunabilme konusunda kendilerini geliştirme fırsatı bulmuşlardır. Bu çalışma, öğrencilerimizin bilimsel düşünmelerini, bilimsel bilgiye ulaşmalarını ve bunun önemini kavramalarını sağlayarak, onların bilimsel çalışma yapmaları için ilk adım olmuştur.

Anahtar sözcükler: bilimin doğası, bilimsel bilgi, doğrudan gözlem, dolaylı gözlem

INTRODUCTION

Starting from the idea 'No matter how different students are, each of them should be scientifically literate.' the curriculum of 2004 Science and Technology was prepared. When the subject scopes, contents and target behaviour of the curriculum were studied, not only was it the understanding based on observation but it was also expected from students to carry out studies in which they effectively participated.

Nature of Science

According to the widely accepted description, the nature of science reflects epistemological and social structure of science and it also expresses scientific knowledge, values and beliefs of the formation of scientific knowledge. (Lederman,1992). In the recent years, researches introducing nature of science with different practices have been done. For instance, Wong and others (2008) gathered nine scientists who studied on SARS virus and prospective teachers in order to ask them to share the period of fighting off the virus they suffered and the characteristics of science were discussed in this context. Schwartz, Lederman & Crawford (2004) designed an application which thirteen prospective teachers could interact with scientists five hours in a week for ten weeks and identify the different characteristics of science in this way. Here are the main characteristics of the nature of science that are the research subjects about teacher and students. (Akerson&Abd-El-Khalick,2005);

- Scientific knowledge is reliable however it changes over time.
- There is not only one scientific method. There are several versions of the scientific method.
- Imagination and creativity play an important role in constructing scientific knowledge.
- Although there is a relation between theories and laws, two of them are different from each other.
- Although there is a relation between observations and inferences, both of them are different from each other.
- Scientific knowledge is subjective and based on theories.
- Scientific knowledge is affected by the socio-cultural environment where it is constructed

In this study, the activities named 'Scientific Knowledge' and 'Direct-Indirect Observation' related with the main characters of the nature of science were conducted.

Scientific Knowledge

From primary education, it is necessary for students to pay attention to the following points to develop the understanding of scientific knowledge (Akerson and others,2006):

- Scientific knowledge is reliable.
- Scientific knowledge is not fixed.
- There is no one single method to attain scientific knowledge.
- Creativity plays an important role in developing scientific knowledge.
- There is a relation between scientific theories and laws.
- Socio-cultural environments play an important role in developing scientific knowledge.
- Even though science deals with objective knowledge, it has a subjective factor in the development of scientific knowledge.

Çüçen (2001) specified the main characteristics of scientific knowledge as;

- people research it by using their mind
- it handles a subject area
- it uses a method (experiment and observation)
- it is systematic and regular
- it is consistent and regular
- it is verifiable and controllable
- scientific knowledge is objective

While students are thinking about nature of science with the activity called 'Scientific Knowledge' that finds out the main characteristics mentioned above, students are expected to realize that science has a dynamic structure and science may change as knowledge changes.

Direct and Indirect Observation

We typically think of observations as having been seen 'with our own eyes,' but an observation can be made directly by seeing, feeling, hearing, and smelling. We can also extend and refine our basic senses with tools during direct observation. There are many phenomena that humans cannot sense by direct observation (such as inside of the atom and objects that seen by X-ray devices). Through these tools, we can make observations much more precisely than those our basic senses are equipped to handle. Students have taken an opportunity to improve observation and scientific inquiry abilities and also defend their own arguments with the activity of Direct and Indirect Observation.

METHOD

In this study, in addition to objectives of the science curriculum, there are two activities that form a basis of science to perceive nature of science and understand the importance of observation.

Participants

The participants of the study are a total of 59 fifth and sixth grade students - 14 female students, 18 male students from 5th grade, 14 female students, 13 male students from 6th grade -

Data Collection

The data of the study were collected by carrying out activities called 'Scientific Knowledge' and 'Direct and Indirect Observation' and evaluating worksheets given to students.

Data Analysis

The items of the study are formed by using responses of students about

- Similarities between science and the activity of scientific knowledge
- Changeability of science and scientific knowledge
- Needs of students for qualified direct observation
- Relation of not showing objects in the box with science during the activity of indirect observation.

The percentage distributions of these items were calculated according to grade levels and genders of the participants.

Students were asked to guess which objects there are in the box through indirectly observation. When students were asked how they came to the conclusion, **'the sounds coming from the box', 'the weight of the box'** and **'the movements in the box'** items were formed according to students' responses.

FINDINGS

As a result of the study done by using the scale developed by Özmusul (2012), Çoban and Ergin(2008), the views of students towards the understanding of scientific knowledge in the dimension 'scientific knowledge may change' are at medium level. On the other hand, according to the activities carried out, 72,88% of the participants indicated that scientific knowledge may change. 71,88% of 5th grade students and 74,04% of 6th grade students believed that scientific knowledge may change.

It is provided that students correlate technology and technological advancements with the changeability of scientific knowledge. According to the examples given by students, it is understood that students correlate 52,54% of the improvement of telephone technology and 44,07% of treatments of illnesses with the activity applied in the study. The rates of the examples for the development of telephone technology, which is in the first place, from 5th and 6th grade students proving the changeability of science and scientific knowledge are near to each other. While fifth grade students give 12,06% more examples for treatments of illnesses, which is in the second place, sixth grade students give 12,84% more examples for transportation technology, which is in the third place.

35,59% of all participants and 46,88% of the 5th grade students indicated that it is necessary to use other sense organs in addition eye for qualified direct observation in the first place. Moreover, 25,93% of the 6th grade students indicated that it is necessary to look in to the box from a different perspective in the first place. 34,38% of 5th grade students and 22,22% of 6th grade students respectively needed more observation time and using other sense organs in the second place.

During the activity named direct observation, 46,43% of female students paid attention to cosmetics and 45,16% of male students interested in toy car in the first place.

28,13% of 5th grade students answered as 'Science needs effort' and 40,74% of 6th grade students answered as 'Intuitions are used with sense organs in science' to correlate not showing objects in the box with science during the activity of indirect observation.

CONCLUSION AND RECOMMENDATION

'Scientific knowledge is reliable however it changes over time' item which is one of the main characteristics of nature of science determined by Akerson&Abd-El-Khalick(2005) and **'Scientific knowledge is not fixed'** item which is necessary to improve an understanding about scientific knowledge in primary school years determined by Akerson and others,(2006) emphasized on changeability of science. In this study, it is also determined that students reached the changeability of science dimension by giving related examples in the activities. Students gave examples especially about technological developments. According to Prensky (2001), the reason is that this generation is living in an environment surrounded with technological equipments.

Participants of the study noticed that all sense organs and supportive devices are needed for qualified direct observation.

Two years old children relate certain tasks and stuffs with male or female such as they consider cooking and vacuum cleaner with female and automobile and repair kit with male. (Ruble & Martin,1998;Signorella,Bigler & Liben,1993; Bee, H., Boyd, D., (2009).). During direct observation activity, students interested in materials related to their gender. At the end of the activity, the idea was explained that social-cultural environment and experience can determine the scientific study subject but cannot influence scientific method.

Students have taken an opportunity to improve observation and scientific inquiry abilities and also defend their own arguments

In case of carrying out this study with students from different social cultural environment, it would be possible to reach 'Socio-cultural environments play an important role in developing scientific knowledge' item mentioned as nature of science dimensions by Akerson&Abd-El-Khalick, (2005).

This study has been the first step for our students to study scientifically enabling to think scientifically, to reach scientific knowledge and realize its importance.

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REMEDYING MISCONCEPTIONS OF 8TH GRADE STUDENTS ABOUT THE CONCEPTS OF EVAPORATION AND BOILING THROUGH CONCEPTUAL CHANGE TEXTS

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ABSTRACT: The purpose of this study is to investigate the effect of conceptual change text on remedying the misconceptions of 8th grade students about the concepts of evaporation and boiling. 25 students who were studying in a public middle school located at a town in the central Anatolia participated in the study. The experimental model of the study is a pretest-posttest single group design. Before the treatment, an open ended questionnaire was administered to the students to determine their misconceptions about the concepts of evaporation and boiling. In the treatment, prepared conceptual change texts developed by the researchers were used in a 5E learning cycle to remove students' misconceptions. After the treatment, the same open ended questionnaire was administered to the students as post assessment. The results of the study indicated that most of the misconceptions of the students about the concept of evaporation and boiling disappeared. Implications for classroom practices were discussed.

Key words: misconception, conceptual change text, evaporation, boiling.

8.SINIF ÖĞRENCİLERİNİN BUHARLAŞMA VE KAYNAMA KAVRAMLARINA YÖNELİK YANILGILARININ KAVRAMSAL DEĞİŞİM METİNLERİ KULLANILARAK GİDERİLMESİ

ÖZET: Bu çalışmanın amacı, sekizinci sınıf öğrencilerinin, buharlaşma ve kaynama konularındaki kavram yanılgılarının giderilmesinde kavramsal değişim metinlerinin etkisini araştırmaktır. Çalışmaya orta Anadolu'daki bir ilçenin devlet ortaokulunda öğrenim gören 25 öğrenci katılmıştır. Araştırma deseni olarak tek gruplu ön-test son-test modeli kullanılmıştır. Uygulamadan önce, öğrencilerin buharlaşma ve kaynama kavramlarına ilişkin kavram yanılgılarını tespit etmek işin açık uçlu sorulardan oluşan bir anket kullanılmıştır. Uygulama sırasında öğrencilerin kavram yanılgılarını ortadan kaldırmak için araştırmacılar tarafından hazırlanmış kavram değişim metinleri 5E öğrenme döngüsü içinde öğrencilere uygulanmıştır. Uygulama sonrasında ön değerlendirme ile aynı sorulardan oluşan son değerlendirme yapılmıştır. Araştırma sonuçları, öğrencilerdeki buharlaşma ve kaynama kavramlarına ilişkin yanılgılarının büyük kısmının ortadan kalktığını göstermiştir. Sınıf içi uygulamalarına yönelik çıkarımlar tartışılmıştır.

Anahtar kelimeler: kavram yanılgısı, kavramsal değişim metni, buharlaşma, kaynama.

GİRİŞ

Öğrenciler sınıf seviyesinden bağımsız olarak fen konularına ilişkin yaygın kavram yanılgılarına sahiptir (Özdemir & Clark, 2007; Özgür, 2013; Westbrook & Marek, 1992). Kavram yanılgıları formal ve informal öğrenmelerle oluşan, öğrencilerin farkında olmadığı perçinlenmiş ontolojik ve epistemolojik inançların bir sonucu olduğundan, kavram yanılgılarını gidermek genelde oldukça zor ve zaman alan bir süreçtir (Ioannides & Vosniadou, 2002; Özdemir & Clark, 2007). Kavram yanılgıları sonraki öğrenmeleri oldukça olumsuz yönde etkilediğinden, anlamlı öğrenmelerin önünde büyük bir engel teşkil etmektedir (Özdemir & Clark, 2007). Bu farkındalıklarla alan yazınındaki araştırmalar sadece öğrencilerin çeşitli fen kavramlarına ilişkin kavram yanılgılarını tespit etmekle yetinmeyip, bu kavram yanılgılarının giderilmesine odaklanmıştır. Bu amaçla, kavram haritaları (Kaptan, 1998; Kaya, 2003; Kılıç & Sağlam, 2004); kavram karikatürleri (Kete, Avcu, & Aydın, 2009; Köse, 2008; Taş, 2013); analoji (Akyürek & Afacan 2013; Duit, Roth, Komorek, & Wilbers, 2001); anlam çözümleme tabloları (Çetinkaya & Taş, 2011); kavramsal değişim metinleri (Akyürek & Afacan 2013; Çetingül & Geban, 2011; Köse, Kaya, Gezer, & Kara, 2011; Pabuçcu & Geban, 2006; Pınarbaşı & Canpolat, 2002; Şen & Yılmaz, 2012;) gibi yöntem ve teknikler araştırmalarda öğrencilerin fen kavramlarına ilişkin kavram yanılgılarını gidermek için kullanılmıştır. Kullanılan bu yöntem ve tekniklerin hemen hepsinin kuramsal temeli Piaget'in şema teorisine ve bu teoriden etkilenerek Posner, Strike, Hewson ve Gertzog'un geliştirdiği kavramsal değişim yaklaşımına dayanmaktadır.

Bu araştırmada, geleneksel kavramsal değişim yaklaşımına sadık kalınarak, kavramsal değişim metinlerinin 5E öğrenme döngüsü içinde kullanıldığı bir ders planıyla, 8. Sınıf öğrencilerinin buharlaşma ve kaynama kavramlarına ilişkin yanılgılarının giderilmesi amaçlanmıştır. Aşağıdaki bölümlerde araştırmaya öncülük eden kuramsal temellere ve ayrıca araştırmada kavram yanılgılarını gidermek için kullanılan kavramsal değişim metinleri hakkındaki bilgilere yer verilecektir.

Geleneksel Kavramsal Değişim Yaklaşımı

Kavramsal değişim yaklaşımı Piaget'in şema teorisine dayanmaktadır. Bu teoriye göre öğrenciler her bir kavrama ilişkin, formal ve informal öğrenmelere bağlı olarak gelişmiş, kavramla ilgili birçok olayı açıklama yeteneğine sahip şemalara sahiptir. Fakat bu kökleşmiş şemalar çoğunlukla hatalı, yanlış veya eksik bilgi yapılarıdır. Bu hatalı bilgi yapılarını düzeltmek işin şemanın tekrar organize edilmesine, daha köklü hatalar için ise radikal bir şekilde şemanın tamamen ortadan kaldırılıp, bilimsel olarak doğru şemanın konumlandırılmasına ihtiyaç vardır. Bu yüzden Posner ve ark. (1982) tarafından geliştirilen kavramsal değişim yaklaşımı, öğrencilerin ön bilgilerinin tespit edilmesini ve öğrencilerin kendi kavram yangıları ile yüzleştirilmelerini önemser. Bu yaklaşımda yeni öğrenmelerin daha önce bilinenlerden bağımsız olarak gerçekleşmesi mümkün olmadığından, öğrenciye eski bilgilerini kontrol etmesi, bu bilgileri düzenlemesi ve eski bilgiler ile yeni bilgiler arasında gerekli bağlantıları kurması için fırsat tanınmalıdır. Bazen yüzeysel bazense radikal kavram değişimine gidecek olan bu sürecin her basamağı ancak iyi planlanmış öğrenme etkinlikleriyle gerçekleşebilir. Posner ve ark. (1982) planlanan öğretimde kavramsal değişimin gerçekleşmesini dört ön koşula bağlamaktadır;

Hoşnutsuzluk: Öğrenciler bazı olayları açıklamada mevcut bilgilerinin yetersiz olduğunun farkına varmalıdır. Örneğin öğrenciler mevcut bilgileri ile yeni gözlemlerinin çeliştiğini görmelidir.

Açıklık ve Anlaşılırlık: Yeni gelen bilgi öğrenciler için açık ve net olmalıdır. Bu yüzden öğrencilerin yeni öğrenmeleri sırasında birinci elden deneyimlere sahip olması önem taşımaktadır.

Mantıklılık: Öğrenciler için yeni gelen bilgi makul ve mantıklı olmalıdır. Yani öğrenciler birinci elden edindikleri deneyimler ile mevcut bilgileri arasında doğru bağlantıları kurabilmeli ve bilimsel olarak doğru açıklamalara ulaşabilmelidir.

Verimlilik: Öğrenciler öğrendikleri kavramları yeni durumlara uygulayabilmeli, bu konuya ilişkin benzer problemleri çözebilmeli ve farklı durumları açıklamada kullanabilmelidirler. Diğer bir ifadeyle öğrenilen bilgi öğrenciler için işlevsel olmalıdır. Öğrendikleri bilgileri çözüme muhtaç durumlara transfer edebilmelidir.

Kavramsal Değişim Metinleri

Kavram değiştirme metinleri bilimsel olarak doğru kabul edilen bilgiler ile kavram yanılgıları arasındaki çelişkileri açık bir şekilde ortaya koyan metinlerdir (Hynd & Alvermann, 1986). Bu metinlerde öğrencilerin sahip olduğu yetersiz veya yanlış bilgiler ifade edilir, bilimsel kanıtlar ışığında geçerli olan bilgiler vurgulanır ve böylece öğrencilerde kavramsal değişim meydana getirilmeye çalışılır (Berber & Sarı, 2009; Dilber, 2006; Vatansever, 2006).

Kavramsal değişim metinlerinde öncelikle öğrencilerin kavram yanılgılarını ortaya çıkarmak için bir soru sorulur. Daha sonra o konuyla ilgili yaygın kavram yanılgılarını çürütmeye yönelik hazırlanmış metinler öğrencilere okutulur. Bu metinlerin her birinde öncelikle söz konusu yanılgı açık bir şekilde ifade edilir. Böylece öğrencilerin kendilerinde mevcut olan kavram yanılgılarını sorgulamaları ve kendi bilgilerinin yetersiz olduğunu görmeleri sağlanmış olur. Daha sonra bilimsel doğrular yine açık ve anlaşılır olarak, kanıtlar ve örneklerle metinler içinde sunulur (Pınarbaşı & Canpolat, 2002).

Kavramsal değişim metinlerinin kullanıldığı pek çok çalışma bulunmaktadır. (Berber & Sarı, 2009; Dilber, 2006; Önder & Geban, 2006; Pabuçcu, & Geban, 2006; Şendur & Toprak & Pekmez, 2008; Yılmaz, 2010). Fakat yapılan ulusal çalışmalar incelendiğinde buharlaşma ve kaynama kavramları konusundaki kavram yanılgılarının giderilmesine yönelik araştırmalara ihtiyaç olduğu tespit edilmiştir. Kavram değişimini destekleyen, 5E öğrenme döngüsü içinde kavramsal değişim metinlerinin kullanıldığı, buharlaşma ve kaynama kavramlarına ilişkin yanılgıların giderilmesine yönelik herhangi bir çalışmaya rastlanmamıştır.

Amaç ve Araştırma Soruları

Bu çalışmanın amacı Maddenin Halleri ve Isı ünitesi içerisinde yer alan "buharlaşma" ve "kaynama" kavramlarına ilişkin, 8.sınıf öğrencilerinin yanılgılarını kavramsal değişim metinleri kullanarak 5E öğrenme döngüsü içinde gidermektir. Araştırma soruları aşağıdaki gibidir.

1. 8. Sınıf öğrencilerinin buharlaşma ve kaynama kavramlarına ilişkin kavram yanılgıları nelerdir?
2. Kavramsal değişim metinleri 8. Sınıf öğrencilerinin buharlaşma ve kaynama kavramlarına ilişkin yanılgılarını gidermede ne derece etkilidir?

YÖNTEM

Çalışma Grubu

Çalışma grubunu 2014-2015 eğitim öğretim yılı bahar döneminde Orta Anadolu'daki bir ilçenin devlet ortaokulunun 8. sınıfında öğrenim gören 25 öğrenci oluşturmuştur. Uygulamanın yapılmasında ve verilerin toplanmasında kolaylık sağlaması için araştırmaya liderlik eden birinci yazarın Fen Bilimleri dersine girdiği sınıf amaçlı olarak seçilmiştir.

Veri Toplama Aracı

Veri toplama aracı olarak EK-1' de verilmiş olan sekiz açık uçlu soru hazırlanmıştır. 3., 6. ve 8. sorular Kırıkkaya ve Güllü' nün (2008) 5.sınıf öğrencilerinin ısı-sıcaklık ve buharlaşma-kaynama konularındaki kavram yanılgılarını tespit etmek için yaptıkları çalışmadan alınmıştır. Diğer sorular ise Fen Bilimleri öğretmeni olan birinci yazar tarafından geliştirilmiştir. Bütün sorular iki uzman tarafından kontrol edilmiş, ihtiyaç duyulan değişiklikler yapılmıştır. Bu sorular hem ön değerlendirme hem de son değerlendirme olarak uygulanmıştır.

Araştırma Modeli ve Uygulama

Deneme öncesi modellerden, tek grup ön-test son-test modeli kullanılmıştır (Karasar, 2013). Yapılan çalışma 1+2+1 olmak üzere üç ayrı oturumdaki toplam dört ders saatini kapsamıştır. İlk saatte, 5E öğrenme döngüsünün giriş aşaması için öğrencilere ön değerlendirme için hazırlanan sekiz açık uçlu sorudan oluşan bir anket uygulanmıştır(EK-1). Öğrencilere anket sorularını cevaplamaları için 40 dakikalık zaman verilmiştir. Öğrencilerin cevapları, yoğunlukla sahip oldukları kavram yanılgılarını tespit etmek için betimsel olarak analiz edilmiştir. Tespit edilen öğrenci yanılgılarını gidermeye yönelik dört ayrı kavramsal değişim metni hazırlanmıştır (EK-2). Kavramsal değişim metinleri hazırlanırken öğrenci yanılgıları metnin girişine yazılmıştır. Daha sonra öğrencilerin düşüncelerinin neden yanlış olduğu açık ve net bir dille ifade edilmiştir. Öğrencileri ikna edebilmek için bilimsel kanıtlar kullanılmış, günlük hayattan örnekler verilmiştir. İkinci ders saatinde, 5E öğrenme döngüsünün keşfetme aşamasında buharlaşma ve kaynama kavramlarına odaklanarak öğrencilere sorular yöneltilmiş kendilerinin bu kavramları ayırt etmeleri sağlanmıştır. Daha sonra öğrencilere Ek-2'de yer alan kavramsal değişim metinlerinin birinci ve ikincisi okutulmuştur. 5E öğrenme döngüsünün açıklama aşamasında öğrencilerin mevcut bilgileri ile buharlaşma ve kaynamayı tanımlamaları istenmiştir. Bilimsel gerçeği savunan öğrencilerle yanılgıya sahip öğrenciler tartıştırılmıştır. Üçüncü ders saatinde, 5E öğrenme döngüsünün derinleştirme aşamasında kalan iki kavramsal değişim metni öğrencilere okutulup tartıştırılmıştır. Burada amaç, öğrencilerin öğrendiklerini günlük hayata uygulayıp konuyu daha iyi kavramalarını sağlamaktır. Bu uygulama sonunda, konudaki kavramlara yönelik bir anlam çözümleme tablosu öğrencilerle birlikte yapılmıştır. Dördüncü ders saati içinde yani 5E öğrenme döngüsünün değerlendirme aşamasında ise öğrencilere son değerlendirme yapmak için ön değerlendirmede kullanılan sekiz açık uçlu soru tekrar sorulmuş, cevap vermeleri için yine 40 dakika verilmiştir. Uygulama sonunda öğrencilerin cevapları yine betimsel olarak analiz edilmiştir. Böylece buharlaşma ve kaynama kavramlarına yönelik öğrencilerin sahip oldukları yanılgıların giderilmesinde kavramsal değişim metinlerinin etkili olup olmadığı tespit edilmiştir.

BULGULAR

Tablo 1. "Kaynama Nedir?" Sorusuna Verilen Yanıtlar

	Ön Değerlendirme(f)	Son Değerlendirme(f)
Sıvı sıcaklığının belirli bir noktaya geldiği anda taneciklerin maksimum hıza ulaşmasıdır	3	15
Sıvının ısı alarak fokurdamasıdır	6	-
Sıcaklığın belli bir noktaya geldiği andır	4	-
Sıvıyı çok ısıtmaktır	4	2
Suyun yumuşatılmasıdır	2	-
Kaynama ısıdır.	2	2
Sıvıyı buharlaştırmak için yapılan işlemdir	4	1
Sıvının buhar basıncının dış basınca eşit olduğunda sıvının her yerinden gaz kabarcıkları çıkmasıdır	-	5

Ön değerlendirmede 25 öğrenciden sadece 3'ü bilimsel olarak doğru cevap vermiştir (Tablo 1). Altı öğrenci "sıvının ısı alarak fokurdamasıdır" ve 4 öğrenci "sıcaklığın belli bir noktaya geldiği andır" cevabını vererek kaynamayı kısmen doğru tanımlamışlardır. Dört öğrenci "sıvıyı buharlaştırmak için yapılan işlemdir" şeklinde cevap vermiş dolayısıyla kaynama olmadan buharlaşma olamayacağını iddia etmiştir. Öğrencilere uygulanan kavramsal değişim metinleri hazırlanırken bu yanılgıya değinilmiştir. Son değerlendirme sonuçlarına bakıldığında "sıvı sıcaklığının belirli bir noktaya geldiği anda taneciklerin maksimum hıza ulaşmasıdır" cevabını veren 15 öğrenci ve "sıvının buhar basıncının dış basınca eşit olduğunda sıvının her yerinden gaz kabarcıkları çıkmasıdır" cevabını veren 5 öğrencinin doğru cevap verdiği görülmektedir. Ön değerlendirmede kavram yanılgısına sahip olan öğrenci sayısı 4 iken son değerlendirmede bu sayının 1'e düştüğü görülmektedir.

Tablo 2. "Buharlaşma Nedir?" Sorusuna Verilen Yanıtlar

	Ön Değerlendirme(f)	Son Değerlendirme(f)
Sıvının ısı alarak gaz haline geçmesidir	9	21
Sıvıyı çok kaynatarak buhara dönüştürmektir	9	-
Sıvıyı yok etmektir	4	2
Su döngüsünü anlatanlar	3	-
Sıvının azalmasıdır	-	3

Ön değerlendirmede 25 öğrenciden 9'u "sıvının ısı alarak gaz haline geçmesidir" cevabını vererek bilimsel olarak doğru açıklamada bulunmuşlardır (Tablo 2). Üç öğrencinin açıklamaları su döngüsü ile ilgili olup herhangi bir kavram yanılgısı içermemektedir. Fakat söz konusu açıklamalar buharlaşma kavramını tanımlamamaktadır. Öğrencilerin 9'u "sıvıyı çok kaynatarak buhara dönüştürmektir" yorumunu yaparak kavram yanılgısına sahip olduklarını göstermişlerdir. Burada katılımcılar kaynama gerçekleşmeden buharlaşma olamayacağını düşünerek yanılgı içerisine girmişlerdir. Diğer bir yanılgı ise 4 katılımcının verdiği "sıvıyı yok etmektir" yanıtında görülmektedir. Öğrenciler buharlaştırma olayı sonrasında gaz haline geçen sıvıyı göremedikleri için yok olduğunu iddia etmektedir. Öğrencilerin sahip oldukları bu yanılgılar doğrultusunda hazırlanan kavramsal değişim metni kendilerine uygulandıktan sonra, 21 öğrenci soruyu doğru cevaplarken, ön değerlendirmede kavram yanılgısına sahip 13 öğrenciden 11'inin yanılgılarının giderildiği görülmektedir.

Tablo 3. "Elinize Kolonya Sürdüğünüzde Serinlemenizin Nedeni Nedir?" Sorusuna Verilen Yanıtlar

	Ön Değerlendirme(f)	Son Değerlendirme(f)
Buharlaşma olduğu için serinleriz	4	20
Isı alışverişi olduğu için serinleriz	5	3
İçerisinde asit olduğu için serinleriz	9	2
İçerisinde alkol olduğu için serinleriz	3	-
Diğer sebepler(yanıcı olması vb.)	4	-

Ön değerlendirmede 25 öğrenciden 9'u "buharlaşma olduğu için serinleriz" ve "ısı alışverişi olduğu için serinleriz" cevaplarını vermiş ve soruyu doğru yanıtlamışlardır (Tablo 3). 16 öğrenci ise serinleme sebebini kolonyanın içerisindeki maddelere dayandırmaktadır. Son değerlendirme sonuçlarına göre 25 öğrenciden 23'ü doğru cevap vermiştir. Büyük oranda kavram yanılgılarının giderildiği görülmüştür. Kavram yanılgısına sahip 16 öğrenciden 14'ünün yanılgısı giderilmiştir.

Tablo 4. "Buharlaşma Her Sıcaklıkta Gerçekleşir mi? Neden?" Sorusuna Verilen Yanıtlar

	Ön Değerlendirme(f)	Son Değerlendirme(f)
Evet		
Isı alması yeterli olduğu için	5	18
Buharlaşma yok etmek olduğu için	1	-
Kaynayınca buharlaşma olduğu için	-	1
Neden belirtmeyen	-	1
Hayır		
Kaynaması gerekir.	7	-
Buharlaşma noktasına gelmesi gerekir.	6	2
Buharlaşma olması için güneşin olması gerekir.	2	-
Neden belirtmeyen	4	1

Ön değerlendirmede 25 öğrenciden 6'sı "evet, buharlaşma her sıcaklıkta gerçekleşir" yanıtını vererek soruyu doğru cevaplamıştır (Tablo 4). Öğrencilerin "evet" yanıtlarının hangi nedenlere dayandırıldığına bakıldığında 5'i "evet, ısı alması yeterli olduğu için" cevabını vererek doğru açıklamada bulunmuştur. Bir öğrenci soruyu yanlış bir gerekçeyle doğru olarak cevaplamıştır. Açıklamasında, "buharlaşma yok etmek olduğu için her sıcaklıkta gerçekleşir" ifadesini kullanmıştır. Ona göre sıvı fazdaki maddeler buharlaştığında yok olmaktadır. Ön değerlendirmede 25 öğrenciden 19'u "hayır, buharlaşma her sıcaklıkta gerçekleşmez" yanıtını vererek soruyu yanlış cevaplamıştır. Öğrencilerin cevaplarının nedenselliğine bakıldığında; kaynama olmadan buharlaşma olamayacağı yanılgısına 7 öğrencinin sahip olduğu, buharlaşma olması için sıvının belirli bir buharlaşma noktasına gelmesi gerekir yanılgısına ise 6 öğrencinin sahip olduğu görülmüştür. Son değerlendirme sonuçları incelendiğinde 18 öğrenci "evet, ısı alması yeterli olduğu için buharlaşma her sıcaklıkta gerçekleşir" yanıtını vererek bilimsel olarak doğru açıklamada bulunmuşlardır. Kaynama olmadan buharlaşma olamayacağı yanılgısına sahip öğrencilerden 6'sının yanılgısı giderilirken 1'inin yanılgısı devam etmiştir. Buharlaşma olması için sıvının belirli bir buharlaşma noktasına gelmesi gerekir yanılgısına sahip öğrencilerden 4'ünün yanılgısı giderilirken 2'sinin yanılgısı devam etmiştir.

Tablo 5. "Kaynama Her Sıcaklıkta Gerçekleşir mi? Neden?" Sorusuna Verilen Yanıtlar

	Ön Değerlendirme(f)	Son Değerlendirme(f)
Evet		
Isı alması yeterli olduğu için	6	-
Kaynama maksimum güçtür	-	1
Neden belirtmeyenler	5	1
Hayır		
Belirli sıcaklığı vardır	11	22
Buharlaşma olduğu için	1	-
Sıcaklığı fazla olduğu için	1	-
Neden belirtmeyenler	1	1

Ön değerlendirmede 25 öğrenciden 14'ü "hayır. Kaynamanın belirli bir sıcaklığı vardır" yanıtını vererek soruyu doğru cevaplamıştır (Tablo 5). Katılımcıların "hayır" yanıtlarının hangi nedenlere dayandırıldığına bakıldığında 11'i "belirli sıcaklığı vardır" yanıtını vererek bilimsel olarak doğru açıklamada bulunmuşlardır. Bu soruda öğrencilerin kaynama ve buharlaşma kavramlarını karıştırdıkları görülmüştür. Öğrencilerin 6'sı "kaynama her sıcaklıkta gerçekleşir bunun için sadece sıvının ısı alması yeterlidir" cevabını vermiştir. Fakat son değerlendirmede katılımcıların 22'si aynı soruya "hayır. Belirli sıcaklığı vardır" cevabını vererek doğru açıklamada bulunmuşlarıdır. Kaynamanın her sıcaklıkta gerçekleşeceğini bunun için sadece sıvının ısı almasının yeterli olduğu düşünen öğrencilerin tamamı, bu kavram yanılgılarını uygulamadan sonra terk etmiştir.

Tablo 6. "Çamaşırlar Sıcak Yerde mi Yoksa Soğuk Yerde mi Daha Çabuk Kurur? Neden?" Sorusuna Verilen Yanıtlar

	Ön Değerlendirme(f)	Son Değerlendirme(f)
Sıcakta kurur		
Buharlaşma daha hızlı olduğu için	8	24
Isı alışverişi olduğu için	9	-
Güneş etki ettiği için	3	-
Soğukta donar	1	-
Neden belirtmeyen	4	1
Soğukta kurur.	-	-

Ön değerlendirmede 25 öğrencinin tamamı çamaşırların sıcakta kuruyacağı cevabını vererek soruyu doğru yanıtlamıştır (Tablo 6). Nedenleri incelendiğinde "buharlaşma daha hızlı olduğu için çamaşırlar sıcakta kurur" yanıtını veren 8 katılımcı doğru açıklamada bulunurken, "ısı alışverişi olduğu için çamaşırlar sıcakta kurur" yanıtını veren 9 katılımcının açıklaması kısmen doğru olarak değerlendirilmiştir. Günlük hayattan örneklerle sorulan sorulara katılımcıların verdiği cevapların doğruluk oranının daha yüksek olduğu gözlenmiştir. Son değerlendirmeye bakıldığında bu oran daha da artmıştır.

Tablo 7. "Kaynama Sıvının Her Yerinde Gerçekleşir mi? Neden?" Sorusuna Verilen Yanıtlar

	Ön Değerlendirme(f)	Son Değerlendirme(f)
Gerçekleşir		
Isı sıvının her yerine etki ettiği için	8	-
Isı aldığı için	1	-
Tanecikler her yerde olduğu için	1	-
Tanecikler ısı aldığı için sıvının her yerinde hareketlenme olur	-	22
Neden belirtmeyen	4	2
Gerçekleşmez		
Sıvının önce altı kaynadığı için	4	-
Isı sıvının her yerine etki etmediği için	3	-
Neden belirtmeyen	4	1

Ön değerlendirmede öğrencilerin 14'ü "kaynama sıvının her yerinde gerçekleşir" yanıtını vererek doğru cevaplamıştır (Tablo 7). Nedenler incelendiğinde "ısı sıvının her yerine etki ettiği için" yanıtını veren 8 katılımcı kısmen doğru cevap vermiştir. Öğrencilerden 4'ü "sıvının önce altı kaynadığı için kaynama sıvının her yerinde gerçekleşmez" cevabını verirken, 3 katılımcı "ısı sıvının her yerine etki etmediği için kaynama sıvının her yerinde gerçekleşmez" cevabını vermiştir. Son değerlendirme sonuçları incelendiğinde 22 öğrenci "tanecikler ısı aldığı için sıvının her yerinde hareketlenme olur bu yüzden kaynama sıvının her yerinde gerçekleşir" cevabını vererek bilimsel olarak doğru açıklamada bulunmuşlardır. "Sıvının önce altı kaynadığı için kaynama sıvının her yerinde gerçekleşmez" yanılgısına sahip öğrencilerin tamamı, bu yanılgılarını uygulama sonunda terk etmiştir.

Tablo 8. "Kaynayan Suda Kabarcıklar Çıkmasının Nedeni Nedir?" Sorusuna Verilen Yanıtlar

	Ön Değerlendirme(f)	Son Değerlendirme(f)
Kaynayan sıvının her taraftan buharlaşması	3	16
Sıvının çok kaynaması	14	-
Isının alttan etki etmesi	4	-
Sıvı taneciklerinin hızının artması	-	5
Sıvının sıcaklığı ile hava çıkması	-	4
Diğer	4	-

Ön değerlendirmede 25 öğrenciden sadece 3'ü "kaynayan sıvı her taraftan buharlaştığı için kaynayan suda kabarcıklar çıkar" yanıtını vererek doğru açıklamada bulunmuşlardır (Tablo 8). 14 öğrenci "sıvı çok kaynadığı için kaynayan sudan kabarcıklar çıkar" cevabını vererek tam olarak doğru yanıt verememişlerdir. Bu öğrenciler buharlaşma olayını göz ardı etmiştir. Dört öğrenci "ısı alttan etki ettiği için kaynayan suda kabarcıklar çıkar" cevabını vererek yanlış bir açıklamada bulunmuşlardır. Dört öğrenci birbirinden farklı cevap verdiği için diğer başlığı altında toplanmıştır. Diğer olarak belirttiğimiz kısmın içinde "yoğuştuğu için", "yoğunluğu arttığı için", "tanecikler suda dağıldığı için" ve "tanecikler gevşediği için" nedenleri yer almaktadır. Ön değerlendirmede 22 öğrenci buharlaşma olayının her sıcaklıkta gerçekleştiğini ve kaynama olayı esnasında suyun her taraftan buharlaştığını düşünememiştir. Son değerlendirmede 16 öğrenci "sıvı her taraftan buharlaştığı için kaynayan suda kabarcıklar çıkar" yanıtını vererek bilimsel olarak doğru açıklamada bulunmuşlardır. Beş katılımcı ise "sıvı taneciklerinin hızı arttığı için kaynayan suda kabarcıklar çıkar" cevabıyla kısmen doğru açıklamada bulunmuşlardır. Dört katılımcı "sıvının sıcaklığı ile hava çıkar" cevabını vererek buharlaşma olayının her sıcaklıkta gerçekleştiğini göz ardı etmişlerdir. Son değerlendirmede soruya verilen doğru cevap sayısı artmıştır.

TARTIŞMA VE SONUÇ

Yapılan çalışmada elde edilen veriler değerlendirildiğinde 8. Sınıf öğrencilerinin buharlaşma ve kaynama kavramlarına ilişkin kavram yanılgılarının 5E öğrenme döngüsü içinde uygulanan kavramsal değişim metinleriyle önemli ölçüde giderildiği gözlenmiştir. Kavram yanılgısı en çok "kaynama nedir?" ve "buharlaşma nedir?" sorularına verilen yanıtlarda gözlenmiştir. "Kaynama olmadan buharlaşma olmaz" ve "buharlaşma sıvıyı yok etmektir" cevapları bu sorulardaki en kuvvetli kavram yanılgılarıdır. Fakat günlük hayatta, öğrencilerin aşina olduğu bir bağlam içinde sorulan sorularda öğrencilerin kavram yanılgılarının daha az olduğu tespit edilmiştir. Örneğin, "çamaşırları sıcak yerde mi yoksa soğuk yerde mi daha çabuk kuruturuz?" sorusuna daha yüksek oranda doğru yanıt vermeleri, katılımcıların günlük hayatta sıkça karşılaştıkları olayları daha kolay özümsediklerini göstermektedir. Bu sebeple kavram öğretiminin günlük hayatla ilişkilendirilerek yapılmasına özen gösterilmelidir.

Bu çalışmaya benzer olarak, Kırıkkaya ve Güllü (2008) çalışmasında buharlaşma ve kaynama kavramları ile ilgili 5.sınıf öğrencilerinin sahip oldukları kavram yanılgılarını tespit etmişlerdir. Yaptığımız çalışma ile bu çalışma tarafından tespit edilen birçok kavram yanılgısı birbiri ile örtüşmektedir. Her iki çalışmada da tespit edilen yanılgılar şu şekildedir; "kaynama olmadan buharlaşma olmaz", "her sıcaklıkta buharlaşma olmaz", "elimize kolonya sürdüğümüzde serinlememizin nedeni içerisindeki asit ve alkoldür", "kaynama her sıcaklıkta gerçekleşir". İki çalışmanın örneklemini oluşturan öğrenciler arasında gelişim düzeyi farklılığı olmasına rağmen tespit edilen yanılgılar aynıdır. Bu da yerleşmiş kavram yanılgılarının farklı sınıf seviyelerinde kalıcılığını koruduğunu göstermektedir.

Öğrencilerin sahip oldukları yanılgılar büyük oranda giderilmiştir. Fakat bazı kavram yanılgılarının kalıcılığı düşünüldüğünde, kavramsal değişim metinleri yanında kavram yanılgılarını giderecek ek yöntemler de kullanılabilir. Bu çalışma sonunda anlam çözümleme tablosu yapılmış buharlaşma ve kaynama kavramlarının özellikleri daha da somutlaştırılmıştır. Anlam çözümleme tablolarına her konunun bitiminde yer verilmesi öğrencilerin kavramları daha iyi anlamlandırmalarını sağlayacaktır. Öğretimin başında, işlenecek konu ile ilgili öğrencilerin kavram yanılgıları tespit edilmeli ve öğretim aşamaları tespit edilen kavram yanılgılarına odaklanılarak hazırlanmalıdır. Öğretmen kılavuz kitapları öğretim öncesi öğrencilerde var olabilecek kavram yanılgıları hakkında öğretmenleri bilgilendirecek şekilde hazırlanmalıdır. Muhtemel yanılgılar dikkate alınarak öğrenme süreci planlanmalıdır.

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EK-1

Açık Uçlu Sorular
1. Kaynama nedir?
2. Buharlaşma nedir?
3. Elinize kolonya sürdüğünüzde serinlemenizin nedeni nedir?
4. Buharlaşma her sıcaklıkta gerçekleşir mi? Neden?
5. Kaynama her sıcaklıkta gerçekleşir mi? Neden?
6. Çamaşırlar sıcak yerde mi yoksa soğuk yerde mi daha çabuk kurur? Neden?
7. Kaynama sıvının her yerinde gerçekleşir mi? Neden?
8. Kaynayan suda kabarcıklar çıkmasının nedeni nedir?

EK-2

Kavramsal Değişim Metni-1

Bazı öğrenciler buharlaşma ve kaynama kavramları ile ilgili aşağıdaki yanlış düşüncelere sahip olabilir.
*Kaynama sıvıyı buharlaştırmak için yapılan işlemdir.
*Buharlaşma sıvıyı yok etmektir.
*Buharlaşma olması için sıvının kaynaması gerekir.

Üzgünüm…
Eğer sizde buharlaşma ve kaynama kavramları ile ilgili bu şekilde düşünüyorsanız bu soruya doğru cevap veremediniz demektir…

Çünkü
Bu düşünceleriniz yanlıştır. Bu yanlış düşüncelerinizin sebebi buharlaşma ve kaynama kavramlarını ayırt edemiyor oluşunuz olabilir. Ya da buharlaşma olması için sıvının kaynaması gerektiğini düşünmenizin sebebi kaynayan sıvının buharlaşmasını daha net gözlemlediğinizden olabilir. Gaz halindeki maddenin havaya karışma anını tam göremediğiniz için sıvıyı yok oluyormuş gibi algılayıp bir yanılgıya düşebilirsiniz. Buharlaşan sıvıyı gözünüzle göremediğiniz için yok olduğunu düşünebilirsiniz.

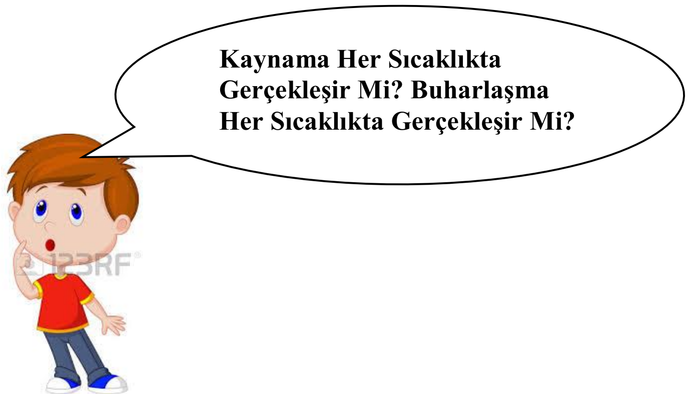
Şunu bilmelisiniz ki kaynama ile buharlaşma kavramları aynı kavramlar değildir. Kaynamanın basit tanımı ısı alan sıvının fokurdamasıdır diyebiliriz. Kaynamanın genel tanımı ise sıvının buhar basıncının dış basınca eşit olduğunda sıvının her yerinden gaz kabarcıkları çıkmasıdır. Diğer bir kaynama tanımı ise şöyledir: ısıtılan sıvının sıcaklığı belli bir noktaya geldiğinde sıvı taneciklerinin maksimum hıza ulaşmasıdır.

Buharlaşma sıvı haldeki maddenin ısı alarak gaz haline geçmesidir. Sıvı haldeki madde gaz haline geçer ve havaya karışır. Bildiğimiz gibi bazı gazlar renksiz maddelerdir. Eğer buharlaşma yok olmak olsa idi su döngüsü diye bir şey olmazdı. Yeryüzündeki sular ısının etkisi ile buharlaşarak atmosfere karışır. Bu sular yok olmaz.

Buharlaşma olması için sıvının ısı alması yeterlidir. Sıvının kaynamasına gerek yoktur. Isı alan her sıvı buharlaşır.

Tebrikler!!!
Artık buharlaşma ve kaynama kavramlarını doğru bir şekilde ifade edebilirsiniz.

Kavramsal Değişim Metni-2



Bazı öğrenciler buharlaşma, kaynama kavramları ve sıcaklıkla ilgili aşağıdaki yanlış düşüncelere sahip olabilir.

*Buharlaşma olması için sıvının buharlaşma noktasına gelmesi gerekir.

*Kaynama olması için sıvının ısı alması yeterlidir.

Üzgünüm…
Eğer sizde buharlaşma ve kaynama kavramları ile ilgili bu şekilde düşünüyorsanız bu soruya doğru cevap veremediniz demektir…

Çünkü
Bu düşünceleriniz yanlıştır. Bu yanlış düşüncelerinizin sebebi kaynama ve buharlaşma kavramlarını karıştırıyor olmanız olabilir.

Şunu bilmelisiniz ki buharlaşma ve kaynama kavramları farklı özelliklere sahip kavramlardır. Her sıvının kendine ait kaynama noktası vardır. Örneğin; suyu kaynatmak için ateş üzerine yerleştirdiğiniz kap içerisindeki suyun 100C sıcaklığa gelmesini beklemeniz gerekir. 100C sıcaklığa ulaşmayan suyu için kaynama olayı gerçekleşmez. Sıcaklık 100C de ise kaynama gerçekleşir. Başka bir sıvı olan alkolü kaynatmak isterseniz alkolün kaynama sıcaklığı olan 78C'ye ulaşmasını beklemeniz gerekir. Bu sıcaklığa ulaşmayan alkol kaynamaz. Bu iki örnekten her sıvının belli bir kaynama sıcaklığı olduğunu kaynama olayının her sıcaklıkta gerçekleşmediğini öğrenmiş oldunuz. Bilimsel olarak kaynama sıcaklığına kaynama noktası da denilmektedir.

Buharlaşma ise her sıcaklıkta gerçekleşen bir olaydır. Buharlaşma olması için sıvının ısı alması yeterlidir. Örneğin; eriyen karın buharlaşmasını düşününüz. Güneşin birazcık bile etrafı ısıtması eriyen karların buharlaşmasına neden olmaktadır. Makarna yaparken önce ocağa su koyup kaynamasını beklersiniz. Bu esnada ısı alan suyun yavaşça yüzeyden buhara dönüştüğünü fark etmişsinizdir. Suyu ısıtırken suyun sıcaklığı 30C, 40C, 53C, 76C de olsa buharlaşma olayının gerçekleştiğini gözlemleyebilirsiniz. Örnekten de anlaşılacağı gibi sıvıların belli bir buharlaşma sıcaklığı yoktur. Sıvılar her sıcaklıkta buharlaşırlar. Kaynama sıcaklığına ulaşan sıvının buharlaşma hızı maksimum düzeydedir.

Tebrikler!!!
Artık sıvıların belli bir sıcaklıkta kaynadığını fakat her sıcaklıkta buharlaştığını biliyorsunuz.

Kavramsal Değişim Metni-3

Bazı öğrenciler günlük hayattaki örneklerde buharlaşma ile ilgili aşağıdaki yanlış düşüncelere sahip olabilir.
*Kolonyanın içerisindeki alkol serinleme sebebimizdir.
*Kolonyanın içerisindeki asit serinleme sebebimizdir.

Üzgünüm…
Eğer sizde günlük hayattaki örneklerde buharlaşma ile ilgili bu şekilde düşünüyorsanız bu soruya doğru cevap veremediniz demektir…

Çünkü
Bu düşünceleriniz yanlıştır. Bu yanlış düşüncenizin sebebi kolonyayı buharlaşma ile ilişkilendirememiş olmanız olabilir.

Kolonyanın içerisinde alkol, su ve limon, tütün gibi maddelerin esansları bulunur. Kolonya sürdüğümüzde serinlememizin nedeni kolonya içerisindeki alkol ve asit değildir. Alkol kolonyayı oluşturan bileşenlerden bir tanesidir. Alkolün mikrop kırıcı özelliği vardır. Kolonya içerisindeki asit miktarı azdır. Asitler tahriş edici maddelerdir. Asitler serinleme nedeniniz değildir.

Kolonya bilindiği gibi sıvı bir maddedir. Sıvı olan her madde buharlaşırken ısı alır. Tıpkı banyo sonrasında saçlarınızı kurutmak için sıcak hava üfleyen saç kurutma makinelerini kullanıyor olmanız gibi. Saç kurutma işlemi saçınızdaki fazla suyu buharlaştırmaktır. Saçlarımızdaki fazla su makinenin üflediği havadan ısı alarak buharlaşır. Kolonya da buharlaşırken elimizden ısı alır ve bu bizim serinlememizi sağlar.

Tebrikler!!!
Artık her sıvının buharlaşırken ısı aldığını biliyorsunuz.

Kavramsal Değişim Metni-4

Bazı öğrenciler kaynamanın sıvının neresinde gerçekleştiği ile ilgili aşağıdaki yanlış düşüncelere sahip olabilir.

*Kaynama sıvının sadece alt kısmında gerçekleşir.
*Kaynama sıvının her yerinde olmaz.
*Isı alttan etki ettiği için kaynayan suda kabarcıklar oluşur.

Üzgünüm…
Eğer sizde kaynamanın sıvının neresinde gerçekleştiği ile ilgili bu şekilde düşünüyorsanız bu soruya doğru cevap veremediniz demektir…

Çünkü
Bu düşünceleriniz yanlıştır. Bu yanlış düşüncenizin sebebi kaynama olayını gözlemlerken sıvının alt kısmında oluşan kabarcıkları önce görmeniz olabilir. Bu size kaynamanın sadece sıvının alt kısmında gerçekleştiği yanılgısına düşürebilir.

Kaynama sıvının her yerinde gerçekleşen bir olaydır. Sıvı tanecikleri ısı aldığı için hareketleri hızlanır. Hızlanan sıvı tanecikleri yukarı doğru hareket eder. Sıcaklığı azalan tanecik aşağı iner. Aşağıdan ısı alan taneciklerin sıcaklığı artar ve yukarı doğru çıkar. Bu döngü devam eder. Böylece sıvının her yerinde hareketlenme olur. Bu hareketlenme kaynama olayıdır. Yani kaynama sıvının her yerinde gerçekleşir.

Kaynayan su her taraftan buharlaştığı için kaynayan suda kabarcıklar çıkar. Buharlaşma bildiğiniz gibi sıvının gaz hale dönüşmesidir. Sıvının alt kısmı ya da orta kısımlarında gerçekleşen buharlaşma olayı sonucunda o bölgelerdeki sıvı taneciklerinin bir kısmı gaza dönüşür. Gaza dönüşen tanecikler baloncuk oluşturur ve yüzeye çıkma eğilimi gösterirler. Bu şekilde kaynayan suda kabarcıklar çıkar.

Tebrikler!!!
Artık kaynamanın sıvının her yerinde gerçekleştiğini ve kaynayan su her taraftan buharlaştığı için kaynayan sudan kabarcıklar çıktığını biliyorsunuz.

TEACHING METHODS OF SCIENCE TEACHERS ACCORDING TO STUDENTS' VIEWS

Aslı KAYGIN
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ABSTRACT: The purpose of this study is to determine teaching methods employed by the science teachers in their instructions and students' views about these methods in practice. Data was gathered from 5th grade 75 students who study in a middle school located at south east part of the Turkey. A likert type instrument was used to assess students' views evaluated via a descriptive analyses method. The results of the study indicate that science teachers most frequently use verbal lecture, demonstration in class, whole class discussion, and question-answer teaching methods in their instructions. Students most frequently want to be used verbal lecture, doing experiment in laboratory, demonstration in class, observation on events in nature, and out-of- class or out-of-school trips as methods of teaching. Implications for classroom practices were discussed.

Key words: science teaching, teaching methods, science education

ÖĞRENCİ GÖRÜŞLERİNE GÖRE FEN BİLİMLERİ ÖĞRETMENLERİNİN ÖĞRETİM YÖNTEMLERİ

ÖZET: Bu çalışmada, Fen Bilimleri öğretmenlerinin kullandığı öğretim yöntemleri ve bu yöntemlerin uygulanmasına ilişkin öğrenci görüşlerini tespit etmek amaçlanmıştır. Veriler Türkiye'nin güney doğu bölgesinde yer alan bir ortaokulun 5. sınıfında öğrenim gören 75 öğrenciden toplanmıştır. Veri toplama aracı olarak likert tipi anket kullanılmıştır. Betimsel yöntemle öğrencilerin görüşleri analiz edilmiştir. Araştırmadan elde edilen bulgulara göre; Fen Bilimleri öğretmenlerinin en sık kullandığı yöntemler; anlatım yöntemi, öğretmenin sınıfta deney yapması, sınıf tartışması ve soru cevap tekniği ile konunun işlenmesidir. Öğrencilerin fen öğretiminde en sık kullanılmasını istedikleri yöntemler ise anlatım yöntemi, laboratuvarda deney yapma, öğretmenin sınıfta deney yapması, doğa olayları hakkında gözlem yapma, sınıf veya okul dışına gezi düzenlenmesi yöntemleridir. Sınıf içi uygulamalara yönelik çıkarımlar tartışılmıştır.

Anahtar kelimeler: fen öğretimi, öğretim yöntemleri, fen eğitimi

GİRİŞ

Öğrencilere bilgileri direkt olarak aktarmak yerine, bilgilere ulaşmak için onlara rehberlik edip beceri kazandırmak günümüzdeki eğitim sisteminin temel amacı olmalıdır (Doğru ve Aydoğdu, 2003). Yani öğrenci ezberlemek yerine, kavrayarak öğrenmelidir. Karşılaştığı problemi bilimsel süreç becerilerini kullanarak çözebilmelidir. Bu becerilerin kazanıldığı dersin başında ise Fen Bilimleri dersi gelmektedir (Doğdu ve Aydoğdu, 2003).

Fen Bilimleri dersinin amacı, öğrencilerin fen kavramları kalıcı bir şekilde öğrenmelerini sağlamak, onlara bilimsel düşünme, araştırma ve sorgulama kabiliyeti kazandırmaktır (Birbir, 1999). Aktepe ve Aktepe (2009)' ye göre ise fen eğitiminde amaç, yaşadığı çevreyi doğru anlaması için fayda sağlamak ve bilimsel düşünme yeteneği kazandırmak olmalıdır. Fen Bilimleri eğitiminde, günümüzdeki yenilikler takip edilebilirse istenilen amaca ulaşılabilir (Akdeniz, Yiğit ve Kurt, 2002). 2006 yılında MEB tarafından, yapılandırmacı öğrenme yaklaşımına dayalı yeni bir program uygulamaya konulmuştur. Yenilenen bu program, öğretmen merkezli yöntemler yerine öğrenciyi merkeze alan yöntemlerin kullanılmasını önermektedir (MEBTTKB, 2013). Fakat öğretmenler programları uygulamadığı sürece programların yenilenmesi hiçbir şey ifade etmez (Tekbıyık & Akdeniz, 2008). Öğretmen, öğretime yön veren, öğrencide davranış değişikliğine yol açan en önemli öğedir (Sönmez, 2002). Öğretmenin öğrenciyle ve öğrenciye uyguladığı yöntemler arasında bir etkileşim olmalıdır. Çünkü öğrenciler farklı farklı yöntemlerle öğrenerek başarıya ulaşabilirler. Bu nedenle öğretmen sayıca fazla yöntemler geliştirmeli, bunlardan uygun olanlarını seçip kullanmalıdır (Şahin, 1998).

Ülkemizde Sıklıkla Kullanılan Öğretim Yöntemleri

Anlatım yöntemi, öğretmen merkezli bir yöntem olup, pasif bir şekilde dinleyen öğrencilere bilgilerin direkt olarak aktarıldığı geleneksel yöntemdir (Küçükahmet, 1997). Modern öğretimde anlatım yöntemine pek fazla yer verilmemesine rağmen öğretmenler bu yöntemi bazı durumlarda tercih etmektedirler. Fakat anlatım yönteminde öğretmen, bir plan dahilinde hareket eder bu nedenle bazı sınırlılıkları vardır. Bu sınırlılıklar: konular sürekli tekrar edildiği için dersin sıkıcı hale gelmesi, öğrenci ile yeterli iletişim kurulamadığı için ilgi ve ihtiyaçlarının belirlenememesi, öğrenciler derste pasif oldukları için geri bildirimlerin verilememesidir (Küçükahmet, 1997).

Soru Cevap Yöntemi; öğrenciye bilgilerin hatırlatılması, konuların analiz edilmesi ve tekrar edilmesi amacıyla kullanılan etkin bir yöntemdir (Demircioğlu, 2003). Bu yöntem ile öğrencinin utangaçlığı gider ve grup içerisinde kendini gerçekleştirme fırsatı bulur (Duruhan, 2001). Bu yöntemi uygulayan öğretmen soruları dikkatli bir şekilde seçmeli, öğrenciyi düşündüren ve öğrencinin yaratıcılığını geliştirecek sorular sormalıdır (Doğanay, 2002).

Problem Çözme Yöntemi; bu yöntem bilimsel araştırma yöntemini temel alır. Öğrenci bir problem durumuyla karşılaştığında, problemi tanıma, hipotez kurma, veri toplama, değerlendirme, açıklama basamaklarını kullanarak sonuca ulaşır ve test eder (Aktepe ve Aktepe, 2009). Öğrenci o problemi çözdüğü zaman cesaretlenir ve her zaman problemi çözecek gücü kendinde bulur (Küçükahmet, 1997).

Gösteri (Demonstrasyon) Yöntemi; öğretmenin sınıf ortamında yapacağı şeyi öğrencilere göstererek yapmasına veya bir ilkeyi doğrulamak için yapacağı faaliyete denir (Doğanay, 2002). Bu yöntemin amacı, konuyu göstererek açıklamak ve ispat etmektir (Doğanay, 2002). Gösteri yönteminin bazı sınırlılıkları vardır. Bu sınırlılıklar: yöntem uygulanırken fazla malzeme gerektirmesi ve uzun süreli planlama gerektirmesidir. Gösteri yönteminde öğretmen planı yapıp materyali önceden hazırlamalı ve öğrencilerin görebileceği şekilde yapmalıdır (Küçükahmet, 1997).

Gezi-Gözlem Yöntemi; önceden hazırlanmış bir planla olayları veya durumları incelemektir (Büyükkaragöz ve Çivi, 1994). Bu yöntem öğrenciye bakmayı değil, görmeyi öğretir (Duruhan, 2002). Gezi gözlem yönteminin fazla zaman alması ve maddiyat gibi bazı sınırlılıkları vardır. Fakat bunlara rağmen, öğretmenler bu yöntemden vazgeçmemeli ve mesafesi kısa da olsa geziler düzenlemelidir (Doğanay, 1993). Bu yöntem öğrenciler için oldukça yararlı bir yöntemdir. Çünkü öğrencide okul çevre ilişkisinin gelişmesi, gözlem yapma yeteneği kazanması, merak duygusunun uyandırılması gibi durumlar bakımından etkisi oldukça büyüktür (Gardner & Demirtaş & Doğanay, 1997; Gök & Girgin, 2001).

Rol Oynama Yöntemi; bir durumun veya olayın sınıf içerisindeki bir grubun önünde seçilen üyelerce dramatize edilmesidir. Rol oynama yönteminde öğrenciler yalnızca dinlemek yerine konunun ayrıntısına inerler (Çebi, 1985).

Tartışma Yöntemi; bu yöntemde öğrenciler sorunlara çözüm yolları ararlar. Yöntemin esas amacı ise tüm grubun tartışmaya katılmasını sağlamaktır (Aktepe ve Aktepe, 2009).

Laboratuar Yöntemi**;** öğrencilerin anlatılan konuları öğrenmek için laboratuar ortamında bireysel olarak ya da gruplar halinde deneyler, gözlemler ve araştırmalar yapmasıdır. Öğrenciler bu yöntem sayesinde yaparak yaşayarak öğrenirler. (Hesapçıoğlu, 1994). Sorunların ortaya çıkış nedenleri bulmak için deney yönteminin uygulanması gereklidir. Bir varsayımı ispatlamak, bilimsel bir gerçeği gözlemleyip göstermek laboratuar yönteminin amaçlarındandır (Doğanay,1993; Gök & Girgin, 2001).

Proje yöntemi; bir konu ile ilgili derinlemesine araştırma yapmak için kullanılan yöntemdir. Proje yönteminde öğrenciler yaparak yaşayarak öğrenirler ve bu yöntemin sonucunda bir ürün ortaya çıkar (Kaptan ve Korkmaz, 2002). Proje Yönteminde öğrenci pasif bir konumda olmak yerine, araştıran, inceleyen, bilgileri kullanabilen bir konumda olmalıdır (Uzun, 2007). Bu yöntem de öğrenciler aktiftir ve öğrencilerin yaratıcı düşünme becerileri gelişir (Aktepe ve Aktepe, 2009).

Buna göre, Fen eğitiminde öğretmenler, bilgiyi direkt aktarmak yerine öğrencilere, araştırma yapmayı, düşünerek sonuçlara ulaşmayı, sonuçları yorumlamayı ve problemleri çözebilmeyi öğretmelidirler. Aynı zamanda öğretmenler, öğrencilere model olan, iletişimi güçlü, bireysel farklılıklara özen gösteren, alanında yeterli, kendine güvenen, yeniliklere açık insanlardır (Aktepe ve Aktepe, 2009).

Bu çalışma da, Fen Bilimleri öğretmenlerinin derste kullandıkları yöntemlerin sıklıklarına ilişkin öğrenci görüşlerini ortaya koymaktadır. Ayrıca kullanılan öğretim yöntemlerinin hangi sıklıkla kullanılmasının daha iyi olacağına dair öğrencilerin düşünceleri de alınmıştır. Çünkü öğretim yapılırken öğrencilerin bireysel farklılıkları dikkate alınmalıdır ki öğrenmenin başlatılması ve yönlendirilmesi anlamlı hale gelebilsin. Öğretmen öğrenciyi ne kadar iyi tanırsa yönlendirmesi ve güdülemesi de o kadar kolay olur.

Araştırmanın Amacı ve Araştırma Soruları

Bu araştırmanın amacı; 5. sınıflarda Fen Bilimleri öğretmenlerinin kullandığı yöntemlerini ve bu yöntemlerin öğrenci görüşlerine göre hangi sıklıkla uygulandığını tespit etmektir. Bu amaca göre; aşağıdaki iki soruya cevap aranmıştır:

1. Fen Bilimleri öğretmenlerinin kullandığı öğretim yöntemleri nelerdir? Söz konusu öğretim yöntemlerinin sıklığı nedir?
2. Öğrencilerin Fen Bilimleri dersinde kullanılmasını istedikleri öğretim yöntemlerinin sıklığı nedir?

YÖNTEM

Çalışma Grubu

Çalışma grubunu, Gaziantep ilindeki bir ortaokulda 2014-2015 eğitim-öğretim yılı 5. sınıfa devam eden 75 öğrenci oluşturmuştur. Seçilen öğrencilerin cinsiyete göre dağılımları Tablo 1'de verilmiştir.

Tablo 1. Araştırma Grubundaki Öğrencilerin Cinsiyete Göre Dağılımları

Cinsiyet	(f)	(%)
Kız	44	59
Erkek	31	41
TOPLAM	75	100

Çalışmadaki öğrencilerin 44'ü kız, 31'i erkek olmak üzere toplam 75 öğrenciye anket uygulanmıştır. Bunun yüzdelik dağılımına bakıldığında % 59'sini kızlar, % 41'ini erkekler oluşturmaktadır.

Veri Toplama Aracı ve Süreci

Bu araştırma da Genel Tarama Modeli kullanılmıştır. Genel Tarama Modeli, Karasar'a göre, çok sayıda elemandan oluşur. Grup hakkında genel bir yargıya varmak için çalışma grubunun tümü ile ya da ondan alınacak bir grup üzerinde yapılan tarama düzenlemeleridir (Karasar, 1994). Bu çalışmada, Doğru'nun (2000) benzer bir araştırmada kullandığı anketten yararlanılmıştır. Anket iki bölümden oluşmaktadır. İki bölümde de on soru bulunmaktadır. Ankette "üçlü likert tipi" ölçek kullanılmıştır. Öğrenciler anketteki sorulara "hiç", "ara sıra" ve "her fırsatta" kategorilerinden işaretleyerek cevap vermişlerdir. Oluşturulan ölçekte; nitelik grupları, bunların sınırları ve verilen puanları aşağıda gösterilmiştir.

Tablo 2. Nitelik Gruplarının Sınırları Ve Verilen Puan Ölçeği

Verilen Puan	Nitelik Grupları	Sınırı
3	Çok Yeterli	2.34-3.00
2	Yeterli	1.67-2.33
1	Kısmen Yeterli	1.00-1.66

Verilerin Analizi

Bu araştırma da Fen Bilimleri öğretmenlerinin kullandıkları öğretim yöntemleri, öğrenci görüşlerine göre betimsel olarak analiz edilmiştir. Fen Bilimleri öğretmenlerinin kullandığı öğretim yöntemlerini ve yöntemlerin uygulanmasına ilişkin öğrenci görüşlerinin frekans (f) ve yüzdeleri (%) kullanılmıştır. Öğrenci görüşlerinin düzeyini belirlemek amacı ile aritmetik ortalama değerleri de kullanılmıştır.

BULGULAR VE YORUM

Bu kısımda, Fen Bilimleri öğretmenlerinin kullandığı öğretim yöntemlerinin ve bu yöntemlerin uygulanmasına ilişkin öğrenci görüşleri Tablo 3'de verilmiştir.

Tablo 3. Fen Bilimleri Öğretmenlerinin Kullandığı Öğretim Yöntemlerinin Ve Yöntemlerin Uygulanmasına İlişkin Öğrenci Görüşleri

Anket Maddeleri	Hiç		Ara Sıra		Her Fırsatta		
A.Fen Bilimleri dersini işlerken, öğretim yöntemlerinden hangileri sıklıkla kullanılmaktadır	f	%	f	%	f	%	$\bar{X}$
1. Öğretmenin ders anlatması	0	0	1	1	74	99	2,99
2. Laboratuarda deney yapma	7	9	55	74	13	17	2,08
3. Soru cevap şeklinde konunun işlenmesi	4	5	37	49	34	46	2,40
4. Öğretmenin sınıf ortamında deney yapması ve göstermesi	2	3	36	48	37	49	2,47
5. Sınıfça ders konusu hakkındaki düşünceleri tartışma	7	9	28	37	40	54	2,44
6. Problem çözme	8	11	39	52	28	37	2,27
7. Sınıf veya okul dışı gezi düzenleme	62	83	10	13	3	4	1,21
8. Doğa olayları hakkında gözlem yapma	12	16	36	48	27	36	2,20
9. Proje yapma	2	3	50	67	23	30	2,28
10. Canlandırma (rol yapma) yaparak ders işleme	13	17	32	43	30	40	2,23

Öğrencilerin Fen Bilimleri öğretiminde en yüksek seviyede görüş bildirdiği ifade, “Öğretmenin ders anlatması” ifadesi olmuştur. Bu ifadenin aritmetik ortalaması tabloda gösterildiği gibi 2,99 bulunmuştur. Öğrencilerin % 99’u “her fırsatta”, % 1’i “ara sıra” seçeneğini işaretlemişlerdir. Aritmetik ortalama değeri 2,47 olan “Öğretmenin deney yapması ve göstermesi” ifadesi en yüksek düzeyde ikinci görüş bildiren ifade olmuştur. Öğrencilerin Fen Bilimleri öğretiminde en düşük seviyede görüş bildirdiği ifade 1,21 aritmetik ortalamayla “Sınıf veya okul dışı gezi düzenleme” ifadesi olmuştur. Aritmetik ortalama değeri 2,08 olan “Laboratuarda deney yapma” ifadesi en az düzeyde ikinci görüş bildiren ifade olmuştur. Sonuç olarak; öğrencilere göre Fen Bilimleri öğretiminde en sık kullanılan öğretim yöntemlerinden en az kullanılana doğru sıralama şu şekildedir:

1. Öğretmenin dersi anlatması. (Aritmetik Ortalama = 2,99) “her fırsatta”
2. Öğretmenin sınıf ortamında deney yapması ve göstermesi. (Aritmetik Ortalama =2,47) “her fırsatta”
3. Sınıfça ders konusu hakkındaki düşünceleri tartışma. (Aritmetik Ortalama = 2,44) “her fırsatta”
4. Soru cevap şeklinde konunun işlenmesi. (Aritmetik Ortalama = 2,40) “ara sıra”
5. Proje yapma. (Aritmetik Ortalama = 2,28) “ara sıra”
6. Problem çözme. (Aritmetik Ortalama = 2,27) “ara sıra”
7. Canlandırma (rol yapma) yaparak ders işleme. (Aritmetik Ortalama = 2,23) “ara sıra”
8. Doğa olayları hakkında gözlem yapma. (Aritmetik Ortalama = 2,20) “ara sıra”
9. Laboratuarda deney yapma. (Aritmetik Ortalama = 2,08) “ara sıra”
10. Sınıf veya okul dışı gezi düzenleme. (Aritmetik Ortalama = 1,21) “hiç”

Öğrencilerin Fen Bilimleri öğretmenlerinin kullandıkları yöntemlerin hangi sıklıkla kullanmasının daha iyi olacağına yönelik görüşleri ise Tablo 4’de verilmiştir.

Tablo 4. Fen Bilimleri Öğretmenlerinin Kullandığı Öğretim Yöntemlerinin Öğrencilere Göre Hangi Sıklıkla Kullanılmasının İyi Olacağına Yönelik Öğrenci Görüşleri

Anket Maddeleri	Hiç		Ara Sıra		Her Fırsatta		
B.Fen ve Teknoloji dersini işlerken öğretim yöntemlerinden size göre, bu yöntemlerden hangilerinin daha sıklıkla kullanılması iyi olur.	f	%	f	%	f	%	$\bar{X}$
1. Öğretmenin ders anlatması	3	4	10	14	62	82	2,79
2. Laboratuarda deney yapma	0	0	13	18	62	82	2,83
3. Soru cevap şeklinde konunun işlenmesi	5	7	33	44	37	49	2,43
4. Öğretmenin sınıf ortamında deney yapması ve göstermesi	2	3	21	28	52	69	2,67
5. Sınıfça ders konusu hakkındaki düşünceleri tartışma	5	7	32	43	38	50	2,44

6. Problem çözme	16	21	30	40	29	39	2,17
7. Sınıf veya okul dışı gezi düzenleme	11	15	13	17	51	68	2,53
8. Doğa olayları hakkında gözlem yapma	3	4	26	35	46	61	2,57
9. Proje yapma	4	5	31	41	40	54	2,48
10. Canlandırma (rol yapma) yaparak ders işleme	8	11	22	29	45	60	2,49

Öğrencilerin 2,83 aritmetik ortalamayla en fazla görüş bildirdiği ifade "Laboratuarda deney yapması" ifadesi olmuştur. Öğrencilerin % 82'si "her fırsatta", % 18'i "ara sıra" seçeneğini işaretlemişlerdir. Öğrencilerin 2,79 aritmetik ortalamayla en yüksek seviyede ikinci görüş bildirdiği ifade "Öğretmenin ders anlatması" ifadesi olmuştur. Öğrencilerin en düşük seviyede görüş bildirdiği ifade ise 2,17 aritmetik ortalama ile "Problem çözme" olmuştur. Öğrencilerin % 39'u "her fırsatta", % 40'ı "ara sıra", % 21'i "hiç" seçeneğini işaretlemişlerdir. 2,43 aritmetik ortalama ile en az seviyede ikinci görüş bildirilen ifade ise "Soru cevap şeklinde konunun işlenmesi" olmuştur. Sonuç olarak; Çalışma grubundaki öğrencilerin Fen Bilimleri öğretiminde en sık kullanılmasını istediği öğretim yönteminden en az kullanılmasını istediği öğretim yöntemine doğru sıralaması şöyledir:

1. Laboratuarda deney yapması (Aritmetik Ortalama = 2,83) "her fırsatta"
2. Öğretmenin ders anlatması. (Aritmetik Ortalama = 2,79) "her fırsatta"
3. Öğretmenin sınıf ortamında deney yapması ve göstermesi. (Aritmetik Ortalama = 2,67) "her fırsatta"
4. Doğa olayları hakkında gözlem yapma. (Aritmetik Ortalama = 2,57) "her fırsatta"
5. Sınıf veya okul dışı gezi düzenleme. (Aritmetik Ortalama = 2,53) "her fırsatta"
6. Canlandırma (rol yapma) yaparak ders işleme. (Aritmetik Ortalama = 2,49) "her fırsatta"
7. Proje yapma. (Aritmetik Ortalama = 2,48) "her fırsatta"
8. Sınıfça ders konusu hakkındaki düşünceleri tartışma. (Aritmetik Ortalama = 2,44) "her fırsatta"
9. Soru cevap şeklinde konunun işlenmesi. (Aritmetik Ortalama =2,43) "her fırsatta"
10. Problem çözme. (Aritmetik Ortalama = 2,17) "ara sıra"

TARTIŞMA

Yapılan bu çalışmada anlatım yönteminin en sık kullanılan yöntem olduğu tespit edilmiştir. Anlatım yöntemini uygulamak diğer derslerde olduğu gibi Fen Bilimleri öğretiminde de kolay ve ekonomiktir. Anket sonuçlarına göre öğrenciler anlatım yönteminin her fırsatta kullanılmasını istemektedir. Bu sonuç anlatım yönteminin önemini ortaya koymaktadır. Öğrenciler bu yolla öğrenmeye alıştıkları için her şeyi öğretmenden dinlemeyi tercih etmektedirler. Öğretmenin deney yaparak göstermesi Fen Bilimleri öğretiminde en sık kullanılan ikinci yöntem, sınıfça tartışma ise Fen Bilimleri öğretiminde en sık kullanılan üçüncü yöntemdir. Öğrencilerin deney yapması onları derse karşı isteklendirir ve dersin eğlenceli geçmesini sağlar. Öğrenci deney yaparak konuyu somutlaştırdığı için ulaştıkları bilginin kalıcılığı da artar. Sınıf ortamında tartışma yönteminin kullanılması ise ortamın demokratik olmasını sağlar, öğrencideki empati yeteneğini geliştirir (Aktepe ve Aktepe, 2009). Öğrencilerin "laboratuarda deney yapma" yöntemini ilk sırada en sık kullanılmasını istemelerinin sebebi Fen Bilimleri dersini deney yaparak işleme bu dersi eğlenceli hale getirme isteklerindendir. Fakat öğrencilerin bu yöntemi ilk sıralarda kullanılmasını istemelerine rağmen laboratuarda deney yapma yöntemi derste sık kullanılmamaktadır. Bu da derste öğrencinin yeterince aktif olmadığını gösterir durumdadır.

Soru cevap yöntemi Fen Bilimleri öğretiminde "ara sıra" kullanılmaktadır. Soru cevap yöntemi öğrenciyi cesaretlendirir, güdüler, derse odaklar ve dikkatini toplamasına yardımcı olur. Böylece konu daha iyi pekişir (Aktepe ve Aktepe, 2009). Fakat anket sonuçlarına göre öğrencilerin soru cevap şeklinde konu işlenmesini son sıralarda istemektedirler. Bunun sebebi yanlış soru sormaktan çekinmeleri ve korkmaları olabilir.

Problem çözme yöntemi Fen Bilimleri öğretiminde anket sonuçlarına göre, "ara sıra" kullanılmaktadır. Öğrenciler bu yöntemin azda olsa ara sıra kullanılmasını istemektedirler. Çünkü bu yöntemde öğrenciler aktiftirler. Fakat öğrenciler problem çözme yönteminin ne anlama geldiğini veya nasıl uygulandığını bilmiyor olabilirler çünkü anket sonuçlarına göre ders öğretmeni bu yöntemi son sıralarda ara sıra kullanmaktadır. Eğer dersinde sık sık kullanmış olsaydı öğrencilerin istekleri de bu doğrultuda değişebilirdi.

Proje yöntemi Fen Bilimleri öğretiminde anket sonuçlarına göre, "ara sıra" kullanılmaktadır. Bu yöntemin uygulanması öğrencide öğrenme becerilerini geliştirip zenginleştireceği için pozitif katkı sağlar (Çepni, 2007). Öğrenciler ise bu yöntemi son sıralarda her fırsatta kullanılmasını istemektedirler.

Gezi gözlem yöntemleri, öğrencilerin çevrelerini öğrenmesi ve okul çevre ilişkilerinin geliştirilmesi açısından faydalıdır. Fen Bilimleri öğretiminde anket sonuçlarına göre, sınıf dışı gezi gözlem yöntemleri "hiç" kullanılmaktadır. Öğrenciler bu yöntemlerin ilk sırada kullanılmasını istemektedirler. Bu sonuçlar Öğrencilerin çevrelerini gezerek görerek öğrenmek istediklerini ancak yasal sorumluluğunun fazla olması ve disiplin sorunlarına yol açmasından dolayı kullanılmayan bir yöntem olduğunu göstermektedir. Canlandırma yöntemi yapılan çalışmaya göre Fen Bilimleri öğretiminde "ara sıra" kullanılmaktadır. Canlandırma yöntemi özel yetenek gerektiren bir yöntemdir. Öğrencilerin yaratıcılık ve empati yeteneğini geliştirir, onları cesaretlendirir ve dersi eğlenceli hale getirir (Aktepe ve Aktepe, 2009). Öğrenciler de anket sonuçlarına göre, canlandırma yöntemini orta sıralarda kullanılmasını istemektedirler.

SONUÇ VE ÖNERİLER

Bu araştırmanın ilk bölümünde, öğrenci görüşlerine göre Fen Bilimleri öğretmenlerinin öğretim yöntemlerini hangi sıklıkla kullandığı, ikinci bölümünde ise öğrencilere göre hangi yöntemlerin uygulanmasının daha iyi olacağı incelenmiştir. İnceleme sonrası bulgulardan yola çıkılarak ulaşılan sonuçlar şunlardır:

Öğrencilere göre Fen Bilimleri dersinde en çok kullanılan yöntemlerin, anlatım yöntemi, tartışma, soru-cevap yöntemi, öğretmenin sınıfta deney yaparak göstermesi, proje yapma gibi yöntemlerdir. En az kullanılan yöntemleri ise; Problem çözme yöntemi, Canlandırma yaparak ders işleme, Laboratuarda deney yapma, gezi düzenleme, gözlem yapma yöntemleri olduğu görülmektedir.

Fen Bilimleri öğretim yöntemlerinden hangisinin uygulanmasının daha iyi olacağına yönelik sonuçlar ise:
Öğretmenin dersi anlatması, deney yaparak ders işleme, gözlem yapma, gezi düzenleme gibi yöntemler öğrencilerin Fen Bilimleri dersinde daha sık kullanılmasını istedikleri yöntemlerdir. Öğrencilerin Fen Bilimleri öğretiminde daha az kullanılmasını istedikleri yöntemler ise, problem çözme, soru-cevap şeklinde konunun işlenmesi, proje yöntemi, tartışma yöntemi ve canlandırma gibi yöntemlerdir. Araştırma sonuçlarına göre, fen öğretiminde öğretmenlere şu önerilerde bulunulabilir:

Fen bilimleri dersi aktif öğrenme ilkesine göre işlenmelidir. Öğrenciler için geziler planlanmalı doğa olayları ile ilgili beraber gözlem yapılmalıdır. Fen dersleri mümkün olduğu kadar laboratuar ortamında yapılmalı öğrencilerin yaparak yaşayarak öğrenmesine imkan tanınmalıdır. Çünkü laboratuar dersleri ve laboratuarda deney yapılması öğrencilerin ilgisini çeker, dersi eğlenceli hale getirir ve dolayısıyla öğrencilerin öğrenmeye isteklerini arttırır. Böylelikle konu öğrenciler için daha kalıcı hale gelmiş olur. Aynı zamanda Projeleri öğrenciler günlük hayatla ilişkilendirdikleri ve topluma yararlı projelerin üretilmesini sağladıkları için öğretmenlerin bu yöntemi kullanmaları da faydalı olacaktır.

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INVESTIGATION OF THE INFLUENCE OF THE PRE-SCHOOL EDUCATION ON THE SUCCES LEVELS OF UNDERGRADUATE STUDENTS IN ENGINEERING FACULTY

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ABSTRACT: The facilities in Pre-school education (PSE) program covers science, math, arts, game, music, preparation for read-write etc. In this study, the influence of pre-school education on the students of engineering faculty where there is science based education was investigated. For this purpose, a comprehensive questionnaire was applied to 203 senior students studying in Engineering Faculty of Gaziantep University. The purpose of the questionnaire is to determine the level of different aspects of success between the students who received and not received PSE. The data obtained from questionnaire were statistically analyzed to find out the difference in the level of success. Based on the findings, it was observed that the students receiving PSE had been more successful in winning the university entrance exam and generally were more successful during studying in engineering faculty than the others. Knowing that although the level of preschool education is very low in Turkey (about 10%), there is an impressive finding that 41% of the students investigated in this study had received PSE.

Key words: Preschool education, higher education, science/math studies

OKULÖNCESİ EĞİTİMİNİN MÜHENDİSLİK FAKÜLTESİ ÖĞRENCİLERİNİN BAŞARI DÜZEYLERİ ÜZERİNDEKİ ETKİSİNİN ARAŞTIRILMASI

ÖZET: Okul öncesi eğitim programı fen, matematik, sanat, oyun, müzik, okuma-yazmaya hazırlık ve benzeri etkinlikleri içerir. Bu çalışmada okulöncesi eğitiminin fen tabanlı eğitim veren mühendislik fakültesindeki öğrencilerin başarıları üzerindeki yansımaları araştırılmıştır. Bu amaca yönelik olarak Gaziantep Üniversitesi Mühendislik fakültesinde öğrenim görmekte olan son sınıf öğrencilerine (203 kişi) anket uygulanmıştır. Anketin amacı okul öncesi eğitimi alan ve almayan öğrencilerin başarı düzeylerinin tespit edilmesidir. Bu çalışma kapsamında yapılan istatistiksel analiz ile okulöncesi eğitimi almış ve almamış öğrencilerin başarı düzeyleri arasında anlamlı farklılıklar olup olmadığı irdelenmiştir. Elde edilen bulgulara göre, okulöncesi eğitimi almış öğrencilerin üniversiteye girişte ve sonrasında lisans eğitimleri sürecinde okulöncesi eğitimi almamış olanlara göre nispeten daha başarılı oldukları görülmüştür. Ayrıca, Türkiye'de okulöncesi okullaşma oranının oldukça düşük seviyelerde olduğu düşünülürse, araştırmaya katılan öğrencilerin %41'nin okulöncesi eğitimi almış olmasının bu çalışmanın diğer önemli bir bulgusu olduğu söylenebilir.

Anahtar sözcükler: Okulöncesi eğitim, yükseköğrenim, fen/matematik uygulamaları

GİRİŞ

Okulöncesi eğitimi verilirken çocuklar çevrelerindeki dünyayı araştırırlar. Onlar dokunarak, bakarak, işiterek, tadarak evren hakkında bilgi kazanmaya çalışırlar. Okulöncesi eğitim programlarında yer alan fen ve matematik çalışmaları, çocukların doğal araştırma ve inceleme meraklarından yararlanılarak, onların çevrelerini ve doğayı tanımalarına, düşüncelerini açığa çıkarmalarına, sorular sormalarına vardım eden etkinliklerden oluşmaktadır (Ünal ve Akman, 2006). Olayları gözlemleyip, çeşitli aletlerin nasıl çalıştığını araştırarak, eğitici oyuncaklarla oynayarak, deneyler yaparak kısaca fen bilim süreçlerini kullanarak öğrenirler. Okulöncesi eğitiminin çocukların akademik başarılarını etkilediği bilinen bir gerçektir. Avrupa'da okulöncesi eğitimi çok yüksek bir orana sahipken Türkiye'de bu oran oldukça düşük düzeydedir (Yıldırım 2008). Türkiye'de okulöncesi eğitimde okullaşma oranı, 2000–2001 öğretim yılı verilerine göre yüzde 10,1'dir (MEB, 2002). Eğitim Sen tarafından 2011-2012 eğitim-öğretim yılına ait yapılan araştırmalar, ülkemizde okulöncesi okullaşma seviyesinin çok düşük oranlarda olduğunu göstermiştir. Araştırmada, 3 ile 5 yaş grubunda okullaşma oranının toplamda yüzde 29.85'dir. 3 ile 5 yaş arasındaki kız çocukları için yüzde 29.43; erkek çocukları için ise yüzde 30.3 seviyesinde olduğu, 4 ile 5 yaş grubuna bakıldığında ise toplamda yüzde 43.1, kız çocukları için yüzde 42.47; erkek çocukları için ise yüzde 43.7 seviyesinde olduğu görülmüştür. Tüm yaşlar bazında ise bu oran % 37 olarak açıklanmıştır (http://www.doktorsitesi.com). Bu oranın oldukça düşük olduğu söylenebilir. Belçika'da okulöncesi okullaşma oranı üç yaş için %92, dört yaş için 97'dir. Beş yaş ve üstü için ise % 100'dür (Gülcan, 2005). Amerika'daki Minnesota Üniversitesinde yapılan bir araştırma anaokuluna giden çocukların hayatta daha başarılı olduğunu ortaya koymaktadır. Bu araştırma basında da aşağıdaki gibi yer almıştır:

"Saygın bilim dergisi Science, ABD'de yer alan Minnesota Üniversitesinin okul öncesi eğitim alan çocukların hayattaki başarı grafiğini irdeleyen araştırma raporunu internet sitesinde yayınladı. 1980'lerde anaokuluna gönderilen 900 ve gönderilmeyen 500 çocuğun yetişkinlik dönemleri karşılaştırıldı. Araştırmanın ilginç sonuçları şöyle:
- Anaokuluna gidenlerin yüzde 80'i liseyi bitiriyor. Gitmeyenler de bu oran yüzde 75.
- Anaokuluna gidenlerin üniversiteye girme olasılıkları yüzde 4 daha fazla.
- Bağımlılık yapan madde kullanımı oranları da anaokuluna gidenler arasında yüzde 5 daha az." (Milliyet Gazetesi, 12.06.2011)

Yukarıdaki bilgilere dayanarak, ülkemizdeki üniversitelerin dünya sıralamalarında oldukça geride kalmalarının (http://www.timeshighereducation.co.uk) nedenlerinden birinin de yetersiz okul öncesi eğitim olduğu düşünülebilir. Fen ve matematik çalışmaları da çocukları yaşama hazırlamada etkili araçlar arasında yer almaktadır(Aktaş 2002; Ayvacı ve diğ. 2002; Wilson 2002). Günlük yaşamda birçok şekilde karşılaşılan fen ve matematik konularını okul öncesi dönemde ele alıp çocukları geleceğe daha donanımlı biçimde hazırlamak okul öncesi eğitimin önemli fonksiyonlarından biridir. Ayrıca, bu bilgilerin günlük yaşantıda ne şekillerde kullanılabileceğini öğretmenin yanı sıra fen ve matematiği çocuklara sevdirmek onların ileri dönemlerde alacakları eğitimi de destekleyebilecek etkili bir davranıştır(Öncü ve Arı 2005).

Çocuğun gelişimlerinin en hızlı olduğu,psikomotor gelişimi, Türkçe dil gelişimi, bilişsel gelişimi özbakım gelişimlerinin en kritik olduğu dönem 0-6 yaş dönemidir. Okulöncesi eğitim bu dönemleri kapsadığı için önemlidir. Çocukların bu kadar değerli ve önemli yıllarının eğitim ve öğretimle desteklenmesi gelişimlerini olumlu yönde etkileyecektir. Okul öncesi eğitim alan öğrencilerin bazı önemli kazanımları aşağıdakiler gibidir (Adıbelli, 2011):

•Kendini daha kolay ifade edebilir.
•Okul ortamına uyumlu olur.
•El becerileri gelişmiş olur.
•Akranları ile iyi iletişim kurabilir.
•Özgür ve kendine güveni olur.
•Aile bağımlılığı azalır.
•Yönergeleri rahat algılayıp, uygulayabilir.
•İşbirliği yapmaya daha eğilimli olur.
•Sözcük dağarcığı daha zengin olur.
•Paylaşıma daha açık olur.
•Hayal güçleri gelişmiş olur.
•Öz bakım becerileri konusunda daha bilinçli olur.
•Sosyal yönleri daha gelişmiş olur.

Yukarıda da bahsedildiği gibi ülkemizde çocukların büyük bir çoğunluğu okulöncesi eğitiminden yoksundur. Bu durum çocukların gelişimlerinin kritik bir dönemini uygun bir eğitim almadan, onların geliştirilmeye müsait potansiyellerinin bastırılmasına sebep olabilecek bir olgudur. Okul öncesi eğitim almamış öğrenciler bazı özellikleri şöyle sıralanabilir:

•Kendini ifade etmekte zorlanma
•Okula gitme konusunda olumsuz tavır sergileme
•Yetenekleri konusunda farkındalık sağlayamama,
•Sosyalleşme problemi
•Özgüven problemi
•Ailelerine aşırı bağımlılık ve çekingenlik
•Yeni bilgileri kabullenmede zorluk çekme
•Öz bakım becerileri konusunda sorun yaşama

Bu çalışmada okul öncesi eğitimin önemli bir bileşeni olan fen/ matematik uygulamalarının yükseköğrenimdeki yansımalarının tespit edilmesi hedeflenmiştir. Bu bağlamda Gaziantep Üniversitesi Mühendislik Fakültesi son sınıf öğrencelerine anket uygulanarak okul öncesi eğitim almış olanların oranı belirlenecektir. Ayrıca anket çalışması kapsamında bu öğrencilerin yükseköğrenim süresince performanslarını değerlendiren sorular da mevcut olacaktır. Böylece okul öncesi eğitimin, fen-matematik tabanlı eğitim alan mühendislik fakültesi öğrencilerinin başarı düzeyleri üzerinde anlamlı bir etkiye sahip olup olmadığı istatistiksel olarak irdelenmiş olacaktır.

ARAŞTIRMANIN AMACI

Mühendislik fakültesi son sınıf öğrencileri arasında okulöncesi eğitimi (OÖE) almış ve almamış öğrencilerin başarı düzeylerinin araştırılması amaçlanmıştır. Ayrıca OÖE almış ve almamış öğrencilerin gelir seviyelerinin, cinsiyetlerinin, bölümlerinden memnun olup olmama durumları vb. faktörlerin de başarı düzeyi üzerindeki etkileri irdelenmiştir.

Problem Cümlesi

Araştırmanın problem cümlesi; "Okulöncesi eğitimi almış ve almamış mühendislik fakültesi son sınıf öğrencilerinin başarı düzeylerinde anlamlı bir farklılık var mıdır?"

ALT PROBLEMLER

1. OÖE almış ve almamış mühendislik fakültesi son sınıf öğrencilerinin üniversiteye giriş başarı düzeyleri arasında anlamlı bir fark var mıdır?
2. OÖE alma ile öğrencilerin lisans eğitimi başarı düzeyleri arasında anlamlı faklılık var mıdır?
3. OÖE almış öğrencilerin lisans eğitimi başarı düzeyleri ile gittikleri okul öncesi kurumunun türü arasında anlamlı faklılık var mıdır?
4. OÖE almış ve almamış öğrencilerin ailelerinin gelir durumları lisans eğitimi ile başarı düzeyleri arasında anlamlı faklılık var mıdır?
5. OÖE almış ve almamış öğrencilerin başarı düzeyleri ile cinsiyetleri arasında anlamlı faklılık var mıdır?
6. OÖE almış ve almamış öğrencilerin başarı düzeyleri ile bölümlerinden memnuniyetleri arasında anlamlı faklılık var mıdır?

YÖNTEM

Araştırma Modeli

Bu araştırmada ilişkisel araştırma modeli kullanılmıştır. "İlişkisel tarama modelleri, iki veya daha çok sayıdaki değişken arasında birlikte değişim varlığını ve/veya derecesini belirlemeyi amaçlayan araştırma modelleridir." Karasar (1991, s. 81). Bu araştırma da, Okulöncesi eğitimi almış ve almamış öğrenciler arasında mühendislik fakültesindeki son sınıf öğrencilerinin başarı düzeyleri ve okulöncesi eğitimi almış öğrencilerin fen- matematik alanlarına ilgisi ve bu öğrencilerin üniversiteye girişteki zaman ve başarı dilimleri vurgulanmıştır. Okulöncesi eğitimi almamış öğrencilerle bu bilgiler karşılaştırılarak başarı düzeylerinin ne oranda olduğu amaçladığından, "ilişkisel araştırma modeli "ne uygun olarak düzenlenmiştir.

Çalışma Grubu

Gaziantep üniversitesi mühendislik fakültesi son sınıf öğrencilerinden 203 öğrenci seçilmiştir. Mühendislik fakültesinde farklı bölümlerden 35 kız ve 168 erkek öğrenci ile çalışılmıştır.

Veri Toplama Araçları

Araştırma veri toplama araçlarından yapılandırılmış anket tekniği kullanılarak yapılmıştır. Anket, belirli bir amaca yönelik bilgi toplamak üzere, ilgili ve belli kişilere yöneltilecek soru listesini kapsayan veri toplama aracıdır (Taymaz, 1997). Yapılandırılmış anket ise soruların verilip cevapların şıklar halinde verilmesiyle oluşturulan veri toplama aracıdır. Bu çalışmada kullanılan anket soruları Ek 1'de yer almaktadır.

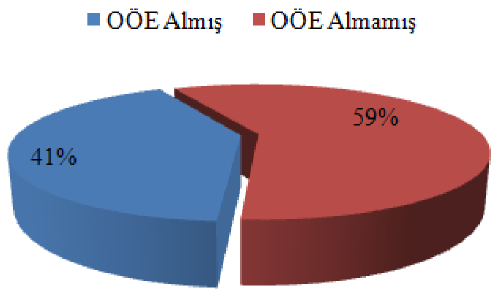
Verilerin Analizi

Okulöncesi eğitimi almış ve almamış mühendislik fakültesi son sınıf öğrencilerinin başarı düzeylerinde anlamlı bir farklılığın ne oranda olduğunu ilişkisel araştırma modeli kullanılarak yapılmıştır. Verilerin değerlendirilmesinde MİNİTAB versiyon 15 istatistiksel yazılım kullanılarak ONE WAY-ANOVA (tek yönlü varyans analizi) yapılmıştır.

Araştırmada okulöncesi eğitimi (OÖE) olarak kodlanmıştır.

BULGULAR VE YORUM

Anket çalışması Gaziantep Üniversitesi Mühendislik Fakültesi son sınıfta okuyan 203 öğrenciye uygulanmıştır. Bu öğrencilerin OÖE alma oranları aşağıdaki grafikte gösterilmiştir (Şekil 1). Buna göre, değerlendirilen öğrencilerin %41'i okul öncesi eğitimi almışken almamış alanların oranı %59 düzeyindedir. Söz konusu öğrencilerin okulöncesi eğitimlerini yaklaşık olarak 90'lı yılların başlarında aldıkları ve o yıllarda OÖE okullaşma oranının oldukça düşük seviyelerde olduğu düşünülürse OÖE'nin üniversiteye girişte önemli bir rol aldığı kanaatine varılabilir.



Şekil 1. Mühendislik Fakültesi Son Sınıf Öğrencilerin OÖE Alma Oranları

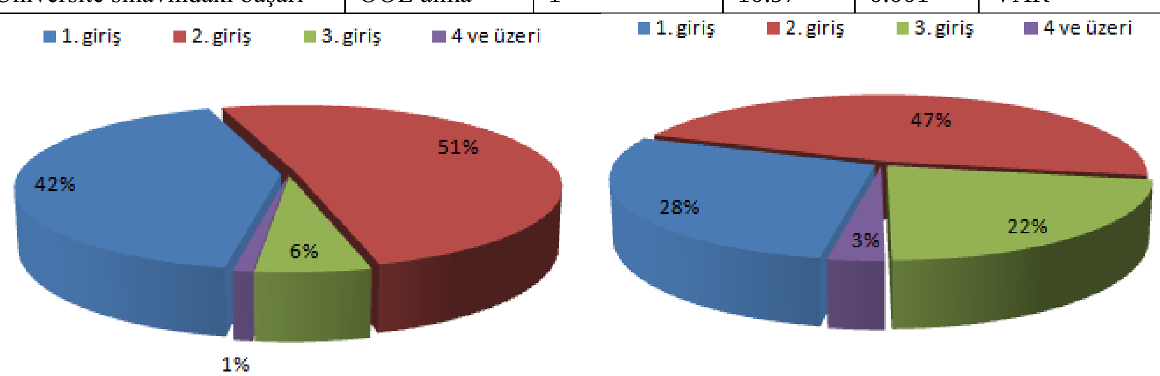
OÖE almış ve almamış öğrencilerin başarı düzeyleri ve bunları etkileyen faktörlerin istatistiksel analizi aşağıda verilmiştir.

1. OÖE almış ve almamış mühendislik fakültesi son sınıf öğrencilerinin üniversiteye giriş başarı düzeyleri arasında anlamlı bir fark var mıdır?

Tablo 1'de verilen istatistiksel analize göre %5'lik istatistiksel anlamlılık düzeyi göz önünde bulundurulduğunda OÖE almış ve almamış öğrencilerin üniversiteye giriş performansları arasında fark görülmüştür. Bu çalışmada üniversite sınavı başarı değerlendirme kriteri; sınavı "1. girişte kazanma", "2. girişte kazanma", "3. girişte kazanma" "4 ve üzeri girişte kazanma" olarak değerlendirilmiştir. Şekil 2'de gösterilen yüzdelik dilimler dikkate alındığında OÖE almış öğrencilerin 1. ve 2. girişte kazanma oranları diğerlerine göre daha yüksektir. OÖE almamış öğrencilerin 3 ve daha fazla girişte üniversite sınavını kazanma oranları %25 iken OÖE almış öğrencilerde bu oran %7'dir. Öğrencilerin erken çocukluk eğitiminin bireylerin akademik başarıları üzerinde, bu eğitimden faydalanmayanlara göre daha etili olduğu ve ayrıca akademik başarının ise hayat başarısını olumlu yönde etkilediği vurgulanmaktadır (Taiwo ve Tyolob, 2002).

Tablo 1. OÖE Almış ve Almamış Öğrencilerin Üniversite Sınavındaki Başarılarının Tek Yönlü Varyans Analizi

Bağımlı değişken	Bağımsız değişken	Serbestlik derecesi	F değeri	P değeri	İstatistiksel fark
Üniversite sınavındaki başarı	OÖE alma	1	10.97	0.001	VAR



a) b)

Şekil 2. a) OÖE almış b) OÖE almamış öğrencilerin üniversite sınavındaki başarı durumları

2. OÖE alma ile öğrencilerin lisans eğitimi başarı düzeyleri arasında anlamlı faklılık var mıdır?

OÖE almış öğrenciler ile almamış öğrencilerin başarı düzeyleri arasında istatistiksel olarak anlamlı bir farklılık vardır (Tablo 2). Bu bağlamda yapılan anket çalışmasının sonuçlarına göre OÖE almış öğrencilerin not ortalamalarının 4.0 tam not üzerinden 2.19 olduğu, almamış olanların ise 2.04 olduğu tespit edilmiştir. Bu durum OÖE almış mühendislik fakültesi son sınıf öğrencilerinin nispeten daha başarılı olduğunu işaret etmektedir. Yani OÖE almış öğrencilerin analitik düşünce yeteneklerinin genellikle daha gelişkin olduğu söylenebilir. Okulöncesi eğitim kurumlarında uygulanan fen ve doğa etkinliklerinin çocukların problem çözme becerilerine etkisinin araştırıldığı bir çalışmada aşağıdaki sonuç verilmiştir (Akkaya, 2006).

"Öğretmenler fen ve doğa etkinliklerinin çocuklarda problem çözme becerilerine etkisi ile ilgili olarak inceleme ve düzenleme becerilerini ***yeterli,*** *yaratıcılık, hayal gücü, gözlem, sayısal, uygulama, iletişim ve sosyal becerileri* ***çok yeterli*** *düzeyde kazandırdığı görüsündedirler."* (Akkaya, 2006).

Tablo 2. OÖE Alma ile Öğrencilerin Lisans Eğitimindeki Başarı Düzeyleri Arasındaki İlişkinin Tek Yönlü Varyans Analizi

Bağımlı değişken	Bağımsız değişken	Serbestlik derecesi	F değeri	P değeri	İstatistiksel fark
Lisans eğitimindeki başarı	OÖE alma	1	5.95	0.016	VAR

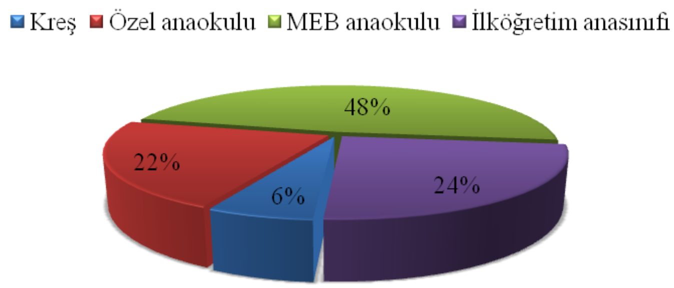
3. OÖE almış öğrencilerin lisans eğitimi başarı düzeyleri ile gittikleri okul öncesi kurumunun türü arasında anlamlı faklılık var mıdır?

Tablo 3'den görüleceği üzere OÖE kurumunun türünün bu eğitimi almış öğrencilerin başarı düzeyi üzerinde anlamlı bir farklılık teşkil etmediği anlaşılmaktadır. Şekil 3'den gözlenen bulgulara göre ise ülkemizde okulöncesi eğitim büyük oranda MEB'e bağlı anaokulları ve ilköğretim anasınıfları aracılığıyla gerçekleşmektedir.

Türkiye'de eğitim hizmeti önemli ölçüde devlet tarafından verilmekte, finanse edilmekte ve denetlenmektedir (Çokgezen ve Terzi, 2008). Bu bağlamda özel ve devlete bağlı eğitim kurumlarının kaliteleri arasında çok büyük farklılıklar olmaması olağan bir durumdur. Nitekim bu çalışmadan elde edilen bulgular dikkate alındığında özel veya devlet okullarının sundukları OÖE2nin lisans başarı düzeyine etkisi olmadığı anlaşılmıştır.

Tablo 3. OÖE Almış Öğrencilerin Bu Eğitimi Aldıkları OÖE kurumunun Türü ile Öğrencilerin Lisans Eğitimindeki Başarı Düzeyleri Arasındaki İlişkinin Tek Yönlü Varyans Analizi

Bağımlı değişken	Bağımsız değişken	Serbestlik derecesi	F değeri	P değeri	İstatistiksel fark
Lisans eğitimindeki başarı	OÖE kurumu	3	0.42	0.740	YOK



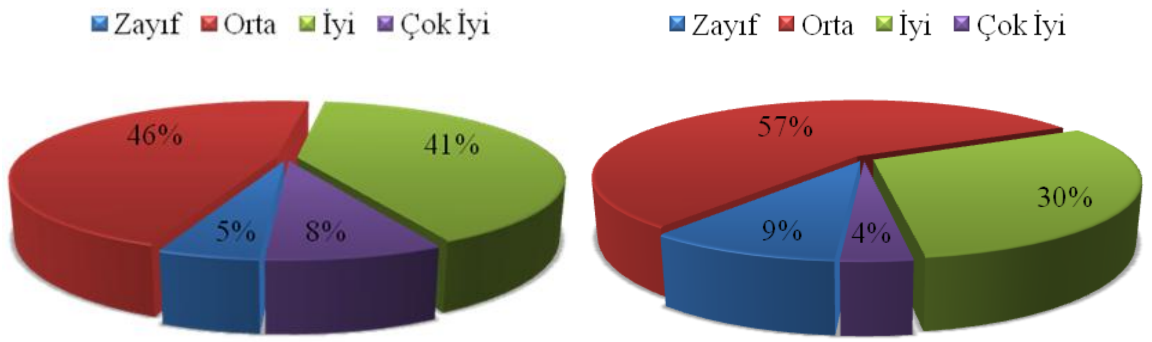
Şekil 3. OÖE Almış Öğrencilerin Bu Eğitimi Aldıkları Kurumların Yüzdelik Dağılımları

4. **OÖE almış ve almamış öğrencilerin ailelerinin gelir durumları ile lisans eğitimi başarı düzeyleri arasında anlamlı farklılık var mıdır?**

Tablo 4'den görüleceği üzere gelir durumları ile lisans başarı düzeyi arasında istatistiksel olarak anlamlı bir fark görülmemiştir. Bunun yanı sıra, OÖE almış ve almamış öğrencilerin ailelerinn gelir düzeyleri incelendiğinde göze çarpan bir fark görülmemiştir (Şekil 4). Öğrencilerin gelir durumlarına bağlı psikolojik durumları akademik başarılarını etkileyen önemli faktördür. Özdel ve ark. (2002) çalışmalarında *"üniversite öğrencilerinin gelir durumları sorgulandığında ekonomik durumla depresif belirtiler arasında bir ilişki yok gibi görülmektedir"* şeklinde bir yargıya varmışlardır.

Tablo 4. OÖE almış ve almamış öğrencilerin ailelerinin gelir durumları ile lisans eğitimindeki başarı düzeyleri arasındaki ilişkinin tek yönlü varyans analizi

Bağımlı değişken	Bağımsız değişken		Serbestlik derecesi	F değeri	P değeri	İstatistiksel fark
Lisans eğitimindeki başarı	Gelir durumu	OÖE almış	3	0.87	0.461	YOK
		OÖE almamış	3	0.22	0.882	YOK



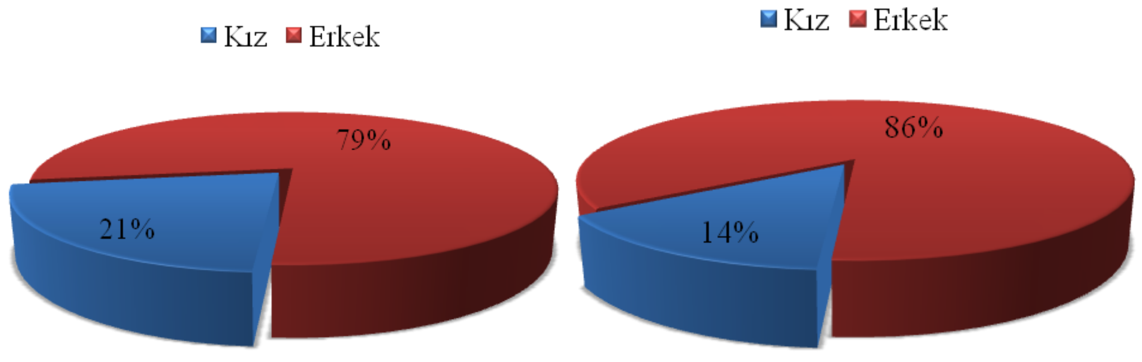
a) b)
Şekil 4. a) OÖE almış b) OÖE almamış öğrencilerin ailelerinin gelir düzeyleri

5. ***OÖE almış ve almamış öğrencilerin başarı düzeyleri ile cinsiyetleri arasında anlamlı faklılık var mıdır?***

Tablo 5'den elde edilen sonuçlara göre, cinsiyet OÖE almış öğrencilerin lisans başarı düzeylerinde etkili bir parametre iken, OÖE almamış öğrencilerde herhangi bir etkileyicilik faktörü bulunmadığı görülmüştür. Şekil 5'deki yüzdelik dağılımlar incelendiğinde OÖE almış öğrenciler arasında kız öğrenci oranının almamışlara göre nispeten daha yüksek olduğu görülmüştür. Korkut (1996) tarafından yapılan araştırmanın bulgularına göre cinsiyet, okul türü, yas, babanın isi vb. faktörlerin araştırmada incelenen lise öğrencilerinin (394 adet) problem çözme becerilerini algılamada fark yarattığı görülmüştür.

Tablo 5. OÖE Almış ve Almamış Öğrencilerin Cinsiyetleri ile Lisans Eğitimindeki Başarı Düzeyleri Arasındaki İlişkinin Tek Yönlü Varyans Analizi

Bağımlı değişken	Bağımsız değişken		Serbestlik derecesi	F değeri	P değeri	İstatistiksel fark
Lisans eğitimindeki başarı	Cinsiyet	OÖE almış	1	13.40	0.000	VAR
		OÖE almamış	1	1.81	0.182	YOK



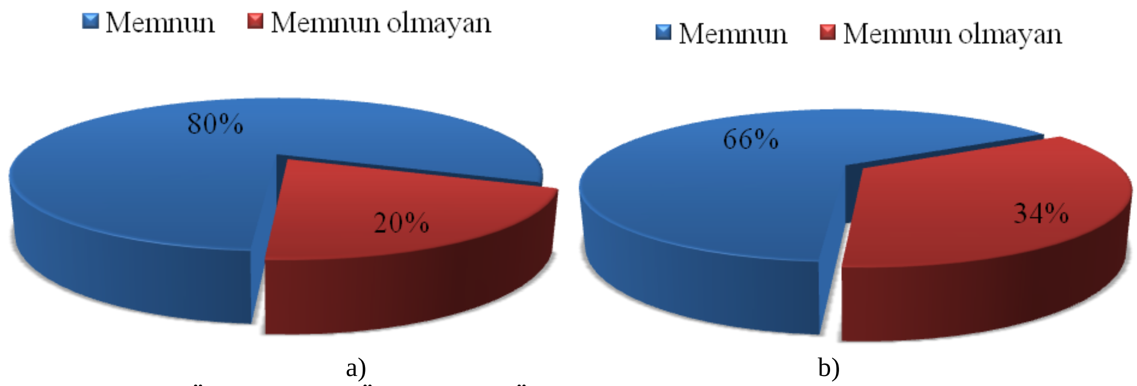
a) b)
Şekil 5. a) OÖE almış b) OÖE almamış öğrencilerin cinsiyetleri

6. ***OÖE almış ve almamış öğrencilerin bölümlerinden memnuniyetleri arasında anlamlı faklılık var mıdır?***

OÖE almış öğrencilerin memnuniyet durumlarının lisans başarı düzeyi üzerinde etkisi olmadığı gözlenmiştir. Ancak OÖE almamış olanlarda memnuiyet ile başarının istatistiksel olarak ilişkili olduğu belirlenmiştir (Tablo 6). Ayrıca Şekil 6'da sunulan bulgulara göre OÖE almamış öğrencilerin bölümlerine karşı duydukları memnuniyetsizlik OÖE almışlara kıyasla daha fazladır.

Tablo 6. OÖE almış ve almamış öğrencilerin bölümlerinden memnuniyetleri ile lisans eğitimindeki başarı düzeyleri arasındaki ilişkinin tek yönlü varyans analizi

Bağımlı değişken	Bağımsız değişken		Serbestlik derecesi	F değeri	P değeri	İstatistiksel fark
Lisans eğitimindeki başarı	Memnuniyet	OÖE almış	1	3.76	0.056	YOK
		OÖE almamış	1	12.06	0.001	VAR



Şekil 6. a) OÖE Almış b) OÖE Almamış Öğrencilerin Bölümlerinden Memnuniyet Oranları

SONUÇ

Yukarıda sunulan bulgulara dayanarak aşağıdaki sonuçlar sunulabilir.

- Türkiye'de OÖE oranı oldukça düşük düzeyde olmasına rağmen değerlendirilen öğrencilerin yarıya yakın bir kısmının bu eğitimden faydalanmış olmasından ve bu öğrencilerin üniversite sınavına girişte daha başarılı olmasından dolayı, OÖE'nin ilk ve ortaöğretimde de akademik başarı üzerinde önemli bir etkiye sahip olduğu söylenebilir.
- OÖE almış öğrencilerin not ortalamalarının 2.19 almamış olanların ise 2.04 olması ve yapılan istatistiksel analiz sonucuna dayanarak, OÖE mühendislik fakültesi son sınıf öğrencilerin lisans başarılarını oldukça olumlu yönden etkilediği söylenebilir
- Ailelerin gelir durumunun OÖE almış ve almamış öğrencilerin başarı düzeyleri üzerinde önemli bir etkiye sahip olmadığı görülmüştür.
- Cinsiyetin OÖE almış öğrencilerin başarı düzeyleri üzerinde etkili bir faktör olduğu görülürken, bu eğitimden faydalanmamış öğrencilerin başarıları arasında istatistiksel bir fark olmadığı tespit edilmiştir.
- OÖE almış öğrencilerin okudukları bölümden memnun olma düzeyleri diğerlerinkine göre daha yüksektir. Bununla birlikte, memnuniyet durumunun OÖE almış öğrencilerin başarı düzeylerine etkisi olmadığı ancak almamış olanlarınkinin bu durumdan etkilendiği anlaşılmıştır.

ÖNERİLER

Bu çalışma kapsamında mühendislik fakültesi son sınıf öğrencilerinin sadece bir kısmı üzerinde araştırma yapılmıştır. Bu çalışmanın kapsamını genişletmeye yönelik olarak yapılabilecekler şöyle sıralanabilir.

- Çalışma grubunda incelenen öğrencilerin sayısı arttırılarak daha gerçekçi sonuçlar elde edilebilir.
- Veri kaynaklarının örneklem açısından sadece mühendislik fakültesi öğrencilerini içermesi bu araştırmanın sınırlılıklarını oluşturur. Araştırma veri toplama araçlarından anket tekniği kullanılarak yapıldığı için sınırlıdır. Bu bağlamda diğer fakülte öğrencilerinin de araştırmaya dahil edilmeleri ve ilişkilendirilmeleri, OÖE'nin lisans eğitimi başarı düzeyi üzerindeki etkisi genelleştirilerek irdelenmiş olacaktır.
- Ayrıca çalışmada diğer veri toplama araçlarından da faydalanılarak bulgular daha da derinleştirilebilir.

Bu araştırmanın bulgularından aşağıda belirtilen şekillerde faydalanılabilir:

- OÖE yaygınlaştırılması yönünde çalışmalar gerçekleştiren ilgili MEB birimleri yapacakları bilgilendirme ve teşvik çalışmalarında bu araştırmada sunulan bulguları vurgulayabilirler.
- Bunun yanı sıra bu araştırmanın bulguları OÖE önemine dikkat çekmek üzere yapılan aile eğitim çalışmalarında kullanılabilir.

KAYNAKLAR

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WHAT DO 6TH GRADE STUDENTS THINK ABOUT THEIR LEARNING ENVIRONMENT IN SCIENCE CLASSES?

Esra ÇAĞINDA
Niğde Ünv., Eğitim Bilimleri Enst., İlköğretim Ana Bilim Dalı, Fen Bilgisi Eğitimi Bilim Dalı, Niğde

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ABSTRACT: The purpose of the study is to evaluate students' views on their science learning environment with regard to the properties of constructivist approach. The sample of the study consisted of 48 sixth grade students who were studying in a middle school located in a developed city at the central Anatolia region. Constructivist Learning Environment Survey (CLES) developed by Taylor, Fraser, and Fisher (1997) and adopted by Küçüközer, Kırtak, Ayverdi, and Eğdir (2012) into Turkish was used as the data collection tool. The data were analyzed descriptively. The results of the study indicated that even students' learning environment had several characteristics in common with the elements of constructivism, students' learning environment was weak in terms of students' questioning and the collaboration between students and teacher in lesson planning, instruction, and assessment. The results imply that democratic learning atmosphere was missing in the science classes.

Key words: constructivism, learning environment, science education, science learning

ALTINCI SINIF ÖĞRENCİLERİ FEN BİLİMLERİ DERSLERİNDEKİ ÖĞRENME ORTAMI HAKKINDA NE DÜŞÜNÜYOR?

ÖZET: Bu çalışmanın amacı öğrencilerin fen öğrenme ortamları hakkındaki görüşlerini yapılandırmacı yaklaşımın unsurları açısından değerlendirmektir. Araştırmanın örneklemini iç Anadolu bölgesindeki gelişmiş bir şehrin ortaokulunda öğrenim gören 48 altıncı sınıf öğrencisi oluşturmuştur. Taylor, Fraser ve Fisher (1997) tarafından geliştirilmiş ve Küçüközer, Kırtak, Ayverdi ve Eğdir (2012) tarafından Türkçe'ye uyarlanmış Yapılandırmacı Öğrenme Ortamı Ölçeği (YÖOÖ) veri toplama aracı olarak kullanılmıştır. Veriler betimsel olarak analiz edilmiştir. Araştırma sonuçları öğrencilerin öğrenme ortamlarının yapılandırmacılığın birçok unsuruyla ortak özelliklere sahip olduğunu gösterse de, öğrencilerin sorgulama yapması ve öğretmenin derste öğrencilerle işbirliği yaparak dersi planlaması, işlemesi ve değerlendirme yapması açısından öğrenme ortamının zayıf olduğunu göstermiştir. Sonuçlar demokratik öğrenme ortamının fen bilimleri derslerinde eksik olduğuna işaret etmektedir.

Anahtar sözcükler: yapılandırmacılık, öğrenme ortamı, fen eğitimi, fen öğrenme

GİRİŞ

Yapılandırmacı öğrenme teorisi sosyal etkileşime izin veren fiziksel şartlar ile gerekli bilişsel faktörlerin bir araya gelmesiyle hayat bulur (Yeşilyurt, 2013). Yapılandırmacı öğrenme ortamında öğrenciler işbirlikli öğrenme ile dayanışma içinde problem çözer, etkinlikler yoluyla birinci elden deneyim kazanır, sorgular ve öğrenmeyi öğrenir (Şaşan, 2002). Ayrıca, böyle bir ortamda öğrenciler öğrenmelerinde inisiyatif alır, çeşitli sorumluluklar üstlenir, öz değerlendirme yapar ve üst düzey bilişsel yetenekleri gelişir (Bay, Kaya ve Gündoğdu, 2010). Yapılandırmacı öğrenme kuramının etkin şekilde uygulandığı sınıflarda öğrencilerin etkinliklere etkin bir şekilde katılması, bilişsel olarak aktif olmaları teşvik edilirken, onların görüş ve düşünceleri saygı ile karşılanır. Bu tür öğrenme ortamlarının, öğrencilerin başarısını arttırdığı gözlenmektedir (Akyol & Fer, 2010; Demirci, 2009; Özerbaş, 2007).

Yakın geçmişte yapılan bir araştırma öğrenme ve öğretme sürecine ilişkin güç ve kontrolün öğrencilerle yeterince paylaşılmadığını ve öğrencilerin daha iyi öğrenmeleri konusunda onların görüşlerinden yeterince faydalanılmadığını ortaya koymaktadır (Özel, Yılmaz, Beyaz, Özer ve Şenocak, 2009). Bu sonuç sınıflarda yapılandırmacı öğrenme ortamlarının tam olarak uygulanmadığına işarettir.

Öğrenme ortamları genellikle öğretmenlerle yapılan görüşmelerle değerlendirilirken; öğrenme ortamının esas muhatabı olan öğrencilerle yapılan çalışmalar çok azdır. Bu nedenle sınıflarda yapılandırmacı öğrenme ortamının uygulanma düzeyinin öğrencilerin görüşleri alınarak değerlendirilmesi de gerekmektedir. Bu tür araştırmalar, bu konudaki aksaklıkların giderilmesine katkıda bulunacak ve öğretmenlerin yapılandırmacı öğrenme ortamı oluşturma bilgi ve becerilerinin düzeyi hakkında bilgi verecektir.

Dolayısıyla bu çalışmada; öğrencilerin gözünden fen bilimleri dersi öğretmeninin derslerinde yapılandırmacı öğrenme ortamını uygulama düzeyinin incelenmesi amaçlanmıştır. Fen öğretmeni sınıfta yapılandırmacı öğrenme ortamını ne ölçüde uyguladığını ve uygulama da hangi boyutlarda yetersiz kaldığını belirlemek amacıyla bu çalışma yapılmıştır.

Araştırma Soruları

Çalışmanın genel amacına uygun olarak aşağıdaki sorulara odaklanılmıştır.
1. Öğrenciler açısından yapılandırmacı öğrenme ortamı hangi düzeydedir?
2. Bu değerlendirmelere göre "Yapılandırmacı Öğrenme Ortamı Ölçeği"nin hangi alt boyutlarında yetersizlik söz konusudur?

YÖNTEM

Bu araştırma da yapılandırmacı öğrenme ortamının sınıfta uygulanma düzeyine ilişkin durum betimsel yolla ortaya konulmaya çalışılmıştır.

Çalışma Grubu

Çalışma grubunu Kayseri ili 'ne bağlı bir devlet ilköğretim okulu altıncı sınıfta öğrenim görmekte olan toplam 42 öğrenci oluşturmaktadır. Aşağıdaki bölümde detaylandırılacak olan ölçme aracı 2014–2015 eğitim yılında fen bilimleri dersinde uygulanmış ve öğrencilerden fen bilimleri dersi ile ilgili deneyimlerini göz önünde bulundurmaları istenmiştir. Çalışma grubundaki öğrencilerin cinsiyet dağılımı Tablo 1 de gösterilmiştir.

Tablo 7. Çalışma Grubunun Cinsiyet Dağılımı

Cinsiyet	Frekans (*f*)	Yüzde (%)
Kız	18	%42,9
Erkek	24	%57,1

Veri Toplama Aracı ve Analizi

Bu çalışmada uygulanan *Yapılandırmacı Öğrenme Ortamı Ölçeğ'i* Taylor, Fraser ve Fisher (1993) tarafından geliştirilmiş ve Küçüközer, Kırtak-Ad, Ayverdi ve Eğdir (2012) tarafından ise Türkçe'ye uyarlanmıştır. Ölçeğin Cronbach-alpha güvenirlik katsayısı .847 olarak tespitedilmiştir (Küçüközer vd., 2012). Bu sonuçlara göre uyarlanan ölçeğin geçerli ve güvenilir bir ölçme aracı olduğu söylenebilmektedir. Beş boyuttan oluşan ölçeğin içeriği aşağıda verilmiştir.

1. Dünyayı Öğrenme Boyutu: Öğrenilenlerin günlük hayatla ilişkilendirilmesi ve günlük deneyimlerin bilgiyi yapılandırmak için işe koşulması.
2.Bilimin Doğasını Öğrenme Boyutu: Bilimin ve bilimsel bilginin doğasını deneyimleme.
3.Düşüncelerini İfade Etmeyi Öğrenme Boyutu: Öğrencilerin, örenme ortamı ile ilgili rahatsızlıklarını çekinmeden ifade edebilmeleri.
4.Öğrenmeyi Öğrenme Boyutu: Hedeflerin, etkinlikleri tasarım ve uygulanmasının ve değerlendirme ölçütlerinin öğrenciyle paylaşılması.
5.İletişim Kurmayı Öğrenme Boyutu: Öğrencilerin fikirlerini açıkça paylaşması ve diğerlerinin bakış açılarını dikkate alarak kendi değerlendirmesini yapması.
Beşli likert tipindeki ölçekte öğrencilerin maddelere katılma dereceleri; "hemen hemen her zaman", "sık sık", "bazen", "nadiren" ve "hemen hemen hiç" biçiminde sınıflandırılmıştır. Sonuçların maddelere verilen cevaplardaki frekans ve aritmetik ortalamalar dikkate alınarak değerlendirilmiştir.

BULGULAR VE YORUM

Dünyayı Öğrenme Boyutu

Öğrencilerin yapılandırmacı öğrenme ortamının dünyayı öğrenme boyutuna yönelik görüşlerinin aritmetik ortalama değerinin 3,21 olduğu görülmektedir. Dünyayı öğrenme boyutuna ilişkin bulgular Tablo.3 de gösterilmiştir. Bu durum öğrencilerin dünyayı öğrenme boyuta ilişkin görüşlerinin ortalama bir değerde olduğunu göstermektedir. Fen öğretmeni öğrencilerin okul dışındaki hayatı öğrenmeleri ve fen dersiyle bunu bağdaştırmaları konusunda bir yeterliliğe sahip olduğunu göstermektedir.

Tablo 8. Dünyayı Öğrenme Boyutuna İlişkin Frekans Dağılımı

		Hemen hemen hiç	Nadiren	Bazen	Sık sık	Her zaman	X̄
Dünyayı Öğrenme	1. Okul dışındaki dünyayı öğreniyorum.	2	9	16	7	8	3,61
	2. Yeni öğrenmelerim okul dışındaki problemlerle başlar.	4	9	16	5	5	2,74
	3. Bilimin nasıl okul dışındaki hayatımın bir parçası olabileceğini öğreniyorum.	3	13	10	12	4	3,02
	4. Okul dışındaki dünyayı daha iyi anlıyorum.	1	9	18	8	6	3,26
	5. Okul dışındaki dünya hakkında ilginç şeyler öğreniyorum.	2	4	19	9	8	3,40
Genel							3,21

Bilimi Öğrenme Boyutu

Öğrencilerin yapılandırmacı öğrenme ortamının bilimi öğrenme boyutuna yönelik görüşlerinin aritmetik ortalama değerinin 3,52 olduğu görülmektedir. Bilimi öğrenme boyutuna ilişkin bulgular Tablo.4 de gösterilmiştir. Bu durum öğrencilerin bilimi öğrenme boyuta ilişkin görüşlerinin ortalama bir değerde olduğunu göstermektedir. Fen öğretmeni öğrencilerin bilimin doğası ile ilgili bilgi edinmelerini sağlamada bir yeterliliğe sahip olduklarını göstermektedir.

Tablo 9. Bilimi Öğrenme Boyutuna İlişkin Frekans Dağılımı

		Hemen hemen hiç	Nadiren	Bazen	Sık sık	Her zaman	X̄
Bilimi Öğrenme	6. Bilimin zamanla değiştiğini öğreniyorum.	2	5	14	8	13	3,60
	7. Bilimin, insanların değerlerinden ve fikirlerinden etkilendiğini öğreniyorum.	1	6	19	8	8	3,38
	8. Diğer kültürlerdeki insanlar tarafından kullanılan farklı bilimleri öğreniyorum.	4	10	18	8	2	4,02
	9. Modern bilimin yıllar önceki bilimden farklı olduğunu öğreniyorum.	3	5	13	14	7	3,40
	10. Bilimin teoriler üretmekle ilgili olduğunu öğreniyorum.	2	12	9	13	6	3,21
Genel							3,52

Düşünceleri İfade Etmeyi Öğrenme Boyutu

Öğrencilerin yapılandırmacı öğrenme ortamının düşünceleri ifade etmeyi öğrenme boyutuna yönelik görüşlerinin aritmetik ortalama değerinin 2,75 olduğu görülmektedir. Düşünceleri ifade etmeyi öğrenme boyutuna ilişkin bulgular Tablo.5 de gösterilmiştir. Bu durum öğrencilerin bilimi öğrenme boyuta ilişkin görüşlerinin ortalamanın altında bir değerde olduğunu göstermektedir. Fen öğretmenlerinin öğrencilerin özgürce düşüncelerini ve kendilerini ifade edebilecekleri bir ortam sağlamada ortalamanın altında olduklarını ve öğrencilere demokratik ve özgür bir ortam hazırlamada yetersiz olduklarını göstermektedir.

Tablo 10. Düşüncelerini İfade Etme Boyutuna İlişkin Frekans Dağılımı

		Hemen hemen hiç	Nadiren	Bazen	Sık sık	Her zaman	X̄
Düşünceleri İfade Etmeyi Öğrenme	11. 'Bu konuyu neden öğrenmek zorundayım?' diye öğretmenime sorabiliyorum.	17	9	5	4	7	2,40
	12. Kullanılan öğretim yöntemlerini sorgulayabiliyorum.	3	12	15	9	3	2,93
	13. Kafa karıştırıcı öğretim faaliyetleri hakkında şikâyet edebiliyorum.	6	9	17	5	5	2,86
	14. Öğrenmelerimi engelleyen herhangi bir şey hakkında şikâyet edebiliyorum.	10	7	13	6	6	2,79
Genel							2,75

Öğrenmeyi Öğrenme Boyutu

Öğrencilerin yapılandırmacı öğrenme ortamının öğrenmeyi öğrenme boyutuna yönelik görüşlerinin aritmetik ortalama değerinin 2,76 olduğu görülmektedir. Öğrenmeyi öğrenme boyutuna ilişkin bulgular Tablo.6 de gösterilmiştir. Öğrenmeyi öğrenme boy Bu durum öğretmenlerin öğrencilere öğrenmesiyle ilgili konularda ne ölçüde sorumluluk verdiği konusuna ilişkin görüşlerinin ortalamanın altında bir değerde olduğunu göstermektedir. Bu sonuçlarda fen öğretmenlerinin öğrencilerine kendi öğrenmeleri ile ilgili daha az sorumluluk verdilerini ve öğrenmeleri ile ilgili karar vermelerine izin vermediklerini göstermektedir.

Tablo 11. Öğrenmeyi Öğrenme Boyutuna İlişkin Frekans Dağılımı

		Hemen Hemen hic	Nadiren	Bazen	Sık sık	Her Zaman	X̄
Öğrenmeyi Öğrenme	15. Ne öğreneceğim konusunda planlama yaparken öğretmene yardım ediyorum.	6	7	18	7	4	2,90
	16. Nasıl daha iyi öğreneceğime karar vermesinde öğretmene yardım ediyorum.	8	9	10	12	3	2,83
	17. Hangi etkinliklerin benim için en iyi olduğuna karar vermesinde öğretmene yardım ediyorum.	5	10	15	6	6	2,95
	18. Öğrenme etkinliklerinde ne kadar vakit harcayacağıma karar vermesinde öğretmene yardım ediyorum.	10	7	12	10	3	2,73
	19. Hangi etkinlikleri yapacağıma karar vermesinde öğretmene yardım ediyorum.	10	10	14	5	3	2,55
	20. Öğrenmelerimi değerlendirmesinde öğretmene yardım ediyorum.	11	7	14	7	3	2,62
Genel							2,76

İletişim Kurmayı Öğrenme Boyutu

Öğrencilerin yapılandırmacı öğrenme ortamının iletişim kurmayı öğrenme boyutuna yönelik görüşlerinin aritmetik ortalama değerinin 3,48 olduğu görülmektedir. İletişim kurmayı öğrenme boyutuna ilişkin bulgular Tablo.7 da gösterilmektedir. Bu durum öğretmenlerin öğrencilerin sınıf içerisinde, öğretim sırasında birbirleriyle ne ölçüde iletişim kurmalarına izin verdikleri ve öğrencilerin işbirlikçi öğrenmelerine ne ölçüde sağladıkları konusuna ilişkin görüşlerinin ortalama bir değerde olduğunu göstermektedir. Bu sonuçlarda fen öğretmenlerinin; öğrencilerinin birbirleriyle iletişimine ve işbirlikçi öğrenmelerine yeterli düzeyde bir fırsat tanıdığını göstermektedir.

Tablo 12. İletişim Kurmayı Öğrenme Boyutuna İlişkin Frekans Dağılımı

		Hemen hemen hiç	Nadiren	Bazen	Sık sık	Her zaman	X̄
İletişim Kurmayı Öğrenme	21.Problemlerin nasıl çözüleceği hakkında arkadaşlarımla konuşuyorum.	3	7	14	7	11	3,38
	22.Anladıklarımı arkadaşlarımla paylaşıyorum.	5	2	19	7	9	3,31
	23.Arkadaşlarımdan düşündüklerini açıklamalarını istiyorum.	5	5	11	15	6	4,0
	24.Arkadaşlarım fikirlerimi açıklamamı istiyor.	3	2	22	8	7	3,33
	25. Arkadaşlarım fikirlerini bana açıklıyor.	4	3	16	12	7	3,36
	Genel						3,48

TARTIŞMA VE SONUÇ

Genel olarak ölçeğin alt boyut puan ortalamalarına bakıldığında sınıf ortamının yapılandırmacı bir anlayışa sahip olduğu anlaşılmaktadır. Bununla birlikte araştırmaya katılan öğrencilerin bilimin nasıl oluştuğunu ve günlük yaşamın bir parçası olduğunu, öğrendikleri bilgileri günlük hayatta kullandıkları sonucuna ulaşılmış, böylelikle bilimin doğasını daha iyi kavradıkları sonucuna ulaşılmıştır. Fakat bu bilgiyi sınıfta öğrenirken öğretmene çeşitli konularda eleştiri getiremedikleri görülmüş, sorgulama-itiraz etme eylemlerinde bulunmadıkları ve şikayetçi bir tarzı benimsemedikleri sonucuna ulaşılmıştır. Ayrıca dersi planlama, işleme ve değerlendirme aşamalarında öğretmenlerin öğrencilerle işbirliği yapmadıkları görülmektedir. Bu durum eğitim ve öğretimin demokratik yollarla yapılmadığını göstermektedir. Öğrencilerin öğretmene eğitim konusunda sınıfta rahat davranamamalarının sebebi öğretmenin, okul yöneticilerinin veya başka hesaba katılmayan değişkenlerin yüzünden olabilir. Ancak öğrencilerin kendi aralarında paylaşımcı ruhu taşıdıkları ve iletişime önem verdikleri de görülmektedir.

Sonuç olarak, öğrencilerin görüşleri doğrultusunda, öğrenim gördükleri öğrenme ortamlarının, yapılandırmacı öğrenme ortamlarının özelliklerini taşıma veya bu özelliklere sahip olma noktasında bazı önemli eksikliklerinin var olduğu tespit edilmiştir. Ancak çalışmanın alt boyutlarının genel ortalamasına bakıldığında; yapılandırmacı öğrenme ortamının uygulanması konusunda genel olarak bir yeterliliğe sahip oldukları sonucuna ulaşılmıştır. Yapılan diğer araştırmalarda sınıf ortamını yapılandırmacı öğrenme ortamı özelliklerini taşıdığı sonucuna ulaşılmıştır (Acat, Karadağ ve Kaplan, 2012; Mengi ve Schreglman, 2013). Ancak yapılan bazı araştırmalarda uygulayıcı olarak üzerine büyük görev düşen öğretmenlerin sınıflarında yapılandırmacı öğrenme ortamını uygulama da yetersiz olduğu ortaya koymaktadır (Gömleksiz, 2005; Gömleksiz, 2007; Özel vd., 2009; Arı, 2010).

ÖNERİLER

Öğretmenlerin yapılandırmacı öğrenme ortamını oluşturmada yetersiz oldukları yapılan diğer araştırmalarında ortak sonucudur (Gömleksiz, 2005; Gömleksiz, 2007; Özel vd., 2009). Buradan yola çıkarak öğretmenlere yeterli bir eğitimin verileceği projelerin yapılması gerekmektedir. Öğretmenler yapılandırmacı öğrenme modelinin ne olduğunu bilmelerine rağmen yapılandırmacı öğrenme ortamının özelliklerine hakim değillerdir. Bu nedenle buna yönelik çalışmalar yapılmalıdır. Araştırmacılar sadece likert tipi anketler ve görüşmeler kullanarak değil de daha detaylı inceleme ve gözlem yapabilecekler araçlar kullanarak, daha büyük örneklem üzerinde bu konuda araştırma yapabilirler.

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ANALYSIS OF 10TH GRADE TEXTBOOK FUNCTIONS UNIT CONTENT WITH ANTHROPOLOGICAL THEORY OF DIDACTICS

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ABSTRACT: The aim of the present study is to examine "operations with function and applications of functions" unit in tenth grade mathematics textbook within the framework of Anthropological Theory of Didactics (ATD). The mathematics textbook, which was distributed free to students by Ministry of National Education in 2014 – 2015 academic year, was examined within the context of the main analysis method of ATD, namely praxeological analysis (task, technique, technology, theory). Analysis results demonstrated that most of the tasks identified in the textbook were solved with algebraic and graphical techniques. In addition, on certain techniques, technological explanations on the validity of the technique used were also provided. However, tasks were generally solved with one technique and alternative techniques were not utilized. It was considered that solutions of the tasks using more than one technique would have positive contributions on instruction.

Key words: Anthropological Theory of Didactics, praxeological analysis, textbook, functions, 10th grade

10. SINIF MATEMATİK DERS KİTABI FONKSİYON KONUSUNUNUN DİDAKTİĞİN ANTROPOLOJİK TEORİSİ IŞIĞINDA İNCELENMESİ

ÖZET: Bu çalışmanın amacı onuncu sınıf matematik ders kitaplarındaki ünitelerden Fonksiyonlarla İşlemler ve Uygulamaları ünitesini Didaktiğin Antropolojik Teorisi (DAT) çerçevesinde incelemektir. Bu doğrultuda 2014-2015 öğretim yılında Milli Eğitim Bakanlığı'nın öğrencilere ücretsiz dağıttığı matematik ders kitabı DAT'nin temel analiz yöntemi prakseolojik analiz (görev, teknik, teknoloji, teori) çerçevesinde incelenmiştir. Analiz sonuçlarına göre ders kitabında belirlenen görevlerin çoğunlukla cebirsel ve grafiksel tekniklerle çözüldüğü belirlenmiştir. Ayrıca bazı tekniklerde tekniğin niçin geçerli olduğuna ilişkin teknolojik açıklamalara da yer verildiği görülmüştür. Bununla birlikte, görevlerin genellikle bir teknikle çözüldüğü ve alternatif tekniklere yer verilmediği tespit edilmiştir. Görevlerin birden fazla teknikle çözümünün ders kitaplarında yer almasının öğretime pozitif bir katkı sağlayacağı düşünülmektedir.

Anahtar sözcükler: Didaktiğin Antropolojik Teorisi, prakseolojik analiz, ders kitabı, fonksiyon konusu, 10.sınıf

GİRİŞ

Ders kitapları lise matematik konularının öğretiminde büyük bir öneme sahiptir. Ders kitapları okulda bilginin öğrenciler tarafından kazanımı için önemli araçlar olarak hizmet etmektedir (Garner, 1992). Matematik ders kitabı matematiksel bilgiyi korumanın tipik bir yolunu ifade etmektedir (Kang & Kilpatrick, 1992). Özgeldi ve Esen (2010) tarafından yapılan çalışmada ders kitaplarının görevlerle (tasklarla) şekillendirilen sınıf aktivitelerinin bir kaynağı olarak düşünülebileceği ve matematik kitaplarındaki görevlerin incelenmesi yoluyla matematiksel görevlerin doğasının belirlenebileceği ifade edilmiştir. Erdoğan (2014) Fransız lise ikinci sınıf matematik ders kitaplarında fonksiyon konuları bağlamında yer alan görevler için kullanılan çözüm teknikleriyle bu tekniklerin kullanımına yönelik verilen açıklamalar arasında nedensellik bağlamında kopukluklar olduğunu belirtmiştir. Erdoğan, ayrıca, söz konusu kitaplarda kavramsal boyutta kalan ve çözüm tekniğine dönüşmeyen açıklamalara da yer verildiğini tespit etmiştir.

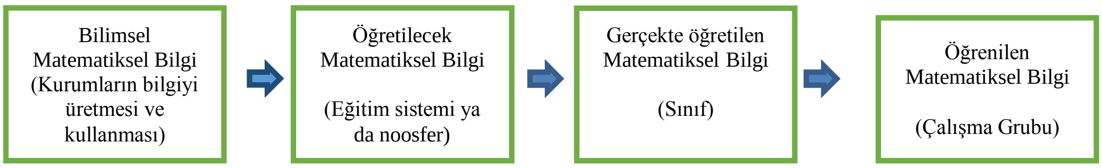
Ders kitaplarında ne tür görevlere yer verildiği, bu görevlerin nasıl çözüldüğü ve yapılan çözümlerin nasıl açıklanıp desteklendiği gibi bilgiler, ders programının hedeflerinin nasıl anlaşıldığının belirlenmesi ve hedeflenen kazanımların ne derece gerçekleşebileceğinin tartışılabilmesi açısından önem arz etmektedir. Bu çalışmada 2013 yılında uygulamaya giren, değişen lise matematik dersi öğretim programında 10. sınıf konularından "Fonksiyonlarda İşlemler ve Uygulamaları" (MEB, 2013) ünitesinin ders kitaplarında nasıl yer aldığının yukarıdaki sorular bağlamında incelenmesi amaçlanmıştır. Daha net bir ifadeyle bu çalışmada aşağıdaki sorulara cevap aranmıştır:

1. Fonksiyonlarda işlemler ve uygulamaları ünitesiyle ilgili olarak ders kitaplarında ne tür görevlere yer verilmiştir?
2. Bu görevlerin çözümü için ne tür teknikler (cebirsel, grafik, tablo, sayısal, vb.) tercih edilmiştir?
3. Bu teknikler hangi açıklamalarla desteklenmiştir?

Bu inceleme için Didaktiğin Antropolojik Teorisi (DAT) teorik çerçeve olarak kullanılmış ve teorinin temel analiz yöntemlerinden prakseolojik analiz yöntemine başvurulmuştur.

Didaktiğin Antropolojik Teorisi

Chevallard'ın önderliğinde geliştirilen Didaktiğin Antropolojik Teorisi (DAT) (Bosch & Gascon, 2006; Chevallard, 1997; 1999) farklı kurumlarda matematiksel pratiklerin analizi için kullanılabilen teorik bir çerçeve sunmaktadır (Jablonka & Bergsten, 2010). Teorinin hareket noktası matematiksel bilginin öğretilen bilgi oluncaya kadar bir dizi didaktik dönüşüm sürecinden geçtiği düşüncesidir (Bosch & Gascon, 2006). Didaktik dönüşümden kastedilen, bilimsel bilginin öğretilecek bilgi olabilmesi için eğitim sisteminin bazı zorunlulukları altında gerçekleştirilen veya gerçekleşen dönüşümlerdir. Daha ayrıntılı olarak didaktik dönüşüm, üniversitelerde bilim adamları tarafından üretilen bilgilerin programlara ve ders kitaplarına geçiş sürecinde ve bunların sınıflarda uygulanması sürecinde geçirdiği dönüşümler şeklinde açıklanabilir (Chevallard, 1985). Bu dönüşümlerin birincisi, bilimsel matematiksel bilgiden öğretilecek matematiksel bilgiye geçişi, ikincisi öğretilecek matematiksel bilgiden gerçekte öğretilen matematiksel bilgiye geçişi ve sonuncusu ise gerçekte öğretilen matematiksel bilgiden öğrenilen matematiksel bilgiye geçişi ifade etmektedir (Bosch & Gascon, 2006). Bu dönüşüm süreçleri şekil 1'de görülmektedir.



Şekil 1. Didaktik dönüşüm süreci[8]

Şekil 1'de ifade edilen dönüşümlerden bilimsel matematiksel bilgiden öğretilen matematiksel bilgiye geçiş noosfer[9] tarafından ve öğretilecek matematiksel bilgiden gerçekte öğretilen matematiksel bilgiye geçiş öğretmenler tarafından gerçekleştirilmektedir (Østergaard, 2013).

Bu teoride, en basit insanoğlu eylemlerinde olduğu gibi (örneğin dikiş dikmek) matematik de, bir sorun veya problem ile başlayan, bu sorun veya probleme bulunan bir çözüm ve bu çözümün neden mantıklı ve doğru bir çözüm olduğunun belirlenip kurumsallaştırılması ile topluma mal olan bir insan eylemi olarak görülmektedir. Teoride bu eylemler prakseoloji terimiyle açıklanmaktadır (Chevallard, 1999; 2006). Prakseolojiler 4 temel elemandan oluşmaktadır. Bunlar tablo 1'de verilmiştir.

Tablo 1. Prakseolojik Analizin Temel Bileşenleri

Pratik Bloğu	**Bilgi Bloğu**
Görev Tipi(T)	Teknoloji (θ)
Teknik(**τ**)	Teori(Θ)

Prakseolojik analiz, görev tipleri ve onları çözmek için kullanılan teknikler olarak ifade edilebilecek pratik bloğu ve pratik bloğunu matematiksel anlamda meşru kılan bilgi bloğundan oluşmaktadır (Barbé, Bosch, Espinoza, & Gascón, 2005).

Niçin Fonksiyonlar Konusu?

Matematiğin temel kavramlarından biri olan fonksiyon kavramı (Sajka, 2003; Even, 1993) lise matematiğinde limit, süreklilik, türev ve integral gibi birçok konunun ön öğrenmesini oluştururken aynı zamanda konular arasında birleştirici ve merkezi bir rol oynamaktadır (Selden & Selden, 1992; NCTM, 1989). Yenilenen lise

[8] Bosch & Gascon'den (2006) uyarlanmıştır.
[9] Noosfer, eğitimsel süreçler hakkında kararlar alan ve düşünen insanların oluşturduğu topluluk olarak tanımlanmaktadır (Bosch, 2012).

matematik öğretim programında (MEB, 2013) fonksiyon konusunun öğretiminin tablo 2'de açıklandığı şekliyle yapılması istenmektedir.

Tablo 2. Türkiye'de Lise Matematik Öğretim Programında Fonksiyon Konusuna İlişkin Üniteler

Üniteler	Sınıf Düzeyi	İlgili Kazanım
Fonksiyonlar	9.sınıf	1. Fonksiyon kavramını açıklar. 2. Fonksiyonların grafik gösterimini yapar 3. $f(x)=x^n$ ($n \in Z$) biçimindeki fonksiyonların grafiklerini çizer. 4. Bire bir ve örten fonksiyonları açıklar.
Fonksiyonlarla İşlemler ve Uygulamaları	10.sınıf	1. Bir fonksiyonun grafiğinden, simetri dönüşümleri yardımı ile yeni fonksiyon grafikleri çizer. 2. Gerçek sayılar kümesinde tanımlı f ve g fonksiyonlarını kullanarak f+g, f-g, f·g ve f/g fonksiyonlarını elde eder. 3. Fonksiyonlarda bileşke işlemini açıklar. 4. Bir fonksiyonun bileşke işlemine göre tersinin olması için gerekli ve yeterli şartları belirleyerek, verilen bir fonksiyonun tersini bulur. 5. İki miktar (nicelik) arasındaki ilişkiyi fonksiyon kavramıyla açıklar; problem çözümünde fonksiyonun grafik ve tablo temsilini kullanır.
İkinci Dereceden Denklem ve Fonksiyonlar	10. sınıf	1. İkinci dereceden bir değişkenli fonksiyonu açıklar ve grafiğini çizer. 2. İkinci derece denklem ve fonksiyonlarla modellenebilen problemleri çözer.
Trigonometri	11. sınıf	1. Trigonometrik fonksiyonları birim çember yardımıyla oluşturur ve grafiklerini çizer. 2. Tanjant, sinüs ve kosinüs fonksiyonlarının ters fonksiyonlarını oluşturur.
Üstel ve Logaritmik Fonksiyonlar	11. sınıf	1. Üstel fonksiyonu açıklar. 2. Üstel fonksiyonların bire bir ve örten olduğunu gösterir. 3. Logaritma fonksiyonunu üstel fonksiyonun tersi olarak oluşturur. 4. On tabanında logaritma fonksiyonunu ve doğal logaritma fonksiyonunu açıklar 5. Logaritma fonksiyonunun özelliklerini gösterir ve uygulamalar yapar.
Türev (Limit ve Süreklilik, Türev, Türev Uygulamaları)	12.sınıf	1. Bir fonksiyonun bir noktadaki limiti, soldan limiti ve sağdan limiti kavramlarını tablo ve grafik kullanarak örneklerle açıklar. 2. Bir fonksiyonun bir noktadaki sürekliliği kavramını açıklar. 3. Bir fonksiyonun bir noktadaki sürekliliği kavramını açıklar. 4. Türevlenebilen iki fonksiyonun toplamının, farkının, çarpımının ve bölümünün türevine ait kuralları açıklar ve bunlarla ilgili uygulamalar yapar. 5. İki fonksiyonun bileşkesinin türevine ait kuralı (zincir kuralı) oluşturur ve bunu kullanarak türev hesabı yapar. 6. Bir fonksiyonun yüksek mertebeden türevlerini açıklar ve bulur. 7. Verilen bir fonksiyonun bir noktadaki teğet ve normalinin denklemlerini bulur. 8. Bir fonksiyonun artan ve azalan olduğu aralıkları türevinin işaretine göre belirler. 9. Bir fonksiyonun ekstremum noktalarını türev yardımıyla belirler. 10. Bir fonksiyonun grafiği üzerinde bükeylik ve dönüm noktası kavramlarını açıklar. 11. Fonksiyonların grafiğini çizerken türevi kullanır.
İntegral (Belirli ve Belirsiz integral, Belirli İntegralin Uygulamaları)	12.sınıf	1. Bir fonksiyonun grafiği ile x-ekseni arasında kalan sınırlı bölgenin alanını Riemann toplamı yardımıyla tahmin eder. 2. Bir fonksiyonun grafiği altında kalan alanı veren fonksiyonun türevi ile grafiğin temsil ettiği fonksiyon arasındaki ilişkiyi açıklar. 3. Bir fonksiyonun belirli ve belirsiz integralleri arasındaki ilişkiyi açıklar. 4. Bir fonksiyonun bir sabitle çarpımının, iki fonksiyonun toplamının ve farkının belirli integraline ait kuralları oluşturur. 5. Bir fonksiyonun bir sabitle çarpımının, iki fonksiyonun toplamının ve farkının belirsiz integraline ait kuralları bulur ve bunları kullanarak integral hesabı yapar.

Tablo 2 de görüleceği üzere lise matematik öğretim programında 9. sınıfta fonksiyon kavramının tanıtılması ve 10. sınıfta fonksiyon grafiklerinin yeni fonksiyonlar türetmek için kullanılması, fonksiyonlardaki temel işlemlerin öğretilmesi ve problem çözümlerinde fonksiyonların bir araç olarak kullanılmaya başlanılması hedeflenmektedir. 11. sınıfta okul matematiği için önemli bazı fonksiyonlar (trigonometrik, üstel, logaritma gibi) ve bunların özellikleri verildiği görülmektedir. 12. sınıfta ise artık analizin temeli olarak ifade edilebilecek fonksiyonların limitleri, süreklilik, türev ve integral gibi konuların öğretildiği anlaşılmaktadır. Bu bağlamda fonksiyon kavramı ile ilgili 10. sınıf konuları lise ve üniversite matematiğinin en temel konularından biri olan analizin (limit, türev ve integral) temelini oluşturmaktadır. Bu nedenle bu araştırmada 10. sınıf matematik ders kitabındaki ünitelerden "Fonksiyonlarla İşlemler ve Uygulamaları" ünitesi DAT çerçevesinde incelenmiştir.

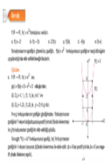
YÖNTEM

Bu çalışma nitel araştırma yöntemlerine göre gerçekleştirilmiştir. Çalışmada özel bir içerik analiz yöntemi olan prakseolojik analiz yöntemine başvurulmuştur (Erdoğan vd., 2015). 2014-2015 öğretim yılında Talim ve Terbiye Kurulu tarafından onaylanmış tek bir 10. sınıf matematik kitabı bulunmaktadır. Dolayısıyla MEB tarafından 10. sınıf öğrencilerine ücretsiz olarak bu ders kitabı dağıtılmıştır. Çalışma bu ders kitabındaki fonksiyonlarla işlemler ve uygulamaları ünitesiyle sınırlandırılmıştır. Tek bir ders kitabı söz konusu olduğundan kitap ismi ile ilgili bulgularda herhangi bir kodlama yapılmamıştır. Bahsi geçen kaynak ders kitabı olarak ifade edilmiştir.

Analiz Aşaması

Ders kitabının analizi DAT'ın temel analiz yöntemi olan prakseolojik analizin bileşenleri doğrultusunda gerçekleştirilmiştir. Bunun için öncelikle Fonksiyonlarla İşlemler ve Uygulamaları ünitesiyle ilgili görevler çıkarılmıştır. Bu görevlerden aynı teknikle çözülebilenler bir araya getirilerek görev tipleri oluşturulmuştur. Tekniklerin uygulanmasındaki, eğer varsa, teknolojik açıklamalar belirlenmiştir. Ayrıca bu teknolojilerin arka planındaki teori veya teoriler de araştırmada tespit edilmeye çalışılmıştır. Ayrıca her bir görevin hangi teknikle çözüldüğü belirlenerek ders kitabındaki görevlerin çözümünde yoğun olarak kullanılan teknikler hakkında fikir sahibi olunmaya çalışılmıştır. Burada cebirsel teknik, grafiksel teknik, cebirsel ve grafiksel teknik birlikte, şema tekniği, teknolojik teknik ve liste tekniği gibi çözüm yaklaşımları altında teknikler toplanmıştır. Ders kitabının analizi aşağıda verilen tablo ile yapılmıştır.

Tablo 3. Ders Kitabındaki Görevlerin Prakseolojik Analizin Bileşenleri Doğrultusunda İncelenmesi

Ünite	Alt Başlık	Sayfa	No	Alıntı	Görev	Teknik	Teknoloji	Teori	Prg Uyum	No	Görev tipi
Fonksiyonlarla İşlemler ve Uygulamaları	Fonksiyonların Simetrileri ve Cebirsel Özellikleri 1.Fonksiyonların Grafikleri ve Dönüşümler	42	1		$y=f(x)=x^2$ fonksiyonu ile $y=f(x)+2$ fonksiyonunun grafiklerini çizerek, aralarındaki ilişkiyi bulma	Grafik	Fonksiyonlarda dört işlem, Grafik çizme, Parabol, Afin dönüşüm Öteleme	izometri	U	1	Cebirsel temsille verilen y=f(x) fonksiyonunun grafiğinden yararlanarak y=f(x)+k fonksiyonunun grafiğini bulma (1, 25, 26,32)

Ders kitabının prakseolojik analizi tablo 3'te görüldüğü üzere, en sol sütundan sağa doğru ünite (ünite başlığı), alt başlık (ünite içindeki yer alan alt başlıklar), sayfa (görevin ders kitabındaki yeri), no (görevin prakseolojik analizdeki sırası), alıntı (görev ve ders kitabında görevin çözümünün nasıl yapıldığı), görev (görevin ifadesi), teknik (görevin çözümünde ağırlıklı olarak kullanılan çözüm yaklaşımı), teknoloji (görevde kullanılan matematiksel nesneler, kavramlar,..vs ile birlikte, eğer varsa, verilen açıklamalar), teori (teknolojinin ardındaki daha genel bilgi), prg uyum (görevin yürürlükteki öğretim programı açısından değerlendirilmesi U: Uygun ya da UD: Uygun Değil), no (görevin ait olduğu görev tipinin numarası), görev tipi (görevlerin sınıflandırıldığı görev tiplerinin ifadesi ve hangi görevlerin ilgili görev tipine ait olduğu) şeklindedir.
Bu analizlerin nasıl yapıldığının görülebilmesi için aşağıda bir görevin detaylı analizleri sunulmuştur.

Bir Görevin Analizi Örneği

Ders kitabı, Fonksiyonlarla İşlemler ve Uygulamaları ünitesi, Alt başlık: Fonksiyonlarda dört işlem, sayfa 47, görev no: 19

Görev (Kitapta verildiği şekliyle) : $f\colon R\rightarrow R$, $f(x)=x+1$ ve $g\colon R\rightarrow R$, $g(x)=2x$ fonksiyonları verilsin. $f+g$ fonksiyonunu bulunuz?

Çözüm (Kitapta verildiği şekliyle): $f+g\colon R\rightarrow R$, $(f+g)(x)=f(x)+g(x)=(x+1)+2x=3x+1$

Prakseolojik bileşenler

- T_1 (Görev tipi): Birinci dereceden iki polinom fonksiyonun toplamını bulma
- τ_1 (Teknik 1): (Cebirsel Teknik): İki polinom fonksiyon toplanırken aynı dereceli terimlerin katsayıları toplanır ya da çıkarılır.
- θ (Teknoloji): P(x)=$a_n x^n$+$a_{n-1}x^{n-1}$+…+$a_1 x^1$+a_0 ve Q(x)= $b_n x^n$+$b_{n-1}x^{n-1}$+…+$b_1 x^1$+b_0 şeklinde verilsin. O halde, (P+Q)(x)=P(x)+Q(x)=$(a_n + b_n)x^n$+$(a_{n-1} + b_{n-1})x^{n-1}$+…+$(a_1 + b_1)x^1$+$(a_0 + b_0)$
  olarak elde edilir.
- Θ (Teori): Polinom Halkaları

Bu görev matematik dersi öğretim programı açısından incelendiğinde, 10. sınıf öğrencilerinin "değişkenin aynı dereceli katsayıların toplanması" ile ilgili teknolojik bilgiye, önceki sınıflardaki kazanımlarından sahip olduğu söylenebilir. Öğrenciler formal anlamda polinom halkalarıyla ilgili teoriyi bilmeseler dahi teknolojik açıklamayı bildiklerinden dolayı bu görevin matematik dersi öğretim programı açısından uygun olduğu söylenebilir.

BULGULAR

İlk olarak tablo 4'te 10. sınıf matematik ders kitabında Fonksiyonlarla İşlemler ve Uygulamaları ünitesi içinde yer alan görevlerin görev tiplerine dağılımı görülmektedir. Bu görev tiplerinin ilgili olduğu çözüm teknikleri yanlarında verilmiştir.

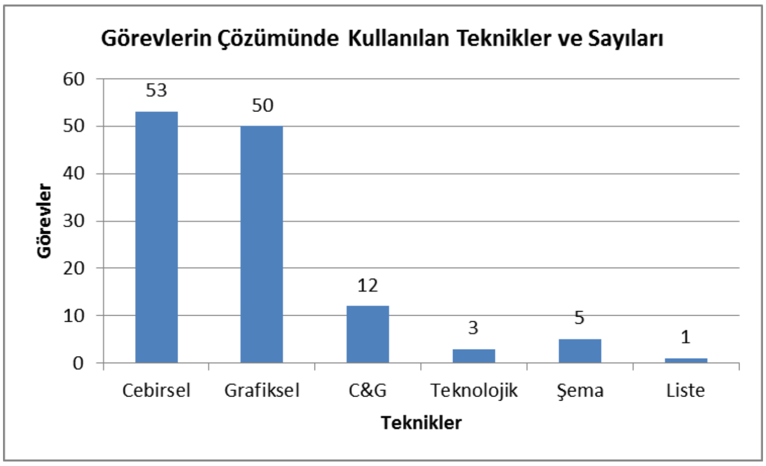
Tablo 4. Ders Kitabındaki Görevlerin Görev Tiplerine Dağılımı

Alt Başlık	Görev Tipi	Görevler	Teknik
Fonksiyonların Simetri Dönüşümleri	T_1: Fonksiyon grafiğinin y ekseninde ötelenmesiyle ilgili görevler	1-25-26-32	Grafiksel
	T_2: Fonksiyon grafiğinin x ekseninde ötelenmesiyle ilgili görevler	2-31	Grafiksel
	T_3: Fonksiyonun grafiğinin y ekseninde ölçeklenmesiyle (genişleme ya da daralma) ilgili görevler	3	Grafiksel
	T_4: Fonksiyon grafiğinin x ekseninde ölçeklenmesiyle (genişleme ya da daralma) ilgili görevler	4-27	Grafiksel
	T_5: Fonksiyon grafiğinin x eksenine göre simetrisiyle ilgili görevler	5-8-13-29-34	Grafiksel (Teknolojik-13)
	T_6: Fonksiyon grafiğinin y eksenine göre simetrisiyle ilgili görevler	6-9-12-28-33	Grafiksel (Teknolojik-12)
	T_7: Fonksiyon grafiğinin x ve y ekseninde ötelenmesiyle ilgili görevler	7	Cebirsel
	T_9: Fonksiyon grafiğinin x ve y eksenine göre simetrisiyle ilgili görevler	14-30-107	Grafiksel (Teknolojik-14)
	T_{28}: Fonksiyon grafiğinin x ekseninde simetrisi ve y ekseninde ötelenmesiyle ilgili görevler	102	Cebirsel
Tek ve Çift Fonksiyon	T_8: Tek ya da çift fonksiyon için cebirsel tekniklerle çözülebilen görevler	10-11-15-16	Cebirsel (Grafiksel-10 ve 11)
	T_{29}: Tek ya da çift fonksiyon için grafiksel tekniklerle çözülebilen görevler	103-104	Grafiksel
Fonksiyonlarda Dört İşlem	T_{10}: Cebirsel tekniklerle çözülebilen dört işlem içeren görevler	17-19-20-21-22-23-35-37-38-39	Cebirsel
	T_{11}:Grafik çizme yoluyla dört işlem içeren görevler	18-36	Grafiksel
	T_{30}: Grafik yorumu ile dört işlem içeren görevler	24-108	Grafiksel
Bileşke İşlemi ve Bir Fonksiyonun Tersi	T_{12}: Cebirsel teknikle yapılan bileşke işlemiyle ilgili görevler	40-41-43	Cebirsel
	T_{13}: Şema tekniğiyle çözülen bileşke işlemi içeren görevler	42	Şema
	T_{14}: Cebirsel teknikle çözülen bileşke işleminde görüntü bulmayla ilgili görevler	44-45	Cebirsel
	T_{15}: Grafiksel yorumla bileşke işleminde görüntü-ters görüntü bulma ile ilgili görevler	46-56-66-67-68-69-75-105-106-115	Grafiksel (C&G-105)
	T_{16}: Şema tekniğinde verilen fonksiyonun ters fonksiyonunu belirtmeye ilişkin görevler	47-48-49	Şema
	T_{17}: Cebirsel tekniklerle ters bulmaya ilişkin görevler	50-51-53-54-65	Cebirsel (Liste-50) (Şema-50)

	T_{18}: Grafiksel tekniklerle grafiği verilen bir fonksiyonun tersinin grafiğini çizmeye ilişkin görevler	52-76-77	Grafiksel
	T_{19}: Cebirsel tekniklerle yapılan iki fonksiyonun bileşkenin tersiyle ilgili görevler	55	Cebirsel
	T_{20}:Cebirsel tekniklerle yapılan bileşke ve fonksiyonlardan biri belli iken diğerini bulmaya ilişkin görevler	57-58-59-60-61-62-63-71-72-73-109-114	Cebirsel (Cebirsel-63)
	T_{21}: Cebirsel tekniklerle yapılan bileşke ve ters fonksiyonla ilgili karmaşık görevler	64-70-74-111-112-113	Cebirsel
	T_{31}: Cebirsel tekniklerle yapılan iki değişkenli fonksiyonlarda belli bir değerin ters görüntüsüyle ilgili görevler	110	Cebirsel
Fonksiyonlarda Uygulamalar	T_{22}: Sözel temsilden cebirsele geçiş ile ilgili görevler	78-79-84-91-92-118	Cebirsel
	T_{23}: Grafik temsilinde grafiğin pozitif-negatif aralıkların bulunmasına ilişkin görevler	80-81-96	Grafiksel
	T_{24}: Grafik temsilinde grafiğin artan-azalan aralıklara ilişkin görevler	82-95-119	Grafiksel
	T_{25}: Grafik temsilinde maksimum minimum noktalarla ilgili görevler	83-97	Grafiksel
	T_{26}: Grafik temsilinde ortalama değişim hızına ilişkin görevler	85-86-87-88-89-90-98-99-100-101-117	G&C
	T_{27}: Fonksiyon grafiği ile y=a doğrusunun kesim noktalarına ilişkin görevler	93-94-116	Grafiksel

Tablo 4 incelendiğinde onuncu sınıf matematik ders kitabında Fonksiyonlarla İşlemler ve Uygulamaları ünitesiyle ilgili 119 görevin olduğu görülmektedir. Bu görevler 31 adet görev tipi altında sınıflandırılmıştır. Fonksiyonların simetri dönüşümleri alt başlığında 9 görev tipi, tek ve çift fonksiyon alt başlığında 2 görev tipi, fonksiyonlarda dört işlem alt başlığında 3 görev tipi, bileşke işlemi ve bir fonksiyonun tersi alt başlığında 11 görev tipi, fonksiyonlarla uygulamalar alt başlığında 6 görev tipi ortaya çıkmıştır. Örneğin fonksiyonların simetri dönüşümleri alt başlığında T_1 görev tipi "grafiği verilen bir fonksiyonun y ekseninde ötelenmesi yoluyla başka fonksiyonların grafiklerini bulma" şeklinde ifade edilmiştir. Bu görev tipine ilişkin ders kitabındaki görevler analizlerde yer alan 1, 25, 26 ve 32 nolu görevlerdir.

Görevlerin hangi görev tiplerine ait oldukları kadar nasıl çözüldükleri de prakseolojik analizde önemli görülmektedir. Şekil 2'de görevlerde kullanılan teknik sayıları verilmiştir. Ancak buradaki görevlerden 4 tanesinin ders kitabında birden fazla teknikle çözümlendiği belirlenmiştir. Bunlardan 10 ve 11 nolu görevler hem cebirsel hem grafiksel olmak üzere 2 farklı teknikle, 50 nolu görev cebirsel, şema ve liste şeklinde 3 farklı teknikle ve 63 nolu görev farklı 2 cebirsel teknikle çözümlenmiştir. Diğer görevler sadece 1 teknikle ders kitabında çözülmüştür. Şekil 2'de görevlerde kullanılan teknikler verilmiştir.



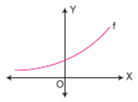
Şekil 2. Görevlerin Çözümünde Kullanılan Teknikler

Şekil 2'de görüleceği üzere, 10.sınıf matematik ders kitabında Fonksiyonlarla İşlemler ve Uygulamalar ünitesiyle ilgili görevlerin %43'ünde cebirsel teknik, %40'ında grafiksel teknik, %10'unda cebirsel ve grafiksel teknik birlikte ve %7'sinde diğer tekniklerin kullanıldığı görülmektedir. Fonksiyon konusunun öğretiminde cebirsel ve grafiksel tekniklerin en fazla kullanıldığı ve bu tekniklerin kullanım oranlarının birbirine yakın olduğu görülmektedir. Bu sonuçlardan görevlerin %93'ünde ağırlıklı olarak cebirsel ya da grafiksel teknikler kullanıldığı söylenebilir.

Burada ayrıca ders kitabında geçen görevlerin 115'inin tek bir teknikle, 3 görevin 2 teknikle ve 1 görevin 3 teknikle çözüldüğü belirlenmiştir. Dolayısıyla görevlerin çözümünde alternatif tekniklere neredeyse hiç yer verilmediği anlaşılmaktadır.

Ders kitabında yer alan görevler prakseolojik olarak nasıl yapılandırılmıştır? Teknolojik açıklamalara ne ölçüde yer verilmiştir? Bu tür soruların yanıtları tablo 5'teki bazı görevlerin prakseolojik analizinde görülmektedir.

Tablo 5. Ders Kitabında Geçen Bazı Prakseojiler

Görev	No	Teknik	Teknoloji	Teori
$y=f(x)=x^2$ fonksiyonu ile $y=f(x)+2$ fonksiyonunun grafiklerini çizerek, aralarındaki ilişkiyi bulma	1	Grafiksel	Sonuçta "f(x) + b" fonksiyonunun grafiği, f(x) fonksiyonunun grafiğinin y ekseni boyunca |b| birim ötelenmesi ile elde edilir. ($b > 0$ ise pozitif yönde, $b < 0$ ise negatif yönde öteleme yapılır).	-
f ve g Reel sayılardan Reel sayılarda iki fonksiyon olsun. $f(x)=x+1$ ve $g(x)=2x$ ise $(f+g)(x)$ nedir?	19	Cebirsel	-	-
 Analitik düzlemde f fonksiyonunun grafiği verilmiştir. Buna göre f^{-1} grafiğini çiziniz?	52	Grafiksel	f ile f^{-1} birbirinin tersi iki fonksiyon ise $\forall(x, y) \in f$ için $(y, x) \in f^{-1}$ ve (x, y) noktasının $y = x$ doğrusuna göre simetriği de (y, x) olduğundan f^{-1} fonksiyonunun grafiği şekilde görüldüğü gibi f fonksiyonunun grafiğinin $y = x$ doğrusuna göre simetriği alınarak çizilir.	-

Tablo 5'de görüldüğü üzere, bazı görevlere ilişkin teknolojik açıklamalara ders kitabında yer verildiği anlaşılmaktadır. Ancak teori türünden açıklamalar yer almamaktadır. Burada 1 ve 52 nolu görevin teorisi düzlem geometri içerisinde yer alan ve uzaklığı koruyan dönüşümler olarak tanımlanan izometriler olarak ifade edilebilir. 19 nolu görevin teorisi ise polinom halkası olarak belirlenmiştir.

SONUÇ

Bu çalışmada 10.sınıf matematik ders kitabındaki fonksiyonlarla işlemler ve uygulamaları ünitesi DAT'ın temel analiz yöntemi olan prakseolojik analiz yaklaşımıyla incelenmiştir.

Analiz sonuçlarına göre ders kitabında belirlenen görevlerin çoğunlukla cebirsel ve grafiksel tekniklerle çözüldüğü tespit edilmiştir. Ders kitabında grafiksel tekniklere neredeyse cebirsel teknikler kadar yer verilmesinin, matematik dersi öğretim programının fonksiyon konusunun öğretimi ile ilgili benimsediği yaklaşımla uyumlu olduğu söylenebilir. Zira programda, fonksiyonların öğretiminde kullanılan bağıntı temelli yaklaşım terkedilmiş, reel fonksiyon temelli, analiz konuları ile daha uyumlu olan bir yaklaşım benimsenmiştir. Bu yeni yaklaşımda fonksiyonların grafik temsili ve grafik temsili ile cebirsel temsil arasında ilişki ön plana çıkmaktadır. Ayrıca bazı tekniklerde tekniğin niçin geçerli olduğuna ilişkin teknolojik açıklamalara da yer verildiği görülmüştür. Bununla birlikte, görevlerin genellikle bir teknikle çözüldüğü ve alternatif tekniklere yer verilmediği tespit edilmiştir. Bir görevin farklı tekniklerle çözülmesi öğrencilere daha fazla bir otonomi verebilir, muhtemel teknikleri değerlendirerek, probleme en uygun tekniği seçmelerini sağlayabilir ve böylelikle öğrendikleri konu ve kavramları daha iyi anlamlandırmalarına katkı sağlayabilir. Bu nedenle ders kitaplarında daha fazla görevin farklı tekniklerle çözümüne yer verilmesinin öğretime pozitif bir katkı sağlayacağı düşünülmektedir.

NOT

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SEVENTH GRADE STUDENTS' IDEAS ABOUT THE HYDROELECTRIC PLANT TRIP

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ABSTRACT: Learning occurs not only in the formal learning environment, but also in the informal learning environment which is outside of the school/class. In recent years, informal learning activities are organized and used as the learning environments such as museums, zoos, botanical gardens, and planetarium. Within the scope of this activities, learning can be performed the trips being drawn up within a plan and taking into account of students' interests and desires outside the school boundaries. Considering this context, this study is intended to reflect the information and the impressions gained from the hydroelectric power plant (HEPP) trip designed for 7th grade students in a TUBITAK project. In accordance with the nature of the study process, this study has been designed by qualitative research methods on the purpose of capturing and making sense of "lived experience" with their perspectives. The sample of the study consists of 30 students. Data are collected by the form of Know-Want-Learn (KWL). On the eve of the trip, experiments and explanations related transformers were discussed and the HEPP was mentioned. Before the trip, "What do I know?" - "What I want to know?" sections and after the trip "What have I learned?" section in the KWL form are filled by the students. The data are analyzed descriptively and the examples of students' expressions are presented. The findings show that the students mostly know the electric energy generating from water/potential energy, want to know how to work the HEPP and have learned the generation process of electricity. It is seen that the students who think HEPP damage to the environment before the trip change their opinions after the trip. With the informal learning activities, the students have received information not only on the subject and also on the subject in the context of different disciplines. Therefore, as an important element to gain knowledge for students the field trips must be a part of the learning environment.

Key words: hydroelectric power plant, 7th grade student, informal learning environment, field trip.

YEDİNCİ SINIF ÖĞRENCİLERİNİN HİDROELEKTRİK SANTRAL GEZİSİ HAKKINDAKİ DÜŞÜNCELERİ

ÖZET: Öğrenme sadece formal öğrenme ortamlarında değil, okul/sınıf dışında oluşan informal öğrenme ortamlarında da gerçekleşmektedir. Son yıllarda informal öğrenme faaliyetleri düzenlenmekte ve müzeler, hayvanat-botanik bahçeleri, gözlemevleri gibi ortamlar bir öğrenme ortamı olarak kullanılmaktadır. Bu faaliyetler kapsamında, öğrenme bir plan dâhilinde hazırlanacak olan gezilerle okul sınırları dışında öğrencilerin ilgi ve isteklerini de dikkate alarak gerçekleştirilebilir. Bu bağlam dikkate alınarak, bu çalışmada 7. sınıf öğrencileri için düzenlenmiş olan bir TÜBİTAK projesinde öğrencilerin hidroelektrik santral (HES) gezisinden edindikleri izlenimlerini ve HES hakkındaki bilgilerini yansıtmak amaçlanmaktadır. Çalışma "Yaşanmış deneyimleri" onları yaşayanların bakış açısı ile yakalamak ve anlamlandırmak amacıyla çalışma sürecinin doğasına uygun olarak nitel araştırma yöntemine göre desenlenmiştir. Çalışmaya 30 öğrenci katılmıştır. Veriler Know-Want-Learn (KWL) formu ile toplanmıştır. Gezi öncesinde transformatörler ile ilgili deney ve açıklamalar yapılmış ve gezinin yapılacağı HES'ten bahsedilmiştir. Geziden önce KWL formunun "Ne biliyorum?" ve "Ne öğrenmek istiyorum?" kısımları ile gezi tamamlandıktan sonra formun "Ne öğrendim?" kısmı öğrenciler tarafından doldurulmuştur. Veriler betimsel olarak analiz edilerek, öğrencilerin ifadelerinden alıntı örnekleri sunulmuştur. Elde edilen bulgular, öğrencilerin en çok su/potansiyel enerjiden elektrik enerjisi üretildiğini bildiklerini, HES'in nasıl çalıştığını öğrenmek istediklerini ve elektrik üretim sürecini öğrendiklerini göstermektedir. Geziden önce HES'in doğaya zarar verdiğini düşünen öğrencilerin, gezi sonrasında fikirlerinin değiştiği görülmektedir. Hazırlanan informal öğrenme faaliyetleri ile öğrencilerin sadece konuyu değil, konu bağlamında farklı disiplinlerde de bilgiler edindiklerini göstermektedir. Bu sebeple, öğrencilerin bilgi kazanımı açısından önemli bir unsur olarak alan gezilerinin öğrenme ortamlarının bir parçası olması gerektiği düşünülmektedir.

Anahtar sözcükler: hidroelektrik santrali, 7. sınıf öğrencileri, informal öğrenme ortamları, alan gezisi.

GİRİŞ

Son yıllarda müzeler, akvaryumlar, hayvanat-botanik bahçeleri, gözlemevleri gibi yerler informal öğrenme ortamları olarak düzenlenmekte ve öğrenmenin gerçekleştirilmesi için kullanılmaktadır. İnformal öğrenme "sınıf dışında keşif yoluyla gerçekleşen, yaparak deneyimsel öğrenme süreci" (Priest, 1986) olarak tanımlanmaktadır. İnformal öğrenmenin karakteristik özelliği, öğrenenin neyi, niçin, nasıl ve ne zaman öğrendiğini kontrol edebilmesidir (Lakin, 2006). İnformal öğrenme ortamlarında süreçte öğrenciler fen, matematik, çevre bilinci ve okulla ilgili diğer alanlarda çeşitli bilgi ve beceriler kazanma olanağı elde ederler (Anderson, Kisiel & Storksdieck, 2006; Çavuş, Topsakal & Kaplan, 2013). Öğrencilerin sınıf içi etkinliklerle kazanmaları neredeyse çok zor olan bilgileri ve becerileri iyi yapılandırılmış informal öğrenme ortamları sırasında daha kolay edinebilmekte ve pekişebilmekte buna ek olarak kalıcı ve anlamlı öğrenmeye yardımcı olmaktadırlar (Altıntaş, 2014; Laçin-Şimşek, Balkan Kıyıcı & Atabek Yiğit, 2013; Lakin, 2006). Bozdoğan (2007) bilim müzelerinde gerçekleştirdiği çalışmasında, çalışmaya katılan öğrencilerin akademik başarısının arttığını ortaya çıkarmıştır. Balkan-Kıyıcı ve Atabek-Yiğit (2010) rüzgâr enerjisi konusu paralelinde Bandırma Rüzgar Enerjisi Santrali"ne yaptıkları teknik gezi sonrasında Fen Bilgisi öğretmen adaylarının birinci elden bilgi edinmeye fırsat vermesi, gözlem yapma olanağı sağlaması, öğrenilenlerin somut olarak gözlenmesi neticesinde kalıcı ve anlamlı öğrenmeye yardımcı olması ve aynı zamanda öğrenmenin yanında eğlence faktörünü de içinde barındıran sosyal etkileşime fırsat tanıması şeklinde olumlu fikirlere sahip olduklarını tespit etmişlerdir. Nitekim soyut olan konuların somut bir şekilde öğrencilerin zihinlerinde yapılandırılmasına katkı sağlayan yöntem ve aktivitelerin öğrenmeyi kolaylaştırdığı da bilinmektedir (Dönmez-Usta, Karslı & Durukan, 2016). Yine informal bir öğrenme ortamında gerçekleştirilen ve Ertaş, Şen ve Parmasızoğlu (2011) tarafından yürütülen çalışmada, Enerji Parkı'na gezi öncesinde HES'teki elektrik üretimi ile ilgili hareket enerjisinin elektrik enerjisine dönüşmesi doğru yanıtını veren öğrenci sayısı, gezi sonrasında artmıştır. Bu durum, öğrencilerin bilim müzesine yönelik gezisi sonrasında konu ile ilgili bilgilerinin arttığını gösterebilir. Ayrıca informal fen öğrenme ortamları ve deneyimleri farklı özellikteki öğrencilere uygun öğrenme fırsatları sunmada ve öğrencileri her alanda feni öğrenmeye motive etmede (Hofstein & Rosenfeld, 1996) ve fene yönelik tutumlarında (Wulf, Mayhew, Finkelstein, Singh, Sabella & Rebello vd., 2010) önemli katkılara sahiptir. Bu nedenlerle fenin öneminin ve gerekliliğinin öğrencilere kazandırılması için formal eğitimin yanında informal öğrenme olanaklarının da kullanılarak öğretimin desteklenmesi öğrencilere önemli katkılar sağlayacaktır.

2013 yılı Fen bilimleri dersi öğretim programında da derslerin planlanması ve uygulanması sırasında, öğrencilerin anlamlı ve kalıcı öğrenmelerinin sağlanması için informal öğrenme ortamlarının tasarlanmasına yer verildiği görülmektedir (MEB, 2013). Çünkü okul dışı öğrenme ortamları dikkatleri çabuk dağılan öğrencilerde uyarıcı etki yaratarak, öğrenilenlerin hatırlanabilirliğini arttırmakta, öğrencilerin bilişsel becerilerinin yanı sıra duyuşsal ve psikomotor becerilerinin de gelişimine katkı sağlamaktadır (Lakin, 2006). Buna ek olarak okul dışı ortamlar öğrencilerin gündelik yaşamlarındaki olaylar ile fen konularının ilişkilendirilmesinde etkin rol oynamaktadırlar (Ertaş, Şen & Parmasızoğlu, 2011). Bu özelliklerinden dolayı öğretim programlarında yer verilen informal öğrenme ortamlarında öğretimin uygulamada da yapılması oldukça önemlidir. Öğretim programına uygun informal öğrenme ortamlarına arazi gezileri, Hidroelektrik Santrali (HES) gezileri, zeytinyağı, iplik-dokuma, un, fındık vb. gibi bitkisel kaynaklı üretim yapan işletmelere yapılan geziler, doğal anıt örnekleri gezileri, gökyüzü gözlem evi gezisi ve su arıtma tesisleri gezisi örnek olarak verilebilir (Bozdoğan, 2007).

Enerji ve HES

Günümüzde enerji ihtiyacı her geçen gün artmaktadır. Fosil yakıtlar ve yenilenemeyen enerji kaynaklarının kullanımı ile enerji ihtiyacının önemli bir kısmı karşılanmasına rağmen bu kaynakların rezervlerinin tükenebilir olması yenilenebilir enerji kaynaklarına doğru bir yönelime sebep olmuştur. Bir çok ülke yenilenebilir enerji kaynağı olarak hidrolik, güneş, rüzgar gibi yenilenebilir enerji kaynaklarından yararlanmaktadır. Ülkemiz hidrolik enerji açısından büyük bir potansiyele sahiptir (Gençoğlu, 2002; Kumbur, Özer, Özsoy & Avcı, 2005). Bu sebeple akarsularımızda birçok HES kurulmuş ve kurulmaya devam edilmektedir. HES basitçe suyun belli bir kottan düşürülüp türbinleri döndürmesi yolu ile elektrik üreten merkezlerdir (Ürker & Çobanoğlu, 2012).

Son yıllarda artan HES yapımı ile kamuoyunun dikkati bu konuya çekilmiştir. Bu durum aynı zamanda, eğitim araştırmacılarının da dikkatini çekmiş, özellikle öğretmen adaylarının HES'e yönelik görüşlerini ortaya çıkaran çalışmalar yapılmıştır (Kılıçaslan, Aymen-Peker & Gün, 2011; Yangın, Geçit & Delihasan, 2012; Geçit & Yangın, 2012; Bodur & Şenyuva, 2013). Buna benzer olarak Sever ve Ulu-Kalın (2010) da Deriner ve Yusufeli Barajları çevresinde yaşayan halkın HES ile ilgili görüşlerini ortaya çıkarmışlardır. Bu araştırmalarda katılımcıların HES ile ilgili yeterli bilgiye sahip olmadıklarını ortaya çıkaran açıklamalar yaptıkları görülmektedir (Kılıçaslan, Aymen-Peker & Gün, 2011; Yangın, Geçit & Delihasan, 2012; Geçit & Yangın, 2012; Bodur & Şenyuva, 2013; Sever & Ulu-Kalın, 2010). Öztürk ve Leblebicioğlu (2012) ise, HES'ler ile ilgili değişik gruplardan katılımcıların görüşlerini almışlardır. Konu ile ilgili gruplardan, sorumluların ülkenin kalkınması için HES'lerin yapımının devam etmesini buna karşın çevre örgüt üyelerinin HES'lerin doğaya vereceği zararları gerekçe göstererek yapımının durdurulmasını ve halk grubunun çoğu HES'lerin neden olacağı ekolojik tahribatı sosyo-ekonomik zararları gerekçe göstererek yapımının durdurulmasını savunmuşlardır. Ancak yapılan çalışmalardan küçük yaşlardaki öğrencilerin HES ile ilgili düşüncelerini, HES gezisi sonrası edindikleri deneyimlerini ve bilgilerini ortaya çıkarmaya yönelik bir çalışmaya rastlanılamamıştır. Küçük yaştaki öğrencilerin HES ile ilgili görüşlerinin neler olduğunun belirlenmesinin ve onların informal öğrenme ortamı sonrasındaki görüşlerinin değişimi üzerine olan katkılarının araştırılması önemli ve gerekli görülmektedir. Böylece öğretmenin kontrolü altındaki ortaokul öğrencileri santraller ile küçük yaşlarda tanışarak kalıcı öğrenmeler sağlayabilirler.

Bu bağlamda yapılan çalışmanın amacı 7. sınıf öğrencileri için düzenlenmiş olan bir projede öğrencilerin HES gezisinden edindikleri izlenimlerini ve HES hakkındaki bilgilerini ortaya çıkarmaktır.

YÖNTEM

Araştırmanın amacına, sürecin işlenişine ve doğasına en uygun yöntem olarak araştırma nitel araştırma yöntemine göre desenlemiştir. Nitel araştırmanın temel özelliklerinden birisi ele alınan olguyu katılımcıların bakış açısıyla anlamaya odaklanmasıdır. Araştırmada "yaşanmış deneyimleri" onları yaşayanların bakış açısı ile yakalamak ve anlamlandırmak istiyorsanız nitel çalışma yapmak uygundur (Şimşek & Yıldırım, 2013).

Çalışma grubu

Araştırmanın örneklemini ortaokul 7. Sınıfı tamamlamış 30 (yaşları 13 ile 14 arası değişen, 16 kız-14 erkek) öğrenci oluşturmaktadır. Örneklemi belirlemek için; Giresun ili ve çevre ilçeleri kapsamındaki tüm ortaokullara TUBİTAK doğa eğitimi projesine katılım çağrısı yapılmış, başvurular sonrası 7. sınıf karne başarısı yüksek olan gönüllü ilk 30 öğrenci araştırmaya alınmıştır. Katılımcılar Ö1, Ö2, Ö3,………, Ö30 şeklinde kodlanmıştır.

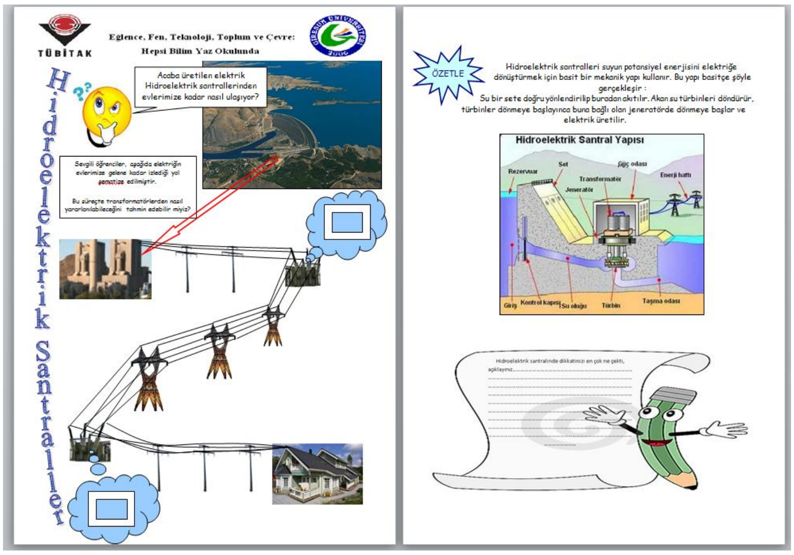
Veri toplama aracı ve verilerin analizi

Bildiklerim-Öğrenmek istediklerim-Öğrendiklerim (Know-Want-Learn / KWL) tüm konular için kullanılabilecek şema teorisine dayanan basit ama güçlü bir stratejidir (Tok, 2013). Bu sorulardan oluşan form, öğrencilerin konu ile ilgili bilgilerine, ne öğrenmek istediklerine ve sürecin sonunda ne öğrendiklerine dayanan grafiksel bir düzenleme yaklaşımıdır (Camp, 2000). Bu strateji ile öğrenci süreçten edindiği bilgi ile önceki bilgileri arasında bir bağ kurar, bilgiyi organize eder, birleştirir ve özetler (Headley & Dunston, 2000). Çalışmaya ait veriler "Ne biliyorum?", "Ne öğrenmek istiyorum?" ve "Ne öğrendim?" şeklindeki üç açık uçlu sorudan oluşan bu form aracılığıyla toplanmıştır.

Veriler betimsel olarak analiz edilmiştir. Öğrencilerin yanıtları, benzer özelliklerine göre kodlara ayrılarak, bu kodlara ait ifade sıklığı (frekanslar) belirlenmiştir. Öğrencilerin birden fazla kodda yer alan yanıtları da bulunmaktadır. Bu nedenle, bazı sorularda verilen yanıtlara göre oluşturulan koda ait ifade sayısı, öğrenci sayısından fazladır. Verilen yanıtlar, birbirinden bağımsız iki uzman tarafından kodlanarak, uzmanlar arasında fikir birliğine varılan kodlarda karar kılınmıştır. Bununla birlikte, düzenlenen verilerin geçerliğini sağlamak amacıyla öğrencilerin ifadelerinden doğrudan alıntılara yer verilmiş ve tablolar eşliğinde sunulmuştur.

Uygulama süreci

Gezi gerçekleştirilmeden önce bir fen laboratuvarında "elektrik akımının manyetik alan oluşturması" ve "manyetik alanın elektrik akımı oluşturması" ile ilgili iki deney gerçekleştirilmiştir. Bu deneylerden yola çıkılarak transformatörler tanıtılmış, transformatörlerle ilgili bir deney yapılmış ve kullanım alanları tartışılmıştır. Kullanıldığı alanlardan birinin de HES olduğundan bahsedilmiştir. Gezi öncesinde HES'in ürettiği elektriğin evlerimize nasıl ulaştığı ve bu sırada transformatörlerden nasıl yararlanıldığı tartışılmıştır. Sonrasında da gezi yapılacak olan HES kısaca tanıtılmıştır. Gezi süresince öğrencilerin not alabileceği bir çalışma yaprağı hazırlanmış (Şekil 1) ve gezi öncesinde onlara dağıtılmıştır.



Şekil 1. Çalışma yaprağı

Geziden önce öğrencilere KWL formu dağıtılmış ve HES ile ilgili “ne biliyorum?” ve “ne öğrenmek istiyorum?” sorularını cevaplamaları istenmiştir. Öğrenciler HES’i 10 kişilik gruplar halinde yaklaşık yarım saat süreyle gezmişlerdir. Bu sırada santraldeki elektrik, elektronik ve makine mühendislerine merak ettikleri soruları yöneltmişlerdir. Öğrencilere, 6 rehber, 3 mühendis ve 6 eğitmen eşlik etmiştir. Gezi sonrasında konu ile ilgili bilgilerini toparlamak amacıyla 10 dakika süren kısa bir soru-cevap uygulaması yapılmıştır. Ardından, KWL formunda “ne öğrendim?” kısmını doldurmaları istenmiştir.

BULGULAR

KWL formundan elde edilen veriler sorular bazında özetlenerek sunulmuştur. Öğrencilerin formdaki HES ile ilgili “ne biliyorum?” sorusuna verdikleri yanıtlar Tablo 1’de yer almaktadır.

Tablo 1. Öğrencilerin HES ile ilgili “ne biliyorum?” sorusuna verdikleri yanıtlar

Kodlar	Öğrenci kodu	f
Su enerjisini elektrik enerjisine çevirdiğini	Ö1, Ö5, Ö7, Ö10, Ö12, Ö22, Ö23, Ö28, Ö29	9
Potansiyel enerjiden elektrik enerjisi üretildiğini	Ö6, Ö8, Ö11, Ö15, Ö27, Ö30	6
Potansiyel enerjinin kinetik enerjiye dönüştüğü	Ö17, Ö23	2
Yerçekimi potansiyel enerjisini elektrik enerjisine dönüştüğü	Ö19	1
Suyun kinetik enerjisini elektrik enerjisine dönüştüğünü	Ö20	1
Elektrik enerjisi ürettiğini	Ö14, Ö16, Ö21, Ö22, Ö23, Ö24, Ö25, Ö26	8
Yenilenebilir enerji kaynağı olduğunu	Ö8, Ö9, Ö30	3
Elektrik santrali olduğunu	Ö3, Ö18	2
Enerji kaynağı olduğunu	Ö2	1
Barajlarda bulunduğu	Ö8, Ö15, Ö21, Ö30	4
Transformatörleri içerdiği	Ö2, Ö9, Ö13, Ö20	4
Maliyeti fazla olduğunu	Ö8, Ö30	2
Doğaya zarar verdiğini	Ö19, Ö29	2
Patlama olasılığı olduğunu	Ö14	1
Toplumun tepkili olduğunu	Ö18	1
Akarsu üzerine kurulduğunu	Ö25	1
Açıklama yok	Ö4, Ö20	2

f: ifade sıklığı

Tablo 1’den öğrencilerin HES ile ilgili genel olarak HES’te enerji dönüşümlerinin meydana geldiğini ve HES’in enerji ürettiğini bildikleri görülmektedir. Bununla birlikte, öğrencilerin HES’lerin barajlarda bulunduğunu ve transformatörleri içerdiğini belirttikleri görülmektedir. Ayrıca, öğrenciler HES’in maliyetinin fazla olduğunu ve doğaya zarar verdiğini de ifade etmişlerdir. Öğrencilerin formdaki ilk soruya verdikleri yanıtlardan birkaç alıntı aşağıda yer almaktadır:

> "*Barajlarda elektrik üretildiğini ve potansiyel enerjiden elektrik enerjisi elde edildiğini biliyorum (Ö15)*"
> *"HES Karadenizli tarımcılar tarafından pek hoş karşılanmayan ama topluma çok büyük katkısı olan santrallerdir (Ö18)"*
> *"… Akarsuların yolunu kestiği için doğaya zarar verdiğini biliyorum (Ö19)"*.

Öğrencilerin formdaki HES ile ilgili "ne öğrenmek istiyorum?" sorusuna verdikleri yanıtlar Tablo 2'de sunulmuştur.

Tablo 2. Öğrencilerin HES ile ilgili "ne öğrenmek istiyorum?" sorusuna verdikleri yanıtlar

Kodlar	Öğrenci kodu	f
HES'in/içerisindeki aletlerin nasıl çalıştığını	Ö2, Ö4, Ö9, Ö12, Ö13, Ö15, Ö20, Ö21, Ö25, Ö26, Ö27, Ö28, Ö29, Ö30	14
Mekanizmasını incelemeyi ve isimlerini öğrenmeyi	Ö17, Ö25	2
HES'teki transformatörlerin görevini	Ö2, Ö13	2
Nasıl bir enerji kaynağı olduğunu	Ö8	1
Elektrik enerjisinin nasıl ürettiğini	Ö14, Ö21, Ö22, Ö24	4
Ne kadar elektrik ürettiğini	Ö21	1
Enerji türleri arasındaki dönüşümü	Ö22, Ö27	2
Üretilen elektriğin evimize nasıl ulaştığını	Ö10	1
HES'in nasıl göründüğünü	Ö10, Ö19, Ö27	3
Santralin kurulumu için neler gerektiğini	Ö14, Ö28	2
Elektrik santrali patlarsa/bozulursa ne olacağını	Ö3, Ö4	2
HES'in özelliklerini	Ö16	1
Doğaya verdikleri zararı	Ö14, Ö18, Ö19, Ö29	4
HES hakkındaki her şeyi	Ö1, Ö3, Ö5, Ö6, Ö7, Ö11, Ö16, Ö23, Ö24	9

Öğrenciler HES'in nasıl çalıştığını, nasıl elektrik ürettiğini, mekanizmasını, doğaya verdikleri zararı ve HES hakkındaki bilmedikleri her şeyi öğrenmek istediklerini belirtmektedirler (Tablo 2). Öğrencilerin bu soru için verdikleri yanıtlardan birkaç alıntı aşağıda yer almaktadır:

> *"Santral kurulumu için neler gerektiğini, elektrik enerjisinin nasıl üretildiğini ve hidroelektrik santrallerinin zararlı yanlarını öğrenmek istiyorum (Ö14)"*
> *"Santrallerin şeklini, nasıl çalıştığını, potansiyel enerjiyi nasıl elektrik enerjisine dönüştüğünü öğrenmek istiyorum (Ö27)"*
> *"Barajların nasıl çalıştığını, sistemlerde ve santrallerde hangi alet ve gereçlerin kullanıldığını, kaç kişinin çalıştığını, bir santral için nasıl bir alan gerektiğini vb merak ediyorum (Ö28)"*.

Öğrencilerin HES gezisinden sonra formdaki HES ile ilgili "ne öğrendim?" sorusuna verdikleri yanıtlar Tablo 3'te sunulmuştur.

Tablo 3. Öğrencilerin HES ile ilgili "ne öğrendim?" sorusuna verdikleri yanıtlar

Kodlar	Öğrenci kodu	f
Elektrik enerjisi üretim süreci	Ö1, Ö2, Ö3, Ö4, Ö6, Ö7, Ö8, Ö9, Ö10, Ö11, Ö12, Ö13, Ö14, Ö15, Ö17, Ö19, Ö20, Ö22, Ö23, Ö24, Ö25, Ö26, Ö27, Ö28, Ö29, Ö30	26
Üretilen enerji miktarını	Ö1, Ö5, Ö8, Ö12, Ö21	5
Transformatörleri süreçteki görevini	Ö2, Ö20, Ö25, Ö28	4
Çarkların çok hızlı ve güçlü olduğunu	Ö1, Ö2, Ö3, Ö4, Ö5, Ö7, Ö9, Ö21, Ö27	9
Elektriğin evlerimize gelmesini	Ö21, Ö22, Ö23, Ö24, Ö30	5
Suyun geri dönüşümlü kullanımını	Ö5, Ö16, Ö18	3
Çevreye etkisini	Ö11, Ö16, Ö19	3
Canlılara etkisini	Ö7	1
HES'in yapısını	Ö19, Ö30	2
HES'in verimliliğini	Ö19	1
Santralin kurulumu için gereken sürecini	Ö14, Ö20	2
Santralde dikkat edilmesi gereken hususlarını	Ö14	1

Santral çalışanlarının eğitimini	Ö14	1
Çalışanların ücretini	Ö15, Ö16, Ö18, Ö19, Ö20, Ö21, Ö22	7
İş kazaları/Çalışanların güvenliği	Ö15, Ö19, Ö20, Ö26	4
Toplumun tepkisi	Ö18	1
Enerji hattı olan yerin çok tehlikeli olduğunu	Ö9	1
Elektrik santrallerinin patlamasının küçük bir ihtimal olduğunu	Ö3	1
Santral kaynaklı elektrik arızalarını	Ö21	1
Santraldeki riskleri	Ö14	1

Öğrencilerin önemli bir çoğunluğu gezi sonrası HES'teki elektrik enerjisi üretim sürecini öğrendiklerini belirtmişlerdir (Tablo 3). Bunun yanı sıra, HES mekanizmasının içerisindeki çarkların ve transformatörlerin nasıl çalıştığını öğrendiklerini ifade etmişlerdir. HES'te üretilen enerji miktarı ve üretilen bu enerjinin evlerimize kadar nasıl ulaştığı hakkında da bilgi sahibi olduklarını açıklamışlardır. HES'in çevreye ve canlılara etkilerini öğrendiklerini belirten öğrenciler az sayıdadır. Bununla birlikte, öğrenciler santral, santral çalışanları, çalışanların eğitimi ve güvenliği hakkında bilgi aldıklarını ifade etmişlerdir. Öğrencilerin 'ne öğrendim?' sorusu için verdikleri yanıtlardan örnek alıntı ifadeler aşağıda sunulmaktadır:

> *"Suyun çarka çarpınca çarkı döndürdüğünü ve bu olay üzerine bir enerji ortaya çıktığını ve hidroelektrik santrallerinde evimize gelen elektrik geriliminin 150000 V'tan 220 V'a kadar düştüğünü öğrendim (Ö1)"*
>
> *"Su çarkı döndürür ve jeneratörü çalıştırır. Bu sayede elektrik üretilir (Ö6)"*
>
> *"…Suyun hızıyla araya canlıların girebildiğini ve çarkın araya giren canlıları öldürdüğünü öğrendim. Ama çok az oluyormuş… (Ö7)"*
>
> *"Su bir sete doğru yönlendirilip buradan akıtılır. Gelen su türbinleri döndürür ve elektrik üretilir… (Ö8)"*
>
> *"…HES projesi doğaya o kadar zarar vermiyormuş… (Ö16)"*
>
> *"Vatandaşın tepkilerinin boş yere olduğunu, aslında abartıldığı kadar kötü olmadığını öğrendim… (Ö18)"*
>
> *"Transformatörler ile elektrik Volt'unun arttırılıp azaltılabileceğini, derelerin boyutlarına göre HES yapılabileceğini, … olası kazaları ve alınacak önlemleri öğrendim (Ö20)".*

TARTIŞMA ve SONUÇ

Bu çalışma, 7. sınıf öğrencilerinin HES gezisinden edindikleri izlenimlerini ve HES hakkındaki bilgilerini ortaya çıkarmak için yapılmıştır. Ulaşılan sonuçlar, öğrencilerin HES'in su/potansiyel enerjiden elektrik enerjisi ürettiğini ve transformatörleri içerdiğini bildiklerini; HES'in nasıl çalıştığını, nasıl elektrik enerjisi ürettiğini ve özelliklerini öğrenmek istediklerini göstermektedir. Buna ek olarak öğrenciler HES'te elektrik üretim sürecini, çarkların ve transformatörlerin süreç içerisindeki görevlerini, üretilen enerji miktarını, üretilen elektriğin evlerimize nasıl ulaştığını, çalışanların güvenliği ile aldıkları ücretlerini ve HES'in çevreye zarar vermediğini öğrendiklerini göstermektedir.

Öğrencilerin ne biliyorum kısmında ifade ettikleri HES'lerin yapım maliyetlerinin yüksek olması ifadesi literatürdeki farklı çalışmalarda da yer almaktadır (Yangın, Geçit & Delihasan, 2012). Bunun aksine farklı çalışmalarda HES'in maliyetinin düşük olduğunu ifade eden katılımcılarda bulunmaktadır (Sever & Ulu-Kalın, 2011). HES'lerin maliyetin düşük, ekonomik ömrünün yüksek olması gibi nedenlerden dolayı kullanımı/yapımı ülkemizde gün geçtikçe arttığı da bilinmektedir (Sever & Ulu-Kalın, 2011; TMMOB HES Raporu, 2011).

Öğrencilerin gezi öncesinde HES'in elektrik enerjisi ürettiğini ve elektrik enerjisi üretirken enerji dönüşümlerinin gerçekleştiğini bildikleri görülmektedir. Kılıçarslan, Aymen-Peker ve Gün (2011) ise yaptıkları çalışmada öğrencilerin önemli bir kısmını HES ve hidroelektrik enerji kaynakları hakkında bilgi sahibi olmadıklarını göstermektedir. Gezi sonrasında ise, elektrik enerjisi üretim sürecini açıklayabildikleri görülmektedir. Bu noktada, öğrencilerin var olan bilgilerini arttırabildiği yorumu öğrencilerin üretim sürecini açıklayabilmeleri ile yapılabilir. Öğrencilerin gezi öncesindeki bilgileri ile gezi sonrasındaki bilgileri karşılaştırıldığında, gezinin öğrenciler adına faydalı geçtiği ve HES ile ilgili birçok bilgiye sahip oldukları söylenebilir. Gezi öncesinde öğrenciler HES'in elektrik enerjisi ürettiğini ifade ederken; gezi sonrasında elektrik enerjisi üretim sürecini açıklamaları, HES'in çalışma prensiplerinden (mekanizmasından) haberdar olmaları ve üretilen elektriğin evimize kadar ulaşması sürecini ifade etmeleri gezinin öğrenciler adına faydalı olduğunun bir örneğidir. Araştırma sonuçlarına benzer olarak; Balkan-Kıyıcı ve Atabek-Yiğit (2010) yaptıkları araştırmada konuyla ilgili informal öğrenme ortamlarını ziyaret eden kişilerin çoğunluğunun gezi deneyimlerinden birçok şey öğrendiğini belirtmiştir. Bu durum öğrencilerin öğrenme sürecine aktif olarak katılımının, süreci yerinde gözlemlemelerinin ve merak ettikleri her duruma birinci elden bilgi edinmeye fırsat bulabilmelerinin bir yansıması olabilir.

Öğrencilerin "ne öğrenmek istiyorum" sorusuna verdiği cevaplar öğrencilerin HES ile ilgili merak ettikleri durumları ve bilgileri ortaya çıkarmaktadır. Özellikle HES'in nasıl çalıştığını merak etmeleri ve çalışma prensiplerini öğrenmeyi istedikleri görülmektedir. Öğrencilerin ne öğrendim sorusuna verdikleri cevapların, merak ettikleri durumlar ile uyumlu olduğu görülmektedir. Bu durum HES gezisinde öğrencilerin sürece aktif olarak katılarak HES'teki görevlilere ve eğitmenlerine soru sormaları için teşvik edilmelerinin ve yerinde gözlem yapmaların bir sonucu olabilir. Merak ettikleri bilgilerin yanı sıra, öğrencilerin HES ve çalışanları hakkında da bilgi edindikleri tespit edilmiştir. Yapılan çalışmalarda öğrencilere informal öğrenme ortamlarının öğrencilere uygun öğrenme fırsatları sunmada, öğrenmede uyarıcı etki yaratmada ve öğrencilerin ilgi, istek ve meraklarını arttırmada önemli rol oynadığı tespit edilmiştir (Lakin, 2006; Tatar & Bağrıyanık, 2012). Bununla birlikte, HES'in çevreye ve canlılara etkisi ile ilgili bilgi edindikleri de ortaya çıkmıştır. Öğrencilerin alınan önlemler dahilinde HES'in çevreye ve canlılara bahsedildiği kadar zararlı olmadığını ifade ettikleri görülmektedir. Bununla birlikte, enerji üretimi sırasında HES'in su kanallarına girebilen bazı canlıların ölmesine rağmen bu sayının oldukça az olduğunu belirtmişlerdir. Bu durum HES'te öğrencilere bilgi veren mühendislerin elde edilen yüksek miktardaki enerjiye karşın yaşanan zayiatın çok az olduğunu açıklamış olmasının bir sonucu olabilir. Yangın, Geçit ve Delihasan (2012) çalışmalarında az sayıdaki öğretmen adayının HES ile ilgili "Hidroelektrik santraller, işletmeleri esnasında doğaya en az etkisi olan çevre dostu santrallerdir" şeklinde düşündüklerini belirlemiştir. Ancak yapılan bazı çalışmalar katılımcılarının HES'te enerjinin üretimi, iletimi ve kullanımı sırasında ekolojik dengenin bozulması, tarım alanlarına zarar vermesi gibi çevre sorunlarını ortaya çıkardığını belirttiklerini göstermektedir (Sever & Ulu-Kalın, 2011; Öztürk & Leblebicioğlu, 2012; Bilgili & Kocalar, 2014). Benzer şekilde, Bodur ve Şenyuva (2013) öğretmen adaylarının HES'in çevreye zarar verdiğini düşündüklerini ortaya çıkarmıştır. Bu zararları, "Bölgedeki doğal alanlara zarar verir.", "Santralin kurulduğu akarsunun/derenin kurumasına sebep olur.", "Su kaynaklarının kirlenmesi gıda güvenliğini tehdit eder." şeklinde ifade etmektedirler.

ÖNERİLER

HES gibi çevre ile ilgili boyutlara sahip konularda bireylerin bilinçlendirilmesi ve bilgilendirilmesi ile bireylerin çevreye yönelik tutumlarının olumlu yönde geliştirilebileceği düşünülmektedir. Örneğin, Bodur ve Şenyuva (2013), HES hakkında bilgi sahibi olma durumu ile çevreye yönelik tutumları arasında HES hakkında bilgiye sahip olmayan öğrenciler aleyhine anlamlı fark olduğu belirlemişlerdir. Bu bulgu göz önüne alındığında, HES hakkında bilgi sahibi olmayan öğrencilerin çevre ile daha az ilgilendikleri ve çevreye yönelik tutumlarının daha olumsuz olduğunu ifade etmişlerdir. Bu örnek, bu tür etkinliklerin çevreye yönelik tutumu da etkilediğini göstermektedir. Bununla birlikte, HES'in çevreye verdiği zarar konusunda öğrencilerin öğrendikleri ile literatürde var olan çalışmalar arasında farklılık olduğu görülmektedir. Bu durum, yapılan HES gezisi sırasında yalnızca HES'te çalışan mühendislerden bilgi almanın yeterli olmadığını gösterebilir. HES ile ilgili bilgi edinirken yalnızca HES'te çalışan mühendislerden değil coğrafya, biyoloji gibi farklı disiplinlerde uzmanlaşmış kişilerinde desteğinin alınması gerekli olduğu ortaya çıkmaktadır.

Hazırlanan informal öğrenme faaliyetleri ile öğrencilerin sadece konuyu değil, konu bağlamında farklı disiplinlerde de bilgiler edindiklerini de göstermektedir. Bu sebeple, öğrencilerin bilgi kazanımı açısından önemli bir unsur olarak alan gezilerinin öğrenme ortamlarının bir parçası olması gerektiği düşünülmektedir. Bu noktada, informal (okul dışı) öğrenme ortamlarına yönelik bu tür etkinlikleri geliştirmek için öğretmenlerin konu ile ilgili bilgi düzeyleri de önemlidir. Yapılan çalışmalar, öğretmen adaylarının Örneğin HES konusu ile ilgili genel olarak öğretmen adaylarının yeterli bilgi birikimine sahip olmadıklarını göstermektedir (Geçit & Yangın, 2012). Bu sebeple, öğretmen adaylarının da kendilerini geliştirmeleri teşvik edilmeli ki meslek hayatlarında bu tür etkinlikleri rahatlıkla planlayıp yürütebilmeleri sağlanmalıdır. Bilim müzelerine yapılan gezilerinde öğrencilerin konu ile ilgili öğrenmelerine etkisi olduğu tespit edilmiştir (Bozdoğan, 2007). Örnek olarak, Ertaş, Şen ve Parmasızoğlu (2011) tarafından yürütülen çalışmada HES ile ilgili Enerji Parkı'nda yapılan gezi sonrasında konu ile ilgili bilgilerinin arttığını gösterebilir. Bu çalışma ortaokul 7. Sınıf öğrencileriyle sınırlandırılmıştır. Daha geniş kitlelerin (öğrenci, veli, öğretmen adayı ve öğretmenler) okul dışı öğrenme ortamlarında öğrenmenin gerçekleştirilmesine yönelik projelere katılmaları için gerekli destekler verilmeli ve projeler tüm Türkiye geneline yaygınlaştırılmalıdır.

NOT

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THE IMPACT OF ROTATING CLASS SYSTEM ON THE SUCCESS LEVELS AND ATTITUDES OF THE STUDENTS IN THE LIGHT UNIT

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ABSTRACT: The purpose of this study is to examine whether 7th grade "light topic" taught in rotating class has an impact on students' attitudes towards science and technology. This study, which was designed as an experimental design in the form of pre-test post-test control group, was carried out with 46 7th grade students in the 60th Year Secondary School in Altınordu district of Ordu province in the second semester of 2014-2015 academic year. The sample group of the study was chosen via convenience sampling and the experimental and control groups were randomly selected among the sample. The classes of the experimental group of the study (n=23) were taught in rotating classrooms whilst the classes of students in the control group (n=23) were taught in classical classroom for 4 class hours in a week for 4 weeks as stated in the annual plan. The quantitative data used in the study have been abtained from the achievement test and The Attitude survey for Science and Technology. The data collection tools were administered as a pre-test before the experimental process and a post-test after the experimental process. The collected quantitative data in the study were analyzed using SPSS 16.0 package programme. And since the data in the study showed a normal distribution, parametric tests were used. The courses carried out in the rotating classrooms were photographed and were used in appropriate places in the study. The results of the analyses revealed that the success levels and attitudes of the students who were taught in rotating classrooms were higher. In this sense, it is believed that wider use of rotating classroom system will have positive effects on success levels.

Key words: rotating class system, science education, light

IŞIK ÜNİTESİNDE ÖĞRENCİLERİN BAŞARILARI VE TUTUMLARI ÜZERİNDE BRANŞ DERSLİK SİSTEMİNİN ETKİSİ

ÖZET: Bu çalışmanın amacı, branş derslik sisteminde işlenen 7.sınıf ışık ünitesinin öğrencilerin akademik başarıları ile fen ve teknolojiye yönelik tutumlarına bir etkisinin olup olmadığını belirlemektir. Ön test-son test kontrol gruplu deneysel tasarımın kullanıldığı bu çalışma 2014-2015 eğitim ve öğretim yılının ikinci döneminde Ordu ili Altınordu ilçesinde 60. Yıl ortaokulunda 7.sınıfta eğitimlerine devam eden 46 öğrenci ile gerçekleştirilmiştir. Araştırma örneklemi kolay ulaşılabilir örneklem metoduyla seçilmiş ve deney ve kontrol grubu seçilen örneklemden rastgele belirlenmiştir. Araştırmanın deney grubunda bulunan öğrencilerin (n=23) dersleri branş derslik sınıfında, kontrol grubunda bulunan öğrencilerin (n=23) dersleri ise aynı süreçte klasik sınıfta yıllık plandaki gibi haftada 4 ders saati olmak üzere toplam 4 hafta süreyle işlenmiştir. Araştırmada kullanılan nicel veriler, başarı testi ve fen ve teknolojiye yönelik tutum anketinden elde edilmiştir. Veri toplama araçları deneysel işlem öncesinde ön test, deneysel işlem sonrasında son test olarak uygulanmıştır. Çalışma sonucunda elde edilen nicel verilerin değerlendirilmesi SPSS16.0 programı kullanılarak yapılmıştır. Çalışmada veriler normal dağılım gösterdiğinden parametrik testler kullanılmıştır. Branş derslik sisteminde yapılan uygulama fotoğrafları çekilerek, çalışma içerisinde uygun yerlerde kullanılmıştır. Analiz sonuçlarında branş derslik sistemi ile eğitim gören öğrencilerin akademik başarıları ve tutumlarının daha yüksek olduğu görülmüştür. Bu bağlamda okullarda branş derslik sisteminin daha yaygın bir şekilde uygulanmasının istenilen başarı düzeyine ulaşmada olumlu etkilerinin olacağı düşünülmektedir.

Anahtar sözcükler: branş derslik sistemi, fen eğitimi, ışık

GİRİŞ

İlk ve orta öğretim kurumlarımızda günümüzde geçerli olan ortam düzenlemesinde, öğrenciler sınıf ve şubelere ayrılmakta ve her dersin öğretmeni bu sınıf ve şubelerde ders dağıtım çizelgesine uygun olarak eğitim ve öğretimi sürdürmektedir. Yani her dersin öğretmeni ders sırası kendine geldiğinde sınıfta yerini almaktadır. Bu durumda sınıflarda (yönetmeliklere göre) masa, sıra, dolap, askı, harita, tahta vb. araç-gereç standart olarak bulunmakta bunların dışında derslerin işlenişinde kullanılacak ders araç gereçleri, donatım malzemeleri sınıflarımızda yer almamaktadır (İbret ve diğerleri, 2011). Niemeyer'e (2003) göre; hem öğrencilerin, hem öğretmenlerin verimini artırmak için, sınıfların hem görsel, hem donanımsal ortam düzenlemeleri dikkatlice düşünülmelidir. Çünkü eğitim ortamlarının düzenleniş şekilleri, öğrenme oranını artırabileceği gibi öğrenmeyi engelleyici de olabilir. Zengin öğrenme ortamlarını, bireylerin öğrenmesi için gerekli araç ve gereçlerin yer aldığı ve bireyin daha aktif olarak öğrenmeye katıldığı ortamlar olarak tanımlanabilir. Uyarıcıların yoğun olduğu çoklu ortamlarda, öğrenme daha iyi gerçekleşebilmektedir. Bu tanımın dışında kalan sınıf çevreleri geleneksel sınıflar olarak adlandırılmaktadır (Keser ve Akdeniz, 2002).

Sorunun ülke gerçeklerine uygun ve kalıcı bir çözüme kavuşturulabilmesi için; ilgili girişimlerin "yeni bina yapımı" yanında, " mevcut binaların etkili kullanımı" boyutunu da göz ardı etmemesi gereksinimi vardır. Bunun çözümü için alınması önerilen önlemlerden birisi de şudur: "Her şubeye bir derslik" tahsis etmek yerine, yükseköğretimde olduğu gibi "her ders için bir derslik" ayrılması yoluna gidilerek, dersliklerin zamansal kullanım oranları artırılmaya çalışılmalıdır (Şimşek, 1995). Her dersin kendine özel konusu ve içeriği olduğu gibi bu konu ve içerikle ilgili hedef ve amaçların (kazanımların) belli bir eğitim düzeyindeki öğrencilere kazandırılabilmesi için de o yöntemlerin uygulanabileceği özel ortamlara ihtiyaç olacağı doğaldır. Yani hangi düzeyde olursa olsun fen bilgisi ile ilgili kazanımları öğrencilerin yapılandırabilmesi için gerekli olanakların sağlanabileceği, özel bir şekilde donatılmış yerlere, özel araç ve gereçlere gereksinim vardır. Öğrenciler, fen bilimlerini gerçek yaşamla ilişkili bir biçimde kullanırlarsa, bu ilişkilendirme öğrenmelerini kolaylaştırabilir (Akgün, 2005).

Öğretim etkinliklerinin planlanmasında öğrencilere kazandırılmak istenen hedef davranışları kazandırmaya, öğrenmelerin daha kalıcı olmasını sağlamaya yönelik daha çok duyu organına hitap eden bir öğrenme ortamının düzenlenmesi, bu ortamın görsel ve işitsel çeşitli araçlarla zenginleştirilmesi oldukça önemlidir. Çünkü öğrenmede kullanılan duyu organının sayısı artıkça öğrenilenlerin kalıcılığı da artmaktadır (Yiğit, Alev, Özmen, Altun, Akyıldız, 2007). Araç-gereçlerle yapılan öğretimin etkililiği ve verimliliğine yönelik alan yazın incelendiğinde pek çok çalışmanın yapıldığı görülmektedir. Bu çalışmalara göre araç-gereçlerle yapılan eğitim; öğrenciler için çoklu öğrenme ortamı sağlamakta, öğrencilerin farklı öğrenme ihtiyaçlarını karşılayarak dersi daha iyi anlamalarını sağlamakta, öğrendiklerinin kalıcı olmasını ve hatırlamalarını kolaylaştırmakta, öğretimi çeşitlendirmekte, öğretimin öğrenciler için ilginç ve eğlenceli olmasını sağlamakta, soyut konuları somutlaştırmakta, içeriği basitleştirmekte, öğrenme kaynaklarını çoğaltmakta, zaman tasarrufu sağlamakta, güvenli gözlem imkânı sağlamakta, eğitimin niteliğini artırıp öğretmenin görevlerini kolaylaştırmaktadır (Çilenti, 1984; Alkan, 1984; Kaya, 2006; Uşun, 2006; Yanpar, 2006; Demirel, 2008; İşman, 2008; Yalın, 2008; Kuzu ve Yeşilyurt, 2008; Yiğit ve diğerleri, 2007).

Eğitim sürecinde bu araçlardan faydalanma da en büyük sorumluluk öğretmene düşmektedir. Çünkü sürecin planlayıcısı, uygulayıcısı ve değerlendiricisi öğretmendir. Bununla birlikte okullarında bulunan pek çok öğretim araç-gerecinin öğretmenler tarafından yeterli sıklıkta kullanılmadığı (Öztürk ve Oltuoğlu, 2003), bazı öğretmenlerin ellerindeki basit bir aracı bile kullanmaktan çekindiği gözlenmektedir (Küçükahmet, 1995). Ülkemizde de öğretim sürecinde ders araç gereçlerinin kullanılması istenilen düzeyde değildir. Uluslararası testlerde (PIRLS) Türkiye'nin aldığı sonuçlar, ders araç-gereç ve eğitim teknolojilerinin etkin bir şekilde kullanılamadığı gerçeğini göstermektedir (Yazıcı, 2006).

Dersin türüne göre, konusuna göre sınıfın yerleşim düzeninin farklı olması gerekebilir (Cangelosi ve Lemoine, 1988). Dolayısıyla sınıf, ustaca düzenlenmiş bir çevre olmalıdır. Çünkü davranışı değiştirmenin en etkili yollarından bir tanesi çevreyi değiştirmektir (Başar, 1998). Günümüzde uygulanan eğitim sistemlerinde öğrenci başarı düzeyini arttırmak için gerekli olan laboratuvar, işlik, branş dersliği gibi eğitim mekânlarının dersin yapısına, konusuna ve çeşidine göre fiziksel ve teknolojik donanımlar ile donatılmış olması önemli görülmektedir (Gültekin ve diğerleri, 2014).

Eğitim ortamını meydana getiren unsurlardan, öğretmen, öğrenci ve öğretilecek konunun içeriği bir araya geldiğinde, etkili ve verimli bir eğitim sağlanabilmesi için, içerisinde çeşitli araç ve gereçlerin de bulunduğu fiziksel bir ortam önem kazanmaktadır. Zira bu ortamın kalitesi, eğitimin de kalitesinin belirlenmesinde etkin rol oynayacaktır (Uçar, 1999). Ersöz'e (2012) göre branş derslik sisteminde öğrencilerde görsel öğrenme artabilir, her dersteki ortam değişikliği monotonluğu azaltabilir. Derslerde daha zengin araç-gereç kullanımı mümkün olabilmektedir. Alan yazın incelendiğinde; branş derslik sistemiyle ilgili yapılan çalışmaların anket ölçme aracı ile öğrenci, öğretmen ve idarecilerin görüşlerinin belirlenmesi ile sınırlı kaldığı görülmektedir. Yapılan bu çalışma ile deneysel olarak branş derslik sisteminin öğrencilerin akademik başarıları ve tutumları üzerindeki etkileri incelenmiştir.

Araştırmanın Amacı

Işık ünitesinde öğrencilerin başarıları ve tutumları üzerinde branş derslik sisteminin etkisinin belirlenmesi bu çalışmanın amacını oluşturmaktadır.

Araştırmanın Problemi

Çalışmanın problem cümlesi "Işık ünitesinde öğrencilerin başarıları ve tutumları üzerinde branş derslik sisteminin etkisi nedir?" olarak belirlenmiştir. Sonrasında da şu alt problemlere cevap aranmıştır.

1. Işık ünitesinin öğretiminde derslik sisteminde öğrenim gören deney grubu ile kendi şubelerinde öğrenim gören kontrol grubunun başarı testi ön-test puanları arasında anlamlı bir farklılık var mıdır?
2. Işık ünitesinin öğretiminde derslik sisteminde öğrenim gören deney grubunun başarı testi ön test ve son test puanları arasında anlamlı bir farklılık var mıdır?
3. Işık ünitesinin öğretiminde kendi şubelerinde öğrenim gören kontrol grubunun başarı testi ön test ve son test puanları arasında anlamlı bir farklılık var mıdır?
4. Işık ünitesinin öğretiminde derslik sisteminde öğrenim gören deney grubu ile kendi şubelerinde öğrenim gören kontrol grubunun başarı testi son-test puanları arasında anlamlı bir farklılık var mıdır?
5. Işık ünitesinin öğretilmesinde deney ve kontrol grubunun fen ve teknolojiye karşı tutum anketi ön test puanları arasında anlamlı bir fark var mıdır?
6. Işık ünitesinin öğretilmesinde deney grubunun fen ve teknolojiye karşı tutum anketi ön test ve son test puanları arasında anlamlı bir fark var mıdır?
7. Işık ünitesinin öğretilmesinde kontrol grubunun fen ve teknolojiye karşı tutum anketi ön test ve son test puanları arasında anlamlı bir fark var mıdır?
8. Işık ünitesinin öğretilmesinde deney ve kontrol grubunun fen ve teknolojiye karşı tutum anketi son test puanları arasında anlamlı bir fark var mıdır?

YÖNTEM

Araştırma Modeli

Araştırmada ön test-son test kontrol gruplu yarı deneysel desen kullanılmıştır. Özellikle eğitim ile ilgili araştırmalarda deney ve kontrol gruplarının oluşturulmasında uyulması gereken yansızlık (Random) kuralını gerçekleştirmek kimi zaman olanaksız, gereksiz veya pahalı olabilir. Bu durumda kullanılmaya en uygun olan model ön test- son test kontrol gruplu modeldir (Kaptan, 1991; Karasar, 2002; Schumacher & McMillan, 1993). Ön test son test kontrol gruplu yarı deneysel desende, bağımsız değişkene maruz kalan bir deney grubu ve bağımsız değişken etkisinde kalmayan ilave bir grup bulunur. Grupların ön test puanları arasında anlamlı bir farklılık yoksa göreceli olarak grupların birbirine denk olduğu söylenebilir. Denencelerin test edilmesinde, her iki grubun ön testten son teste değişim gösteren puanları, anlamlı bir farkın olup olmadığını belirlemek için karşılaştırılır (Bulduk, 2003; Büyüköztürk, Kılıç Çakmak, Akgün, Karadeniz ve Demirel, 2012; Christensen. 2004).

Çalışma Grubu

Bu çalışma 2014-2015 eğitim ve öğretim yılının ikinci döneminde Ordu ili Altınordu ilçesinde 60.yıl ortaokulunda 7.sınıfta eğitimlerine devam eden 46 öğrenci ile gerçekleştirilmiştir. Araştırma örneklemi kolay ulaşılabilir örneklem metoduyla seçilmiş ve deney ve kontrol grubu seçilen örneklemden rastgele belirlenmiştir.

Veri Toplama Araçları

Araştırmada kullanılan ışık ünitesi başarı testi 27 maddeden oluşmakta ve Cronbach Alpha değeri 0,73'tür. Çil (2010) tarafından geliştirilen bu test kendisinden izin alınarak kullanılmıştır. Ayrıca öğrencilerin tutumlarını ölçmek için Aydın (2011) tarafından geliştirilen Cronbach Alpha değeri 0,94 olan fen ve teknolojiye yönelik tutum anketi kendisinden izin alınarak kullanılmıştır. Veri toplama araçları deneysel işlem öncesinde ön test, deneysel işlem sonrasında son test olarak uygulanmıştır.

Deneysel Uygulama

Araştırmanın uygulandığı okulda müsait bir sınıf branş dersliği olarak düzenlendi. Araştırmanın deney grubunda bulunan öğrencilerin (n=23) dersleri branş derslik sınıfında, kontrol grubunda bulunan öğrencilerin (n=23) dersleri ise aynı süreçte klasik sınıfta yıllık plandaki gibi haftada 4 ders saati olmak üzere toplam 4 hafta süreyle işlendi.

Verilerin Analizi

Çalışma sonucunda elde edilen nicel verilerin değerlendirilmesi SPSS16.0 programı kullanılarak yapılmıştır. Analize başlamadan önce elde edilen verilerin normal dağılıma uygun olup olmadığını tespit edebilmek amacıyla, 50'den küçük grup büyüklükleri için uygun görülen (Büyüköztürk, 2012) Shapiro-Wilks testleri uygulanmıştır. Bu teste göre $p>.05$ ise veriler normal dağılım sergiler. Bu doğrultuda veriler normal dağılım gösterdiğinden verilerin analizinden parametrik testler kullanılmıştır.

BULGULAR

Araştırmanın Birinci Alt Problemine İlişkin Bulgular ve Yorumlar

Araştırmanın birinci alt problemi olan "Işık ünitesinin öğretiminde derslik sisteminde öğrenim gören deney grubu ile kendi şubelerinde öğrenim gören kontrol grubunun başarı testi ön-test puanları arasında anlamlı bir farklılık var mıdır?" sorusuna cevap bulmak amacı ile t-testi yapılmıştır.

Tablo 1: Deney Grubu ile Kontrol Grubunun Ön Test Puanları Arasında Bir Farklılık Olup Olmadığını Belirlemek Üzere Yapılan Bağımsız Grup t Testi Sonuçları

Puan	Gruplar	N	$\bar{x}$	ss	$Sh_{\bar{x}}$	*t* Testi		
						t	Sd	p
Başarı Testi Puanı (Ön Test)	Kontrol	23	24,00	8,090	1,687	-0,640	44	0,525
	Deney	23	25,70	9,791	2,042			

Tablo 1 incelendiğinde, kontrol grubunun ön test başarı puan ortalamasının 24,00; deney grubunun ön test başarı puan ortalamasının 25,70 olduğu görülmektedir. Tablodan deney ve kontrol gruplarının ön test başarı puan ortalamaları arasında istatistiksel olarak anlamlı bir fark olmadığı görülmektedir ($p>0,05$).

Araştırmanın İkinci Alt Problemine İlişkin Bulgular ve Yorumlar

Araştırmanın ikinci alt problemi olan "Işık ünitesinin öğretiminde derslik sisteminde öğrenim gören deney grubunun başarı testi ön test ve son test puanları arasında anlamlı bir farklılık var mıdır?" sorusuna cevap bulmak amacı ile t-testi yapılmıştır.

Tablo 2: Deney Grubunun Öntest-Sontest Puanları Ortalamaları Arasında Bir Farklılık Olup Olmadığını Belirlemek Üzere Yapılan Bağımlı Grup t Testi Sonuçları

Puan	Gruplar	N	$\bar{x}$	ss	$Sh_{\bar{x}}$	*t* Testi		
						t	Sd	p
Başarı Testi Puanı	Ön test	23	25,70	9,791	2,042	-6,693	22	0,000
	Son test	23	45,30	11,315	2,359			

*****$p<0,05$ düzeyinde anlamlı

Tablo 2 incelendiğinde, deney grubunun ön test başarı puan ortalamasının 25,70; son test başarı puan ortalamasının 45,30 olduğu görülmektedir. Tablodan deney grubunun ön test ve son test başarı puan ortalamaları arasında istatistiksel olarak anlamlı bir fark olduğu görülmektedir ($p<0,05$).

Araştırmanın Üçüncü Alt Problemine İlişkin Bulgular ve Yorumlar

Araştırmanın üçüncü alt problemi olan "Işık ünitesinin öğretiminde kendi şubelerinde öğrenim gören kontrol grubunun başarı testi ön test ve son test puanları arasında anlamlı bir farklılık var mıdır?" sorusuna cevap bulmak amacı ile t-testi yapılmıştır.

Tablo 3: Kontrol Grubunun Öntest-Sontest Puanları Ortalamaları Arasında Bir Farklılık Olup Olmadığını Belirlemek Üzere Yapılan Bağımlı Grup t Testi Sonuçları

Puan	Gruplar	*N*	$\overline{X}$	*ss*	$Sh_{\overline{X}}$	*t* Testi		
						t	*Sd*	*p*
Başarı Testi Puanı	Ön test	23	24,00	8,090	1,687	-5,022	22	0,000
	Son test	23	33,83	10,478	2,185			

*****p<0,05 düzeyinde anlamlı

Tablo 3 incelendiğinde, kontrol grubunun ön test başarı puan ortalamasının 24,00; son test başarı puan ortalamasının 33,83 olduğu görülmektedir. Tablodan deney grubunun ön test ve son test başarı puan ortalamaları arasında istatistiksel olarak anlamlı bir fark olduğu görülmektedir (p<0,05).

Araştırmanın Dördüncü Alt Problemine İlişkin Bulgular ve Yorumlar

Araştırmanın dördüncü alt problemi olan "Işık ünitesinin öğretiminde derslik sisteminde öğrenim gören deney grubu ile kendi şubelerinde öğrenim gören kontrol grubunun başarı testi son-test puanları arasında anlamlı bir farklılık var mıdır?" sorusuna cevap bulmak amacı ile t-testi yapılmıştır.

Tablo 4: Deney Grubu ile Kontrol Grubunun Son Test Puanları Arasında Bir Farklılık Olup Olmadığını Belirlemek Üzere Yapılan Bağımsız Grup t Testi Sonuçları

Puan	Gruplar	*N*	$\overline{X}$	*ss*	$Sh_{\overline{X}}$	*t* Testi		
						t	*Sd*	*p*
Başarı Testi Puanı(Son Test)	Kontrol	23	33,39	10,845	2,261	-3,645	44	0,001
	Deney	23	45,30	11,315	2,359			

*****p<0,05 düzeyinde anlamlı

Tablo 4 incelendiğinde, uygulamadan sonra kontrol grubundaki öğrencilerin başarı testi puan ortalamalarının 33,39; deney grubundaki öğrencilerin başarı testi puan ortalamalarının ise 45,30 olduğu görülmektedir. Tablodan deney ve kontrol gruplarının son test başarı puan ortalamaları arasında deney grubu lehine anlamlı bir fark olduğu görülmektedir (p<0,05).Deney ve kontrol grubundaki öğrencilerin başarı testi puanları uygulamadan sonra artmıştır. Ancak bu artış deney grubunda, kontrol grubuna göre daha fazla olmuştur. Bu bağlamda branş derslik sisteminin öğrencilerin başarıları üzerinde, mevcut şube sisteminden daha etkili olduğu söylenebilir.

Araştırmanın Beşinci Alt Problemine İlişkin Bulgular ve Yorumlar

Araştırmanın beşinci alt problemi olan "Işık ünitesinin öğretilmesinde deney ve kontrol grubunun fen ve teknolojiye karşı tutum anketi ön test puanları arasında anlamlı bir fark var mıdır?" sorusuna cevap bulmak amacı ile t-testi yapılmıştır.

Tablo 5: Deney Grubu ile Kontrol Grubunun Fen ve Teknolojiye Karşı Tutum Anketi Ön Test Puanları Arasında Bir Farklılık Olup Olmadığını Belirlemek Üzere Yapılan Bağımsız Grup t Testi Sonuçları

Puan	Gruplar	*N*	$\overline{X}$	*ss*	$Sh_{\overline{X}}$	*t* Testi		
						t	*Sd*	*p*
Fen ve Teknoloji Karşı Tutum Anketi Puanı(Ön Test)	Deney	23	122,61	15,421	3,216	0,633	44	0,530
	Kontrol	23	119,35	19,286	4,021			

Tablo 5 incelendiğinde, Deney grubunun ön test tutum puan ortalamasının 122,61; kontrol grubunun ön test tutum puan ortalamasının 119,35 olduğu görülmektedir. Tablodan deney ve kontrol gruplarının ön test başarı puan ortalamaları arasında istatistiksel olarak anlamlı bir fark olmadığı görülmektedir (p>0,05).

Araştırmanın Altıncı Alt Problemine İlişkin Bulgular ve Yorumlar

Araştırmanın altıncı alt problemi olan "Işık ünitesinin öğretilmesinde deney grubunun fen ve teknolojiye karşı tutum anketi ön test ve son test puanları arasında anlamlı bir fark var mıdır?" sorusuna cevap bulmak amacı ile t-testi yapılmıştır.

Tablo 6: Deney Grubunun Fen ve Teknolojiye Karşı Tutum Anketi Öntest-Sontest Puanları Ortalamaları Arasında Bir Farklılık Olup Olmadığını Belirlemek Üzere Yapılan Bağımlı Grup t Testi Sonuçları

Puan	Gruplar	N	$\bar{x}$	ss	$Sh_{\bar{x}}$	t Testi t	Sd	p
Fen ve Teknoloji Karşı Tutum Anketi Puanı	Ön test	23	122,61	15,424	3,216	-7,015	22	0,000
	Son test	23	147,09	16,814	3,506			

*p<0,05 düzeyinde anlamlı

Tablo 6 incelendiğinde, deney grubunun ön test tutum puan ortalamasının 122,61; son test tutum puan ortalamasının 147,09 olduğu görülmektedir. Tablodan deney grubunun ön test ve son test tutum puan ortalamaları arasında istatistiksel olarak anlamlı bir fark olduğu görülmektedir ($p<0,05$).

Araştırmanın Yedinci Alt Problemine İlişkin Bulgular ve Yorumlar

Araştırmanın yedinci alt problemi olan " Işık ünitesinin öğretilmesinde kontrol grubunun fen ve teknolojiye karşı tutum anketi ön test ve son test puanları arasında anlamlı bir fark var mıdır?" sorusuna cevap bulmak amacı ile t-testi yapılmıştır.

Tablo 7: Kontrol Grubunun Fen ve Teknolojiye Karşı Tutum Anketi Öntest-Sontest Puanları Ortalamaları Arasında Bir Farklılık Olup Olmadığını Belirlemek Üzere Yapılan Bağımlı Grup t Testi Sonuçları

Puan	Gruplar	N	$\bar{x}$	ss	$Sh_{\bar{x}}$	t Testi t	Sd	p
Fen ve Teknoloji Karşı Tutum Anketi Puanı	Ön test	23	119,35	19,286	4,021	-2,229	22	0,036
	Son test	23	132,65	21,027	4,384			

*p<0,05 düzeyinde anlamlı

Tablo 7 incelendiğinde, kontrol grubunun ön test tutum puan ortalamasının 119,35; son test tutum puan ortalamasının 132,65 olduğu görülmektedir. Tablodan kontrol grubunun ön test ve son test tutum puan ortalamaları arasında istatistiksel olarak anlamlı bir fark olduğu görülmektedir ($p<0,05$).

Araştırmanın Sekizinci Alt Problemine İlişkin Bulgular ve Yorumlar

Araştırmanın sekizinci alt problemi olan "Işık ünitesinin öğretilmesinde deney ve kontrol grubunun fen ve teknolojiye karşı tutum anketi son test puanları arasında anlamlı bir fark var mıdır?" sorusuna cevap bulmak amacı ile t-testi yapılmıştır.

Tablo 8. Deney Grubu ile Kontrol Grubunun Fen ve Teknolojiye Karşı Tutum Anketi Son Test Puanları Arasında Bir Farklılık Olup Olmadığını Belirlemek Üzere Yapılan Bağımsız Grup t Testi Sonuçları

Puan	Gruplar	N	$\bar{x}$	ss	$Sh_{\bar{x}}$	t Testi t	Sd	p
Fen ve Teknoloji Karşı Tutum Anketi Puanı(Son Test)	Kontrol	23	132,65	21,027	4,384	-2,571	44	0,014
	Deney	23	147,09	16,814	3,506			

*p<0,05 düzeyinde anlamlı

Tablo 8 incelendiğinde, uygulamadan sonra kontrol grubundaki öğrencilerin Fen ve Teknolojiye yönelik tutum puan ortalamalarının 132,65; deney grubundaki öğrencilerin tutum puan ortalamalarının ise 147,09 olduğu görülmektedir. Tablodan deney ve kontrol gruplarının son test tutum puan ortalamaları arasında deney grubu lehine anlamlı bir fark olduğu görülmektedir ($p<0,05$).Deney ve kontrol grubundaki öğrencilerin Fen ve Teknolojiye yönelik tutum puanları, uygulamadan sonra artmıştır. Ancak bu artış deney grubunda, kontrol grubuna göre daha fazla olmuştur. Bu bağlamda branş derslik sisteminin öğrencilerin Fen ve Teknolojiye yönelik tutumları üzerinde, mevcut şube sisteminden daha etkili olduğu söylenebilir.

SONUÇ

Yapılan çalışmada deney grubu ön test başarı puanı ortalaması 25,70; son test başarı puanı ortalaması ise 45,70 olarak bulunmuştur. Kontrol grubu ön test başarı puanı ortalaması 24,00; son test başarı puanı ortalaması ise 33,83 olarak bulunmuştur. Bu sonuçlar doğrultusunda deney grubunun başarı testi ortalamasında 20,00 puanlık bir artış; kontrol grubunun başarı testi ortalamasında ise 9,83 puanlık bir artış meydana gelmiştir. Bu durumda yapılan uygulama sonrasında her iki grubun başarı testi puan ortalaması artmıştır. Ancak bu artış; deney grubunda, kontrol grubuna göre daha fazla olmuştur. Deney grubunda bulunan öğrencilerin derslik sınıfında bulunan araç gereçleri kullanma imkânı bulması onların daha iyi öğrenmelerini sağlamıştır. Hung' da (2011) yapmış olduğu çalışmada benzer sonuçlara ulaşmıştır.

Weinstein ve Mayer'a (1986) göre, iyi bir öğretim, öğrencilere nasıl öğreneceğini, nasıl hatırlayacağını, nasıl düşüneceğini ve kendilerini nasıl güdüleyeceklerini öğretmeyi kapsar (Akt: Açıkgöz, 2005,79). Derslik sisteminde yapılan uygulama sürecinde deney grubundaki öğrencilerin teneffüslerde sınıf panolarındaki görselleri incelediği ve konu ile ilgili kendi aralarında tartıştıkları ve bazı görselleri sorguladıkları gözlenmiştir. MEB'in (2013) fen bilimleri dersi öğretim programında sınıf içi öğrenme ortamlarının araştırma-sorgulamaya dayalı öğrenme stratejilerine göre tasarlanması gerektiğinden söz edilmektedir. Derslik sisteminde yapılan uygulamada öğrencilerin daha sorgulayıcı oldukları ve bilimsel süreç becerilerini kontrol grubundaki öğrencilerden daha iyi kullandıkları görülmüştür.

Uygulama sonunda deney grubu öğrencileri ile yapılan görüşmede öğrenciler; panolardaki görsellerin dikkatlerini çektiğini, ders araç gereçlerini daha çok kullanma imkânları olduğunu belirtmişlerdir. Ersöz'de (2012) yapmış olduğu çalışmada benzer sonuçlara ulaşmıştır. Derslik sisteminde konu ile ilgili her türlü görsel ve araç-gereç öğrencilere kolaylıkla gösterilmiştir.

Derslik sisteminde yapılan etkinliklerde kullanılan araç, gereç ve malzemelerin kolay ulaşılabilen ve maliyeti düşük malzemeler olmasına dikkat edilmiştir. Malzemelerin sınıfta malzeme dolabında hazır olarak bulundurulması uygulama süresince kolaylık sağlamıştır. Bu durum, aynı zamanda öğrencilerin zaman zaman teneffüslerde tekrar uygulama yapmalarına imkân sağlamıştır. İbret (2011) sosyal bilgiler öğretmenleri ile yapmış olduğu çalışmanın sonucunda öğretmenlerden birisinin "Öğrencilerin bu sınıflarda materyale ulaşması dersi daha etkili kılacaktır..." şeklindeki görüşü ile branş dersliğinin öğrenci açısından önemine değinmiştir.

Yapılan çalışmada deney grubu ön test tutum puanı ortalaması 122,61; son test tutum puanı ortalaması ise 147,09 olarak bulunmuştur. Kontrol grubu ön test tutum puanı ortalaması 119,35; son test tutum puanı ortalaması ise 132,65 olarak bulunmuştur. Bu sonuçlar doğrultusunda deney grubunun tutum puan ortalamasında 24,48 puanlık bir artış; kontrol grubunun tutum puan ortalamasında ise 13,3 puanlık bir artış meydana gelmiştir. Bu durumda yapılan uygulama sonrasında her iki grubun tutum puan ortalaması artmıştır. Ancak bu artış; deney grubunda, kontrol grubuna göre daha fazla olmuştur. Bu sonuç öğrencilerin başarılarına da aynı şekilde yansımıştır. Bloom (1995) yaptığı çalışmada, öğrencilerin tutumlarının fen bilimlerindeki başarıyı % 27 oranında etkilediğini ortaya koymuş; olumlu yönde duyuşsal ve bilişsel giriş özellikleri bir araya getirilen öğrencilerdeki başarının, öğretim ortamının öğrencilere uygun olmasa dahi gerçekleşebileceğini belirtmiştir (Demirbaş ve Yağbasan, 2004).

Eğitim ve öğretimi kaliteli hale getirmek, birçok etkenle birlikte eğitim teknolojisinden en etkin biçimde yararlanmakla mümkündür. Eğitim teknolojisinin en önemli araçlarından birisi de bilgisayar olduğu göz önüne alındığında; bilgisayarın verimli şekilde kullanılması, eğitim ortamlarını olumlu yönde etkileyecektir. Ancak bilgisayarın da öğrenci başarısında ve öğretim kalitesinde tek etken olduğunu düşünmek yanlış olacaktır (Geban ve diğerleri, 1994). Derslik sisteminde yapılan uygulamada sınıf imkânlar dâhilinde dersin içeriğine göre düzenlenmiştir. MEB'in (2013) fen bilimleri dersi öğretim programında belirttiği gibi teknolojinin sınıf içerisine entegrasyonu sağlanmıştır. Uygulama sırasında zaman zaman bilgisayar teknolojilerinden yararlanılmasının olumlu katkıları deney grubunun son test puanlarında görülmektedir. Yalın'da (2009) yapmış olduğu çalışmada öğrencinin bilgiyle iletişimi çok yönlü olarak arttıkça, görsel olarak uyarıldıkça, öğrenme oranının artacağı sonucuna ulaşmıştır.

ÖNERİLER

Branş derslik sistemi ile ilgili diğer dersler için de benzer çalışmalar yapılabilir.

Branş derslik sistemi ile ilgili yurt dışındaki uygulamaların ve çalışmaların incelenmesi ve mevcut okullarımızın branş derslik sistemi ile ilgili eksiklerinin genel olarak belirlenmesine yönelik çalışmalar yapılabilir.

Yapılan bu çalışmada kullanılan branş dersliği eldeki imkânlar doğrultusunda oluşturulmuştur. Bu bağlamda branş derslik sistemlerinde ortam düzeninin nasıl olması gerektiği ile ilgili çalışmalar yapılabilir. Bu konuda da alanında uzman eğitimcilerden ve iç mimarlardan görüş alınabilir.

Altyapısı uygun olan okullarda kademeli bir şekilde branş derslik sistemine geçilmesi ve sistemin artı ve eksilerinin yaparak ve yaşayarak öğrenilmesi faydalı olabilir.

Yapılan bu çalışmada deney ve kontrol gruplarında bulunan toplam kırk altı öğrenci ile gerçekleştirilmiştir. Örneklem sayısı artırılarak daha kalabalık gruplar üzerinde de branş derslik sisteminin etkileri incelenebilir.

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EKLER

Ek 1. Fen ve Teknoloji Dersliği Ünite Köşesi

Ek 2. Fen ve Teknoloji Dersliği Öğretmen Masası

Ek 3. Fen ve Teknoloji Dersliği Malzeme Dolabı

Ek 4. Fen ve Teknoloji Dersliği Etkinlik Köşesi

REFLECTIONS OF MATHEMATICS TEACHING APPLICATIONS IN REAL-CLASSROOM ENVIRONMENT

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ABSTRACT: This study was carried out to ascertain whether and how pre-service teachers' experience gained in the "Mathematics Teaching Course" is actually reflected in the real classroom environment. The sample of the current study consisted of 10 pre-service elementary teachers who are receiving this course at the school of education. The researchers also participated in real classroom environment to closely observe how pre-service teachers teach mathematics topics and interacted with students. Data generation methods such as interviews and observational field notes were used to collect the data in comprehensive manner. Qualitative data analysis methods were employed to analyse the actual data. The findings obtained in this study were composed of two phases i.e. in the form of teachers' evaluation and researchers' evaluation. In the light of the observations of researchers, it can be said that pre-service teachers primarily faced with classroom management issue when they enter the real classroom comparing to teaching experience in the course at the university. In addition, pre-service teachers benefited from pedagogical content knowledge when students asked interesting questions on the subject-related area. The results gathered from interviews with teachers' candidates revealed that students could require more concrete mathematics teaching activities and materials. Finally, students-centred activities should be arranged in order to encourage students in real classroom environment to participate actively.

Key words: mathematics teaching, real-classroom environment, school-based practicum

MATEMATİK ÖĞRETİMİ UYGULAMALARININ GERÇEK SINIF ORTAMINA YANSIMALARI

ÖZET: Bu çalışma, öğretmen adaylarının matematik öğretimi dersinde kazandıkları deneyimlerin gerçek sınıf ortamına yansımalarını analiz etmek amacıyla yapılmıştır. Çalışmanın örneklem grubunu sınıf öğretmeni adaylarından 10 kişi oluşturmaktadır. Araştırmacılar da gerçek sınıf ortamında bulunarak öğretmen adaylarının matematik dersindeki konu anlatımlarını gözlemlemiştir. Bu nedenle çalışmada veri toplama aracı olarak gözlemlerden yola çıkarak tutulan alan notları kapsamlı bir şekilde kullanılmıştır. Çalışmanın diğer veri kaynağı ise öğretmen adayları ile yapılan görüşmelerdir. Veri analizinde nitel veri analiz yöntemleri kullanılmıştır. Çalışmada elde edilen bulgular araştırmacıların değerlendirmeleri ve öğretmen adaylarının değerlendirmeleri şeklinde iki bölümden oluşmaktadır. Araştırmacıların gözlemleri ışığında, üniversitede matematik öğretimi dersinde de konu anlatan öğretmen adaylarının, gerçek sınıf ortamına girdiklerinde en çok sınıf yönetiminde sorun yaşadıkları söylenebilir. Ayrıca matematik dersinde ilköğretim öğrencilerinin konuyla ilgili sordukları ilginç sorular karşısında, öğretmen adayları alanı öğretme bilgisinden faydalanmıştır. Öğretmen adayları ile yapılan görüşmeler sonucunda ise somutlaştırmaya yönelik matematik öğretimi yapılması gerektiği ortaya çıkmıştır. Özellikle sınıfın yaş seviyesi düştükçe somutlaştırmanın üzerinde daha çok durulması gerektiği sonucuna ulaşılmıştır. Ayrıca gerçek sınıf ortamındaki öğrencilerin, matematik dersi süresince sürekli aktif olması için etkinliklerin öğrenci merkezli olması gerektiği üzerinde durulmuştur.

Anahtar sözcükler: matematik öğretimi, gerçek sınıf ortamı, öğretmenlik uygulaması

GİRİŞ

Öğretmen eğitimi ve öğretmen yetiştirme konusu bir ülkenin kalkınması için son derece önemli bir konudur (Ayaz, Oral ve Söylemez, 2015). Öğretmen yetiştirme sisteminin tüm bileşenlerinin, sürekli bir değerlendirme süreci içinde sorgulanması, bugünün ve geleceğin gerektirdiği nicelik ve nitelikte öğretmen yetiştirmek için sürekli iyileştirilmesi gerekmektedir (Azar, 2011). Bu nedenle öğretmen adaylarının mesleğe hazırlanma süreçlerinde bu derslerle ve dolayısıyla da öğretmenlik mesleği ile ilgili kazanımlarının oluşmasında ve gelişmesinde yasayacakları deneyimlerin ve uygulamaların niteliği önem kazanmaktadır (Devecioğlu ve Akdeniz, 2016). Öğretmen adaylarının bu deneyimleri kazanmaları için okul ortamında bulunmaları gerekmektedir.

Öğretmen adayları, mesleki hayatlarını sürdürecekleri okul ortamına 'Öğretmenlik Uygulaması' dersi aracılığıyla girmektedir (Özden, Önder ve Karapınar, 2015). Bu nedenle öğretmenlik uygulaması hiç kuskusuz hizmet öncesi öğretmen yetiştirmede vazgeçilmez deneyimlerin en önemlilerinden biridir ve öğretmen olma yolunda son sınıf öğrencilerinin öğretmenliğe doğru giden süreçte bir ön çalışmasıdır (Paker,2008). Ayrıca öğretmen adaylarını öncesinde Öğretmenlik Uygulaması dersi ile uygulama okullarına ve devamında ise öğretmenlik mesleğine ve görev alacakları gerçek öğrenme ortamlarına hazırladığı bir gerçektir (Devecioğlu ve Akdeniz, 2016).Öğretmen adaylarının gerçek öğrenme ortamına hazırlanması tüm derslerde olduğu gibi matematik dersinde de oldukça önemlidir. Öğretmen adayları bu uygulamalar esnasında matematik dersinde bir takım zorluklarla karşılaşarak deneyim kazanmaktadır. Öğretmen adayları, matematik dersinde öğrenme-öğretme sürecini fakültede gördükleri öğretim yöntemlerini kullanarak şekillendirmeye çalışmaktadırlar.

Okul semineri dersinde, öğrenciler matematik derslerinin anlatımında öğretim yöntem ve tekniklerini yeni kullandıklarından dolayı acemilik yasamaktadırlar. Bundan dolayı her öğretmen adayına, kendi fakültelerinde matematik öğretim derslerinde öğretim yöntem ve teknikleri teorik anlatıldıktan sonra bu teorik bilgilerini bir defa da olsa uygulama fırsatı verilmelidir. Böylece öğretmenlik uygulaması sırasında kazanmış olduğu deneyimlerini okuldaki deneyimleri ile karşılaştırarak bu yönde kendisini geliştirebilmesi sağlanabilir (Soylu, 2009).

Literatür incelendiğinde öğretmenlik uygulaması üzerine daha özelinde matematik dersinde birçok çalışma görülmüştür. Ancak ilköğretimin temel basamağında hizmet verecek olan sınıf öğretmeni adaylarının matematik dersindeki öğretmenlik uygulamalarını yansıtan çalışmalara az rastlanmaktadır. Bu nedenle fakültede 'Matematik Öğretimi' dersini alan, Öğretmenlik Uygulaması dersi kapsamında bunun uygulamasını yapan sınıf öğretmenlerinin matematik dersindeki deneyimlerinin yansımalarının incelenmesine ihtiyaç duyulmuştur. Araştırmanın amacını da, sınıf öğretmeni adaylarının matematik öğretimi uygulamalarında öğrenim gördükleri üniversite ve gerçek sınıf ortamlarındaki deneyimlerini ortaya çıkarmak oluşturmaktadır.

YÖNTEM

Bu araştırma nitel araştırma yöntemlerinden durum çalışması deseninde tasarlanmıştır. Nitel durum çalışmasının en temel özelliği bir ya da birkaç durumun derinliğine araştırılmasıdır. Bir duruma ilişkin etkenler (ortam, bireyler, olaylar, süreçler, vb.) bütüncül bir yaklaşımla araştırılır ve ilgili durumdan nasıl etkilendikleri üzerine odaklanılır (Yıldırım ve Şimşek, 2011).
Araştırmacının katılımcılarını, Artvin Çoruh Üniversitesi'ndeki sınıf öğretmenliği bölümünde olan 10 öğretmen adayı oluşturmaktadır.

Veri Toplama

Araştırmada veriler gözlem ve yazılı görüşme formuyla toplanmış. Her öğretmen adayı bir dönem boyunca öğretmenlik uygulamasını yaptığı okulda en 2 kez gözlenmiştir. Gözlemler her öğretmen adayının matematik dersinde 2.sınıf ve 4.sınıflarda oluşturduğu öğrenme-öğretme süreçlerini kapsamaktadır. Bu sınıflarda matematik dersinin gerçek sınıf ortamında işlenişi alan notları alınarak araştırmacılar tarafından izlenmiştir. Yazılı görüşme formunda ise öğretmen adaylarına 3 soru yöneltilmiştir. İlk soru, üniversitede gördükleri matematik öğretimindeki konu anlatımları ile gerçek sınıf ortamındaki düşüncelerini ortaya çıkan bir sorudan oluşmaktadır. İkinci ve üçüncü soru ise matematik dersinde 2. ve 4.sınıf ortamına yönelik sorulardan oluşmaktadır. Bu sorularla öğretmen adaylarının gerçek sınıf ortamına yönelik matematik dersindeki düşünceleri ortaya çıkarılmak istenmiştir.

Verilerin Analizi

Verilerin analizinde ise içerik analizi yapılmıştır. Alan notları ile öğretmen adaylarının görüşme formundaki cevapları eşleştirmeli bir şekilde incelenmiştir. İçerik analizinde temel amaç, toplanan verileri açıklayabilecek kavramlara ve ilişkilere ulaşmaktır (Yıldırım ve Şimşek, 2011).

BULGULAR

Bu araştırmanın bulgular bölümü iki kısımdan oluşmaktadır. Birinci kısımda, öğretmen adaylarının matematik öğretimi uygulamalarında okul ve üniversite ortamlarında karşılaştıkları durumlar genel bir bakış açısıyla incelenmiştir. İkinci kısımda ise öğretmen adaylarının uygulama yaptıkları gerçek sınıf ortamlarından olan 2.sınıf ve 4.sınıfta karşılaştıkları durumlar daha detaylı bir şekilde incelenmiştir. Tablo 1' de öğretmen adaylarının matematik öğretimi uygulamalarının okul ve üniversiteye göre görüşlerinin değerlendirilmesi sunulmuştur.

Tablo 1: Öğretmen Adaylarının Matematik Öğretimi Uygulamalarının Okul ve Üniversiteye Göre Değerlendirilmesi

	Okul	Üniversite
Farklılıklar	• Matematiksel konuya yönelik öğrencilerden gelen ilginç sorular • Matematik dersi dışındaki öğrenmeye yönelik konuşmalar • Matematiğe öğrencilerin dikkatini çekmede zorluk • Zaman problem • Sınıf yönetiminde yaşanan zorluklar	Matematik öğrenme ortamı
Benzerlikler	• Matematiksel konunun somutlaştırılmasına yönelik etkinlik tasarlama • Kazanıma göre gerekli hazırlık yapmaEkinliklerin sonunda çalışma yapraklarıyla değerlendirme yapma	

Öğretmen adaylarının kendilerinin gerçekleştirmiş olduğu matematik öğretimi uygulamaları hakkında görüşleri Tablo1'de incelenmiştir. Tabloya göre gerçek sınıf ortamı olan okul ve öğrenim gördükleri üniversite açısından benzerlikler ve farklılıklar olduğu görülmektedir. Öğretmen adayları, matematiksel konuları öğretmek için somutlaştırmanın olması gerektiğini düşünmektedirler. Bu durum, okul ve üniversite ortamındaki matematik öğretimi uygulamalarındaki benzerlikler arasındadır. Ayrıca ilgili kazanıma yönelik etkinlik tasarlamak ve ders sonunda değerlendirme olması gerektiği de benzerlikler arasındadır. Öğretmen adaylarının bu durumlara ilişkin ifadeleri aşağıda yer almaktadır.

''*Üniversitede gördüğümüz Matematik Öğretimi I ve II dersinde ilköğretim 4.sınıfa kadar bütün kazanımları ayrıntılı olarak işliyoruz. Biz kendimiz anlatarak bilgi ve tecrübe kazanıyoruz. Bu yüzden stajda konu anlatırken matematik dersinde zorlanmadım…*'' (Ö5)

Okul ve üniversite ortamındaki gerçekleştirilen matematik öğretimi uygulamalarındaki farklılıklar arasında okul ortamındaki beklenmeyen durumlar yer almaktadır. Öğretmen adaylarının ifadelerine göre öğrenciler tarafından sorulan matematiksel konuya yönelik ilginç soruların farklılıklar arasında yer aldığı görülmektedir. Bunun yanı sıra farklılıklar arasında matematik dersi dışındaki öğrenmeye yönelik konuşmaların, da bulunduğu görülmektedir. Ayrıca matematik dersinde dikkat çekmede zorluk ve devamında gelen sınıf yönetiminde zorlukların olması, okul ortamında olmasında nedeniyle gözlenen farklılıklar arasındadır. Öğretmen adaylarının bu durumlara ilişkin ifadeleri aşağıda yer almaktadır.

''Üniversitede verilen derslerle stajda gerçekleştirilen dersler arasında farklılıklar var. Stajda öğrencilere konuyu bir kez anlatınca anlamayabiliyorlar. Bir kaç kez anlatmak gerekiyor. Bu da bizi zaman açısından matematik dersinde olumsuz etkiliyor…'(Ö2)''Üniversitede öğrendiğimiz çoğu şeyi dersteki kadar rahat bir şekilde anlatamadığımızı fark ettik. Aslında matematik dersini anlatmak zor değil sadece nasıl verebileceğini bulacak etkinlikleri bulmak gerekli…''(Ö6)

Öğretmen adaylarının matematik öğretimi uygulamalarının üniversite ortamından kaynaklanan farklıklarına bakıldığında ise matematik öğrenme ortamı açısından farklılık olduğu tespit edilmiştir. Öğretmen adaylarının bu durumlara ilişkin ifadeleri aşağıda yer almaktadır.

''Üniversitede öğrenciler biz olduğumuz için sınıf disiplinini sağlamak daha kolay…''(Ö3)

Öğretmen adaylarının, matematik öğretimi uygulamalarında okul ortamındaki 2.sınıf ve 4.sınıfa yönelik farklılıklarının karşılaştırıldığı durumlar Tablo 2'de verilmiştir.

Tablo 2: Öğretmen Adaylarının Matematik Öğretimi Uygulamalarında 2.sınıf ve 4.sınıfa Yönelik Farklılıklarının Karşılaştırılması

Olumlu		Olumsuz	
2.sınıf	**4.sınıf**	**2. sınıf**	**4.sınıf**
Oyunla matematik öğretimi Eğlenceli ders ortamı Seviyeye uygun anlatmak için çaba Süreçte olumlu geri dönüt	Öğrencilerin aktif katılımını sağlama Hazır bulunuşluğun öneminin farkında olma	Daha çok somutlaştırıcı etkinlik uygulama Zaman problemi Dikkat çekmede zorluk Sınıf yönetiminde zorluk	İçerik nedeniyle daha fazla hazırlık Etkinlik bulmada zorluk Uygun problem bulmak

Tablo 2'den görüldüğü gibi 2. sınıf ve 4. sınıflarda matematik öğretimi uygulamalarında öğretmen adaylarının sınıflara göre olumlu ve olumsuz düşüncelere sahip olduğu görülmektedir. Öğretmen adaylarının ifade ettiği deneyimlerden 2.sınıfta matematik dersinde oyunla matematik öğretiminin daha çok kullanılması gerektiği anlaşılmaktadır. Bu yaş grubu sınıflarda oyunla matematik öğretiminin dersi daha eğlenceli hale getirdiği görülmektedir. Ayrıca öğretmen adaylarının matematiği seviyeye uygun anlatmak için 2.sınıfta 4.sınıfa göre daha çok çaba harcadıkları ve süreçte olumlu geri bildirim almaları 2.sınıfa yönelik olumlu düşünceler arasındadır. Matematik öğretimi uygulamalarında 2.sınıfa yönelik olumlu düşünceleri destekleyen ifadeler aşağıda sunulmuştur.

'' İkinci sınıflarda staja başladığımda ise biraz ön yargım vardı. Yaşları çok küçük, bunlara anlatmak, bir şeyler öğretmek hiç de kolay değil diye düşünüyordum. Daha sonra matematik dersini bu çocuklara oyun oynatarak ve ya oyun tarzı etkinliklerle anlatmayı düşündüm. Bu öğrencilere, matematik dersini anlattıktan sonra bu sınıftaki hoca gelip beni tebrik etti..''(Ö1)

''Öğrencilere somut ve görsel materyallerle ders anlatmak dersi ilgi çekici ve dersin daha iyi anlaşılmasını sağlıyordu. Anlattığım konun anlaşıldığını bilmek, öğrencilerin bir şeyleri başarmasına yardımcı olmak beni mutlu ediyordu…'' (Ö4)
''Kavramlarla yeni karşılaştıkları için bunları onların seviyesinde anlatmanın zor olacağını tahmin ediyordum. O yüzden ders anlatmadan önce tedirgin olarak başladım dersi anlatmaya…''

Öğretmen adaylarının matematik öğretimi uygulamalarında 4.sınıfta yönelik olumlu düşünceleri arasında öğrencilerin derse daha aktif katıldığı söylenebilir. Ayrıca öğretmen adaylarının matematik öğrenmek ve öğretmek için öğrencilerin hazırbuluşluğun yeterli olması gerektiğini düşündüğü görülmektedir. 4.sınıfa yönelik matematik öğretimi uygulamalarında olumsuz düşünceler arasında içerik nedeniyle matematik dersine daha çok hazırlık yapmak, içeriğe uygun etkinlik bulmakta zorluk yaşamak olduğu görülmektedir. Ayrıca problem çözmek için uygun problem bulmanın da olumsuz düşüncelerden olduğu tabloya göre söylenebilir. Matematik öğretimi uygulamalarında 4.sınıfa yönelik olumlu ve olumsuz düşünceleri destekleyen ifadeler aşağıda sunulmuştur.

'' Dördüncü sınıf öğrencileriyle matematik dersini işlerken hiç zorlanmadım açıkçası. Alt yapıları çok iyiydi ve hepsi bu derse karşı çok ilgiliydi…'' (Ö3)

'' 4.sınıf konuları daha fazla hazırlık yapmayı gerektiriyor. Özellikle matematik dersinde materyal bulma konusunda sıkıntılar yaşadık. Konular diğer sınıf düzeylerine göre daha zor...'' (Ö1)

SONUÇ ve ÖNERİLER

Öğretmen adayları, Öğretmenlik Uygulaması dersi kapsamında gittikleri okullarda diğer derslerde olduğu gibi matematik derslerinde de matematik öğretimi için uygulamalar yapmaktadırlar. Öğretmen adaylarının matematik öğretimi uygulamalarında gerçek sınıf ortamında bulunmaları onlara bu konuda farklı deneyimler kazandırabilir. Bu araştırmada da, öğretmen adaylarının böyle bir ortamda matematik öğretimi uygulamalarından yansımalar incelenmek istenmiştir. Öğretmen adaylarına göre matematik öğretimi uygulamaları, okul ve üniversite ortamında farklılıklar ve benzerlikler göstermektedir. Bu durum, araştırmacıların alan notlarıyla da desteklenmektedir. İki ortama göre benzerlik ve farklıkların olması, gerçek sınıf ortamındaki öğrencilerin matematiği öğrenirken düşünme süreçlerinden kaynaklanabilir. Araştırma sonuçlarına göre matematiğin somutlaştırılması gerektiği iki ortamda da tespit edilen benzerlikler arasındadır. Bu anlamda matematiğin doğası gereği anlamlı öğrenme için somutlaştırıcı etkinlikler yapılmalıdır. Farklılıklar arasında ise, gerçek sınıf ortamında matematik öğretimi uygulamalarında karşılaşılan zorluklar gelmektedir.

Öğretmen adaylarının, gerçek sınıf ortamı olan 2.sınıf ve 4.sınıfta gerçekleştirdikleri matematik öğretimi uygulamalarında olumlu ve olumsuz düşüncelere sahip olduğu araştırmanın sonuçları arasındadır. 2. sınıflarda öğrencilerin yaş olarak daha küçük olmasından dolayı matematik öğrenimi için daha çok somutlaştırma yapılması gerektiği tespit edilmiştir. Ancak daha çok somutlaştırıcı etkinlik tasarlamak ve uygulamak gerçek sınıf ortamında zaman kaybına neden olduğunu düşünülmektedir. Bu durum ilköğretim matematik öğretmen adaylarının 'öğretmenlik uygulaması' üzerine görüşlerinin incelendiği çalışmayla benzerlik göstermektedir. Bu çalışmada fakülte-okul işbirliği programı çerçevesinde, ilköğretim matematik öğretmen adaylarının okullarda öğretmenlik uygulaması sırasında elde ettikleri deneyim ve değerlendirmeler ortaya konmaya çalışılmıştır. Araştırma, katılan öğretmen adaylarının üçte ikisinden fazlasının bu ders için istenilenleri tam olarak yerine getirme noktasında yeteri kadar fırsat bulamadığını ortaya koymuştur (Erslan, 2009).

4. sınıfta matematik öğretimi uygulamalarında öğretmen adaylarının içerikten kaynaklanan olumsuz düşüncelere sahip olduğu görülmektedir. Bu durum, ilköğretim matematik programının sarmal yapısı nedeniyle konuların bir sonraki sınıfa göre giderek derinleşmesinden kaynaklanabilir. Bu sınıfa yönelik olumlu düşünceler arasında, öğrencilerin daha çok derse katıldığı tespit edilmiştir. Bunun nedeni olarak 2.sınıf öğrencilerinin matematik dersine yönelik dikkatlerini çekmenin daha zor olduğu söylenebilir.

Araştırmadan elde edilen bulgular ışığında, öğretmen adaylarına matematik dersine yönelik öğretim uygulamalarını gerçekleştirebileceği fırsatların daha çok sunulması gerektiği önerilebilir. Ayrıca üniversitede gördükleri matematik eğitimin hemen ardından öğretmen adaylarına gerçek sınıf ortamlarında da uygulama imkanı verilmelidir. Böylece öğretmen adayları, matematik öğretiminde ders planlarının dışında gerçekleşecek durumların az da olsa bilincinde olabilir.

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6TH GRADES STUDENTS' ALGEBRAIC THINKING SKILLS

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ABSTRACT: The purpose of this research is to explore sixth grades students' algebraic thinking levels. As known, The students' process of transition from arithmetic to algebra start in sixth grade. To know the students' level of algeabric thinking and algebraic thoughts they are able to handle in this level will be useful in terms of planning the process of algebra teaching. With this aim, 31 sixth grade students of a middle school which was selected randomly in Burdur were included in the research. In order to gather data, an algebraic thinking levels test (CDSBT-twenty seven items and four levels) were used. This test developed by Hart et. al. (1998). The current research is a qualitative research and the model applied in the study is descriptive method. The current research reveals that 48% of the participants were at the level-1, 26% of them were at the level-2, 23% of them were at the level-3 and also only one student was at the level-4. Also, it was determined that "calculation the values of an algebraic expression", "adding algebraic expressions", "Multiplying a whole number and an algebraic expression" were the main difficulties that do not lead the students to pass the next level.

Key words: Algeabric thinking skill, sixth grade students

6. SINIF ÖĞRENCILERININ CEBIRSEL DÜŞÜNME BECERILERI

ÖZET: Bu araştırma, 6. sınıf öğrencilerinin cebirsel düşünme beceri seviyelerini ve her seviyeye ait cebirsel düşünme eksiklerini belirlemek amacıyla yapılmıştır. Bu amaçla, araştırmaya Burdur İl merkezinden rastgele seçilen bir ortaokulun rastgele seçilen bir altıncı sınıfında bulunan 31 öğrencisi alınmıştır. Veri toplama aracı olarak; Hart ve diğ. (1998) tarafından geliştirilen ve Altun (2005) tarafından Türkçe' ye uyarlanan, 27 maddelik ve 4 seviyeli cebirsel düşünme seviyesi belirleme testi kullanılmıştır. Yapılan araştırma nitel bir çalışma olup, öğrencilerin test sorularına verdiği yanıtlar, betimsel analiz metoduyla incelenerek, hangi oranda öğrencinin hangi seviyede olduğu belirlenmiştir. Ayrıca, öğrencilerin bir üst seviyeye geçememelerine neden olan soruların içeriği incelenmiştir. Araştırmanın sonucunda; öğrencilerin %48'inin 1. düzeyde, %26'sının 2. düzeyde, %23'ünün 3. düzeyde ve 4. düzeyde ise sadece bir öğrencinin bulunduğu belirlenmiştir. Ayrıca öğrencilerin, "bir cebirsel ifadenin değerlerini değişkenin alacağı farklı doğal sayı değerleri için hesaplama", "cebirsel ifadelerle toplama" ve **"**bir doğal sayı ile bir cebirsel ifadeyi çarpma" konularını yeterince kavramamış oldukları ve bu durumun, öğrencilerin cebirsel düşünme seviyelerini geri çeken temel faktörler olduğu tespit edilmiştir.

Anahtar sözcükler: Cebirsel düşünme becerisi, 6. Sınıf öğrencileri.

GİRİŞ

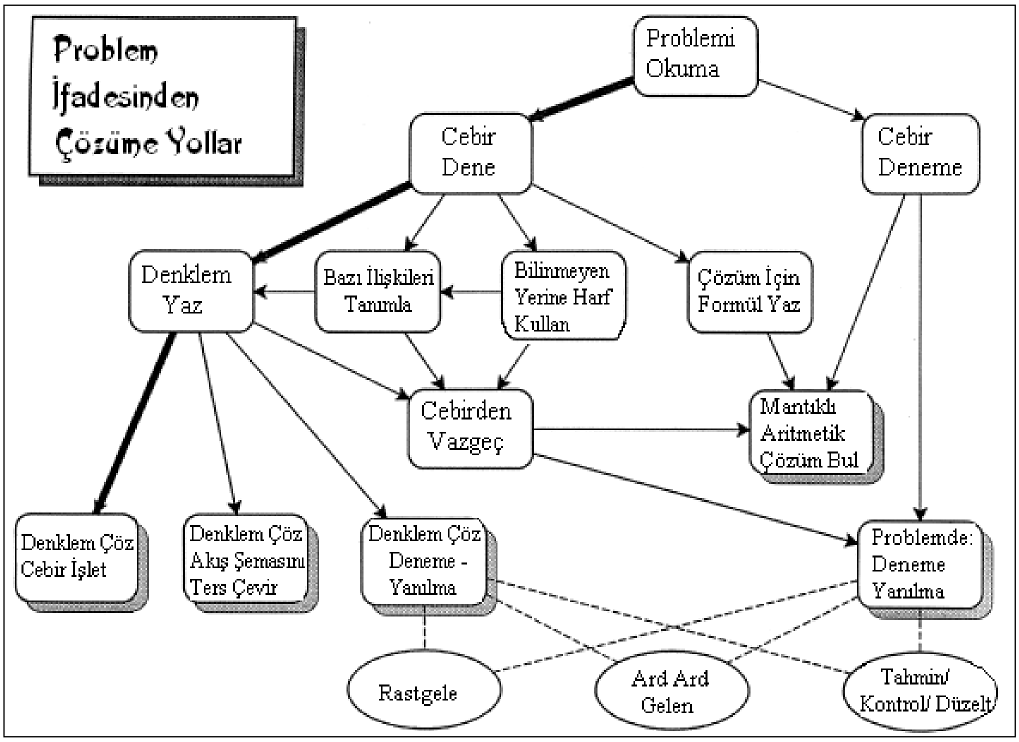
Usiskin (1988) cebiri, genelleştirilmiş aritmetik; problem çözme yöntemi; nicelikler arasında ilişki ve yapıların çalışması olarak sınıflandırmıştır. Bednarz, Kieran & Lee (1996) ise okul cebirini dört ana yaklaşıma ayırmıştır: genelleştirme, problem çözme, modelleştirme ve fonksiyonlar. Cebirsel düşünme; fonksiyonları anlamayı, cebirsel sembolleri kullanarak matematiksel yapı ve durumları farklı şekillerde temsil ve analiz etmeyi, nicel ilişkileri temsil etmek ve anlamak için matematiksel modeller kullanmayı, gerçek yaşamla ilgili çeşitli durumlardaki değişimi analiz etmeyi gerektirir (NCTM, 2000). Cebirsel niceliklerle durumları ifade etme yeteneği, birçok matematik alanını anlamada bir önkoşul olarak merkezî bir yere sahiptir (NCTM, 2000). Cebirsel düşünme sadece matematik derslerinde değil, diğer bilim dallarının ve gerçek yaşam problemlerinin çözümünde de kritik bir öneme sahiptir. İngiltere'de "Concepts in Secondary Mathematics and Science" (CSMS) tarafından 13-15 yaş öğrencileri için yapılan cebir projesinin bulgularına göre öğrencilerin cebirsel düşünme seviyeleri dört gelişim safhasına ayrılmıştır (Hart ve diğ. 1998):

Düzey 1: Bu safhada tümüyle aritmetik işlemlerin sonucunda bir harfin değerini bulma, harfleri birer nesne adı olarak almak suretiyle sonuçlandırma veya içerdiği harflere rağmen bu harflere değer vermeden bir işlemi sonuçlandırma şeklindeki soruların çözülebildiği safhadır.
Düzey 2: Bu düzey, 1. düzeyle soyutluk bakımından aynı olup, farklılık soruların daha karmaşık olmasıdır.
Düzey 3: Bu safha harflerin bir bilinmeyen olarak algılandığı ve kullanılabildiği safhalardır.
Düzey 4: Bu safhada çocuklar 3. safhadakilere benzer fakat daha karmaşık ifadelere anlam yükleyebilir ve işlemleri sonuçlandırabilir.

Bilindiği gibi, öğrenciler aritmetikten cebire geçiş sürecinde zorlanmakta (Herscovics & Linchevski, 1994; Lee, 1996; Moseley & Brenner, 2009) ve sonrasında cebir kavramlarını (eşitlik, denklem, cebirsel ifade, değişken, bilinmeyen) anlama ile ilgili güçlükleri ve kavram yanılgıları oluşmaktadır (Baroudi, 2006; English & Halford, 1995; Kieran, 1992; Perso, 1992; Beaton, Mullis, Martin, Gonzalez, Kelly ve Smith, 1996; Haspekian, 2003; MacGregor & Stacey, 1993; Greenes & Findell, 1999). Bu sorunlara neden olan temel faktörler şunlardır:

- Cebirsel problem çözme yöntemlerinin altında yatan düşüncenin kavranılmamış olması (Stacey & MacGregor, 2000)
- Cebire yeni başlayan öğrencilerin problem çözme yöntem ve deneyimlerinin aritmetiğe dayalı olması sonucunda öğrencilerin problemleri cebir yerine aritmetik kullanarak çözmeye çalışması (Stacey & MacGregor, 2000)
- Öğrencilerin "bilinmeyen", "değişken", "harflerin cebirde kullanımı", "cebirsel ifadeler", "eşitlik", "denklem", "eşitsizlik", "toplama ve çıkarma sembollerinin kullanımı" konularını yeterince kavrayamamış olması (Yenilmez & Avcu, 2009; Swafford & Langrall, 2000; Stacey & MacGregor, 2000; Schoenfeld, 1988; Perso, 1992)
- Verilen sözel problemlerin, cebirsel olarak yazılamaması (Bednarz & Janvier, 1996; Clement, 1982; Makanong, 1993)
- Öğrencilerden, ele alınan konunun bağlamını dikkate almadan değişkenlerle bir takım işlemleri yapılabilmelerinin beklenmesi (Macgregor & Stacey, 1997).
- Örüntü ve genellemeler konusunda, öğrencilerin "genelleme yaparken yanlış akıl yürütmesi", "yaptıkları genellemelerin doğru olup olmadığını kontrol etmemesi" (Stacey, 1989), "dizinin genel teriminin cebirsel olarak ifade edememeleri" (English ve Warren, 1999; Zaskis ve Liljdahl, 2001).
- Sembolleri ve cebirsel ilişkileri kullanamama (Bağdat ve Saban, 2014)

Stacey ve McGrager (2000) tarafından yapılan çalışmada, öğrencilerin cebirsel problem çözme süreci Şekil 1' de özetlenmiştir. Bu şekilden de görüldüğü gibi ortaokul öğrencileri cebirsel problemi çözerken çözüme bir cebirsel yolla başlamış olsa bile çözüm sürecinin ileriki aşamalarında aritmetik yollara da başvurabilmektedir (Akt. Kaş, 2010).



Şekil 1. Cebirsel Problem Çözme Sürecinde Ortaokul Öğrencilerinin Kullandığı Yollar

Cebir öğreniminde karşılaşılan bu problemlerin giderilmesi noktasında, NCTM (2000) orta okul öğrencilerinin cebir yeterliğini artırmak amacıyla şu dört tip çalışmanın yapılmasını önermiştir:

- Örüntüleri, ilişkileri ve fonksiyonları anlama çalışmaları,
- Cebir sembolleri kullanarak matematiksel durumları ve yapıları gösterme ve analiz etme çalışmaları,
- Niceliksel ilişkileri göstermek ve anlamak için matematiksel modeller kullanma çalışmaları,

- Çeşitli bağlamlardaki değişiklikleri grafik çizerek, teknoloji destekli programlar veya çalışma yaprakları kullanarak analiz etme çalışmaları.

Öğrencilerin cebirsel düşünme becerilerinin artırılması amacıyla, Mathews (1997) öğrencilerin cebir problemlerini çözme deneyimlerinin artırılması gerektiğini belirtmiştir. Greenes ve Findell (1999)'e göre bu deneyimi kazanmanın bir yolu; gösterim, eşitlik, değişken, oran, fonksiyon, tümevarım ve tümdengelimli düşünme odaklı, alternatif birçok çözüm yolu olan cebirsel düşünme problemleri kullanmaktır. Diğer taraftan, Ekenstam ve Nilsson (1979), Barnard (1989), cebir öğretimine geçilmeden önce öğrencilerin hazır bulunuşluklarının tam olarak sağlanması ve bu konulardaki kavram yanılgılarının tespit edilerek giderilmesi gerektiğini belirtmiştir.

Kaş (2010), sekizinci sınıflarda çalışma yaprakları ile öğretimin cebirsel düşünme ve problem çözme becerisine olumlu etkisi olduğunu ortaya koymuştur. Benzer şekilde, Akkaya ve Durmuş (2015), 6. sınıf öğrencilerinin cebirde, harflerin kullanımı anlamada, değişkenlerle ve eşitlik kavramı ile ilgili bir takım kavram yanılgılarının olduğunu ve çalışma yaprakları ile yapılan öğretimin belirlenen kavram yanılgılarını azaltmada geleneksel öğretime göre daha etkili olduğunu göstermiştir.

Palabıyık ve Akkuş-İspir (2011), örüntü temelli cebir öğretiminin yedinci sınıf öğrencilerinin cebirsel düşünme becerilerini artırdığını belirtmiştir. Palabıyık (2010) tarafından yapılan çalışmada da örüntü temelli etkinliklerin; öğrencilerin kavramsal cebir başarılarını arttırdığı ortaya konulmuştur.

Çağdaşer (2008) tarafından yapılan çalışmada, yapılandırmacı yaklaşımla cebir öğretiminin 6. sınıf öğrencilerinin cebirsel düşünme düzeylerinin yükselmesi yönünde değişmesinde önemli bir etkiye sahip olduğu belirlenmiştir. Yine yapılandırmacı öğrenmenin etkisi üzerine Hiçcan (2008) tarafından yapılan araştırmada, 5E öğrenme döngüsü modeline dayalı olarak hazırlanan ders etkinlikleri ile işlenen derslerin, hem kavramsal hem de işlemsel düzeyde, birinci dereceden bir bilinmeyenli denklemler konusunun öğretiminde anlamlı düzeyde etkili olduğu sonucuna varılmıştır.

YÖNTEM

Bu araştırma, 6. sınıf öğrencilerinin cebirsel düşünme beceri seviyelerini ve her seviyeye ait cebirsel düşünme eksiklerini belirlemek amacıyla yapılmıştır. Bu amaçla, araştırmaya Burdur İl merkezinden rastgele seçilen bir ortaokulun rastgele seçilen bir altıncı sınıfında bulunan 31 öğrencisi alınmıştır. Yapılan araştırma nitel bir çalışma olup, öğrencilerin cebirsel düşünme seviyesi belirleme testi sorularına verdiği yanıtlar, betimsel analiz metoduyla incelenerek, hangi oranda öğrencinin hangi seviyede olduğu belirlenmiştir. Ayrıca, öğrencilerin bir üst seviyeye geçememelerine neden olan soruların içeriği incelenmiştir.

Veri toplama aracı olarak; Hart ve diğ. (1998) tarafından geliştirilen ve Altun (2005) tarafından Türkçe' ye uyarlanan, 27 maddelik ve 4 seviyeli cebirsel düşünme seviyesi belirleme testi kullanılmıştır. Düzey–1, aritmetik işlemlerin sonucunda bir harfin değerini bulma, harfleri birer nesne adı olarak almak suretiyle bir problemi sonuçlandırma veya içerdiği harflere rağmen bu harflere değer vermeden bir işlemi sonuçlandırma şeklindeki soruları içermektedir. Düzey-2, birinci düzeydeki sorularla soyutluluk bakımından aynı olan ama onlara göre daha karmaşık sorular içermektedir. Düzey-3'te harflerin bilinmeyen olarak algılanması ve kullanılmasına ilişkin sorular bulunmaktadır. Düzey-4'te ise düzey-3'teki sorularda kullanılan ifadelere benzer ama daha karmaşık yapıdaki genellemeleri içeren sorular yer almaktadır. Bu sorularda öğrencilerin, harfleri birer bilinmeyen olarak algılaması, bilinmeyeni bir bağıntı veya denklemde kullanması, bir harfi birden fazla sayının bir temsilcisi olarak görmesi gerekmektedir. Cebirsel Düşünme Seviyeleri Belirleme Testi soruları Ek 1'de verilmiştir. Testi alan öğrencilerin cebirsel düşünme düzeylerini belirlemek için, Düzey–1 sorularından en az dört tanesini, Düzey–2 sorularından en az beş tanesini, Düzey–3 sorularından en az beş tanesini ve Düzey–4 sorularından en az altı tanesini doğru cevaplamaları gerekmektedir. Hart ve diğ. (1998) ayrıca cebirsel düşüme düzeylerinde bir ardışıklığın söz konusu olduğunu belirtmişlerdir. Bu nedenle, örneğin bir öğrencinin Düzey–3'te olduğuna karar vermek için Düzey–1 ve Düzey–2 için gerekli başarı yüzdelerine ulaşması istenmiştir.

BULGULAR

Öğrencilerin cebirsel düşünme seviyelerine ait bulgular Tablo 1' de verilmiştir.

Tablo 1. Öğrencilerin Cebirsel Düşünme Becerisi Seviyelerine Ait Frekans ve Yüzdelikler

Düzey	Frekans	Yüzdelik
D1	15	%48
D2	8	%26
D3	7	%23
D4	1	%3
Toplam	31	%100

Tablo 1' e bakıldığında; öğrencilerin %48'inin 1. düzeyde, %26'sının 2. düzeyde, %23'ünün 3. düzeyde ve 4. düzeyde ise sadece bir öğrencinin bulunduğu görülmektedir.

Öğrencilerin bulundukları düzeyden bir üst düzeye geçememelerine neden olan sorulardan yaygın olanları Tablo 2'de sunulmuştur.

Tablo 2. Öğrencilerin Bir Üst Düzeye Geçememesine Neden Olan Yaygın Sorular

Düzey	Soru	Frekans	Yüzdelik
1	5	12	%80
	13	12	%80
	9	11	%73
	10	11	%73
	19	11	%73
2	11	8	%100
	15	7	%88
	21	7	%88
3	7	7	%100
	24	6	%86
	25	6	%86
	20	5	%71

Tablo 2' de belirtilen soruların içeriği incelendiğinde; "bir cebirsel ifadenin değerlerini değişkenin alacağı farklı doğal sayı değerleri için hesaplama", "cebirsel ifadelerle toplama" ve "bir doğal sayı ile bir cebirsel ifadeyi çarpma" konularını içerdiği görülmüştür.

TARTIŞMA VE SONUÇ

Milli Eğitim Bakanlığı, Ortaokul Matematik Dersi Öğretim Programı (2013)'nda cebir öğrenme alanına ilişkin kazanımlar ilk olarak 6. sınıfta yer almaktadır. Bu sınıf seviyesinde öğrencilerden aritmetik dizilerde istenilen terimi bulmaları, cebirsel ifadeleri anlamlandırmaları ve cebirsel ifadelerde toplama ve çıkarma işlemlerini yapmaları hedeflenmektedir. Bu sınıf seviyesinde yer alan kazanımlar şunlardır (MEB, 2013):

- K1 Aritmetik dizilerin kuralını harfle ifade eder; kuralı harfle ifade edilen dizinin istenilen terimini bulur.
- K2 Sözel olarak verilen bir duruma uygun cebirsel ifade ve verilen bir cebirsel ifadeye uygun sözel bir durum yazar.
- K3 Cebirsel ifadenin değerlerini değişkenin alacağı farklı doğal sayı değerleri için hesaplar.
- K4 Basit cebirsel ifadelerin anlamını açıklar.
- K5 Cebirsel ifadelerle toplama ve çıkarma işlemleri yapar.
- K6 Bir doğal sayı ile bir cebirsel ifadeyi çarpar.

Öğrencilerin %48'inin 1. düzeyde, %26'sının 2. düzeyde, %23'ünün 3. düzeyde ve 4. düzeyde ise sadece bir öğrencinin bulunduğu görülmektedir. 7. ve 24. sorular için 6. sınıf kazanımlarının yeterli olup olmadığı tartışılabilir ancak öğrencilerin testteki soruların çoğuna doğru yanıt verebilecek bilgilerinin olması gerektiği söylenebilir. Oral, İlhan ve Kınay (2013) tarafından yapılan araştırmada da, 8.sınıf öğrencilerinin cebirsel düşünme düzeylerinin düzey-0 seviyesinde yığıldıkları tespit edilmiştir.

Diğer taraftan, düzey 1'deki öğrencilerin 3, 5 ve 6 no'lu kazanımları, düzey 2'deki öğrencilerin 5 ve 6 no'lu kazanımları, düzey 3'deki öğrencilerin 25. soru için 3 no'lu kazanımı kazanamadıklarından dolayı bir üst düzeye geçemedikleri söylenebilir. Diğer taraftan; düzey 3'deki öğrencilerin 20. soruya bir anlam yükleyemediklerinden; 7. soruda bir çokgenin köşegen sayısı formülünü bilmemelerinden veya bulamamalarından; 24. soruda ise yukarıdaki kazanımların herhangi birinden farklı bir beceriye sahip olmamalarından dolayı bir üst düzeye geçemedikleri düşünülmektedir. Genel olarak söylemek gerekirse; öğrencilerin cebir alanına ilişkin olarak "bir cebirsel ifadenin değerlerini değişkenin alacağı farklı doğal sayı değerleri için hesaplama", "cebirsel ifadelerle toplama" ve **"**bir doğal sayı ile bir cebirsel ifadeyi çarpma" konularını yeterince kavramamış oldukları ve bu durumun, öğrencilerin cebirsel düşünme seviyelerini geri çeken temel faktörler olduğu görülmektedir. Soylu (2008), Dede & Argün (2003), Ersoy & Erbaş (2003), Vurt (2011) tarafından yapılan çalışmalarda, öğrencilerin " Değişkene sayısal değer verme", "İşlem yaparken değişkenleri (harfleri) dikkate almama" ve "Değişkenleri belli harflerle sınırlandırma" konularındaki yetersizlikten dolayı cebir başarılarının düşük olduğu ifade edilmiştir.

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SIXTH GRADE STUDENTS VIEWS ON COMPUTER ASSISTED MATHEMATICS EDUCATION

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ABSTRACT: The aim of this study is to reveal the views of sixth grade students about the computer assisted mathematical teaching. Among the qualitative research methods a phenomenological design. In order to increase the reliability of data semi structured interviews with students who are studying in Aşçıbekirli Primary School and observations were carried out. Data were processed by content analysis. According to the findings it is concluded that computer assisted mathematical teaching contributes the students cognitive and affective dimensions positively. However; some problems still exist especially resulting from computer laboratory and students personal insufficient knowledge about computer.

Key words: computer based mathematic education, primary school, mathematic

ALTINCI SINIF ÖĞRENCİLERİNİN BİLGİSAYAR DESTEKLİ MATEMATİK ÖĞRETİMİNE YÖNELİK GÖRÜŞLERİ

ÖZET: Bu araştırmanın amacı altıncı sınıf öğrencilerinin bilgisayar destekli matematik öğretimine yönelik görüşlerini tespit etmektir. Araştırmada nitel araştırma yöntemlerinden biri olan olgu bilim deseni kullanılmıştır. Araştırmanın örneklemi ise ölçüt örnekleme yöntemi ile belirlenmiştir. Çalışmada, altıncı sınıf öğrencilerinden oluşan toplam 21 öğrenci ile sekiz saatlik gözlem gerçekleştirilmiş ardından bu öğrenciler arasında yansız bir şekilde seçilen dokuz öğrenci ile yarı yapılandırılmış görüşme gerçekleştirilmiştir. Veriler içerik analizi yapılarak çözümlenmiştir. Araştırmanın sonucuna göre altıncı sınıf öğrencilerinin bilgisayar destekli matematik öğretimi sürecinde bilişsel ve duyuşsal boyutta olumlu görüşlere sahip oldukları bulgusuna ulaşılmıştır. Diğer taraftan bilgisayar destekli öğretim sürecinde öğrencilerin temel bilgi eksikleri olduğu ve bu nedenle süreç içerisinde bazı eksikliklerin yaşandığı gözlemlenmiştir.

Anahtar sözcükler: bilgisayar destekli matematik öğretimi, ortaokul, matematik

GİRİŞ

Günümüzde bilim ve teknoloji alanında yaşanan gelişmeler eğitim alanında da birçok yenilenmeyi zorunlu hale getirmektedir. Özellikle, son on yılda gelişen bilgisayar ve iletişim ortamları eğitim ve öğretim ortamlarına da doğrudan yansımıştır. Bu bağlamda, özellikle öğretim sürecinde bilgisayarların çok farklı amaçlara hizmet ettiği görülmektedir. Örneğin; bilgisayarların, dersliklerde, kütüphanelerde, yönetimde, bilgilendirmede, rehberlik hizmetlerinde ve etkin iletişimde geniş ve yaygın bir kullanım perspektifine sahip olduğu görülmektedir. Bu doğrultuda, bilgisayarların eğitimde etkin bir şekilde kullanılmasıyla, bilgisayar destekli öğretim uygulamaları büyük bir önem kazanmıştır (Alakoç, 2003; Hangül & Üzel, 2010). Pek çok araştırmacı, bilgisayar destekli öğretimin öğrenenlerin özellikle görsel ve duyuşsal boyuttaki öğrenme becerilerinin geliştirilmesinde etkili bir faktör olduğunu vurgulamaktadır (Arslan, 2003; Baki, 1996; Kaplan & Öztürk, 2014). Ayrıca, eğitimde araç gereçlerin yeterli olmaması, bilginin çoğalması, öğrenci sayısının beklenenden çok fazla olması, bireysel farklılıkların ve yeteneklerin ön planda olmasından dolayı bilgisayarlar destekli öğretim büyük önem taşımaktadır. Yine, öğretmenler açısından, bilgisayarlar yoluyla yapılan uygulamalar, yeni materyallerin sunumunda, konuların tanıtımında, içeriğin sunulmasında, kazanımların test edilmesinde, öğrencilerin yeni beceriler kazanmalarında ve öğrenilen konuların pekiştirilmesinde büyük kolaylıklar sunmaktadır. (Çavuş, 2006).

Bilgisayar destekli matematik öğretimi konusunda yapılan araştırmalar incelendiğinde öğretmen ve öğretmen adaylarıyla (Aktümen, Yıldız, Horzum & Ceylan, 2011; Baki, Yalçıkkaya, Özpınar & Uzun, 2009; Gürol, Donmuş & Arslan, 2012; İlhan, Demir & Arslan, 2013; Kağızmanlı & Tatar, 2012; Kaplan, Öztürk, Altaylı & Ertör, 2013; Karataş, Alcı & Çeri, 2015; Keşan & Kaya, 2007; Kutluca & Birgin, 2007; Özgen, Obay & Bindak, 2009; Yenilmez, 2009; Yenilmez & Karakuş, 2007; Zengin, Kağızmanlı, Tatar & İşleyen, 2013) ilgili birçok çalışmaya rastlanırken öğrencilerle ilgili (Kaplan & Öztürk, 2014; Kutluca & Baki, 2013) sınırlı sayıda çalışma göze çarpmaktadır. Bu kapsamda, örneğin Kutluca & Baki, (2013) yaptıkları çalışmanın sonucunda bilgisayar destekli öğretim ortamının öğrencileri monotonluktan kurtardığı ve öğrencilerin ilgisini çekerek derse daha iyi motive olmalarını sağladığı bulgusuna ulaşmışlardır. Yine, Kaplan ve Öztürk (2014) de çemberde açılar konusunun öğretiminde Cabri yazılımının kullanılmasının geleneksel öğretimden daha etkili olduğu sonucuna ulaşmışlardır.

Yukarıda da ifade edildiği gibi, bilgisayarların bir çok eğitim ortamında öğretmenler için temel yardımcı rolü üstlendiği, yeni konuların öğretiminde, içeriğin sunulmasında öğrencilere yeni becerilerin kazandırılmasında ve kazanımların test edilmesinde önemli bir etmen olduğu açıkça görülmektedir. Bu özellikleri düşünüldüğünde öğrencilerin bilgisayar destekli öğretim yöntemini kullanmalarının kendileri için bir avantaj oluşturduğu düşünülmektedir. Ancak süreç konusunda öğrencilerin neler düşündükleri merak konusudur. Bu sebeble bu çalışmada altıncı sınıf öğrencilerinin matematik dersinde bilgisayar destekli öğretim konusundaki görüşleri araştırılacaktır. Bu genel amaç doğrultusunda araştırmanın alt amaçları şunlardır:

1. Bilgisayar destekli matematik öğretimi konusunda öğrencilerin genel görüşleri nelerdir?
2. Bilgisayar destekli matematik öğretiminin uygulanması sürecinde öğrencilerin yaşadıkları sorunlar nelerdir?

YÖNTEM

Araştırmanın Modeli

Bu araştırma, nitel araştırma yöntemlerinden olgu bilim (fenomeloji) boyutuna göre desenlenmiştir. Olgu bilim araştırmaları, derinlemesine ve ayrıntılı bir anlayışa sahip olmadığımız olgulara odaklanır. Bu araştırmalarda olguyu yaşayan ve bu olguyu dışa vurabilecek bireyler ya da grupların deneyimleri tanımlanır (Büyüköztürk, Çakmak, Akgün, Karadeniz ve Demirel, 2013; Christensen, Johnson & Turner, 2015). Bu bağlamda, araştırmanın olgusu ise bilgisayar destekli matematik öğretimi olup bu öğretim süreci hakkında deneyimli öğrencilerin görüşleri alınarak süreç içerisinde neler yaptıkları gözlemlenmiştir. Nitel araştırma desenine göre tasarlanan çalışmanın geçerliğini artırmak amacıyla hem öğrencilerle yarı yapılandırılmış görüşme yapılmış hem de süreç içerisinde neler yapıldığı sınıf içi gözlem yapılarak not alınmıştır. Ayrıca yarı yapılandırılmış görüşme formunda yer alan soruların uygunluğu hem araştırmacılara hem de alanında uzman iki öğretim üyesinin görüşlerine sunulmuştur. Gelen dönütler doğrultusunda görüşme formlarında son düzenlemeler yapılmıştır.

Çalışma Grubu

Araştırmanın çalışma grubu amaçlı örnekleme yöntemlerinden ölçüt örnekleme yöntemine göre belirlenen Adana İli Pozantı İlçesi'nde alt sosyo-ekonomik düzeyde bir devlet okulunun altıncı sınıf öğrencilerinden oluşmaktadır. Ölçüt olarak ise bilgisayar destekli matematik öğretimine katılan ve matematik dersinde başarılı olan altıncı sınıf öğrencileri seçilmiştir. Bu öğrencilerle dört haftalık matematik dersleri bilgisayar laboratuarında yapılmış ve araştırmacılardan biri aynı zamanda matematik öğretmeni olarak dersi yürütmüştür. Dersi yürüten matematik öğretmeni dersin bitiminde gözlemlerini not almıştır. Ayrıca yirmi bir kişilik sınıfta yürütülen dört haftalık dersin sonunda dokuz öğrenci ile de yarı yapılandırılmış görüşmeler yapılmıştır. Araştırmanın yapıldığı okuldaki bilgisayar dersliğinde on dört tane öğrencilere bir tane de yöneticiye ait olmak üzere toplam on beş bilgisayar bulunmaktadır. Bu bilgisayarların dördü bozuk olup öğrencilerin kullandıkları bilgisayar sayısı on dur. Ayrıca bilgisayar dersliğinde bulunan on sekiz kulaklıktan on üçü çalışmaktadır.

Veri Toplama Araçları

Veri toplama aracı olarak görüşme ve gözlem tekniklerinden faydalanılmıştır. Görüşmede kullanılmak üzere uzman görüşlerinden yaralanılarak yarı yapılandırılmış görüşme formu oluşturulmuştur. Görüşmeler öğrencilerle bireysel olarak öğretmen odasında ya da rehberlik odasında gerçekleştirilmiş ve öğrencilerden gelen yanıtlar not alınmıştır. Daha sonra elde edilen ham veriler aynı gün bilgisayar ortamına aktarılmıştır. Görüşme sırasında gerekli yerlerde ek (sonda) sorular sorularak öğrenci görüşlerinden detaylı olarak yararlanılmaya çalışılmıştır. Gözlem yapılırken ise öğrencilerin işlenilen konularla ilgili çalışmaları bilgisayarda nasıl uyguladıkları, anlamadıkları bir konu olup olmadığı, arkadaşlarıyla nasıl iletişim kurdukları, konuyu ne kadar anladıkları ve uygulayabildikleri, nerelerde daha çok zorlandıkları gözlemlenerek not alınmıştır.

Verilerin Analizi

Verilerin analizinde içerik analizi kullanılmıştır. İçerik analizinde öğrencilerle yapılan görüşme verileri ve sınıf içi etkinliklerde yapılan gözlemler tematik bir yaklaşımla incelenmiştir. Birbirine yakın olan temalar kendi içerisinde kategorize edilerek kodlara ayrılarak çözümlenmiştir.

BULGULAR

Araştırmanın ilk amacı doğrultusunda bilgisayar destekli matematik öğretimi konusunda öğrencilerle yapılan görüşmeler ve sınıf içi gözlemler sonucunda olumlu yönde görüşler ve gözlemler elde edilmiştir. Buna göre Tablo 1 incelendiğinde öğrencilerin görüşleri ve sınıf içi gözlemler bilişsel ve duyuşsal olmak üzere iki tema altında incelenmiştir.

Tablo 1. Bilgisayar Destekli Matematik Öğretimi Hakkında Öğrenci Görüşlerine İlişkin Tema, Kod ve Frekans Dağılımı

Tema	Kod	Görüşme Sıklığı (f)	Gözlem Sıklığı (f)
Bilişsel	Anlamlı Öğrenmeleri Sağlaması	7	16
	İşlem Kolaylığı Sağlaması	6	12
Duyuşsal	Dersin Görselleştirilmesine Yardımcı Olması	7	15
	Dersin İlgi Çekici Olmasını Sağlaması	5	10

Tablo 1 incelendiğinde öğrencilerin görüşleri ve gözlem sonuçları bilişsel ve duyuşsal olmak üzere iki tema altında toplanmaktadır. İlk olarak bilişsel boyut açısından öğrencilerin bilgisayar destekli matematik öğretimi sürecinde problemleri kolaylıkla çözebildikleri, konuyu daha iyi anladıkları, işlemleri kolaylıkla yapabildikleri ve üç boyutlu çizimler sayesinde konuyu daha iyi kavradıkları sonucuna ulaşılmıştır. Bu yönde görüş belirten öğrencilerden bazılarının görüşleri şu şekildedir; "*Programdaki geometri şekilleri kolaylıkla öğreniyoruz. Şekilleri görünce şeklin çizimini hatırlıyorum ve soruları çok kolaylıkla çözebiliyorum*."; "*Resimleri görünce her türlü geometrik şekli çizebilirim."; "… geometri artık çocuk oyuncağı gibi geliyor…".; Bilgisayar laboratuarında sınav yaparsak 5 bile alırım. "matematik sınav korkusu kalmadı gelsin 5'ler gitsin 2'ler 3'ler…".*

Diğer taraftan duyuşsal olarak öğrenciler daha zevkle dersi öğrendiklerini, eğlendiklerini, bu süreçte hiç sıkılmadıklarını, görsel materyallerin konuya olan ilgilerini artırdığını belirtmişlerdir. Bu yönde görüş belirten öğrencilerden bazıları görüşlerini "*Hocam bilgisayardan işlem yapmak çok güzel oluyor, eğlenerek dersi öğreniyorum"; "Bilgisayar çok zeki bütün işlemleri bir saniyede yapıyor. Çok eğleniyoruz…"; "Dersindeki işlemleri hızlı ve kolay bir şekilde yapmak beni çok mutlu etti"* biçiminde ifade etmişlerdir. Yapılan görüşmeler doğrultusunda yine, gözlem verileri de bu bulguyu desteklemektedir. Sınıf içerisinde yapılan gözlemlerde öğrencilerin bilgisayar ekranına bakarken çoğu zaman gülümseme içinde oldukları, aynı zamanda hemen doğru ya da yanlış yaptıklarında yanıt almalarının onları sevindirdiği, boş derslerde bilgisayar laboratuarına gidip matematik dersi çalışmak istedikleri gözlemlenmiştir.

Araştırmanın ikinci alt amacı olarak öğrencilere bilgisayar destekli matematik öğretimi dersinde herhangi bir sorunla karşılaşıp karşılaşmadıkları sorulduğunda öğrencilerden gelen yanıtlar ve yapılan gözlem sonuçları Tablo 2'de yer almaktadır.

Tablo 2. Bilgisayar Destekli Matematik Öğretimi Hakkında Yaşanan Sorunlarla İlgili Öğrenci Görüşleri ve Gözlem Verilerine İlişkin Tema, Kod ve Frekans Dağılımı

Tema	Kod	Görüşme Sıklığı (f)	Gözlem Sıklığı (f)
Yaşanan Sorunlar	Donanım Yetersizliği	2	8
	Temel Bilgi Eksikliği	1	5

Tablo 2 incelendiğinde yapılan gözlem sonuçları ve öğrencilerle yapılan görüşme verilerine göre bilgisayar destekli matematik öğretimi sürecinde öğrencilerin genelde okuldaki alt yapı eksikliğinden ve temel bilgi eksikliğinden kaynaklı sorunlarla karşılaştıkları görülmektedir. Bu yönde görüş belirten öğrencilerden bir kaçı *"..Mouse bozuk hocam çalışmıyor bilgisayar.."; "Bilgisayar çok yavaş hocam"; "Öğretmenim benim bilgisayar internete bağlanmıyor."; "Evimde bilgisayar olmayınca evde çalışamıyorum. Tekrar yapamıyorum. Öğle arasında ve ders çıkışlarında da sistemi kullanmaya nöbetçi öğretmen izin vermiyor."; "Öğretmenim n harfini bulamıyorum."* biçiminde görüşlerini ifade etmişlerdir. Ayrıca, görüşme verilerini destekler nitelikte gözlemlerden elde edilen verilere göre de bilgisayarların 2006 yılı üretimi olduğu o yüzden programı yürütmekte zorlandığı görülmüştür. Bilgisayarların üretim yıllarının eski olduğu gibi yine bilgisayarlara internet sağlayan kabloların eski olduğu görülmüştür. Öğretmenin ve öğrencilerin derse girdikten yaklaşık beş dakika sonra ancak bilgisayarların açılabildiği ve öğrencilerin de ancak sekiz dakikada giriş yapabildiği gözlemlenmiştir. Diğer taraftan bilgisayar klavyelerinin F klavye olması öğrencilerin harf bulmada çok zaman kaybetmelerine ve zorlanmalarına neden olmuştur. Yine, bazı öğrencilerin genel bilgisayar bilgisinin zayıf olmasından dolayı bilgisayarı açma, programları çalıştırma, dosyayı açma gibi temel teknik konularda bilgilerinin yetersiz olmasından ötürü dersin başında bu konuda öğrencilere yoğun bir eğitim verilmiştir.

SONUÇ VE ÖNERİLER

Bu çalışma altıncı sınıf öğrencilerinin bilgisayar destekli matematik öğretimi sürecinde yaşadıkları süreçleri gözlemlemek ve bu konuda görüşlerini incelemek amacıyla yapılmıştır. Bu kapsamda yapılan sınıf içi gözlem ve yarı yapılandırılmış görüşmeler sonucunda elde edilen veriler; bilişsel ve duyuşsal olmak üzere iki kategoriye ayrılmıştır. Öncelikle öğrenciler bilgisayar destekli matematik öğretiminin dersin anlaşılmasını kolaylaştırdığını, sınıf içerisinde çözülen problemleri daha rahat kavrayabildiklerini, konuya daha iyi hakim olabildiklerini belirtmişlerdir. Bu bağlamda, görsel materyaller yardımıyla konunun daha iyi kavrandığı söylenebilir. Duyuşsal boyut açısından ise öğrencilerin dersin daha zevkli işlendiğini düşündükleri, derste çok eğlendikleri, hiç sıkılmadıkları ve üç boyutlu görseller sayesinde konuya olan ilgilerinin arttığı araştırma sonuçlarından açıkça görülmektedir.

Öte yandan, bilgisayar destekli öğretim sürecinde öğrencilerin temel bilgi eksiklerinden ve okuldaki bilgisayarlara yönelik donanım ve teknoloji yetersizliklerinden dolayı bazı sorunlar yaşadıkları araştırmadan elde edilen diğer önemli bir sonuçtur. Bu nedenle öğrencilerin bu tür sorunlarla karşılaşmamaları için okuldaki var olan bilgisayarlardaki eksikliklerin ve donanımsal yetersizliklerin giderilmesi ve öğrencilere gerekli temel bilgilerin verilmesi için gerekli tedbirlerin alınması önerilebilir. Bu çalışma sadece altıncı sınıf öğrencileriyle ve matematik dersiyle sınırlıdır. Diğer sınıf düzeylerinde ve diğer derslerde de bu tür çalışmalar yapılması önerilebilir.

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THE REPRESENTATIONS OF PRE-SERVICE ELEMENTARY TEACHERS APPLIED IN SOLVING NON-ROUTINE MATHEMATICAL PROBLEMS

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ABSTRACT: The study is a mixed research which aims to find out the solution strategies applied by pre-service elementary in solving non routine problem types. The population of this study is 107 pre-service teachers who are educated in an elementary school department. As data collection tool, "Non-Routine Problem Set", which was developed by related literature and expert reviews, was prepared. This problem set consists of 10 non-routine problems. At the end of the study, it was found out that pre-service elementary teachers can apply verbal, algebraic, graphical and tabular in terms of non-routine problem types. In addition, another important finding that obtained from the study is that while the pre-service teachers applied the verbal and algebraic representation most, they applied the numerical representation least.

Key words: pre-service teacher, multiple representations, non-routine problems.

SINIF ÖĞRETMENİ ADAYLARININ RUTİN OLMAYAN PROBLEMLERDE UYGULADIKLARI TEMSİL TÜRLERİ

ÖZET: Bu çalışma, sınıf öğretmeni adaylarının rutin olmayan problemlerin çözümünde kullandıkları temsilleri ve bu temsillerin seçilmesine etki eden faktörleri ortaya çıkarmak amacıyla yapılmıştır. Araştırma, nicel ve nitel araştırma yöntemlerinin bir arada kullanıldığı karma araştırma yöntemine göre desenlenmiştir. Araştırmanın çalışma grubunu sınıf öğretmenliği bölümünde öğrenim gören 107 öğrenci oluşturmaktadır. Veri toplama aracı olarak ilgili literatürden ve uzman görüşünden yararlanılarak on soruluk rutin olmayan problem seti ve yarı yapılandırılmış görüşme formu hazırlanmıştır. Araştırmanın sonucunda öğretmen adaylarının rutin olmayan problemlerde, sözel, cebirsel ve grafiksel temsil türlerini kullanabildikleri sonucuna ulaşılmıştır. Ayrıca, öğretmen adaylarının en çok sözel ve cebirsel temsili; en az düzeyde ise sayısal temsili uyguladıkları araştırmadan elde edilen diğer önemli bir sonuçtur.

Anahtar sözcükler: öğretmen adayı, çoklu temsiller, rutin olmayan problemler

GİRİŞ

Genel bir tanım olarak temsil, olguların farklı perspektiflerden sunulması olarak tanımlanabilir (Even, 1998; Goldin & Kaput, 1996). Matematik öğretimi bağlamında ise temsil ve temsil türleri, matematik öğretim programlarında problem çözme becerilerinin öğrencilere kazandırılması açısından büyük önem taşımaktadır. Bu kapsamda, problem çözme süreçlerinde kullanılan temsil türleri sözel, yazılı, durağan şekil ya da resimler, somut modeller ve gerçek yaşam durumlarını kapsar (Goldin, 1998; Lesh, Post & Behr, 1987). Pek çok araştırmacı iyi bir problem çözücünün bu temsil türlerini kolayca çözdüğü probleme uygulayabilmesi ve gerektiğinde bir temsil türünü diğer bir temsil türüne kolayca dönüştürebilmesi gerektiğini vurgulamaktadır. Öte yandan, literatürde problem türleri rutin problemler ve rutin olmayan problemler olarak iki farklı boyutta ele alınmaktadır (Verschaffel, De Corte & Lasure, 1994). Rutin olan problemler bilinen bir kuralın ya da formülün yeni bir duruma uyarlanmasını gerektiren türdeki problemlerdir. (Polya, 1990). Diğer taraftan rutin olmayan problemler ise gerçek yaşamla ilgili ve öğrencilerin kendi çözüm yöntemlerini üretmelerini ve düşünme becerilerini kullanmalarını gerektiren nitelikteki sorulardır (Elia, Van den Heuvel-Panhuizen & Kolovou, 2009).
Literatürde, problem çözme aşamalarında kullanılan temsil türleri üzerine odaklanan çalışmalar genellikle ilköğretim (Ahmad, Tarmizi, & Nawawi 2010; Akkuş & Çakıroğlu, 2006; Cai, 2000; Cai, 2004; Cai & Hwang, 2002; Gagatsis & Elia, 2004; Hwang, Chen, Dung, Yang, 2007) ve sınırlı sayıda da olsa lisans düzeyindeki çalışmaları kapsamaktadır (Villegas, Castro & Gutierrez, 2009; Delice & Sevimli, 2010; İpek & Okumuş, 2012). Bu bağlamda, Villegas, Castro ve Gutierrez (2009) öğretmen adaylarının kullandıkları temsiller ve bu temsiller arasındaki dönüşümlerin sıklığını inceledikleri araştırmanın sonucunda öğretmen adaylarının problem çözme başarıları ile temsil kullanma ve dönüştürme becerileri arasında anlamlı ve pozitif bir ilişki olduğu sonucuna ulaşmışlardır. Yine Delice ve Sevimli (2010) öğretmen adaylarının belirli integral problemleri çözme sürecinde kullandıkları temsil türlerini inceledikleri çalışmalarında, öğretmen adaylarının en çok cebirsel temsil türünü her türlü problemin çözümünde kullanmak istediklerini ve öğretmen adaylarının bu temsili kullanma alışkanlıklarının oldukları sonucuna ulaşmışlardır.

Bu bulgulardan yola çıkarak özetle, ilköğretim düzeyinde (Ahmad, Tarmizi, & Nawawi, 2010; Akkuş & Çakıroğlu, 2006; Cai, 2000; Cai, 2004; Cai & Hwang, 2002; Gagatsis & Elia, 2004;) ve sınırlı sayıda lisans düzeyinde (İpek & Okumuş, 2012) yapılan araştırmalardan da görüldüğü gibi, matematiksel problemlerin çözüm süreçlerinde kullanılan temsil türleri, öğrencilerin problem çözme becerileri üzerinde olumlu bir etki yaratmaktadır. Ancak alanla ilgili literatür incelendiğinde yukarıdaki çalışmalar haricinde sınıf öğretmeni adaylarının çoklu temsil uygulamalarını doğrudan irdeleyen herhangi bir çalışma göze çarpmamaktadır. Bu olgudan yola çıkarak, bu çalışmanın amacı, sınıf öğretmeni adaylarının rutin olmayan problemlerin çözümünde uyguladıkları temsil türlerini belirlemektir. Bu amaç doğrultusunda aşağıda belirtilen alt amaçlara ulaşılmaya çalışılmıştır.

1) Rutin olmayan problemlerde sınıf öğretmeni adaylarının kullandıkları temsil türleri nelerdir?
2) Rutin olmayan problemlerde seçilen temsil türlerinin belirlenmesine etki eden faktörler nelerdir?

YÖNTEM

Bu araştırma, sınıf öğretmeni adaylarının rutin olmayan problemlerde kullandıkları temsilleri ve bu temsilerin seçilmesine etki eden faktörlerin belirlenmesi yönelik olarak nicel ve nitel araştırma yöntemlerinin bir arada kullanıldığı karma araştırma yöntemine göre desenlenmiş bir çalışmadır.

Çalışma Grubu

Araştırma kapsamında Türkiye'nin güneyinde bir devlet üniversitesinin sınıf öğretmenliği ana bilim dalı birinci sınıfına devam eden 107 öğrenciyle çalışılmıştır. Çalışma grubunu oluşturan birinci sınıf öğrencileri matematik dersiyle ilgili Temel Matematik I dersini tamamlamışlardır. Temel Matematik I dersinin içeriğinde matematiksel kavramlar ve işlemler, sayılar, oran-orantı, denklem ve eşitsizlikler, cebirsel ifadeler ve sözel problemler yer almaktadır. Görüşme yapılacak grubunun belirlenmesinde ise amaçlı örneklem yöntemlerinden ölçüt örnekleme yöntemi kullanılmıştır. Bu çalışmada araştırmaya katılmaya gönüllü olan, Temel Matematik I dersini başarıyla tamamlayan ve rutin olmayan problemlere yönelik çoklu temsil kullanma testinde farklı başarılar gösteren öğretmen adayları seçilerek yarı yapılandırılmış görüşmeler yapılmıştır. Görüşmeye katılan on beş öğretmen adayının onu kız ve beşi erkektir. Problem çözmede çoklu temsil kullanma testinin sonuçları değerlendirildiğinde öğretmen adaylarının dördü düşük, yedisi orta diğer dördü de yüksek başarı düzeyindedir.

Veri Toplama Araçları

Bu çalışmada veri toplama aracı olarak on sorudan oluşan rutin olmayan problem seti ve yarı yapılandırılmış görüşme formu kullanılmıştır. Rutin olmayan problemlerin hazırlanması sürecinde ilgili literatürden yararlanılmıştır (Inoue, 2005; Verschaffel, De Corte & Lasure, 1994; Xin, Lin, Zhang & Yan, 2007). Bu sette yer alan problemlerin hepsi farklı gösterimlerden yararlanılarak çözülebilmektedir. Bu ölçme aracının geçerliğini sınamak üzere, matematik eğitimi alanında iki uzman tarafından testin ölçmeyi hedeflediği davranışlar yönüyle, kapsam ve görünüş geçerliğine sahip olduğu belirlenmiştir. Görüşme formunda ise öğretmen adaylarına rutin olmayan problemlerin çözümünde seçtikleri temsilleri nasıl belirledikleri konusundaki görüşleri yer almaktadır. Ses kayıt cihazıyla kaydedilen görüşmeler bilgisayar ortamına aktarılmış ve 15 sayfalık ham veri elde edilmiştir. Bu aşamada öğretmen adaylarına görüşme sırasına göre ilk görüşülen öğretmen adayına $GÖ_1$, ikinci görüşülen öğretmen adayına $GÖ_2$ biçiminde kodlar verilmiştir.
Veri toplama aracı, Temel Matematik II dersinin son haftasında yaklaşık elli dakikalık bir sürede öğretmen adaylarına uygulanmıştır. Öğretmen adaylarının rutin olmayan problemlerin çözümünde kullandıkları temsil türleri ilgili literatürden yararlanılarak kodlanmıştır. (Lesh, Behr & Post, 1987; İpek & Okumuş, 2012). Buna göre;
1. Sözel Temsil; problemlerin çözüm sürecinin sözel olarak anlatması ve problemlerle ilgili akıl yürütmeleri.
2. *Cebirsel Temsil;* problemlerin çözümünde matematiksel işlemlerin yapılması ya da sembollerin kullanılması.
3. Grafiksel Temsil; problemlerin çözümünde resim, şema, şekil veya sayı doğrusu kullanılması.
4. Sayısal Temsil; problemlerin çözümümde tablo ya da matris kullanılması
Yarı yapılandırılmış görüşme formunun çözümlenmesinde içerik analizi kullanılmıştır. Veri toplama aracı olarak kullanılan problemlerin çözümünde uygulanan kodların güvenirliğinin kontrol edilmesi için rastgele seçilen 15 öğretmen adayının çözümleri matematik eğitimi konusunda bir uzman tarafından analiz edilmiş ve iki kodlayıcı arasındaki uyuşma oranının .94 olduğu görülmüştür.

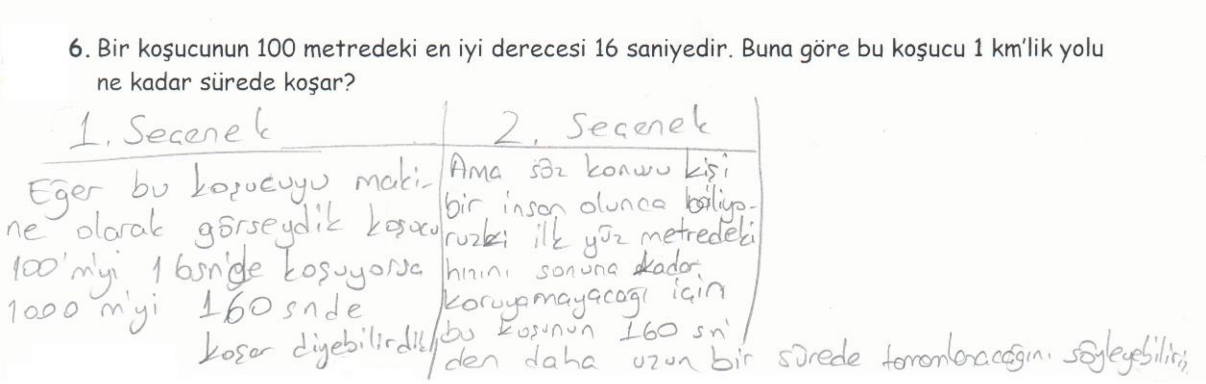
BULGULAR

İlk araştırma sorusu olarak, sınıf öğretmeni adaylarının rutin olmayan problemlerin çözümünde kullandıkları temsil türleri irdelenmiştir. Buna göre sınıf öğretmeni adaylarının rutin olmayan problem türlerinde kullandıkları temsil türleri Tablo 1'de yer almaktadır.

Tablo 1. Sınıf Öğretmeni Adaylarının Rutin Olmayan Problemlerde Kullandıkları Temsil Türlerine Göre Dağılımları

Problem	Sözel Temsil		Cebirsel Temsil		Grafiksel Temsil		Sayısal Temsil	
	f	%	f	%	f	%	f	%
1. Soru	83	73.5	24	21.2	51	45.1	3	2.7
2. Soru	83	73.5	81	71.7	16	14.2	43	38.1
3. Soru	64	56.6	68	60.2	62	54.9	-	-
4. Soru	45	39.8	96	85.0	65	57.5	-	-
5. Soru	64	56.6	103	91.2	16	14.2	-	-
6. Soru	64	56.6	77	68.1	13	11.5	18	15.9
7. Soru	73	64.6	69	61.1	14	12.4	6	5.3
8. Soru	41	36.3	68	60.2	79	69.9	-	-
9. Soru	60	53.1	74	65.5	53	46.9	24	21.2
10. Soru	56	49.6	84	74.3	19	16.8	8	7.1

Tablo 1 incelendiğinde rutin olmayan problemlerin çözümünde, öğretmen adaylarının en çok sözel ve cebirsel temsili kullanırken en az ise sayısal temsili kullandıkları görülmektedir. İlk olarak sözel temsillerin kullanım sıklığı incelendiğinde öğretmen adaylarının en çok birinci ve ikinci soruda (%73.5) bu temsili uyguladıkları en az ise sekizinci (%36.3) soruda kullandıkları görülmektedir. Örneğin ikinci sorunun çözümü aşamasında $Ö_9$ kodlu öğretmen adayının kullandığı sözel temsil Şekil 1'de yer almaktadır.

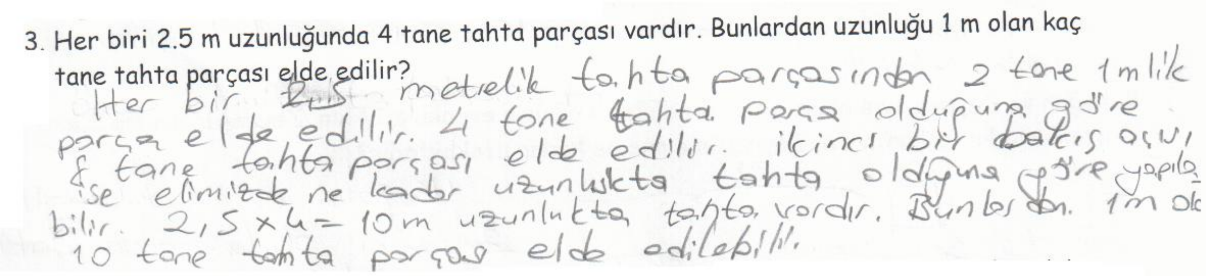

6. Bir koşucunun 100 metredeki en iyi derecesi 16 saniyedir. Buna göre bu koşucu 1 km'lik yolu ne kadar sürede koşar?

1. Secenek
Eğer bu koşucuyu makine olarak görseydik koşucu 100'm'yi 16sn'de koşuyorsa 1000 m'yi 160 snde koşar diyebilirdik

2. Secenek
Ama söz konusu kişi bir insan olunca biliyoruz ki ilk yüz metredeki hızını sonuna kadar koruyamayacağı için bu koşunun 160 sn'den daha uzun bir sürede tamamlanacağını söyleyebiliriz

Şekil 1. $Ö_9$ Kodlu Adayın İkinci Sorunun Çözüm Aşamasında Kullandığı Sözel Temsil

Şekil 1 incelendiğinde $Ö_9$ kodlu öğretmen adayı altıncı sorunun çözümünde sözel temsili kullanarak rutin olmayan problemin çözümünü iki durumda açıklamıştır. Buna göre ilk olarak koşucunun makine olarak düşünülmesi halinde 100 metreyi 16 saniyede koşması durumunda, bu sürenin 10 katı olan mesafeyi 160 saniyede koşabileceğini belirtmiştir. Ancak ikinci durumda ise koşucunun bir insan olduğu ve bu sürede yorulacağının düşünülmesi gerektiğini ve bu nedenle daha uzun sürede bu mesafeyi tamamlayacağını ifade etmiştir. Benzer şekilde üçüncü sorunun çözümünde ise $Ö_{31}$ kodlu öğretmen adayının çözümü Şekil 2'deki gibidir.

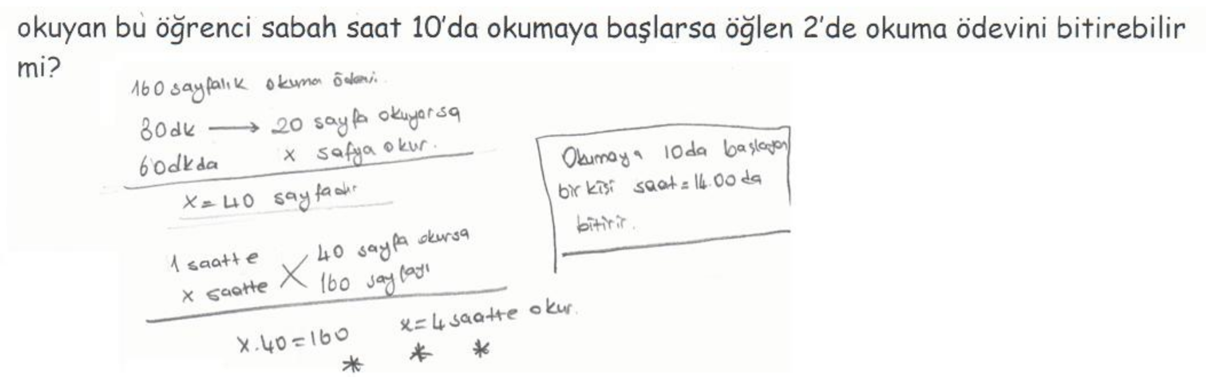

3. Her biri 2.5 m uzunluğunda 4 tane tahta parçası vardır. Bunlardan uzunluğu 1 m olan kaç tane tahta parçası elde edilir?

Her bir 2,5 metrelik tahta parçasından 2 tane 1 m'lik parça elde edilir. 4 tane tahta parça olduğuna göre 8 tane tahta parçası elde edilir. İkinci bir bakış açısı ise elimizde ne kadar uzunlukta tahta olduğuna göre yapılabilir. 2,5 x 4 = 10 m uzunlukta tahta vardır. Bunlardan 1 m ok 10 tane tahta parçası elde edilebilir.

Şekil 2. $Ö_{31}$ Kodlu Adayın Üçüncü Sorunun Çözüm Aşamasında Kullandığı Sözel Temsil

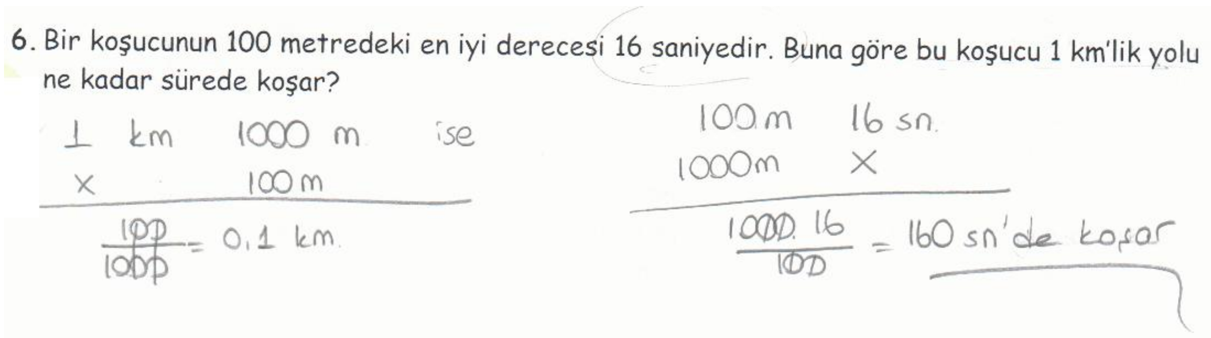
Şekil 2'de görüldüğü gibi $Ö_{31}$ kodlu öğretmen adayı üçüncü sorunun çözümünde sözel temsili kullanarak rutin olmayan problemin çözümünü iki durumda açıklamıştır. Buna göre ilk durumumda her biri 2,5 metrelik tahta parçalarından iki tane birer metrelik tahta elde edileceğini ve bu durumda dört tane tahta parçası olduğuna göre toplamda sekiz tane tahta parçası elde edilebileceğini anlatmıştır. İkinci bir bakış açısı olarak da bu tahta parçalarının birleştirilmesiyle 10 metre uzunluğunda olan tahtalardan birer metrelik on adet tahta parçası elde edilebileceğini vurgulamıştır.

Cebirsel temsilin kullanımına ilişkin olarak öğretmen adaylarının çözümleri Tablo 1 bağlamında incelendiğinde en çok beşinci sorunun (%91.2) sonra dördüncü sorunun çözümünde (%85) bu temsil türünün tercih edildiği görülmektedir. Diğer taraftan ise cebirsel temsilin en az olarak birinci sorunun (%21.2) çözümünde tercih edildiği sonucuna ulaşılmıştır. Bu temsil türünün çözümüne ilişkin olarak $Ö_{45}$ kodlu öğretmen adayının cebirsel temsil ile ilgili yaptığı çözüm Şekil 3'dedir.



Şekil 3. $Ö_{45}$ Kodlu Adayın İkinci Sorunun Çözüm Aşamasında Kullandığı Cebirsel Temsil

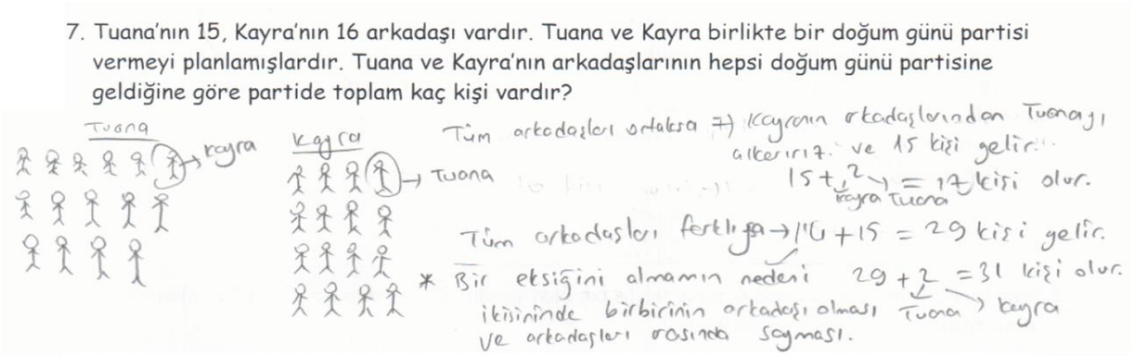
Şekil 3'de görüldüğü gibi $Ö_{45}$ kodlu öğretmen adayı ikinci sorunun çözümünde oran orantı yöntemini kullanarak önce bir saatte kaç sayfa okuyabileceğini hesaplamış. Sonra da bir saatte 40 sayfa okunursa kaç saatte 160 sayfa okunacağını bulmuştur. Benzer şekilde $Ö_{78}$ kodlu öğretmen adayının altıncı sorunun çözümünde uyguladığı cebirsel temsilde Şekil 4'de yer almaktadır.



Şekil 4. $Ö_{78}$ Kodlu Adayın Altıncı Sorunun Çözüm Aşamasında Kullandığı Cebirsel Temsil

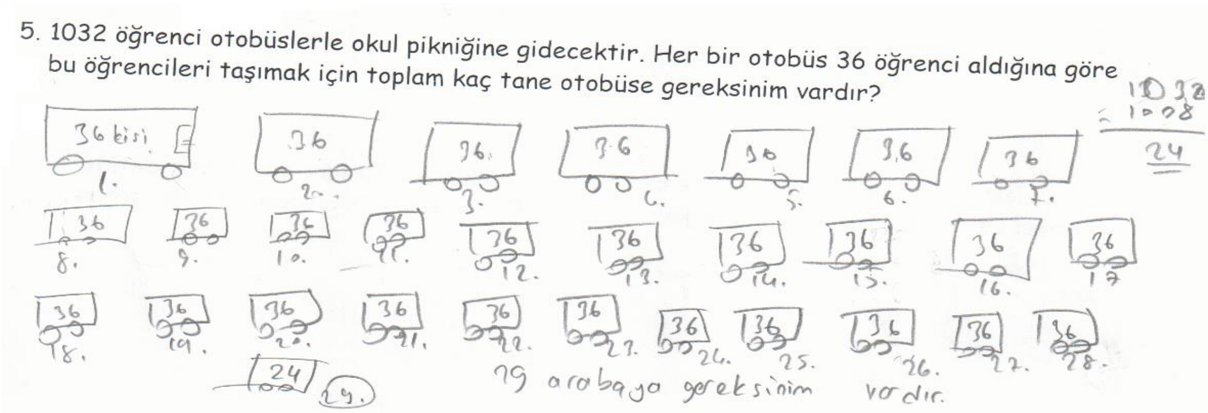
Şekil 4'de görüldüğü gibi $Ö_{78}$ kodlu öğretmen adayı altıncı sorunun çözümünde oran orantı yöntemini kullanarak önce bir kilometrenin 1000 metre ise 100 metrenin kaç kilometre olacağını hesaplamış. Daha sonrada koşucunun 100 metreyi 16 saniyede koşması durumunda 1000 metrenin kaç saniyede koşulacağını oran orantı yöntemiyle hesaplamıştır.

Diğer taraftan grafiksel temsilin kullanımına ilişkin olarak Tablo 1 incelendiğinde bu temsil türünün en çok sekizinci (%69.9) ve dördüncü sorunun (57.5) çözümünde kullanıldığı en az ise ikinci sorunun (%14.2) çözümünde bu temsilin kullanıldığı görülmektedir. Bu bağlamda yedinci sorunun çözümünde $Ö_{29}$ kodlu öğretmen adayının çözümü Şekil 5'deki gibidir.



Şekil 5. Ö$_{29}$ Kodlu Adayın Yedinci Sorunun Çözüm Aşamasında Kullandığı Grafiksel Temsil

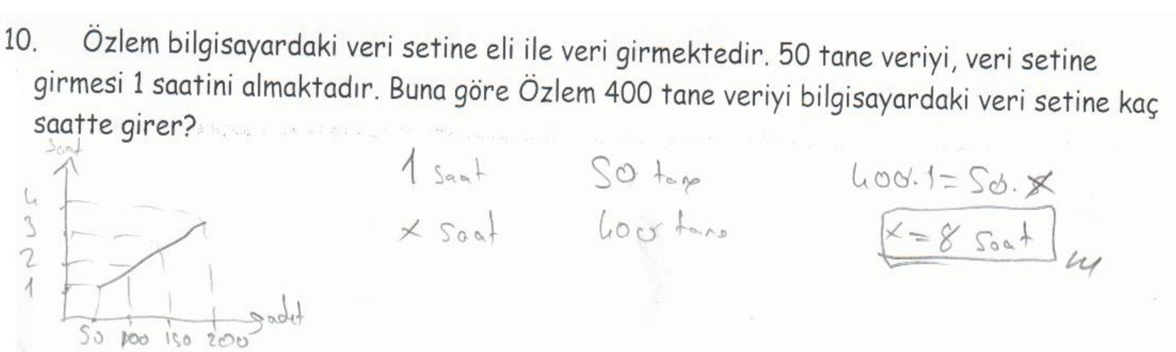
Şekil 5'de görüldüğü gibi Ö$_{29}$ kodlu öğretmen adayı yedinci sorunun çözümünde Tuana'nın 15 arkadaşı ve Kayra'nın da 16 arkadaşı olması durumunu şekil çizerek anlatmaya çalışmıştır. Buna göre öğretmen adayı tüm arkadaşlarının ortak olması durumunda 15+Kayra+Tuana olarak 17 kişinin gelebileceği sonucuna ulaşmıştır. Diğer taraftan ise aynı öğretmen adayı tüm arkadaşlarının farklı olması durumunda 14+15+Kayra+Tuana olarak 31 kişi gelebileceğini düşünmüştür. Buna benzer olarak yine Ö$_{12}$ kodlu öğretmen adayı beşinci sorunun çözümünü Şekil 6'daki gibi ifade etmiştir.



Şekil 6. Ö$_{12}$ Kodlu Adayın Beşinci Sorunun Çözüm Aşamasında Kullandığı Grafiksel Temsil

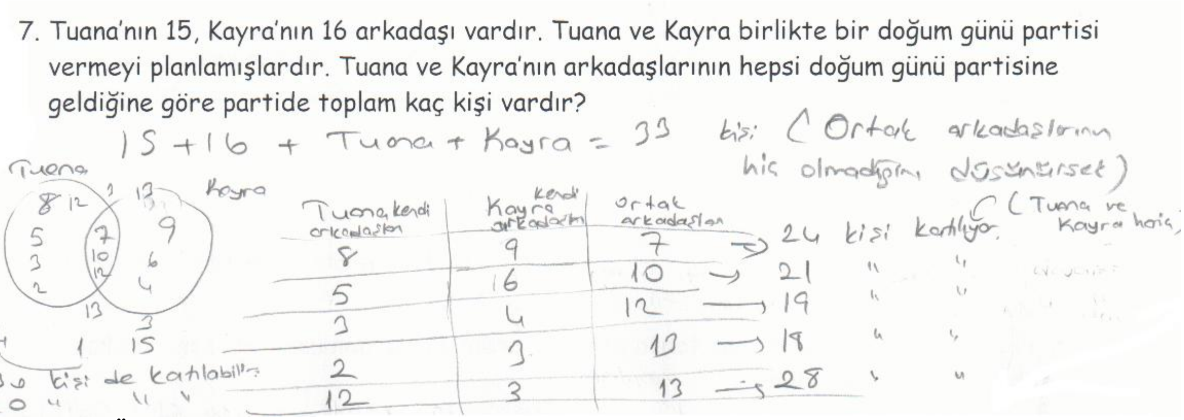
Şekil 6'da görüldüğü gibi Ö$_{12}$ kodlu öğretmen adayı beşinci sorunun çözümünde her bir otobüste 36 kişi olması gerektiğini şekil çizerek belirtmiştir. Buna göre her otobüste 36 kişi olacağından 28 otobüs gerektiğini ve artan 24 öğrenci için de bir otobüse ihtiyaç olacağını ve toplamda 29 otobüse gerek olduğunu belirtmiştir.

Son temsil türü olarak öğretmen adaylarının rutin olamayan problemlerin çözümünde en az sayısal temsil türünü kullandıkları görülmektedir. Bu temsil türünün kullanımına ilişkin veriler Tablo 1 kapsamında incelendiğinde en çok ikinci sorunun (%38.1) çözümünde bu temsil türüne başvurulduğunu ancak, bazı sorularda (3.,4., 5., 8.) ise bu temsil türüne hiç başvurulmadığı görülmektedir. Örneğin onuncu sorunun çözümü aşamasında Ö$_{36}$ kodlu öğretmen adayının kullandığı sayısal temsil Şekil 7'de yer almaktadır.



Şekil 7. Ö$_{36}$ Kodlu Adayın Onuncu Sorunun Çözüm Aşamasında Kullandığı Sayısal Temsil

Şekil 7 incelendiğinde $Ö_{36}$ kodlu öğretmen adayının onuncu sorunun çözümünde tablo çizerek bir saatte 50 veri girilirse iki saatte 100, üç saatte 150 ve dört saatte ise 200 adet veri girileceğini vurgulamıştır. Diğer taraftan yedinci sorunun çözümünde ise $Ö_{35}$ kodlu öğretmen adayı tablo çizerek ve kümelerin kesişiminden yararlanarak Tuana ve Kayra isimli iki arkadaşın birlikte verecekleri doğum günü partisine kaç kişinin gelebileceğini hesaplamıştır. Buna göre, öğretmen adayının yaptığı çözüm yolu Şekil 8'de yer almaktadır.



Şekil 8. $Ö_{35}$ Kodlu Adayın Yedinci Sorunun Çözüm Aşamasında Kullandığı Sayısal Temsil Biçimi

Şekil 8 incelendiğinde söz konusu öğretmen adayının Tuana ve Kayra isimli iki arkadaşın hiç arkadaşları olmaması durumunda sayının 15+16+Tuana+Kayra=33 kişi olacağı; Tuana'nın ve Kayranın 7 ortak arkadaşı olması durumunda sayının 8+9+7=24 kişi olacağı; Tuana'nın ve Kayranın 10 ortak arkadaşı olması durumunda sayının 5+6+10=21 kişi olacağı; Tuana'nın ve Kayranın 12 ortak arkadaşı olması durumunda sayının 3+4+12=19 kişi olacağı; Tuana'nın ve Kayranın 13 ortak arkadaşı olması durumunda sayının 2+3+13=18 kişi olacağı; Tuana'nın ve Kayranın 13 ortak arkadaşı olması durumunda ise sayının 12+3+13=28 kişi olabileceği biçiminde soruyu çözdüğü Şekil 8'den de açıkça anlaşılmaktadır.

Araştırmanın ikinci sorusunda ise öğretmen adayların bu temsilleri seçme nedenlerinin ne olduğu irdelenmiştir. Bu konuda yapılan görüşme sonuçları Tablo 2'de yer almaktadır.

Tablo 2. Rutin Olmayan Problemlerde Öğretmen Adaylarının Kullandıkları Temsilleri Seçme Nedenlerine İlişkin Tema, Kod ve Frekans Dağılımı

Tema	Kodlar	f
Bireysel Özelliklerden Kaynaklı Nedenler	Alışkanlık Olması	10
	Daha Anlaşılabilir Olması	6
	Kolay Hatırlanması	5
	Zihinde Canlandırıması	2
Sorunun Yapısından Kaynaklı Nedenler	İçeriğe Göre	7
	Çözüme Göre	5
	Somutlaştırılabilmesi (Görselleştirilebilmesi)	3

Tablo 2 bağlamında rutin olmayan problemlerde öğretmen adaylarının kullandıkları temsil türleri ve bunların kullanım nedenlerine ilişkin elde edilen veriler bireysel özelliklerden ve sorunun yapısından kaynaklı olarak iki temada değerlendirilmiştir. İlk tema olarak bireysel özelliklerden kaynaklı nedenler incelendiğinde öğretmen adaylarının alışkanlık olması (10 öğretmen adayı), daha anlaşılır olması (6 öğretmen adayı), kolay hatırlanması (5 öğretmen adayı) ve zihinde canlandırılması (2 öğretmen adayı) olmak üzere dört kod altında görüşler toplanmıştır. Örneğin alışkanlık olduğunu belirten $GÖ_{13}$ kodlu öğretmen adayı görüşlerini *"öğrencilik hayatımızda problem çözmeye alıştığımız için ne yapacağımızı biliyoruz. Küçüklükten beri öğretmenimiz kesir denildiğinde bir pasta düşün diyordu, hemen aklımıza daire şekli geliyordu. O zamandan edindiğimiz bir alışkanlık…"* biçiminde ifade ederken, $GÖ_2$ kodlu öğretmen adayı da *"Bazı insanlar görsellerle daha kolay hatırlar, bazıları da sözelle daha iyi anlar. Eğer bir soruyla ilk defa karşılaşıyorsanız kafamızda canlandırabilmemiz için şekille anlatılması gerekiyor."* şeklinde görüş bildirmiştir.

İkinci tema olarak rutin olmayan problemlerin çözümünde öğretmen adayları, sorunun yapısından kaynaklı nedenlere bağlı olarak hangi temsil türünü seçeceklerine karar verdiklerini belirtmişlerdir. Bu tema kapsamında içeriğe göre (7 öğretmen adayı), çözüme göre (5 öğretmen adayı) ve soruların somutlaştırılmasına göre (3 öğretmen adayı) karar verdiklerini belirtmişlerdir. Bu yönde $GÖ_{14}$ kodlu öğretmen adayı "*Soruda şekil çizilmesi* *gerekiyorsa çiziyordum. Bazen hız problemlerinde ya da karışım problemlerinde mutlaka şekil çizilmesi gerekiyor. Bazen de denklemle ilgili mesela bir kesme sorusu ise şekil çiziyorum. Ama bazı sorularda da gerek yok. Örneğin 160 sayfalık okuma kitabı ise burada kitap çizmeye gerek yok diye çizmedim. Sözel olarak açıkladım."* biçiminde görüşünü dile getirmiştir. Aynı kapsamda $GÖ_3$ kodlu öğretmen adayı da *"Sorunun içeriğine göre hangi temsille çözebileceğime karar verdim. Bazı soruları sözel, bazı soruları da cebirsel çözebilirsin bu soruya göre değişiyor..."* biçimde görüşünü ifade etmiştir.

SONUÇ VE ÖNERİLER

Bu çalışma, sınıf öğretmeni adaylarının rutin olmayan problemlerde kullandıkları temsil türlerini ve bu temsil türlerinin seçilmesine etki eden faktörlerin belirlenmesi amacıyla yapılmıştır. Araştırmanın sonucunda rutin olmayan problemlerin çözümünde, öğretmen adaylarının en çok sözel ve cebirsel temsil türlerini kullanırken en az ise sayısal temsil türüne başvurdukları sonucuna ulaşılmıştır. Diğer taraftan öğretmen adaylarına bu temsilleri seçme nedenlerinin neler olduğu sorulduğunda elde edilen sonuçlar bireysel özelliklerden ve sorunun yapısından kaynaklı seçimler yapıldığı sonucunu göstermektedir. Bu araştırma kapsamında sadece rutin olamayan problemler ele alınmıştır. Daha sonra yapılacak araştırmalarda rutin problemlerde öğretmen adaylarının başvurdukları temsiller türlerinin belirlenmesi önerilebilir.

NOT: Bu araştırma Çukurova Üniversitesi Bilimsel Araştırma Projeleri Koordinasyon Birimince Desteklenmiştir. Proje Numarası: EF2013BAP1

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ASCERTAIN MISCONCEPTIONS OF TEACHER CANDIDATES OF PRIMARY SCHOOL TEACHING DEPARTMENT IN THE "FORCE AND MOTION" ISSUE AND CATEGORIZED THESE MISCONCEPTIONS IN AN ONTOLOGICAL SENSE

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ABSTRACT: In this study, it is aimed to ascertain misconceptions of students about basic physical concepts such as force, friction, work, conservation of energy, mechanical energy, kinetic energy, potential energy, energy stored by springs in the "Force and Motion" issue of secondary school seventh class curriculum and categorized these misconceptions in an ontological sense. This research is a descriptive study. The study group of this research is formed of students studying in a foundation university in Istanbul in 2013-2014 academic year. The working group consists of 35 teacher candidates of 30 female and 5 male students studying in the 2nd class of primary school teaching department. Before and after applications after physical concepts about Force and Motion issue were examined and categorized ontologically examined 301 misconception due to placement to upper category and 150 misconceptions due to placement to lateral category

Key words: ontological categories, force and motion, misconceptions

SINIF ÖĞRETMENLİĞİ ÖĞRETMEN ADAYLARININ KUVVET VE HAREKET KONUSUNDAKİ KAVRAM YANILGILARININ ONTOLOJİK AÇIDAN İNCELENMESİ

ÖZET: Bu araştırmada, ortaokul yedinci sınıf öğretim programında yer alan “Kuvvet ve Hareket” konusunda yer alan kuvvet, sürtünme kuvveti, iş, enerjinin korunumu, mekanik enerji, kinetik enerji, potansiyel enerji, yayların depoladığı enerji gibi temel Fizik kavramları ile ilgili, sınıf öğretmenliği öğretmen adaylarında bulunan kavram yanılgılarını ortaya çıkarmak ve bulunan yanılgıların ontolojik açıdan değerlendirilmesi amaçlanmıştır. Yapılan bu araştırma betimsel bir çalışma niteliği taşımaktadır. Araştırmanın çalışma grubunu, İstanbul İlinde bir vakıf üniversitesinde 2013-2014 eğitim-öğretim yılında öğrenim gören öğrenciler oluşturmuştur. Çalışma grubu 30 kız, 5 erkek olmak üzere, 2. Sınıf, Sınıf Öğretmenliği 35 öğretmen adayından oluşmaktadır. Kuvvet ve Hareket konusu ile ilgili belirlenmiş temel Fizik kavramları ontolojik olarak incelenip kategorileştirdikten sonra, öğretmen adaylarının üst kategoriye yerleştirmeden kaynaklanan 301 kavram yanılgısı, yanal kategoriye yerleştirmeden kaynaklanan 150 kavram yanılgısı tespit edilmiştir.

Anahtar sözcükler: ontoloji, kuvvet ve hareket, kavram yanılgısı

GİRİŞ

Yeni Fen ve Teknoloji öğretim programının temelini yapılandırmacı öğrenme kuramı oluşturmaktadır (MEB, 2006). Yapılandırmacı öğrenme kuramında öğrencilerin sahip oldukları ön kavramlar önemli bir yere sahiptir (Bodner 1986; Gilbert, Watts ve Osborne, 1982; Lawson, 1995; Novak 2002; O’shaughnessy, 2006; Sweeney, 2007). Öğrencilerin sahip oldukları ön kavramlar (preconceptions) her zaman bilimsel anlamda doğru olarak kabul edilmeyebilir. Farklı nedenlerden dolayı bazen öğrenciler, bilimsel anlamda doğru kabul edilmeyen kavramlar oluşturarak öğrenme ortamına gelir.

Yirminci yüzyılın son çeyreğinden itibaren fizik öğretimi konusunda yapılan birçok araştırmada, öğrencilerin, genellikle çevrelerinden edindikleri bazı ön bilgilere sahip oldukları ve bu durumun da öğretimi çoğunlukla olumsuz yönde etkilediği görülmüştür (Thornton ve Sokoloff, 1990; Van Heuvelen, 1991; Hestenes ve diğerleri, 1992; Palmer ve Flanagan, 1997; Mazur, 1997; Redish ve diğerleri, 1997; Duit ve diğerleri, 1997). Literatürdeki araştırmalar, öğrencilerin fen bilimlerindeki çok sayıda kavram hakkında bilimsel olarak kabul edilmeyen fikirlere sahip olduklarını ve bu fikirlerin temelini çoğunlukla tutarsız sezgi, önyargı ve günlük hayattan edindikleri deneyimlerin oluşturduğunu ortaya koymaktadır (Griffiths ve Preston, 1992; Osborn ve Cosgrove, 1983; Osborne ve Freyberg, 1985; Yağbasan ve Gülçiçek, 2003). Örneğin, temel fizik konularından olan "kuvvet ve hareket" konusunda ilkokuldan üniversiteye kadar birçok öğrenci tarafından anlaşılması zor ve soyut kavramlar olarak nitelendirilmektedir (Osborne ve Wittrock, 1983; Legendre, 1997; Bektaş, 1999; Bahar, Öztürk ve Ateş, 2002; Aycan ve Yumuşak, 2003; Yağbasan ve diğerleri, 2005; Kurt ve Akdeniz, 2004). Bu nedenle öğrencilerin sahip oldukları ön bilgi veya kavram yanılgılarını belirlemek amacıyla, birçok konuda kavram testleri hazırlanıp uygulanmıştır. Özellikle 1980'li yıllarda, kavram, kavram öğretimi, kavram yanılgıları, kavram yanılgılarının nedenleri ve giderilmesi gibi yeni araştırma alanları ortaya çıkarmıştır (Comber, 1983; Briggs ve Holding, 1986). Yapılan bu araştırmalarda, kavram yanılgıları kavram yanılgısı (misconception), yanlış anlama (misunderstanding), ön kavramlar (preconception), alternatif çatı (alternative framework), çocuk bilimi (children science), kendiliğinden oluşan bilgiler (spontaneus knowledge), saf-deneyimsiz teori (naive theory) gibi farklı şekillerde tanımlanmıştır (Champagne ve diğerleri, 1983; Mintzes, 1984; Kalman ve diğerleri, 1999; Köse, Ayas ve Taş, 2003). Bu terimler temelde aynı anlama gelmektedir. Fakat bu değişik isimlerin kullanılması, öğrencilerin fikirlerinin ve kanılarının karakteristiğini vurgulamasından ileri gelmektedir Genel olarak, kavram yanılgıları, bilimsel olarak doğru kabul edilen ve öğretim süreci sonunda öğrenciler tarafından anlamlı bir şekilde öğrenilmesi amaçlanan kavramların dışında öğrenciler tarafından eksik veya hatalı bir şekilde yapılandırılan kavramlar olarak tanımlanmıştır (Nakhleh, 1992). 2000'li yıllara gelindiğinde ise, kavram yanılgılarına felsefi açıdan da yaklaşılmış ve felsefi temelli bazı tanımlar da yapılmıştır. Chi ve Roscoe (2002), kavram yanılgılarını ontoloji temeline dayandırarak bütün kavramların ve fikirlerin ait olduğu bir ontolojik kategori bulunduğunu, kavramların üyesi oldukları bu ontolojik kategorilerin tüm özelliklerine sahip olduğunu ve kavram yanılgılarının bireylerin yanlış yaptıkları kategorileştirmeler sonucu oluştuğunu belirtmişlerdir. Diğer bir deyişle, bireylerin kavramların özelliklerini tam olarak bilememeleri, kavramları ait olmadıkları ontolojik kategorilere yerleştirmelerine neden olmaktadır.

Ontoloji, sözlük anlamı olarak "varolma bilimi" diye tanımlanmaktadır. Gruber, günümüzde çoğunlukla kabul gördüğü üzere, ontolojiyi "kavramlaştırmanın kesin tanımı" olarak tarif etmiştir (Gruber, 1993). Olası bir ontolojinin en basit tanımlarından birisi de "kontrol edilebilir bir sözlük" olabilir. Ontoloji, varlıklar ve varlıkların ait olduğu temel kategorilerle ilgilenir (Chi, 2001). Ontolojiler, bilgiyi, iyi tanımlanmış anlamsal yapılarla birlikte açık ve anlamlı bir şekilde sunmamızı sağlayan bilgi betimleme araçlarıdır. Ontolojik özellik ise, bir varlığın yer aldığı ontolojik kategori sonucu sahip olma potansiyelini taşıdığı özelliktir (Chi, 1997). Örneğin, madde kategorisi; hacim, kütle, renk gibi ontolojik özelliklere; olay kategorisi ise başlangıcı ve sonu olma gibi ontolojik özelliklere sahiptir. Kavramlar, sahip oldukları ontolojik özelliklere göre, ontolojik kategorilere yerleştirilirler. Ontolojik kategoriler de, temelde üç tanedir: Madde, süreç ve zihinsel durumlar. Öğrenciler, süreç kategorisine yerleştirmeleri gereken bir kavramı, madde kategorisine yerleştirdiklerinde, kavram yanılgısı oluşturmuş olurlar. Dolayısıyla, kavramların ontolojik açıdan hangi kategorilere yerleştirildiğinin belirlenmesi, eğer yanlış kategorilere yerleştirildiyse, çeşitli öğretim yöntem ve teknikleri kullanılarak bu kavramların doğru kategorilere yerleştirilmesinin sağlanması, kavram yanılgılarının kaynağına inilmesi ve böylece giderilmesi açısından oldukça önemlidir.

Fen Bilimlerinde yer alan çok sayıda soyut kavramın doğru şekilde yapılandırılması, kavramların doğru ontolojik kategorilere yerleştirilmesi ile gerçekleşir. Bilgilerin bireyin zihninde kategorileştirme sürecinde birçok faktör etki eder. Bireyin geçmiş yaşantıları bu süreçte belirleyici bir role sahiptir (Duit ve Treagust, 1995). Bu yönüyle kavramlar bazen bireyin zihninde bilimsel durumların dışında farklı olarak algılanabilir ve farklı kategorilere yerleştirilebilir. Bu şekilde kategorileştirilen kavramsal oluşumlar, bireyin kavramlar arası ilişkileri kurabilmesini ve yeni durumlara anlam vermesini güçleştirir. Soyut olgu ve kavramsal ilişkilerden oluşan fizik konularının kavranmasındaki güçlükler de öğrencilerin bu "anlam verme ve kategorileştirme" sürecine örnek olarak verilebilir (Legendre, 1997). Öğrenciler genellikle temel bir fizik kavramına anlam veremeyip zihnide yer alan kategorilerin içlerine yerleştirdiğinde üst düzey ve daha karmaşık kavramları anlamada ve kalıcı öğrenme gerçekleştirmede güçlük çekmektedirler. Bu nedenle, öğrencilerin yaşamlarında karşılaştıkları olaylara ilişkin sezgisel düşünceleri ile fizik konu ve kavramları arasındaki köprüyü anlamlı bir şekilde kurabilmeleri gerekir (Ayvacı ve Devecioğlu, 2002; Devecioğlu ve Akdeniz, 2006). Bu köprülerin de anlamlı bir biçimde kurulması için ilk olarak öğrencilerin kavram yanılgılarının tespit edilmesi ve daha sonra da bu kavram yanılgılarının giderilmesi esas alınmalıdır. (Ayvacı ve Devecioğlu, 2002; Yağbasan ve Gülçiçek, 2003; Turgut ve diğerleri, 2011).

Kavram yanılgılarının giderilmesi sürecinde, öğretim sürecinin planlanması sırasında, hangi kategorilere yanlış yerleştirmeden kaynaklanan kavram yanılgılarının oluştuğunun belirlenmesi, öğrencilerin kendi kavramsallaştırmalarını sınaması, kavramlarla ilgili yanılgılarının olabileceğine ilişkin farkındalığa ulaşması ve bu yanılgıları giderebilmek için gerekli üst düzey düşünme becerilerini edinilmesi kavramların doğru kategorilere yerleştirilmesinde ilk basamak olmaktadır. İkinci basamak ise, öğretim sürecinde, doğru ontolojik kategorilere yerleştirmeyi sağlayacak yöntem ve tekniklerin kullanılmasıdır. Bu bağlamda, düşünme dolayısıyla sebeplendirme aktivitelerinden biri olan argümanın sınıf ortamına entegre edilmesinin öğrencilerin kavramsal

değişime yönelmesinde etkili stratejilerden biri olabileceği belirtilmektedir (Niaz, Aguilera, Maza ve Liendo, 2002; Nussbaum ve Sinatra, 2003). Örneğin, Vygotsky'e göre (1978) farklılıkları ortaya çıkaran ve tartışma ortamı yaratan sosyal etkileşimler olmaksızın, bilimsel kavramların kavranması imkânsızdır. Billig (1996) bu durumu, "tartışmayı öğrenmek düşünmeyi öğrenmenin temel sürecidir" diyerek daha ileri bir noktaya taşımıştır.
Yapılan araştırmalar, kavram yanılgılarının tespiti ya da çeşitli yöntemlerin kavram yanılgılarını gidermedeki etkisi ile sınırlıdır. Kavram yanılgılarını ontolojik açıdan değerlendiren sadece birkaç çalışmaya rastlanmaktadır (Soman, 2000; Özalp, 2008; Özalp ve Kahveci, 2011). Bu araştırma, "Kuvvet ve Hareket" konusu ile ilgili kavramların, ontolojik açıdan değerlendirilmesi açısından oldukça önemlidir. Yapılan çalışmada, 7. Sınıf "Kuvvet ve Hareket" konusunda yer alan kuvvet, sürtünme kuvveti, iş, enerjinin korunumu, mekanik enerji, kinetik enerji, potansiyel enerji, yayların depoladığı enerji gibi temel Fizik kavramlarında, öğrencilerde var olan kavram yanılgılarına ontolojik açıdan bakılmaya çalışılmıştır. Öğrencilerin belirlenen konularda sahip oldukları kavram yanılgıları ontolojik açıdan değerlendirilip, kategorileştirilmeye çalışılmış ve bu kategorilerin karakteristik özelliklerine göre yanılgıların nedenleri ortaya konulmaya çalışılmıştır. Bu durum, bu çalışmanın temel amacını ve problemini oluşturmaktadır.

Ontoloji ve Ontolojik Özellik

Tarihte varlıkları kategorilere ayırma konusunda pek çok filozof çalışma yapmış olmakla birlikte, ilk sistematik çalışma Aristoteles tarafından yapılmıştır. Aristoteles yaptığı çalışmada varlıkların kategorileri arasında hiyerarşik bir düzenleme kurmamış ve varlıkların özünden bahsetmemiştir. Ancak, kategorilerin birbiri ile ilişkili olduğunu ve tüm kategorilerin cisim (substance) kategorisine bağlı olduğunu savunmuştur. Aristoteles bu durumu şu şekilde açıklamaktadır, "Bir şeyin yeşil olduğu söylendiğinde o niteliğin taşıyıcısı olan bir cismin olması gerekir. Cisimler niteliklerden daha önce, nitelikler de ilişkilerden daha önce var olmuşlardır. Bir şeyin ne olduğunu (kedi) bilmek, niteliğini (kahverengi) bilmekten daha çok şey anlatır, niteliğini bilmek de diğer nesnelerle olan ilişkisini (benim kedim) bilmekten daha çok şey anlatır" (Westerhoff, 2005).

Ontoloji, varlık bilimidir. Varlıklar ve varlıkların ait olduğu temel kategorilerle ilgilenir (Wikipedia, 2015). Diğer bir ifadeyle ontoloji gerçeğin kategorik yapısına tekabül eder. Aristoteles zamanlarından beri her şeyin temel olarak farklı kategorilere ait olduğu farz edilmiştir (Chi, 2005; Chi ve Slotta, 1993). Bu kategorilere ontolojik kategoriler denir. Bu görüşe göre dünyadaki tüm varlıklar üç temel ontolojik kategori içine alınabilir. Bu kategoriler "madde (matter)", "süreç (process)" ve "zihinsel durumlar (mental states)" kategorileridir (Chi, Slotta ve Leeuw, 1994; Johnston ve Southerland, 2000). Ontolojik kategorilerin gerçekliği onların ontolojik özellikleri ile tanımlanabilir (Chi ve Hausmann, 2003).

Ontolojik özellik, bir varlığın yer aldığı ontolojik kategori sonucu sahip olma potansiyelini taşıdığı özelliktir (Chi, 1997; Chi ve ve diğerleri, 1994). Diğer bir ifadeyle bir ontolojik kategoriye ait üyelerin sahip oldukları özelliktir (Chi ve Slotta, 1993; Chi ve Hausmann, 2003; Chi, 1997). (yani üye denilen şey bir ontolojik kategoriye örnek olarak verilebilecek kavramlardır. Örneğin masa, sandalye madde kategorisinin ya da elektrik, ısı, kimyasal bağ kavramları süreç kategorisinin üyeleridir). Ontolojik özellikler o kategorinin en temel özellikleridir (Chi ve Slotta, 1993). Örneğin 'madde (matter)' kategorisi hacim, kütle, renk gibi bazı ontolojik özelliklere sahiptir (Chi ve Hausmann, 2003; Chi, 1992; Chi ve diğerleri, 1994). Hacim, kütle, renk gibi özellikler "madde (matter)" kategorisinin üyelerin sahip olabilecekleri temel özellik çeşitleridir (Chi ve Hausmann, 2003). Örneğin renk özelliğini ele alırsak bir sincap renk özelliğine sahiptir yani renkli olabilir. Ancak 'olay' alt kategorisine ait bir üye olan savaş kavramı renk özelliğine sahip değildir. Bu kategori de kendi üyelerinin sahip oldukları bir zaman diliminde meydana gelme, başlangıcı ve sonu olma gibi başka ontolojik özelliklere sahiptir (Chi, 1992; Chi ve diğerleri, 1994). Madde (matter) ve olay kategorileri birbirlerinden farklı ontolojik kategorilerdir çünkü bu iki kategorinin ontolojik özellikleri de birbirlerinden farklıdır (Chi, 1992).

Ontolojik özellik tanımlayıcı ve karakteristik özelliklerden farklıdır. Ontolojik özellik bir kavramın sahip olma potansiyeli gösterdiği özelliktir. Ancak tanımlayıcı özellik sahip olunması gereken özelliktir, karakteristik özellik ise o kavramın genellikle sahip olduğu özelliktir. Örneğin sürahi kavramı ele alınırsa sürahinin bir uca sahip olması onun tanımlayıcı özelliğidir. Bu sürahinin genellikle camdan yapılmış olması onun karakteristik özelliğidir. Ancak kırılabilir olması onun ontolojik bir özelliğidir. Bu nedenle ontolojik özellikler diğer özelliklerden farklıdırlar (Chi, Slotta ve Leeuw, 1994). Ontolojik özellik, bir kategori üyesinin kesin olarak sahip olduğu bir özellik olmamasına rağmen o kategori üyesini kapsayan özelliktir. Bu şöyle de ifade edilebilir: Bir sincap renk özelliğine sahiptir yani renkli olabilir, ancak bir sincap mavi renkli olmaz ama başka bir renkte olma potansiyelini göstermektedir (Chi ve Hausmann, 2003).

Ontolojik bilgi dünyada var olan şeylerin türleri ve bu şeylerin birbirleri ile nasıl alakalı olduğu hakkında sahip olduğumuz günlük bilgilerimizdir (Sera, Gathje ve Del Castillo Pintado, 1999). Psikoloji literatüründe ontolojik bilgi ilk olarak Keil (1979) tarafından incelenmiştir. Keil yaptığı çalışmada ontolojik kategoriler arasında sağlam bir hiyerarşi olduğunu ileri sürmüştür. Keil' in çalışmalarından yola çıkan Chi (1992) ontolojinin bilgilerimizi farklı kavramsal kategorilere böldüğünü söyler. Chi, 1992' de yaptığı bu çalışmasında üç temel ontolojik kategoriden bahsetmiştir; madde, olay ve soyut kavramlar. Bununla birlikte başka kategorilerin de mümkün olabileceğini belirtmiştir. Chi ve Slotta, 1993' te yaptıkları çalışmalarında ontolojik kategorileri madde, süreç, zihinsel durumlar olarak adlandırmışlardır.

Ontolojik Kategorilerin Gerçekliğini Kavramaya İlişkin Yollar

İç Gerçeklik

Belirli bir grup sınırlamalar her bir ontolojik kategorideki varlıkların davranış ve özelliklerini kontrol eder (Chi, 1992). Ontolojik kategoriler, o ontolojik kategorinin üyelerinin davranışlarını kontrol eden bir grup sınırlama veya özelliklerden oluşan ontolojik vasıflar ile ayırt edilirler. Örneğin madde kategorisindeki nesneler, davranışlarını ve sahip olabileceği özellik türlerini belirleyen kesin sınırlamalara sahip olmalıdır (Chi ve Hausmann, 2003). Madde kategorisindeki varlıkların tutulabilmesi, depolanabilmesi, hacmi, kütlesi, rengi olması; süreç kategorisindekilerin belirli bir zaman periyoduna yayılmış olması, zaman içinde devam etmesi gibi. Ontolojik özellikler bir varlığın potansiyel olarak sahip olabileceği nitelikler olarak tanımlanmıştır (Chi, 1992; Chi, 1997). Bir cismin şu anda renkli olmamasına karşın, renkli de olabileceği gibi.

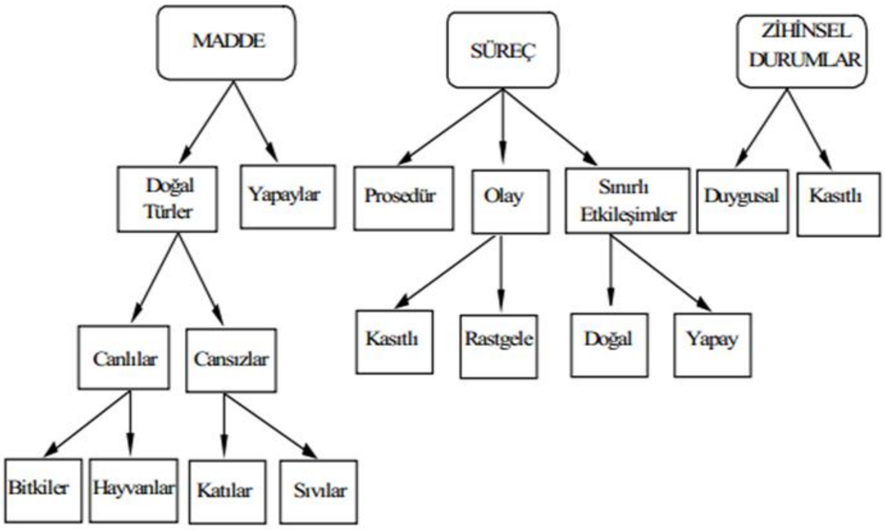
Bakır telin renginin mor olmamasına karşın 'mor renkli bakır tel' ifadesi kullanım itibariyle uygundur fakat 'mor renkli elektrik alan' kullanım olarak uygun değildir. Renk, madde kategorisindeki varlıkların ontolojik özelliklerinden biridir, bundan dolayı süreç kategorisindeki elektrik alan kavramı için kullanımı uygun olmamıştır. Hiçbir fiziksel işlem (örneğin ameliyat, koşma…) bir ontolojik kategorideki varlığı diğer bir ontolojik kategorideki varlığa dönüştürmez. Örneğin bir tahtanın parçalara ayrıldığını düşünelim. Parçalara ayrılmış olmasına karşın tahta özelliğini korur.

Psikolojik Gerçeklik

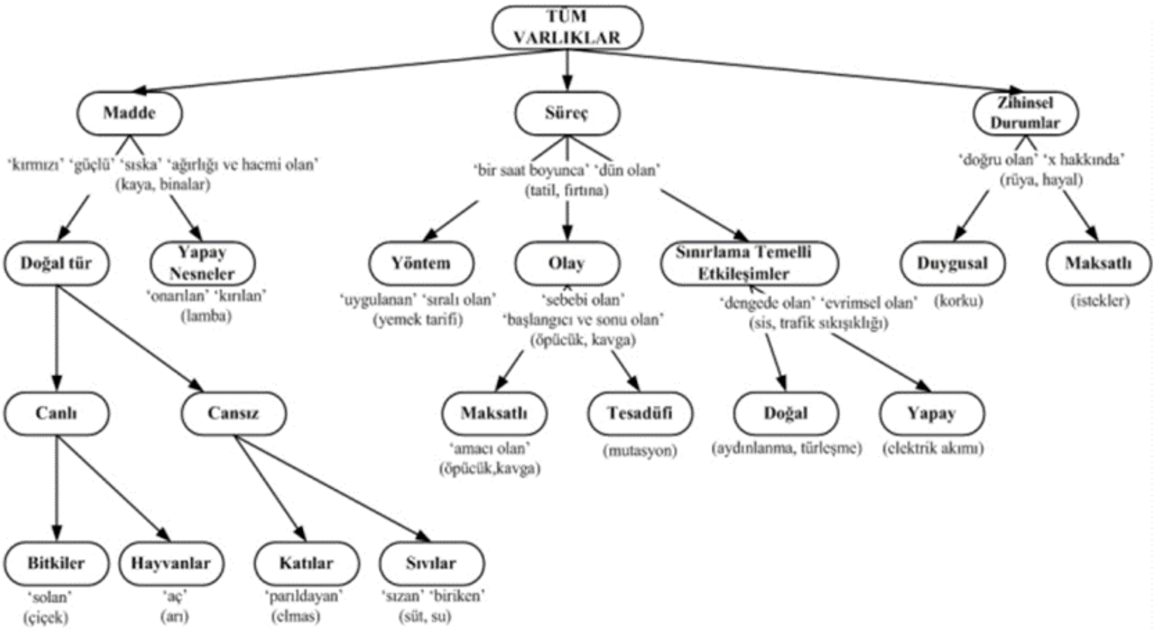
Belirli bir grup yüklemlere bakılarak yapılan yargılamalar ile varlıkların ontolojik kategorileri ayırt edilebilir. Yani bir varlıkla birlikte kullanılan yükleme bakılarak varlığın hangi kategoride olduğu tespit edilebilir. "Bu kaynaktan elektromanyetik dalgaları çıkar." cümlesinde elektromanyetik dalga madde kategorisindedir. "Yüklü cisimlerin ivmeli hareketi elektromanyetik dalga oluşmasına neden olur." cümlesinde elektromanyetik dalga süreç kategorisinde sınıflandırılmıştır. "Yüklü cisimlerin ivmeli hareketi ile elektromanyetik dalga oluşmak ister." cümlesinde ise elektromanyetik dalga kavramı zihinsel durumlar kategorisindedir.
Örneğin; bir kişinin rüzgâr kavramının ontolojik sınıflandırmasının madde ya da süreç kategorisinden hangisinde olduğunu merak ettiğimizi varsayalım. Bu durumda o kişinin rüzgâr için kullandığı ifadeleri incelemeli ve kodlamalıyız. Eğer cümlesi "Duyduğun ses kanyonun içinde hareket eden rüzgârın sesi" ise rüzgârın hareket ettiğini düşündüğü için hareket etme fiilinden dolayı rüzgâr madde kategorisindedir. Ancak "Kanyondaki rüzgâr yalnızca hava hareketidir" şeklindeki bir ifade hareket etme sürecini tanımladığı için kişinin rüzgârı hava hareketi olarak düşündüğünü göstermektedir ve süreç kategorisindedir. Her iki cümlede de hareket etme yüklemi kullanılmasına rağmen her birinde farklı kategoriye dâhil olmuştur. Kavramsal içerik analizlerinde kullanılan yüklemle birlikte, cümle içinde ifade ettiği anlama da hassasiyet gösterilmelidir (Slotta ve diğerleri, 1995). Hiçbir psikolojik mekanizma (özellik eklenip çıkarılması, benzetme model, genelleme, özelleştirme) bir ontolojik kategorideki varlığı diğer bir ontolojik kategorideki varlığa dönüştürmez (Chi, 1992) Elektrik akımını suyun akışına benzeterek anlatmak elektrik akımı kavramının madde kategorisinde sınıflandırılması gereken bir kavram olduğunu göstermez.

Ontolojik Kategoriler

Dünyadaki tüm varlıklar üç temel ontolojik kategori içine alınabilir. Bunlar "madde", "süreç" ve "zihinsel durumlar" kategorileridir (Şekil 1) (Chi ve diğerleri, 1994; Johnston ve Southerland, 2000). Her ontolojik kategorinin alt kategorileri vardır. Bütün ontolojik kategoriler birbirlerinden farklı olduğu gibi alt kategoriler de birbirlerinden farklıdır çünkü her kategori ontolojik olarak birbirinden farklılık göstermektedir. Örneğin "madde" kategorisinin alt kategorileri "süreç" kategorisinin alt kategorilerinden ontolojik olarak farklılık göstermektedir (Chi ve diğerleri, 1994). Şekil 2'de olası bir ontolojik kategori sınıflandırması detaylı olarak verilmektedir.



Şekil 1. Dünyadaki Varlıkların Bulunabileceği Üç Ontolojik Kategori ve Alt Kategorileri



Şekil 2. Olası Bir Ontolojik Kategori Sınıflandırması (Chi ve Slotta, 1993)

Madde (Matter) Kategorisi

Madde fiziksel olarak etkileşime girilen, görme, dokunma gibi duyularla hissedilen şeylerin bileşimidir. Bu kategori somut kavramları içerir. Madde kategorisi içinde yer alan madde özelliği gösteren varlıkları tanımlayan bazı ontolojik özellikler vardır. Madde kategorisinde bulunan kavramlar kütle, hacim, depolanabilme, biriktirilebilme gibi ontolojik özelliklere sahiptir. Öğrenciler de bu özelliklerle daha kolay etkileşime girdikleri için bu kategori onların en kolay kavramsallaştırdıkları kategoridir (Johnston ve Southerland, 2000).

Doğal türler (kedi, papatya, su, krom…), yapay nesneler (lamba, masa…) bu kategoriye dâhildir. Fakat lamba ve su, ikisi de madde kategorisinde olmasına rağmen farklı özelliklere sahiptir. Örneğin "lamba kırıldı" cümlesi anlamlı bir durum ifade ederken "su kırıldı" kulağa yabancı gelmektedir. Bundan dolayı madde kategorisi de alt kategorilere ayrılmıştır (Chi, 1997). Bunlar "doğal türler (natural kind)" ve "yapaylar (artifacts)" dır.

Süreç (Process) Kategorisi

Süreç kategorisindeki kavramlar bir şeylerin ne olduğundan ziyade ne yapıldığını ifade eden kavramlardır. Bir sürecin fiziksel özelliği tanımlanamaz. Örneğin okuma, yazma, düşünme gibi kavramlar süreç kategorisi içinde yer alır (Johnston ve Southerland, 2000). Farklı bir şekilde ifade etmemiz gerekirse belirli bir zaman periyoduna yayılmış durumlarda kullanılan kavramları (elektrik akımı, sağanak yağış...) içerir. Örneğin "on dakika süren fırtına" denildiğinde fırtınanın bir zaman periyoduna yayıldığını anlıyoruz fakat "on dakika süren süt" denildiğinde anlamsız oluyor. Süreç kategorisindeki kavramların (okuma, yazma) rengi, kütlesi, hacmi yoktur. Bu örnekle madde ile süreç kategorisi arasındaki fark görülebilir.

Süreç kategorisi üçe ayrılır. Bunlar "prosedür", "olay" ve "sınırlı etkileşimler (Constraint-Based Interactions)" kategorileridir. Bunlardan en önemlisi sınırlı etkileşimler kategorisidir. Birçok bilimsel kavram sınırlı etkileşimler kategorisinde bulunmaktadır. (Chi ve diğerleri, 1994). Bu tür kavramlara fizik ve biyolojide sıkça karşılaşılmaktadır. (Chi, 1997). Isı, ışık, kuvvet, akım, elektrik, doğal seleksiyon (seçim), difüzyon gibi kavramlar sınırlı etkileşimler kategorisinde bulunan kavramlara örnek olarak verilebilir. Verilen örnekleri, kütle çekimi örneği ile daha da detaylandırabiliriz. Kütle çekim kuvveti iki kütlesel parçacığın arasındaki etkileşimdir. Bu kuvvetin oluşması için iki kütlenin varlığı dışında başka bir sebebin vasıta olmasına gerek yoktur. Elektrik akımı ise, elektriksel olarak yüklü olan parçacıkların elektrik alan etkisi altında hareketi sonucu oluşur. Burada da elektrik alan (uzaydaki iki nokta arasındaki potansiyel fark olması) ile yüklü parçacık arasındaki etkileşim söz konusudur. Aynı örnekler ısı ve ışık gibi kavramlar için de verilebilir (Reiner, Slotta, Chi ve Resnick, 2000). Ayrıca öğrencilerin kavram yanılgılarının en fazla olduğu kategori de bu kategoridir. Sınırlı etkileşimler kategorisinin özelliklerini anlamanın en iyi yolu onu diğer kategorilerle karşılaştırmaktır.

Zihinsel Durumlar Kategorisi

Zihinsel durumlar, zihinsel olarak dış dünyaya ilişkin algılarımızla oluşturduğumuz soyut kavramları içerir (aşk, nefret, istek). Örneğin "sabit kütle üzerine etki eden kuvvet arttıkça ivme de artmak ister" cümlesinde ivme zihinsel temelli bir kavramdır. Ancak "sabit kütle üzerine etki eden kuvvet arttıkça ivme de artar" cümlesinde ivme süreç temelli bir kavram olarak ifade edilmiştir.

Ontolojik Kategorilerin Birbiriyle Karşılaştırılması

Bir kategorinin bir özelliği diğer bir kategorinin elemanlarını kapsayamaz. Bundan dolayı iki kategori ontolojik olarak farklıdır. Bu tip kategorilere paralel kategoriler de denilebilir. Örneğin kırılma özelliği 'yapaylar' kategorisine aittir. Ancak onun paralel kategorisi olan "hayvanlar" kategorisinin üyeleri için kullanılamaz. Örneğin köpekler ve "yapaylar" kategorileri doğrudan bir hiyerarşik ilişki içermemektedir.

Hiyerarşik Kategoriler

Hiyerarşik kategoriler birbirleriyle aşamalı bir sıra içinde bulunan kategorilerdir. Örneğin kobra kavramı "zehirli yılanlar" kategorisinde yer alır. Ayrıca bu kavram "yılanlar" kategorisinde de incelenebilir. Bunun yanında 'sürüngenler' kategorisi içinde de bulunmaktadır. Bahsedilen bu üç kategori daha üst bir kategori (zehirli yılanlar, yılanlar, sürüngenler) olan "canlılar" kategorisinde bulunmaktadır. Bundan dolayı bu kategoriler arasında aşamalı bir sıra vardır; yani birbirleriyle hiyerarşik ilişkilidirler. Birbirine göre hiyerarşik kategorilerdir. Bir kavramın farklı bir hiyerarşik kategoriye yerleştirilmesi bir kavram yanılgısına yol açmaz (Chi ve Roscoe, 2002).

Yanal Kategoriler

Hiyerarşik kategori ilişkileri dışında kategoriler arasında yanal ilişkiler de vardır. Yanal ilişkili kategorilere yanal kategoriler denir. Bu kategoriler arasında bir hiyerarşi bulunmaz. Örneğin kobra ve çıngıraklı yılan kategorileri yanal kategorilerdir. Bunlar ayrıca "kardeş kategoriler" diye de adlandırılabilirler çünkü kobra ve çıngıraklı yılan kategorilerinin her ikisi zehirli yılanlar kategorisinin alt kategorileridir. Ayrıca bu kategoriler hem yılanlar hem de canlılar kategorisinin alt kategorileridir. Yani birden fazla ortak oldukları üst hiyerarşik kategorileri vardır (Chi ve Roscoe, 2002). Yanal kategorilere bir başka örnek de yılanlar ve sandalyeler kategorileri verilebilir (biri doğal diğeri yapay ontolojik kategorilerine aittir). Her iki kategorinin ortak oldukları "somutlar (concrete things)" adında bir üst hiyerarşik kategori bulunmaktadır. Ancak bu kategoriler kardeş kategoriler değil de "kuzen kategoriler" olarak da isimlendirilebilir. Kuzen kategorilerle kardeş kategoriler arasındaki fark kardeş kategorilerin ortak olarak paylaştıkları birden fazla ontolojik kategori varken kuzen kategorilerinin paylaştıkları sadece bir ontolojik kategorinin olmasıdır (Chi ve Roscoe, 2002).

Kategorize Etme

Kategorize etme bir kavramı ait olduğu düşünülen bir kategoriye atama ya da tanımlama sürecidir. Kategorize etme öğrenme sürecindeki önemli bir mekanizmadır çünkü bir kavram hangi ontolojik kategoriye atandı ise o kategorinin ontolojik özelliklerini alır (Chi, 2007). Örneğin kimyasal bağ kavramı süreç kategorisi yerine madde kategorisine atanırsa kavrama hemen madde kategorisinin özelliklerinden biri olan kütleye sahip olma özelliği yüklenir. Eğer kimyasal bağ kavramı doğru olarak süreç kategorisine atandı ise süreç kategorisinin ontolojik özelliklerinden biri olan başlangıcı ve sonu olmama gibi bir özelliğe sahip olacaktır. Bu nedenle kavramların doğru bir şekilde öğrenilebilmesi için doğru kategorilere atanmaları çok önemlidir. Öğrenciler yeni bir kavramla karşılaştıklarında onu kendilerine uygun gelen bir ontolojik kategoriye alırlar; yani o kavramı kategorize ederler. Bir kavram ancak diğer kavramlarla ilişkilendirilerek kategorize edilir ve anlam kazanır. Bu nedenle öğrencilerde bulunan kavramın anlamı ontolojik özelliklerinden önemli ölçüde etkilenir (Johnston ve Southerland, 2000). Kavramlar bulundukları kategorinin ontolojik özeliklerine sahiptirler. Örneğin eğer bize önceden kızılgerdanların kuş oldukları ve kuşların yumurtladıkları söylenmezse biz kızılgerdanların yumurtlayabileceklerini bilemeyiz. Bu nedenle kategorize etme ya da bir kavramı doğru bir kategoriye atama öğretimde önemli bir yer alır (Chi, 2007). Kimyadan bir örnek olarak helyum gazı verilebilir. Helyum soygazdır ve soygazlar (ksenon hariç) reaksiyona girmezler. Eğer öğrencilere helyumun soygaz olduğu söylenmez ise kimyasal reaksiyona girmeme eğilimini düşünemezler. Kategorize etme işlemi karşılaşılan yeni kavramlara kategorik özelliklerin verilmesi ile başlar. Kategorize etmenin öğrenmedeki rolü ile ilgili bir çıkarım şudur: Öğrencide, yeni karşılaştığı kavramı ataması gereken ontolojik kategori yoksa öğrenci o kavramı uygun olan en üst düzeydeki kategoriye atar. Örneğin bir müzede kendisi için farklı olan bir hayvan heykeli gören kişi o hayvanın sürüngen olduğunu bilmiyorsa onun hareket edebilme, yemek yeme gibi özellikleri olduğunu düşündüğü için onu 'hayvanlar kategorisi'ne atar, hemen sürüngenler kategorisine atayamaz (Chi, 2007). Buna göre, öğrenciler yeni kavramları yanlış kategorize ederlerse kavram yanılgıları ortaya çıkabilmektedir (Johnston ve Southerland, 2000).

Kavram ve Kavram Yanılgılarının Ontolojik Nedenleri

Chi (1992)' ye göre bütün kavramlar ve fikirler bir ontolojik kategoriye aittir. Kavram terimi bir kategori örneğini ifade eder. Örneğin "kedi" kavramının "hayvanlar" kategorisine ait olması, "fırtına" kavramının "süreç" kategorisine ait olması ya da "düşünce" kavramının "zihinsel durumlar" kategorisinin bir örneği olması gibi. Bir kavramın birçok algısal ve kavramsal özelliği vardır; ayrıca bir kavram belli kategorilere aittir. Örneğin bir kızılgerdan kırmızı bir göğse sahiptir ve bu onun algısal özelliğidir. Sıcak iklimlerde yaşaması onun kavramsal özelliğidir ve "kuşlar" kategorisine aittir (Chi, 2007). Yani kavramlar bulundukları kategorilerin içeriğiyle yorumlanır ve anlaşılır. Bir kavram bir kategoriye atandığı zaman bu kavram o kategorinin tüm özelliklerini alır. Bu perspektiften bakıldığında kavram yanılgıları kavramların yanlış kategorize edilmesi sonucunda oluşur çıkarımı yapılabilir. Diğer bir ifadeyle kavram yanılgısı bir kavramı yanlış ontolojik kategoriye atama sonucu oluşur (Chi ve Roscoe, 2002; Johnston ve Southerland, 2000). Bu yanlış kategorize etme hiyerarşik değil yanaldır (Chi ve Roscoe, 2002).

Örneğin bir öğrencinin elektrik kavramını süreç kategorisi yerine madde kategorisine aldığını düşünelim. Bu öğrencinin madde kategorisindeki kavramların depolanabilme özelliği taşımasından dolayı elektriğin de bataryada depolandığı düşüncesini taşıdığını söylemek mümkündür. Ayrıca bu gibi düşünen öğrenciler bir telden geçen elektrik akımını gerçek bir akım olarak düşünmektedirler. Yani sıvılar nasıl bir borudan akıyorsa elektrik akımının da bir telden o şekilde aktığını düşünmektedirler (Chi ve Roscoe, 2002). Literatür taramasında görülen yanılgılardan biri de öğrencilerin çözünme olayını erime ile karıştırmalarıdır. Burada karıştırılan her iki kavram ontolojik açıdan süreç kategorisinin alt kategorilerinden biri olan olay kategorisinde yer almaktadır. Ancak olay kategorisinin de alt kategorileri vardır.

Ontolojik olarak kimyadaki erime ve çözünme kavramları süreç kategorisinde yer alan farklı ontolojik kategorilerdir. Örneğin öğrenciler şeker çözündüğünde şekerin katı halden sıvı hale geçtiğini (eridiğini) düşünmektedirler. Yani bu olayı çözünme kategorisine almaları gerekirken erime kategorisine atamışlardır. Bu kavramın yanlış kategorize edilmesi madde çözündüğü sırada eridiği şeklinde bir kavram yanılgısı oluşturmaktadır. Çözünme ile ilgili kavram yanılgılarından bir diğeri de şeker suda çözününce su ile kimyasal bir tepkimeye girdiği düşüncesidir. Burada çözünme ve kimyasal tepkime kategorilerinin ikisi de olay kategorisinde bulunmaktadır ancak bunlar olay kategorisinin farklı alt kategorileridir. Burada da yine öğrenciler fiziksel bir olayı kimyasal bir olay kategorisine atayarak başka bir kavram yanılgısına yol açmaktadırlar. Olay kategorisi kimyaya göre fiziksel olay ve kimyasal olay şeklinde ikiye ayrılabilir. Katıların suda çözünmesi kavramı fiziksel olay kategorisinde yer alır ancak kimyasal tepkimeler kimyasal olay kategorisinde yer alır.

Öğrenciler "şekerin çözünmesi" kavramını fiziksel olay kategorisine almaları gerekirken kimyasal olay kategorisine atamışlar ve böylece kavramı yanlış kategorize ederek bir kavram yanılgısına yol açmışlardır.

Kavram yanılgılarına verilebilecek diğer bir örnek de gazlı içeceklerin kapakları açıldığında dışarıya çıkan kabarcıkların kimyasal bir tepkime sonucu olduğu düşüncesidir. Aslında gazlı içeceğin bulunduğu şişenin kapağı açıldığında suyun içinde çözünmüş olan gaz dışarı çıkar yani burada fiziksel bir olay söz konusudur. Ancak öğrenciler bu olay sırasında kimyasal bir tepkimenin olduğunu düşünerek kavramı fiziksel olay kategorisine atamak yerine kimyasal olay kategorisine atayarak yanlış kategorize etmektedirler. Yanlış kategorize etmeden dolayı da bu şekilde bir kavram yanılgısı oluşmaktadır. Buna benzer olarak bazı öğrenciler su buharlaştığında hidrojen ve oksijen üretildiğini düşünmektedirler. Burada da yine buharlaşma olayı fiziksel olay kategorisine atanması gerekirken kimyasal bir reaksiyonun gerçekleştiği düşüncesiyle kimyasal olay kategorisine atanmaktadır ve kavram yanılgısı açığa çıkmaktadır.

Fen Bilimlerindeki Bazı Kavram Yanılgılarına Ontolojik Açıdan Bakış

Kavram yanılgılarına, daha önce de bahsedildiği gibi ontolojik olarak yanlış kategorize edilmiş kavramlar yol açar. Literatür araştırıldığında en çok fizik bilimine ait ısı ve elektrik akımı kavramları ile ilgili yanılgılar ontolojik açıdan incelenmiştir. Fizik bilimi alanında öğrenciler bazı alternatif ve yanılgılı kavramlara sahiptirler. Bu yanlış kavramlara ısı, ışık, akım, kuvvet gibi kavramlar örnek olarak gösterilebilir. Öğrenciler genellikle bu kavramları süreç kategorisindeki sınırlı etkileşimler kategorisine almak yerine madde kategorisine almaktadırlar. Örneğin kuvvet kavramını vücuda güç veren bir çeşit güç olarak düşünmekte ve bu gücün vücut tarafından kullanılabileceğini kabul ettiklerinden dolayı bu kavramı madde kategorisine ait özelliklerle (kullanılma, bitme, vb.) ifade etmektedirler. Bu nedenle de kavram madde kategorisine yerleştirilmektedir. Benzer olarak yer çekimi kavramını da dünya ile cisimler arasındaki etkileşim olmasından ziyade dünyanın içinde yer alan bir şey olarak görmektedirler (Chi ve Slotta, 1993). Fizikte ısı kavramı öğrenciler için öğrenilmesi zor olan kavramlardan biridir. Çünkü bu kavram süreç kategorisine ait olan sınırlı etkileşimler kategorisinde yer almaktadır. Sınıfta ısı kavramı öğretilirken öğretmenler ısının bir yerden başka bir yere aktığını ifade ederler. Bir fizikçi açısından bu bir enerji değişimidir ve süreç kategorisi içerisindedir. Ancak sınıfta ısının akması ifadesinin kullanılması öğrenciler tarafından farklı olarak anlaşılabilir. Akma özelliği su gibi sıvı halde bulunan maddelere ait bir özelliktir. Bu nedenle öğrenciler süreç kategorisinde yer alan ısı kavramını madde kategorisine yerleştirebilirler. Bu yanlış kategorize etme sonucunda da ısının madde özellikleri taşıdığı ile ilgili kavram yanılgıları ortaya çıkar (Johnston ve Southerland, 2000). Aynı şekilde yine fizik kavramlarından biri olan elektrik akımı kavramı öğrenciler tarafından madde kategorisine alınabilir. Eğer elektrik akımıyla ilgili öğretim yapılırken kullanılan dil öğrenciler tarafından suyun akışı gibi algılanırsa bu kavramı madde kategorisine yerleştireceklerdir. Eğer öğrenciler elektrik akımıyla ilgili yeni bilgileri sıvılar alt kategorisine yerleştirirlerse bu kavram hacim gibi bir özelliğe sahip olacak ve madde kategorisine ait olan diğer ontolojik özellikleri de içerecektir. Bu da öğrencilerde var olan elektrik akımıyla ilgili kavram yanılgılarının nedenini açıklamaktadır (Chi ve Slotta, 1993; Chi ve diğerleri, 1994). Fizikte olduğu kadar biyoloji biliminde de sınırlı etkileşimler kategorisine ait olan bazı kavramlar vardır. Örneğin gelişim konusu içinde mutasyon, genetik gibi kavramlar bu kategoriye aittir (Chi ve Slotta, 1993). Öğrencilerin biyoloji ile ilgili kavram yanılgıları madde tabanlıdır (yani sınırlı etkileşimler kategorisine ait olan bir kavramı madde kategorisine alma durumu söz konusudur). Örneğin biyoloji ile ilgili ilkokul ders kitaplarında insan vücudu sistemleri anlatılırken madde kategorisine girecek birçok kavram kullanılmaktadır. Bunun da, konuyla ilgili kavram yanılgılarını oluşturması doğaldır. Bu gibi kavram yanılgıları madde tabanlı olmasına rağmen bazı yanılgılar zihinsel tabanlı da olabilir. Yani öğrenciler bir kavramı açıklarken kendi düşünceleri üzerine kurdukları görüşleri kullanıyor olabilirler (Chi ve diğerleri, 1994). Fizikteki elektrik akımı kavramındaki duruma kimyadan benzer bir örnek olarak kimyasal bağ kavramı verilebilir. Kimyasal bağ kavramı tanecikler arasında oluşan bir çekim kuvvetidir. Bir tür kuvvet olduğu için "süreç" kategorisinde yer almalıdır. Ancak bazı öğrenciler bu kavramın "madde" kategorisinde bulunduğunu düşünmektedir. Öğrencilerin bir kısmı "bağ" kelimesinden yola çıkıp onu maddeselleştirirken, bir kısmı da "bağların kırılacağı" ifadesinden yola çıkarak kimyasal bağ kavramına maddesel özellikler atamaktadırlar. Böylece öğrenciler süreç kategorisinde bulunana kimyasal bağ kavramını madde kategorisine atayarak böyle bir yanılgıya düşmektedirler. Kimyasal bağ kavramıyla ilgili yanılgının tam tersi bir örnek olarak maddenin üç fazından biri olan "gaz" kavramı verilebilir.

Yapılan bazı araştırmalarda öğrencilerin gazların kütlelerinin olmadığını düşündükleri görülmüştür (Stepans, 2003). Gaz kavramı madde ontolojik kategorisine aittir. Eğer öğrenciler gazların kütlesinin olmadığını düşünüyorlarsa gaz kavramını madde olarak da düşünmüyorlar denilebilir. Bu da gaz kavramıyla ilgili başka bir yanılgı olarak gösterilebilir. Öğrencilerde maddenin tanecikleriyle ilgili en sık görülen kavram yanılgıları ise taneciklere makroskopik özelliklerin atanmasıyla ilgili olan yanılgılardır. Örneğin bazı öğrenciler madde erirken taneciklerinin de eriyeceğini düşünmektedir (Boz, 2006). Bu yanılgının ontolojik açıklaması şu şekilde yapılabilir: Madde kategorisinin alt kategorilerinden olan cansızlar kategorisinin alt kategorileri arasında makroskopik madde ve mikroskopik tanecik kategorileri bulunduğu söylenebilir.

Mikroskopik tanecik grubunda atom, molekül veya iyonlar bulunurken makroskopik madde kategorisinde gözle görülebilen maddeler yer alır. Erime ya da bunun gibi hal değiştirme olayları (donma, yoğunlaşma, buharlaşma, vb.) makroskopik maddelerin sahip oldukları ontolojik özelliklerdir. Temelde, makroskopik madde ile mikroskopik tanecik birbirinden bağımsız özelliklere sahip sistemler olarak düşünülebilirler. Makroskopik madde mikroskopik taneciklerden oluşmaktadır ancak burada toplamın ayrı ayrı öğelerin biraraya gelmesinden daha fazla ve farklı bir nicelik olduğu söylenebilir. Örneğin maddenin rengi basitçe, onu oluşturan taneciklerin renginden kaynaklanmaz. Buna benzer olarak, eğer öğrenciler buz eritildiğinde onun taneciklerinin eriyeceğini düşünüyorlarsa tanecikleri makroskopik madde kategorisine atamakta ve dolayısıyla böyle bir kavram yanılgısını oluşturmaktadırlar. Yine benzer olarak bir madde ısıtılınca taneciklerinin ısınacağı (Boz, 2006; Lee ve diğerleri, 1993) ya da buharlaşacağı (Griffths ve Preston, 1992; Kokotas ve diğerleri, 1998), soğutulunca taneciklerinin donacağı ya da sıcaklığının daha düşük olacağı yanılgıları (Lee ve diğerleri, 1993) mikroskopik tanecik kategorisinde olan taneciklerin makroskopik madde kategorisine atanmış olmalarından kaynaklanmaktadır. Öğrencilerin atom ve molekülleri mikroskopik tanecik kategorisine değil de makroskopik madde kategorisine atadıklarına kanıt olarak taneciklerin mikroskop altında görülebileceği düşüncesi ya da tanecik olarak bir maddenin gözle görülebilen küçük parçaları olduğu düşüncesi gösterilebilir. Altın atomlarının altın gibi sert ve parlak (Stepans, 2003) ya da kükürt atomlarının kükürdün fiziksel özelliklerini paylaştığı (Othman ve diğerleri, 2007) yanılgıları yine bu nedenden kaynaklanmaktadır. Yani parlak olma mikroskopik tanecik olan atomların değil makroskopik madde olan altının ontolojik özelliğidir. Altın atomları bu ontolojik özelliğe sahip değildir.

Öğrenciler atomları makroskopik madde olarak düşündüklerinden dolayı bu yanılgılar açığa çıkmaktadır. Bazı öğrenciler ise suyun taneciklerinin su damlaları olduğunu düşünmektedirler (Nakhleh ve diğerleri, 2005). Suyun taneciklerini (moleküllerini) mikroskopik tanecik olarak düşünmek yerine su damlası olarak düşünerek bu kavramı makroskopik madde kategorisine atadıkları için kavram yanılgısına neden olmaktadırlar. Öğrencilerin bazıları ise su moleküllerinin bakteri, hücre kadar olduğunu düşünmektedirler (Lee ve diğerleri, 1993). Bu kavram yanılgısı da yine aynı nedenden kaynaklanmaktadır. Öğrenciler molekül denince küçük bir şey olduğunu düşünmektedirler. Ancak bunların mikroskopik yapıda olduklarını bilmedikleri için bu kavramlara makroskopik madde özelliklerini yüklemektedirler.

Dolayısıyla mikroskopik tanecik kategorisinde bulunan su molekülünü makroskopik madde kategorisine atamaktadırlar. Bazı öğrenciler “Sıvılar bulundukları kabın şeklini alır” ifadesinden yola çıkarak sıvı molekülerinin şeklinin de bulundukları kaba göre değişeceğini düşünmektedirler (Griffihts ve Preston, 1992). Burada da yine öğrenciler atom ve moleküller gibi mikroskopik tanecik kategorisinde bulunan maddelere makroskopik özellikleri atayarak onları makroskopik madde kategorisine almaktadırlar. Bundan dolayı da bu şekilde bir kavram yanılgısı açığa çıkmaktadır. Öğrencilerin atomları canlı olarak düşünmeleri de başka bir kavram yanılgısına örnek olarak verilebilir (Griffihts ve Preston, 1992; Pideci, 2002; Tezcan ve Salmaz, 2005). Öğrenciler okulda atomların hareketli olduklarını öğrenmektedirler. Atomların hareket etmelerinden dolayı da atom kavramını “canlılar” kategorisine almaktadırlar. Böylece o kavramı aslında “cansızlar” ontolojik kategorisine almaları gerekirken “canlılar” kategorisine alarak bir kavram yanılgısına yol açmaktadırlar. Ne şeklide olursa olsun öğrenciler bu bilimlerle ilgili kavram yanılgılarına sahiptirler. Bu kavram yanılgıları da onların bu bilimlere ait kavramları önceden ait olmadıkları bir kategoriye yerleştirmelerinden kaynaklanmaktadır (Chi ve Roscoe, 2002).

Ontolojik kategorilere göre değerlendirmenin yapıldığı araştırmalar sınırlı sayıdadır. Özellikle Fizik alanında yapılmış çalışmalara neredeyse rastlanmamaktadır. Lee ve Law (2001), yaptığı araştırmada, “elektrik” kavramları ile ilgili bir test uygulamışlar ve belirledikleri yanılgıları daha da derinleştirmek adına yarı yapılandırılmış görüşme formları kullanmışlar ve ortaya çıkan sonuçları sadece ontolojik açıdan değerlendirmişlerdir. Slotta ve Chi (2006) yaptıkları araştırmada, göreve yeni başlayan fizik eğitimcilerinin, ontoloji eğitimi yoluyla kalıcı hale gelmiş bir kavram yanılgısının nasıl üstesinden gelebileceğine dair öneriler vermektedir. Görüldüğü gibi yapılan çalışmalarda Fizik alanında, ontolojik kategorilerin kuramsal çerçeve olarak kullanıldığı, iki aşamalı sorular geliştirildiği ve böylece öğrencilerin bu konu ile ilgili sahip oldukları kavram yanılgılarının ontolojik temelinin tanımlandığı çalışmalara rastlanmamaktadır. Bu araştırmada ise 7. Sınıf “Kuvvet ve Hareket” konusunda yer alan kuvvet, sürtünme kuvveti, iş, enerjinin korunumu, mekanik enerji, kinetik enerji, potansiyel enerji, yayların depoladığı enerji gibi temel Fizik kavramlarında, öğrencilerde var olan kavram yanılgılarına ontolojik açıdan bakılmaya çalışılmıştır. Öğrencilerin belirlenen konularda sahip oldukları kavram yanılgıları ontolojik açıdan değerlendirilip, kategorileştirilmiştir. Fen ve Teknoloji dersi kapsamında yedinci sınıf “Kuvvet ve Hareket” konusunda var olan kuvvet, sürtünme kuvveti, iş, enerjinin korunumu, mekanik enerji, kinetik enerji, potansiyel enerji, yayların depoladığı enerji gibi kavram yanılgılarının ontolojik açıdan incelenmesine yönelik araştırmalar yok denecek kadar azdır. Yapılan taramalarda bu konuda detaylı herhangi bir araştırma bulunmamıştır. Bu nedenle alanda yapılabilecek ilk çalışma olabilmesi nedeniyle uluslararası alınyazında önemli bir yer alacağı düşünülmektedir.

YÖNTEM

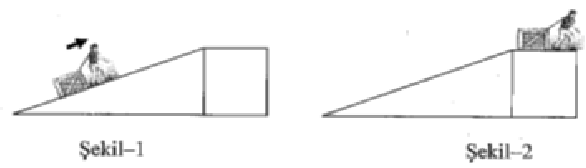
Yapılan çalışma var olan durumu ortaya koymaya çalışan betimsel düzeyde tarama çalışmasıdır. Bir grubun belirli özelliklerini belirlemek için verilerin toplanmasını amaçlayan çalışmalara tarama (survey) araştırması denilmektedir (Büyüköztürk, Kılıç Çakmak, Akgün, Karadeniz ve Demirel, 2012). Bu çalışmada da Kuvvet ve Hareket konusunda belirlenmiş kuvvet, sürtünme kuvveti, iş, enerjinin korunumu, mekanik enerji, kinetik enerji, potansiyel enerji, yayların depoladığı enerji gibi temel Fizik kavramlarının hangi ontolojik kategorilere yanlış yerleştirilmesinden kaynaklanan kavram yanılgılarının belirlenmesi amaçlanmıştır. Uygulama sürecinin bütün aşamaları araştırmacı tarafından gerçekleştirmiştir. Araştırmanın uygulanabilmesi için denekler belirlenmiş ve Kuvvet ve Hareket Konusu Kavram Testi ontolojik özelikler temel alınarak hazırlanmıştır.

Çalışma Grubu

Bu araştırmanın çalışma grubunu, İstanbul İlinde bir Vakıf Üniversitesinde 2013-2014 eğitim-öğretim yılında öğrenim gören öğrenciler oluşturmuştur. Çalışma grubu 30 kız, 5 erkek olmak üzere, 2. Sınıf, sınıf öğretmenliği 35 öğretmen adayından oluşmaktadır.

Kuvvet ve Hareket Konusu Kavram Testi

Öğretmen adaylarının "Kuvvet ve Hareket" konusunda belirlenen bazı kavramlarla ilgili kavram yanılgılarının ontolojik temellere dayandırılmasını amaçlayan Kuvvet ve Hareket Konusu Kavram Testi, iki aşamalı sorulardan oluşan bir test olarak araştırmacı tarafından hazırlanmış, geçerlik ve güvenirlik çalışmaları yapılmıştır. Kuvvet ve Hareket Konusu iki aşamalı kavram yanılgıları teşhis testi olarak geliştirilmesi sırasında, Karataş, Köse ve Coştu (2003) tarafından önerilen adımlar izlenmiştir. Kuvvet ve Hareket Konusu 17 soruluk son halinde yer alan test maddelerinin yedi tanesi Ulu (2011) tarafından geliştirilen testten alınmış, kalan on soru ise literatür taranarak araştırmacı tarafından oluşturulmuştur. Araştırmacı tarafından geliştirilen sorular için önce yurt içi ve yurt dışında yapılan araştırmalarda kuvvet, sürtünme kuvveti, iş, enerjinin korunumu, mekanik enerji, kinetik enerji, potansiyel enerji, yayların depoladığı enerji kavramlarıyla ilgili var olan kavram yanılgıları araştırılmıştır. Sorular, bu kavram yanılgıları ve bunlardan yola çıkarak oluşabilecek başka kavram yanılgılarını açığa çıkarabilecek şekilde düzenlenmiştir. Soruların geliştirilmesinde ontolojik kategoriler esas alınmıştır. Bu kategorilerin nasıl esas alındığı her soru için aşağıda verilen örnek soruda olduğu gibi tek tek özetlenmiştir.



600N ağırlığındaki bir işçi 500N ağırlığındaki bir kutuyu Şekil-1'deki gibi eğik bir düzlemin tepesine çıkarmaktadır. Şekil-2'deki durumda işçi ile kutunun enerjileri hakkında ne söylenebilir? (Sürtünmeleri ihmal ediniz)

A) Hem işçinin hem de kutunun enerjisi yoktur.

B) Sadece işçinin enerjisi vardır. Kutunun enerjisi yoktur.

C) Hem işçinin hem de kutunun enerjisi vardır ve birbirine eşittir.

D) Hem işçinin hem de kutunun enerjisi vardır ve işçinin sahip olduğu enerji kutunun sahip olduğu enerjiden büyüktür.

Bu soruda seçtiğiniz cevabın nedeni aşağıdakilerden hangisidir?

A) Enerji yalnızca hareketle ilgilidir. Hareketli olmayan cisimlerde enerji yoktur.

B) Enerji yalnızca canlılıkla ilişkilidir. Bu nedenle, cansız cisimlerde enerji yoktur.

C) Cisimler konumlarından dolayı çekim potansiyel enerjisine sahiptirler ve çekim potansiyel enerjisi, sadece cismin yüksekliğine bağlıdır.

D) Cisimler konumlarından dolayı çekim potansiyel enerjisine sahiptirler ve bu enerji cismin ağırlığına ve yüksekliğine bağlıdır.

Şekil 3.Kuvvet ve Hareket Konusu Kavram Testi Örnek Sorusu

Bu soruda Kuvvet ve Hareket konusu içerisinde yer alan potansiyel enerji kavramına dikkat çekilmeye çalışılmıştır. Cisimlerin sahip oldukları potansiyel enerjinin hesaplanabilmesi için hangi değerlere bağlı olduğu sorgulanmaktadır. Bu soruda öğrencilerin bir kısmı enerjiyi sadece canlılıkla ilişkilendirirken, bir kısmı da potansiyel enerjiyi etkileyen değişkenleri sadece yükseklik ile ilişkilendirmektedir. Bu soruda yer alan kavram yanılgılarına literatürde de sık sık rastlanmaktadır. Bu soru, süreç kategorisinin alt kategorilerinden biri olan işlem kategorilerindeki yanlış yerleştirmelerden kaynaklanan kavram yanılgılarının belirlenmesi amacıyla hazırlanmıştır.

Sorunun birinci ve ikinci bölümünün doğru cevabı “D” seçeneğidir. Birinci bölümde, “A” seçeneğinin cevap olarak, ikinci bölümde de “A” seçeneğinin birinci bölümde verilen cevabın nedeni olarak seçilmesi, potansiyel enerji kavramını sadece hareketle ilişkilendirmelerinden dolayı, kasıtlı olay kategorisine yerleştirmeden kaynaklanan kavram yanılgısının varlığını göstermektedir.

Birinci bölümde, “B” seçeneğinin cevap olarak, ikinci bölümde de “B” seçeneğinin birinci bölümde verilen cevabın nedeni olarak seçilmesi, potansiyel enerji kavramını sadece canlılıkla ilişkilendirmelerinden dolayı, madde kategorisinin doğal tür cansızlar kategorisine yerleştirmeden kaynaklanan kavram yanılgısının varlığını göstermektedir.

Son olarak birinci bölümde “C” seçeneğinin cevap olarak, ikinci bölümde de “C” seçeneğinin birinci bölümde verilen cevabın nedeni olarak seçilmesi, potansiyel enerjiyi etkileyen değişkenlerin sadece yükseklik ile ilişkilendirilmesi yüzünden, işlem kategorisinin yanal kategorisine yerleştirmeden kaynaklanan kavram yanılgısının varlığını göstermektedir.

İki aşamalı Kuvvet ve Hareket Konusu Kavram Testi Analizi

İki aşamalı çoktan seçmeli teşhis testlerinin analizleri, genellikle öğrencilerin her bir sorunun ilk aşamasına verdikleri cevaplar ile bu cevaplar için seçtikleri gerekçelerin yüzdelerinin tablolaştırılmasıyla sağlanmaktadır. İki aşamalı teşhis testlerinin türleri ve içerikleri Tablo 1’de görülmektedir.

Tablo 1. İki aşamalı Testlerin Türleri ve İçerikleri

İki aşamalı testlerin türleri	I. Aşama	II. Aşama
1. Çoktan seçmeli iki aşamalı testler	Çoktan seçmeli	Çoktan seçmeli+açık uçlu
2. Sınıflama gerektiren iki aşamalı testler	Doğru-yanlış	Çoktan seçmeli+açık uçlu
3. Açık uçlu iki aşamalı testler	Çoktan seçmeli	Açık uçlu

Bu şekilde tablolaştırılan öğrenci cevaplarının, içerik şıklarının bulunduğu ilk aşama ile gerekçe şıklarının bulunduğu ikinci aşamanın kombinasyonuna bakılır. Böylece öğrencilerin içerik aşamasında verdikleri doğru cevaplar ve her iki aşamaya verilen doğru cevapların kombinasyonundan oluşan ikinci bir tablo elde edilebilir. Testin her iki aşamasında da doğru şık işaretlenmişse 1(bir) puan, iki aşamasının herhangi birinde veya her iki aşamasında yanlış şık işaretlenmişse öğrenciye 0 (sıfır) puan verilir (Karataş, Köse ve Coştu, 2003).

Bu durumda onyedi sorudan oluşan testten alınabilecek en yüksek puan onyedi, en düşük puan sıfırdır. Buradan hareketle, öğrencinin aldığı düşük puan, öğrencinin daha yüksek düzeyde kavram yanılgısına sahip olduğunu göstermektedir. Alınan yüksek puan ise, kavram yanılgısının düşük düzeyde olduğunu göstermektedir. 2012-2013 eğitim-öğretim yılında seksen, ikinci sınıf öğretmen adayına ön test ve son test olarak uygulanarak yapılan pilot çalışmada, Kuvvet ve Hareket Konusu Kavram Testi sorularının güçlük indeksleri ile ayırt edicilik indeksleri belirlenmiş ayrıca KR-20 ve Cronbach’s Alpha katsayıları hesaplanmıştır.

Soruların güçlük indeksleri ile ayırt edicilik indeksleri belirlenirken öncelikle üst grup ve alt grup tayinine gidilmiştir. Soruların güçlük indeksleri ile ayırt edicilik indeksleri belirlenirken öncelikle üst grup ve alt grup tayinine gidilmiştir. Bunun için ilk olarak öğrencilerin 17 sorudan oluşan Kuvvet ve Hareket Konusu Kavram Testi sorularına verdikleri yanıtlar incelenmiştir. Öğrenciler kendi aralarında en çok doğru yanıt veren öğrenciden başlayarak en az doğru yanıt veren öğrenciye doğru sıralanmışlardır. Daha sonra uygulamaya katılan öğrenci sayısının %27’si hesaplanmış ve bu sayı 22 olarak bulunmuştur. Test için en yüksek puandan en düşük puana doğru sıralanan öğrencilerden en üstteki 22 ve en alttaki 22 öğrenci tespit edilmiş böylelikle üst grup ile alt grup belirlenmiştir. İlgili test maddesini üst grupta doğru yanıtlayan öğrencilerin yüzdesi (PÜ) ve ilgili test maddesini alt grupta doğru yanıtlayan öğrencilerin yüzdesi

(PA) olmak üzere;
Soruların güçlük indeksi (PG),

$$\frac{(P_{Ü} + P_{A})}{2}$$

PG=

Soruların ayırt edicilik indeksleri (R),
R=PÜ-PA
formülleri kullanılarak hesaplanmıştır. Testteki her bir maddenin güçlük indeksleri ile ayırt edicilik indeksleri Tablo 2'de verilmiştir.

Tablo 2. Kuvvet ve Hareket Konusu Kavram Testi Sorularının Güçlük İndeksleri ile Ayırt Edicilik İndeksleri

Soru Numarası	Güçlük İndeksi	Ayırt Edicilik İndeksi
1	0,62	0,59
2	0,55	0,69
3	0,58	0,45
4	0,48	0,59
5	0,44	0,64
6	0,60	0,55
7	0,42	0,52
8	0,45	0,67
9	0,67	0,55
10	0,55	0,64
11	0,56	0,70
12	0,48	0,55
13	0,67	0,59
14	0,47	0,52
15	0,56	0,45
16	0,68	0,52
17	0,49	0,47

Madde seçiminde, ayırt edicilik için kesin bir sınır belirtilmemekle birlikte, ayırt edicilik indeksi 0,20'ye kadar olanların kullanılmaz, 0,20-0,40 arasındakilerin kabul edilebilir ve 0,40'tan yüksek olanların kullanılabilir nitelikte olduğu genel olarak kabul görmekte olan bir görüştür (Tekin, 1996).

Tablo 2'de görüldüğü üzere soruların güçlük indeksleri 0,44 ile 0.67 arasında, ayırt edicilik indeksleri 0,45 ile 0.70 arasında değişmektedir. Bu sonuçlara göre testten çıkarılacak ya da testte düzeltilmeye ihtiyaç duyulacak nitelikte soru olmadığına karar verilmiştir.

Onyedi sorudan oluşan Kuvvet ve Hareket Konusu Kavram Testinin güvenirliğinin bu kez Kuder-Richardson 20 (KR-20) formülü ile belirlenmesi maksadıyla

Pi= Madde güçlük indeksi

K= Testteki madde sayısı

Sx2=Testin varyansı

Olmak üzere:

$$KR\text{-}20 = \frac{K}{K-1}\left[1 - \frac{\sum pi(1-pi)}{Sx^2}\right]$$

Formülü kullanılarak 0,712 olarak hesaplanmıştır.
Ardından onyedi sorudan oluşan Kuvvet ve Hareket Konusu Kavram Testinin güvenirliğinin belirlenmesi için bu kez Cronbach's Alpha katsayısı hesaplanmış ve bu değer 0,725 olarak bulunmuştur.

Tablo 3. Kuvvet ve Hareket Konusu Kavram Testi Cronbach’s Alpha Katsayısı İçin Madde Analizi

Soru Numarası	Soru Çıkarıldığında Ortalama	Soru-Test Korelasyonu	Soru Çıkarıldığında Cronbach’s Alpha Değeri
1	7,2415	,432	,702
2	7,3025	,356	,700
3	7,2584	,214	,720
4	8,2536	,445	,706
5	7,3853	,291	,709
6	7,2569	,380	,708
7	7,1546	,372	,704
8	7,2856	,413	,712
9	8,0402	,415	,730
10	7,2531	,244	,710
11	7,3670	,291	,709
12	8,0204	,430	,704
13	8,0965	,373	,708
14	7,2752	,198	,700
15	7,3021	,371	,702
16	7,3028	,432	,714
17	7,3945	,368	,730

Tablo 3’deki değerler incelendiğinde testten soru çıkarılması gerek olmadığına karar verilmiştir. Tüm bunların ardından, Kuvvet ve Hareket konusu için öğrencilerin kavram öğrenme düzeylerinde bir farklılığın olup olmadığının tespit edilmesinde kullanılabilecek onyedi soruluk geçerli ve güvenilir bir ölçüm aracının geliştirilmesi işlemi tamamlanmıştır. Bu çalışmada ise Kuvvet ve Hareket Konusu Kavram Testi için Cronbach’s Alpha değeri 0,710, KR-20 katsayısı 0,704 olarak bulunmuştur.

BULGULAR

Bu bölümde, öğrencilerin, testin her sorusuna verdikleri cevaplar tam anlama, kavram yanılgısı ve anlamama durumları olarak yüzde olarak belirlenmiş ve tablolar halinde sunulmuştur. Tablolar içerisinde yer alan kavram yanılgıları ise tek tek analiz edilerek ontolojik kategorilere ayrılarak incelenmiştir. Bulgular kısmında yer alan incelemelerin sayısı çok fazla olduğu için, kavram testi soruları içerisinden üç örnek soru seçilerek detaylı açıklamalar yapılmış, bulunan yanılgılar ontolojik olarak açıklanmış ve elde edilen bulgular toplu olarak sunulmuştur.

Kuvvet ve Hareket Konusu Kavram Testinin Birinci Sorusuna Ait Analizler

Bu soruda Kuvvet ve Hareket Konusu içerisinde yer alan yaylar, yayların esnemeleri ve yaylarda depolanan enerji miktarları ile ilgili kavramlara dikkat çekilmeye çalışılmıştır. Yayların sıkıştırılma ve gerilme durumlarında depoladıkları enerjilerin miktarları sorgulanmıştır. Öğrencilerin yaylarda depolanan enerji ile ilgili anlama seviyeleri, değerlendirme kriterlerine göre sınıflandırılmış, bu kavramla ilgili sahip oldukları kavram yanılgıları ontolojik açıdan incelenmiş ve bu kavram yanılgılarının kaynakları ontoloji temelinde belirlenmiştir.

Tablo 4. Öğrencilerin Kuvvet ve Hareket Konusu Kavram Testinin Birinci Sorusunu Anlama Seviyeleri

Anlama Seviyesi	f	%
Tam Anlama	10	28,57
Kavram yanılgısı	20	57,14
Anlamama	5	14,29

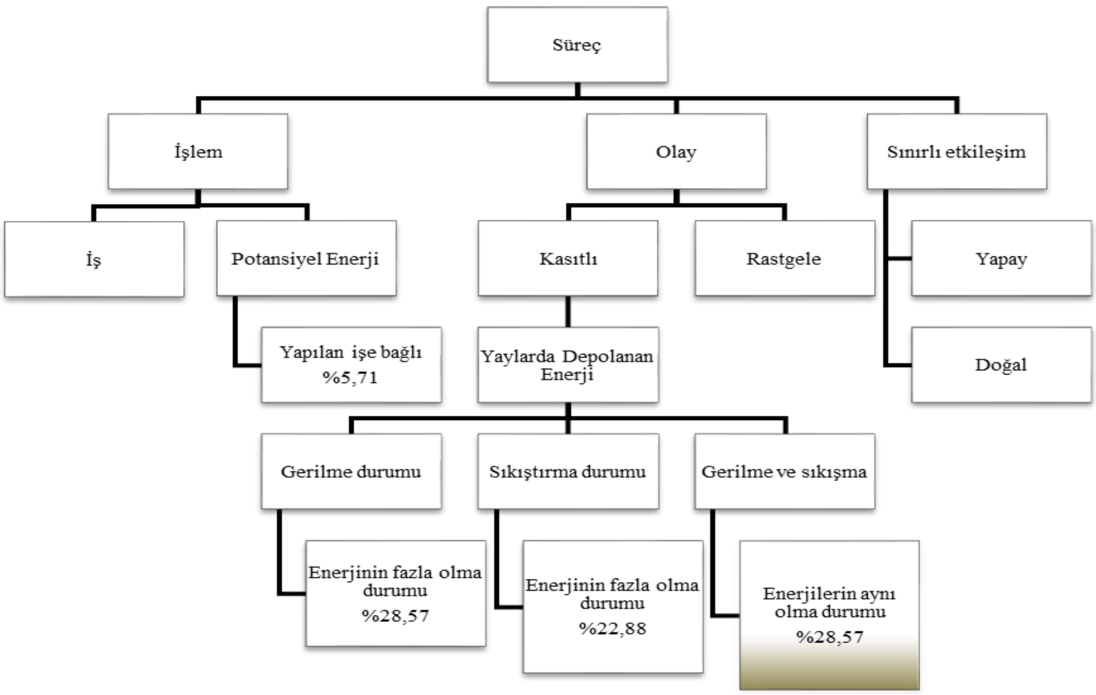
Tablo 4 incelendiğinde, öğrencilerin %28,57’si, yaylarda depolanan enerji miktarları ile ilgili verilen kavramı tam ve doğru anladığı, öğrencilerin %57,14’i, bu kavram ile ilgili kavram yanılgısına sahip olduğu ve öğrencilerin %14,29’unun, 1. soruda sorgulanan kavramı anlamadığı görülmektedir. Kuvvet ve Hareket Konusu Kavram Testinin birinci sorusunun analizi sırasında yapılan diğer işlem de, öğrencilerin sahip olduğu kavram yanılgılarının belirlenmesidir. Tablo 5’de öğrencilerin Kuvvet ve Hareket Konusu Kavram testinin birinci sorusunda sahip oldukları kavram yanılgıları gösterilmiştir.

Tablo 5. Öğrencilerin Kuvvet ve Hareket Konusu Kavram Testinin Birinci Sorusuna Verdikleri Cevaplar İçerisinde Yer Alan Kavram Yanılgıları

Kavram Yanılgısı	f	%
Sıkıştırılmış ya da gerilmiş yay aynı uzamaya sahipken, aynı miktarda enerji depolanmaz. Gerilmiş yayda daha fazla enerji depolanır.	10	28,57
Sıkıştırılmış ya da gerilmiş yay aynı uzamaya sahipken, aynı miktarda enerji depolanmaz. Sıkıştırılmış yayda daha fazla enerji depolanır.	8	22,88
Yaylarda potansiyel enerji depolanması için yaylarla iş yapılması gerekir. Bu nedenle her iki durumda da yaylarda herhangi bir enerji depolanmaz.	2	5,71

Tablo 5 incelendiğinde, öğrencilerin testte en fazla oranda sahip olduğu kavram yanılgısı, "Sıkıştırılmış ya da gerilmiş yay aynı uzamaya sahipken, aynı miktarda enerji depolanmaz. Gerilmiş yayda daha fazla enerji depolanır." şeklinde olduğu görülmektedir. Bu kavram yanılgısının oranı %28,57 olarak bulunmuştur. İkinci olarak en fazla oranda sahip olduğu kavram yanılgısı "Sıkıştırılmış ya da gerilmiş yay aynı uzamaya sahipken, aynı miktarda enerji depolanmaz. Sıkıştırılmış yayda daha fazla enerji depolanır." şeklinde olduğu görülmektedir. Belirlenen bu kavram yanılgısının oranı %22,88 olarak tespit edilmiştir. En az oranda sahip oldukları kavram yanılgısının ise, öğrencilerde "Yaylarda potansiyel enerji depolanması için yaylarla iş yapılması gerekir. Bu nedenle her iki durumda da yaylarda herhangi bir enerji depolanmaz.", şeklinde olduğu görülmektedir. Bu kavram yanılgısısın oranı %5,71 olarak tespit edilmiştir. Öğrencilerin yaptıkları bu kavram yanılgılarının en önemli sebepleri arasında, Fizik kavramlarını öğrenmeye karşı ön yargıları ve hazırbulunuşluk seviyelerinin Fizik kavramları karşısında yetersiz kalması gösterilebilir.

Kuvvet ve Hareket Konusu Kavram Testinin birinci sorusunun analizi sırasında yapılan son işlem de kavram yanılgılarının ontolojik açıdan incelenmesidir. Şekil 4'te öğrencilerin Kuvvet ve Hareket Konusu Kavram testindeki kavram yanılgılarının ontolojik incelemesi gösterilmiştir.



Şekil 4. Öğrencilerin Kuvvet ve Hareket Konusu Kavram Testi Birinci Sorusundaki Kavram Yanılgılarının Ontolojik İncelemesi

Şekil 4 incelendiğinde, Kuvvet ve Hareket Konusu Kavram Testi birinci sorusuna cevap veren öğrencilerin, yaylarda depolanan enerji miktarı ile ilgili kavramı süreç kategorisinin alt kategorisi olan kasıtlı olay kategorisi içerisine doğru yerleştirebildikleri görülmektedir. Bu öğrencilerin oranı %28,57olarak tespit edilmiştir. Bu soruda, yaylarda depolanan enerji ile ilgili kavram yanılgılarının ontoloji temelinde iki farklı kaynağına rastlanmıştır. Bunlardan biri gerilme ve sıkışma durumunda yaylarda depolanan enerji miktarları ile ilgili kavramı, onun yanal kategorilerinden olan "sıkıştırma durumu" ve "gerilme durumu" kategorilerine yerleştirmeden kaynaklanan kavram yanılgıları, diğeri de aynı kavramı süreç kategorisinin alt kategorilerinden biri olan işlem kategorisine yerleştirmeden kaynaklanan kavram yanılgılarıdır. Yanal kategorilere yerleştirilen kavram yanılgılarında, öğrencilerin bir kısmı sıkıştırma durumunda yaylarda depolanan enerji miktarının daha fazla olacağını düşünmektedir. Sıkıştırma durumunda, germe durumundan daha fazla kuvvet uygulanması gerektiği için enerji daha fazla depolanır şeklinde de geri bildirimler vermişlerdir. Bu durum testte %22,88 olarak bulunmuştur. Öğrencilerin bir kısmı da gerilme durumunda yayda daha fazla enerji depolandığını belirtmiştir. Bu durum testte %28,57 olarak tespit edilmiştir.

Süreç kategorisinin alt kategorilerinden biri olan işlem kategorisine yerleştirmelerinden kaynaklanan kavram yanılgısında, öğrenciler gerilen ve sıkışan yaylarda potansiyel enerji depolanması için yayın üzerinde sayısal olarak hesaplanabilecek bir iş yapılmasının gerekliliğini belirtmişlerdir. İşlem kategorisi içerisine yerleştirilen kavram yanılgısının %5,71 olduğu görülmektedir.

Öğrencilerin Kuvvet ve Hareket Konusu kavram testi birinci sorusundaki kavram yanılgılarının ontolojik incelemesine bakacak olursak, kavram yanılgılarının en büyük sebebi, geçmiş yaşam tecrübelerine göre zihinlerinde oluşturdukları yanlış kategorilerin yavaş bir şekilde düzelmesi olarak gösterilebilir. Bu durum, sınıf içi yapılan çalışmaların çeşitliliğini gerekli kılmaktadır. Öğrencilerin bireysel farklılıklarına göre yapılabilecek farklı çalışmaların kavram yanılgılarının düzeltilmesinde etkisi büyüktür.

Kuvvet ve Hareket Konusu Kavram Testinin Dördüncü Sorusuna Ait Analizler

Bu soruda Kuvvet ve Hareket Konusu içerisinde yer alan bilimsel anlamda yapılan iş kavramına dikkat çekilmeye çalışılmıştır. Öğrencilerin günlük hayatta yaptıkları tüm aktiviteleri iş olarak değerlendirip değerlendirmedikleri araştırılmakta ve bilimsel anlamda yapılan iş ile günlük hayatta kullandıkları iş kavramı arasındaki farkı tam olarak ayırabildikleri bu soru ile açığa çıkarılmaya çalışılmaktadır. Öğrencilerin bilimsel anlamda iş ile ilgili anlama seviyeleri, değerlendirme kriterlerine göre sınıflandırılmış, bu kavramla ilgili sahip oldukları kavram yanılgıları ontolojik açıdan incelenmiş ve bu kavram yanılgılarının kaynakları ontoloji temelinde belirlenmiştir.

Tablo 6. Öğrencilerin Kuvvet ve Hareket Konusu Kavram Testinin Dördüncü Sorusunu Anlama Seviyeleri

Anlama Seviyesi	f	%
Tam Anlama	2	5,71
Kavram yanılgısı	33	94,29
Anlamama	0	0

Tablo 6 incelendiğinde, öğrencilerin %5,71'i, bilimsel anlamda yapılan iş ile ilgili verilen kavramı tam ve doğru anladığı, öğrencilerin %94,29'u bu kavram ile ilgili kavram yanılgısına sahip olduğu görülmektedir. Kuvvet ve Hareket Konusu Kavram Testi dördüncü sorusunun analizi sırasında yapılan diğer işlem de, öğrencilerin sahip olduğu kavram yanılgılarının belirlenmesidir. Tablo 7'de öğrencilerin Kuvvet ve Hareket Konusu Kavram testinin dördüncü sorusunda sahip oldukları kavram yanılgıları gösterilmiştir.

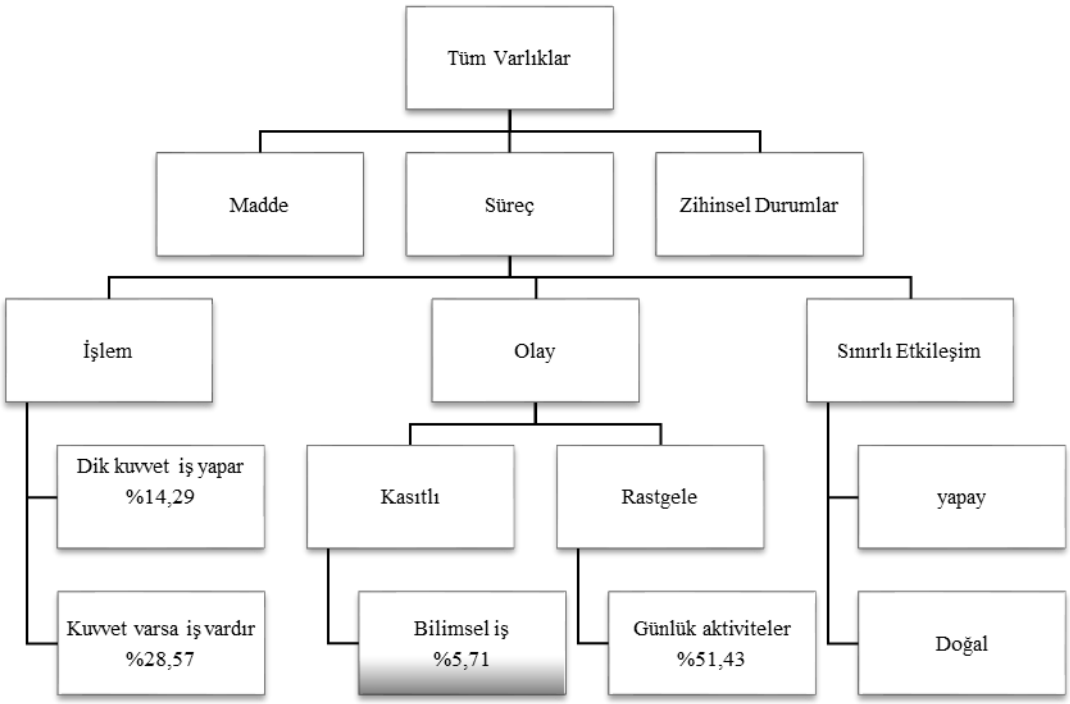
Tablo 7. Öğrencilerin Kuvvet ve Hareket Konusu Kavram Testinin Dördüncü Sorusuna Verdikleri Cevaplar İçerisinde Yer Alan Kavram Yanılgıları

Kavram Yanılgısı	f	%
Sadece hareket doğrultusuna dik olarak etki eden kuvvet, bilimsel anlamda iş yapar.	5	14,29
Bir cisme bir kuvvet etki ediyorsa iş yapılır.	10	28,57
Kişinin günlük hayatta yaptığı her türlü aktivite iştir.	18	51,43

Tablo 7 incelendiğinde, öğrencilerin testte en fazla oranda sahip olduğu kavram yanılgısı, "Kişinin günlük hayatta yaptığı her türlü aktivite iştir." şeklinde olduğu görülmektedir. Bu yanılgının oranı %51,43 olarak tespit edilmiştir.

İkinci olarak en fazla orana sahip yanılgıya bakıldığında ise öğrencilerin "Bir cisme bir kuvvet etki ediyorsa iş yapılır." ifadesi üzerinde yoğunlaştıkları görülmektedir. Bu yanılgının oranı %28,57 olarak tespit edilmiştir. En son olarak ise öğrencilerin "Sadece hareket doğrultusuna dik olarak etki eden kuvvet, bilimsel anlamda iş yapar." ifadesinde yanılgıya düştükleri görülmektedir. Belirlenen bu yanılgının oranı %14,29, kontrol grubu için olarak tespit edilmiştir.

Bu yanılgılara bakıldığında öğrencilerin bilimsel anlamda yapılan iş kavramını, günlük hayatta kullandıkları iş kavramı ile karıştırdıkları görülmektedir. Konu hakkında ön bilgileri olan öğrencilerin ise zamanında yaptığı ezber bilgiler yaptıkları yanılgılarda bir kere daha fark edilmektedir. Öğrenciler, bilimsel anlamda iş yapılabilmesi için uygulanması gereken kuvvetin farkında olmalarına rağmen, uygulanan bu kuvvetin hangi yönde ve ne şekilde uygulanması gerekliliği ile ilgili yeterliliği kazanmadıkları görülmektedir. Kuvvet ve Hareket Konusu Kavram Testinin dördüncü sorusunun analizi sırasında yapılan son işlem de, ön test ve son testlerle belirlenen kavram yanılgılarının ontolojik açıdan incelenmesidir. Şekil 5' de öğrencilerin Kuvvet ve Hareket Konusu Kavram testindeki kavram yanılgılarının ontolojik incelemesi gösterilmiştir.



Şekil 5. Öğrencilerin Kuvvet ve Hareket Konusu Kavram Testi Dördüncü Sorusundaki Kavram Yanılgılarının Ontolojik İncelemesi

Şekil 5 incelendiğinde, Kuvvet ve Hareket Konusu Kavram Testi dördüncü sorusunda bilimsel anlamda yapılan iş kavramı sorgulanmaktadır. Öğrencilerin sorgulanan kavramı süreç kategorisinin alt kategorilerinden biri olan kasıtlı olay kategorisi içerisine, bilimsel anlamda yapılan iş kavramını günlük hayatta yapılan aktivitelerden tam olarak ayırarak yerleştirebilen öğrenciler olduğu görülmektedir. Öğrencilerin oranı %5,71'dir.

Bu soruda, bilimsel anlamda yapılan iş ile ilgili kavram yanılgılarının ontoloji temelinde iki kaynağına rastlanmıştır. Bunlardan ilki, bilimsel anlamda yapılan iş kavramını süreç kategorisinin alt kategorilerinden biri olan işlem kategorisinin içerisine yerleştirmeden kaynaklanan kavram yanılgılarıdır. Öğrenciler işlem kategorisi altında iki farklı yanal kategori yaratmışlardır. İlk yanal kategoride, öğrenciler dik olarak uygulanan kuvvetin her durumda iş yaptığına inandıkları için işlem kategorisinin içerisine yerleştirmişler ve dik etki eden tüm kuvvetleri bilimsel anlamda iş yapar olarak tanımlamışlardır. Bu durum testte %14,29 olarak bulunmuştur. İkinci yanal kategoride ise, kuvvet uygulanan bütün durumlarda öğrenciler bilimsel anlamda iş yapıldığını belirtmişlerdir. Bu durum testte %28,57'dir.

Son durum ise, öğrencinin bilimsel anlamda yapılan iş kavramını süreç kategorisinin alt kategorilerinden biri olan rastgele olay kategorisi içerisine yerleştirmeden kaynaklanan kavram yanılgılarıdır. Öğrenciler günlük hayatta yapılan bütün aktiviteleri iş olarak tanımlamışlar ve verilmek istenen kavramı farklı bir kategoriye yerleştirmişlerdir. Bu durum testte %51,43 olarak tespit edilmiştir.

Kuvvet ve Hareket Konusu Kavram Testinin Onikinci Sorusuna Ait Analizler

Bu soruda Kuvvet ve Hareket Konusu içerisinde yer alan mekanik enerji kavramına dikkat çekilmeye çalışılmıştır. Cisimlerin sahip oldukları mekanik enerjinin hangi durumlarda değişeceği ve enerji korunumu yasasına göre, ortamda herhangi bir sürtünme yok ise toplam enerjinin yani mekanik enerjinin değişip değişmeyeceği soru içerisinde sorgulanmaktadır. Öğrencilerin bu kavrama hâkim olup olamadıkları ve diğer enerji türleri ile karıştırıp karıştırmadıkları ortaya çıkarılmaya çalışılmaktadır.

Öğrencilerin cisimlerin sahip oldukları mekanik enerji ile ilgili anlama seviyeleri, verilen değerlendirme kriterlerine göre sınıflandırılmış, bu kavramla ilgili sahip oldukları kavram yanılgıları ontolojik açıdan incelenmiş ve bu kavram yanılgılarının kaynakları ontoloji temelinde belirlenmiştir.

Tablo 7. Öğrencilerin Kuvvet ve Hareket Konusu Kavram Testinin Onikinci Sorusunu Anlama Seviyeleri

Anlama Seviyesi	f	%
Tam Anlama	5	14,29
Kavram yanılgısı	25	71,43
Anlamama	5	14,29

Tablo 7 incelendiğinde, öğrencilerin %14,29'u cisimlerin sahip oldukları mekanik enerji miktarları ve mekanik enerjinin değişimi ile ilgili verilen kavramları tam ve doğru anladığı, öğrencilerin %71,43'ünün bu kavramlar ile ilgili kavram yanılgısına sahip olduğu görülmektedir. Kuvvet ve Hareket Konusu Kavram Testinin onikinci sorusunun analizi sırasında yapılan diğer işlem de, öğrencilerin sahip olduğu kavram yanılgılarının belirlenmesidir. Tablo 8'de öğrencilerin Kuvvet ve Hareket Konusu Kavram testinin onikinci sorusunda sahip oldukları kavram yanılgıları gösterilmiştir.

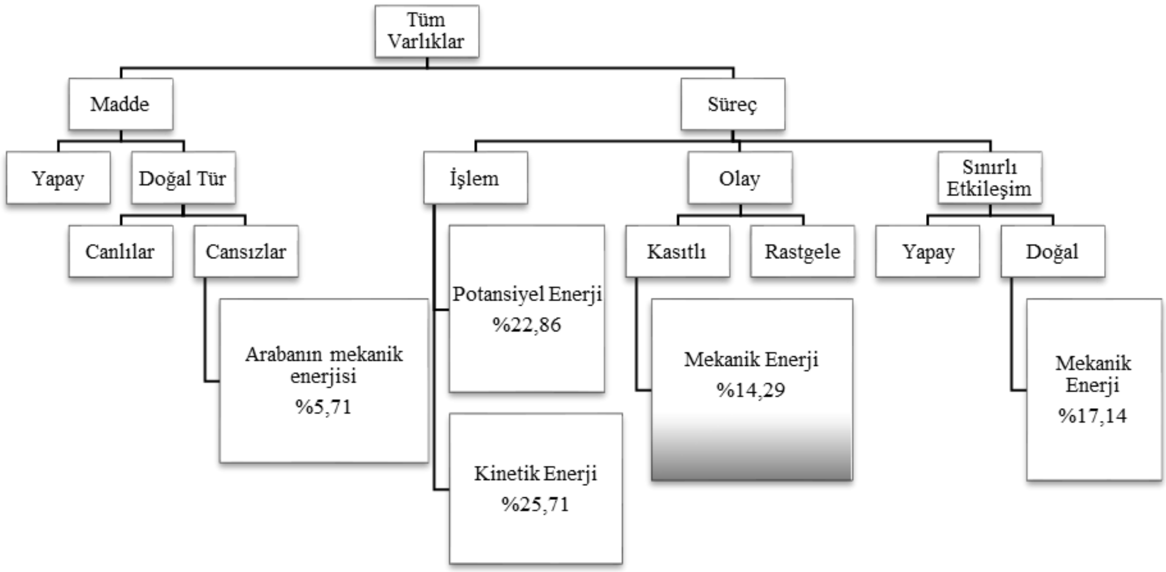
Tablo 8. Öğrencilerin Kuvvet ve Hareket Konusu Kavram Testinin Onikinci Sorusuna Verdikleri Cevaplar İçerisinde Yer Alan Kavram Yanılgıları

Kavram Yanılgısı	f	%
Kinetik enerji değişirse mekanik enerji de değişir	9	25,71
Potansiyel enerji değişirse mekanik enerji de değişir.	8	22,86
Mekanik enerji kinetik ve potansiyel enerjiye bağlı değildir. Sabit bir enerjidir.	6	17,14
Mekanik enerji sadece arabanın mekanik yapısı ile ilgilidir. Arabanın mekanik enerjisi bu nedenle azalır.	2	5,71

Tablo 8 incelendiğinde, öğrencilerin en fazla oranda sahip olduğu kavram yanılgısı, "Kinetik enerji değişirse mekanik enerji de değişir." şeklinde olduğu görülmektedir. Bu oran %25,71 olarak tespit edilmiştir. İkinci olarak en fazla orana sahip oldukları kavram yanılgısı ise "Potansiyel enerji değişirse mekanik enerji de değişir." şeklindedir. Bu oran %22,86 şeklindedir. Diğer bir kavram yanılgısının ise "Mekanik enerji kinetik ve potansiyel enerjiye bağlı değildir. Sabit bir enerjidir." şeklinde olduğu görülmektedir. Bu oran %17,14 şeklindedir. Ayrıca öğrencilerin bir kısmı da "Mekanik enerji sadece arabanın mekanik yapısı ile ilgilidir. Arabanın mekanik enerjisi bu nedenle azalır." şeklinde bir düşünce yapısına sahip oldukları için farklı bir kavram yanılgısı yaratmışlardır. Bu durum %5,71 olarak tespit edilmiştir.

Öğrencilerin yaptıkları kavram yanılgıları incelendiğinde mekanik enerji konusunda ön bilgilerinin ne kadar eksik olduğu görülmektedir. Mekanik enerjiyi, enerji türleri içerisinde sınıflayarak farklı bir anlam yüklemişler ve kavram yanılgısına düşmüşlerdir. Ayrıca bazı öğrencilerin arabanın mekanik yapısını düşünerek kavrama bambaşka bir anlam yüklemişlerdir. Ayrıca enerji konusundaki ön bilgilerinin eksiklikleri yüzünden, herhangi bir enerji değişimi sırasında mekanik enerjinin de değişeceği yönünde kavram yanılgıları bulunmaktadır.

Kuvvet ve Hareket Konusu Kavram Testinin onikinci sorusunun analizi sırasında yapılan son işlem de kavram yanılgılarının ontolojik açıdan incelenmesidir. Şekil 6'da öğrencilerin Kuvvet ve Hareket Konusu Kavram testindeki kavram yanılgılarının ontolojik incelemesi gösterilmiştir.



Şekil 6. Öğrencilerin Kuvvet ve Hareket Konusu Kavram Testi Onikinci Sorusundaki Kavram Yanılgılarının Ontolojik İncelemesi

Şekil 6 incelendiğinde, Kuvvet ve Hareket Konusu Kavram Testi onikinci sorusuna doğru cevap veren öğrencilerin, cisimlerin hareket ve konumlarından dolayı sahip oldukları toplam mekanik enerji değişimi ile ilgili kavramını, süreç kategorisinin alt kategorilerinden biri olan kasıtlı olay kategorisinin içerisine mekanik enerjinin hangi durumlardan etkilendiği ve ne olduğunu tam belirleyerek doğru yerleştirebilen öğrenciler olduğu görülmektedir. Bu öğrencilerin oranı %14,29 olarak tespit edilmiştir.

Bu soruda, cisimlerin hareket ve konumlarından dolayı sahip oldukları toplam mekanik enerji değişimi ile ilgili kavram yanılgılarının ontoloji temelinde üç farklı kaynağına rastlanmıştır. Bunlardan ilki, süreç kategorisinin alt kategorisi olan kasıtlı olay kategorisi içerisinde yer alan mekanik enerji değişiminin enerji dönüşümünden dolayı değişmemesi gerektiği kavramının yerine, mekanik enerji değişimini potansiyel ve kinetik enerjideki değişim ile ilişkilendirip, süreç kategorisinin alt kategorilerinden biri olan işlem kategorinin içerisine yanal olarak yerleştirmeden kaynaklanan kavram yanılgılarıdır. Belirlenen bu kategoride iki farklı yanal kategoriye rastlanmaktadır. Yanal kategorilerin ilki potansiyel enerji değişiminin mekanik enerjiyi değiştireceği yönünde belirlenen kavram yanılgısıdır. Bu öğrencilerin oranı %22,86 olarak bulunmuştur. Yanal kategorilerin ikincisi ise kinetik enerji değişiminin mekanik enerjiyi değiştireceği yönünde belirlenen kavram yanılgısıdır. Bu öğrencilerin oranı %25,71'dir. Belirlenen bu iki kavram yanılgısının sebebi öğrencilerin mekanik enerjideki değişimi kinetik veya potansiyel enerji olarak algılamalarıdır.

Belirlenen ikinci durumda ise öğrencilerin kasıtlı olay içerisinde yer alan mekanik enerji değişiminin, enerji dönüşümünden dolayı değişmemesi gerektiği kategorisinin yerine, mekanik enerjiyi cansız bir varlık olan arabanın yapısı ile ilişkilendirip, madde kategorisinin alt kategorisi olan doğal tür-cansızlar kategorisi içerisine yerleştirmeden kaynaklanan kavram yanılgısıdır. Bu öğrencilerin oranı %5,71 olarak tespit edilmiştir.

Son durum ise, aynı kavramı, öğrencinin süreç kategorisinin alt kategorisi olan sınırlı etkileşim kategorisinin alt kategorilerinden doğal kategorisine farklı şekilde yerleştirmesinden kaynaklanan kavram yanılgısıdır. Öğrenciler mekanik enerjiye farklı bir anlam yüklemişler ve doğada kendiliğinden olan ve diğer enerjilere bağlı olamayan bir enerji türü yaratmışlardır. Onlara göre mekanik enerji sabittir, kinetik veya potansiyel enerjiye bağlı değildir. Bu öğrencilerin oranı %17,14'dir.

Öğrencilerinin Kavram Yanılgılarının Üst ve Yanal Kategorilere Göre Dağılımı

Tablo 9'da deney grubundaki öğrencilerin uygulamadan önce sahip oldukları, uygulamadan sonra giderilen ve uygulamadan sonra yeni oluşan kavram yanılgılarının kaçının üst ontolojik kategoriye yerleştirmeden kaçının ise yanal ontolojik kategoriye yerleştirmeden kaynaklandığı görülmektedir.

Tablo 9. Öğrencilerinin Kavram Yanılgılarının Üst ve Yanal Kategorilere Göre Dağılımı

Soru	**Başlangıçta Var Olan Kavram Yanılgısı Sayısı**		
	Üst Ontolojik Kategori	**Yanal Ontolojik Kategori**	**Toplam**
Soru 1	2	18	**20**
Soru 2	8	11	**19**
Soru 3	0	20	**20**
Soru 4	33	0	**33**
Soru 5	32	0	**32**
Soru 6	1	28	**29**
Soru 7	29	0	**29**
Soru 8	30	0	**30**
Soru 9	15	0	**15**
Soru 10	32	0	**32**
Soru 11	33	0	**33**
Soru 12	25	0	**25**
Soru 13	7	24	**31**
Soru 14	23	2	**25**
Soru 15	18	10	**28**
Soru 16	0	25	**25**
Soru 17	13	12	**25**
Toplam	**301**	**150**	**451**

Tablo 9'da görüldüğü gibi, deney grubundaki öğrencilerin, uygulamadan önce üst kategoriye yerleştirmeden kaynaklanan 301 kavram yanılgısı, yanal kategoriye yerleştirmeden kaynaklanan 150 kavram yanılgısı belirlenmiştir. Bu yanılgıların kategori bazında değerlendirmesi ise Tablo 10'da detaylı olarak sunulmaktadır.

Tablo 10. Grubu Öğrencilerinin Kavram Yanılgılarının Belirlenen Kategorilere Göre Değişimi

Kavram yanılgısı	**Soru**	**Belirlenen Kategoriler**					
		İşlem Kategorisi	Kasıtlı olay Kategorisi	Sınırlı etkileşim Doğal Kategorisi	Rastgele Olay Kategorisi	Sınırlı Etkileşim Yapay Kategorisi	Madde-Doğal Tür-Cansızlar Kategorisi
	1	2	18	-	-	-	-
	2	11	8	-	-	-	-
	3	-	-	20	-	-	-
	4	15	-	-	18	-	
	5	30	-	-	-	2	-
	6	-	23	-	-	-	1
	7	12	-	-	17	-	-
	8	-	30	-	-	-	-
	9	-	-	5	10	-	-
	10	-	-	5	24	3	-
	11	32	-	-	-	-	-
	12	17	-	6	-	-	2
	13	24	-	7	-	-	-
	14	23	2	-	-	-	-
	15	-	10	10	-	8	-
	16	-	25	-	-	-	-
	17	13	12	-	-	-	-
Toplam olan	**var**	179	128	53	69	13	3

Tablo 10'a göre, öğrencilerin, işlem kategorisinde 179 kavram yanılgısı bulunmaktadır. İşlem kategorisinde giderilen kavram yanılgısının oranına bakıldığında %76,30 olduğu görülmektedir. Kasıtlı olay kategorisine bakıldığında, 128 kavram yanılgısının bu kategoriye yerleştirildiğini görmekteyiz. Sınırlı etkileşim-doğal kategorisine bakıldığında 53 kavram yanılgısının bu kategori içerisine yerleştiğini görmekteyiz. Rastgele olay kategorisinde tespit edilmiş 69 kavram yanılgısı görülmektedir. Sınırlı etkileşim-yapay kategorisine bakıldığında belirlenen 13 kavram yanılgısı görülmektedir. Belirlenen son kategori Madde-doğal tür-cansızlar kategorisidir. Belirlenen bu kategoride 3 kavram yanılgısı belirlenmiştir.

Belirlenen kategorilere bakacak olursak en fazla yanılgının işlem kategorisi içerisinde oluştuğu görülmektedir. İkinci olarak en fazla kavram yanılgısının çıktığı kategorinin kasıtlı olay kategorisi olduğu görülmektedir. En az kavram yanılgısı ise madde kategorisi içerisinde oluşmuştur.

SONUÇ

Yapılan çalışmada ontolojiye göre çoğunlukla varlıkların bulunduğu iki temel kategoride (madde, süreç) yanılgılar ortaya çıkmıştır. Bu yanılgılar temel kategorilerin kendi içerisinde gerçekleşmiştir. Yani yanılgılar iki temel kategori arasındaki yanlış kategorize etmeden dolayı değil de her temel kategorinin kendi alt kategorileri arasındaki yanlış kategorize etmeden dolayı oluşmuştur. Araştırmada bulunan kavram yanılgıları ontolojik açıdan incelenerek açıklanmıştır çünkü kavram yanılgıları ontoloji yardımıyla açığa çıkarıldığında bu yanılgıların oluşma nedenleri de bulunabilmektedir. Diğer bir deyişle, bulunan kavram yanılgılarının hangi ontolojik kategoriler arasında gerçekleştiği saptandığından yanılgıların oluşma nedenlerini açıklamak da kolaylaşmaktadır. Yanılgıların nedenlerinin bulunması hem öğretmenlere hem de öğrencilere fayda sağlamaktadır. Ontolojik olarak açığa çıkarılan kavram yanılgılarının nedenlerinin ne olduğunu bilen öğretmenler öğretimlerini ona göre planlayabilmekte ve böylece öğrencilerin daha iyi öğrenmelerini sağlayabilmektedir.

Yapılan çalışmada öğrencilerin, uygulamadan önce üst kategoriye yerleştirmeden kaynaklanan 301 kavram yanılgısı, yanal kategoriye yerleştirmeden kaynaklanan 150 kavram yanılgısı belirlenmiştir. Öğrencilerde bulunan kavram yanılgıları incelendiğinde bu yanılgıların birçoğunun ontolojiye göre süreç kategorisinin alt kategorilerinden işlem, kasıtlı olay, sınırlı etkileşim doğal, sınırlı etkileşim yapay ve rastgele olay kategorisine yanlış kategorize etmeden kaynaklandığı söylenebilir. En büyük bulunma yüzdesine sahip olan kavram yanılgıları süreç kategorisinin alt kategorilerinden biri olan işlem ve kasıtlı olay kategorileri içerisine yanal olarak yerleştirmeden kaynaklanan kavram yanılgıları olduğu görülmektedir. Slotta ve Chi (1999) yaptıkları çalışmada, fizikçilerin ontoloji eğitimi ile güçlü ve değişmez kavram yanılgılarını nasıl yok edeceklerine değinmişler ve temel fizik konularının hangi kategorilerde daha yoğun olarak ortaya çıkabileceklerinden söz etmişlerdir. Elektrik konusunda yaptıkları çalışma incelendiğinde saptanan yanılgıların süreç kategorisi altında toplandığını ve öğretmenlerin verdikleri somut örnekler yüzünden, süreç kategorisinin alt kategorileri içerisine kavramın farklı şekillerde yerleştirildiğinden bahsetmişlerdir. Bu durum yapılan bu çalışma ile benzerlik göstermektedir. Deney grubunda bulunan öğrenciler öğretim öncesi sorgulanan temel fizik kavramları ile ilgili yanılgılarını genellikle süreç kategorisinin alt kategorilerine yerleştirmişlerdir. Acar (2010) yılında yaptığı yüksek lisans tezinde, yine bir fizik konusu olan elektromanyetik indüksiyon üzerinde çalışmış ve kavramsal anlamaları ontolojik olarak kategorize etmeye çalışmıştır. Yaptığı çalışmada saptanan tüm kavram yanılgılarının süreç kategorisi altında toplanmış olduğu görülmektedir.

Yapılan çalışmada saptanan kavram yanılgıları üst ve yanal ontolojik kategoriler dışında farklı bir şekilde daha incelenmiştir. Yapılan bu inceleme içerisinde tespit edilen kavram yanılgıları bu sefer de kategoriler isimlendirilerek değerlendirilmiştir. Yapılan bu incelemeye göre, öğrencilerin, işlem kategorisinde 179 kavram yanılgısı bulunmaktadır. Kasıtlı olay kategorisine bakıldığında, 128 kavram yanılgısının bu kategoriye yerleştirildiğini görmekteyiz. Sınırlı etkileşim-doğal kategorisine bakıldığında 53 kavram yanılgısının bu kategori içerisine yerleştiğini görmekteyiz. Rastgele olay kategorisinde tespit edilmiş 69 kavram yanılgısı bulunmuştur. Sınırlı etkileşim-yapay kategorisine bakıldığında belirlenen 13 kavram yanılgısı görülmektedir. Belirlenen son kategori Madde-doğal tür-cansızlar kategorisidir. Belirlenen bu kategoride 3 kavram yanılgısı belirlenmiştir. Belirlenen kategorilere bakacak olursak en fazla yanılgının işlem kategorisi içerisinde oluştuğu görülmektedir. İkinci olarak en fazla kavram yanılgısının çıktığı kategorinin kasıtlı olay kategorisi olduğu görülmektedir. En az kavram yanılgısı ise madde kategorisi içerisinde oluşmuştur.

Madde kategorisi altında oluşan kavram yanılgılarının özellikleri incelendiğinde, öğrencilerin fizik kavramlarına, kütle, hacim gibi ölçülebilir özellikler yükledikleri fark edilmektedir. Bu durum sınıf içinde, anlaşılırlığı kolaylaştırmak için verilen örneklerden kaynaklandığını söyleyebiliriz. Öğretmenler konu içerisinde aktarım yaparken, somutlaştırmaya çalışırken kavramlara farklı anlamlar öğrenciler tarafından yüklenebilmektedir. Fakat bu kategoride oluşturulmuş yanılgıları düzeltmek kolay olduğu için, öğretmenler kısa sürede ontolojik açıdan düzeltmeler yapabilmektedir. Burada dikkat edilmesi gereken nokta süreç kategorisi altında yer alan kavram yanılgılarıdır. Örneğin en çok kavram yanılgısının çıktığı işlem kategorisi altında yer alan kavram yanılgılarının ontolojik özellikleri incelendiğinde, öğrencilerin sınıf ortamında yaşadıkları bir sıkıntı ney olarak ortaya çıkmaktadır. Özellikle fizik konuları içerisinde matematiksel ve işlem becerileri üst düzeyde kullanılmaktadır. Bu nedenle bu beceriler tam olarak öğrenci tarafından kazanılmadığında, aktarılan yeni kavramlar işlemsel bir özelliği içeriyorsa, kavram yanılgısının ortaya çıkması önlenemez bir durumdur; çünkü öğrenci öğrendiklerine zihninde yer alan kategoriler çerçevesinde anlamlar yüklemektedir. Bu durumlarda, verilmesi gereken kavram kendi içerisinde hangi özellikleri taşıyorsa, farklı disiplinlerle işbirliği yapılıp veya ontolojik özelliklere uygun yöntem ve teknikler seçilerek, bu özellik önce öğrenciye kazandırılmalı sonrasında da kavram öğretilmeye çalışılmalıdır. Yapılan derslerde, verilecek kavramlarla ilgili yapılacak ontolojik çalışma, etkin yöntem ve tekniklerin seçiminde de işimize çok yarayacaktır.

ÖNERİLER

Öğrencilerin Kuvvet ve Hareket konusunda yer alan temel fizik konularında ontolojik olarak yanlış kategoride ifade ettikleri kavramlar incelendiğinde, yaşadıkları öğretim süreci içerisinde yaşanılan aksaklıklar kolayca farkedilmektedir. Öğrencilerin soyut kavramların daha iyi anlaşılabilmesi için kullanılan modelleri gerçek gibi düşünmelerinin, yapılan deneysel çalışmalarda elde ettikleri sonuçların gerçeği tamamen yansıttığı görüşünün, günlük hayata dair verilen örnek içeriklerinin benzer durumları tamamen açıklayabildiği görüşünün, dersi daha anlaşılır kılmak için gösterilen animasyonların sorgulamadan ve doğruyu ne kadar yansıttığı araştırılmadan kabul edilmesinin ve günlük hayatta kullandıkları dilin karşılaşılan durumları tam olarak açıklayabildiği görüşünün, belirlenen kavram yanılgılarının üzerinde fazlasıyla etkisi olduğu düşünülmektedir.

Öğrencilerin kavramların doğası hakkında zihinlerinde sağlam temelli bilgiler yapılandırabilmeleri için; derslerde modellerin kullanımı sırasında, ders içeriklerini anlaşılır kılmak için kullanılan deneysel çalışmalarda, geleneksel olarak yürütülen çalışmalar içerisinde, günlük hayatta karşılaşılan durumlar ile ilgili verilen örnekler ve ilgili animasyon gösterimlerinde; gerçeğin kendisi olmadığı ve durumu eksiksiz ifade edemeyeceği belirtilmelidir.

Yapılan çalışmada öğretmen adaylarının iş, bilimsel anlamda yapılan iş, sürtünme kuvveti, kinetik enerji, potansiyel enerji, mekanik enerji, sürtünme kuvveti, yaylar ve yayların depoladığı enerji gibi kavramları karıştırdığı anlaşılmaktadır. Derslerde birbirine benzeyen temel kavramlar arasındaki farkların vurgulanması bu tür karışıklıkların oluşmasına bir ölçüde engel olabilir. Bu tür kavramların öğrencilerin zihinlerinde şekillenmesi ve doğru biçimde kategorileştirilmesi için, öğrencilerin belli bir süreç geçirmeleri gerekliliği unutulmamalıdır. Yaşadıkları süreç içerisinde kavramlarla ilgili kendi başlarına yapabilecekleri her türlü uygulama, zihinlerinde yer alan kategorilerin düzenlenmesine fırsat yaratacaktır.

Derslerde, pek çoğu süreç temelli olan fizik kavramlarından bahsederken, sürecin gerçekleşme aşamaları ve süreç kategorsisi altında yer alan alt boyutların neler olduğunun vurgulanması sonucu ontolojik kategori yanlışları daha aza indirilebilir. Bu nedenle öğretmenlerin yapacakları ders öncesi, verecekleri kavramların ontolojik özelliklerini ortaya çıkarması ve yaptıkları etkinlikler içerisinde bu özelliklerin vurgulanarak kavramın verilmesi, öğrenme sürecinin daha kolay ilerlemesine katkı sağlayacaktır.

Araştırma sonuçları incelendiğinde öğrencilerde Kuvvet ve Hareket konusu ile ilgili olan pek çok kavram yanılgısının olduğu görülmüştür. Kuvvet ve Hareket konusu ilkokul ve ortaokul ders içeriklerine yayılmış bir ünite olup, fizik dersinin de temel taşlarından birini oluşturmaktadır. Öğrencilerin farklı sınıf seviyelerinde göreceği bu konu ile ilgili kavram yanılgıları düzeltilmeden diğer konuların öğretilmeye çalışılması başka sorunları ortaya çıkaracak ve daha farklı kavram yanılgılarının oluşumuna yol açacaktır. Bu nedenle öğretmenlerin öğrencilerde konu ile ilgili hangi kavram yanılgılarının bulunduğunu öğrenmeleri ve öğretim sürecini de bu yanılgıları kapsayacak ve önleyecek şekilde düzenlemesi, sınıf ortamında tam öğrenme ortamının gerçekleşmesi için fırsat yaratacaktır.

Öğretmenlerin ders programlarını düzenlemeleri müfredatla da çok yakından ilişkilidir. Bu nedenle öncelikle öğretim programlarında bazı değişikliklere gidilmelidir. Örneğin Kuvvet ve Hareket konusu ile ilgili kavram yanılgılarını önleyecek şekilde konu içerikleri düzenlenebilir. Bu yanılgıları belirlemek için çeşitli ölçme araçları kullanılabilir. Bu araştırmada kullanılan iki aşamalı soruları içeren test hem Kuvvet ve Hareket konusu ile ilgili kavram yanılgılarını belirlemede yardımcı olabilir hem de bu yanılgıların hangi nedenlere bağlı olarak ortaya çıktığını belirleyebilir.

Öğretmenler süreç içerisinde yanılgıya neden olacak ifadelerden kaçınmalıdırlar. Öğretim yapılırken öğrenciler ezbere yönlendirilmemeli, mümkün olduğunca öğrenci merkezli öğretim yapılmalıdır. Öğrenciler öğretim sırasında öğrendikleri bilgilerin neden-sonuç ilişkisini kurabilmeli ve öğretim sırasında buna yönlendirilmelidirler. Yüzeysel ve ezbere yönelmek öğrencilerin hem anlamlı öğrenmesini engellemekte hem de konuyla ilgili kavram yanılgılarının oluşmasına yol açmaktadır. Tabi ki bunun için öğretim programları incelenmeli, öğretmene yardımcı olacak ve anlamlı öğrenmeyi destekleyecek şekilde düzenlenmelidir.

Yapılan çalışmada, kavram yanılgılarının ontolojik kategorilere göre değerlendirilmesi bu yanılgıların ontolojiye göre hangi nedenlerden dolayı oluştuğunun anlaşılmasını sağlamıştır. Yanılgıların nedenlerinin bilinmesi bu ve buna benzer araştırmalar için oldukça önemlidir. Kavram yanılgılarının giderilmesi ancak nedenleri üzerine yoğunlaşılıp bunların oluşmalarını engelleyebilecek çalışmaların, öğretim yöntemlerinin, vb. hazırlanmasıyla gerçekleştirilebilir. Bu nedenle ontolojik kategoriler yanılgıların nedenlerinin açığa çıkarılmasını sağladığından dolayı çok önemlidir. Kavram yanılgılarının belirlenmesi, değerlendirilmesi ve giderilmesi gibi araştırmalar ontolojik kategorilerden yararlanılarak gerçekleştirilmelidir.

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INTERNET USAGE AMONG RETIRED PERSONS: HABITS AND PERCEPTIONS

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ABSTRACT: Rapid developments and diffusions of information and communication technologies (ICT) support human power with machine power and thus increase living standards in numerous fields such as housing, nutrition, education and health. Therefore, the increases of elderly population in the society and their problems have also increased research interest germane to these issues. This cross-sectional study explored retired persons' levels, purposes, and perception of Internet usage and the relationships between their usage and some demographic characteristics. It was designed as a correlational survey research. The population of the study comprised those retired persons living in the Isparta city center in Turkey. Regarding the sample of the study, 109 informants (77 male and 32 female) were recruited through visiting mosques, coffee houses, vocational lodges, and residential services where retired people exist intensively. The data were collected by means of a questionnaire with two parts. The first part included questions related demographic information (e.g., gender, educational level, retired profession) and the second included questions related to Internet usage profiles (e.g., frequency, experience, purpose of usage, location of connection) and perceptions. The results showed that most (70%) had a computer and a little more than half (55%) had an Internet connection at home. Almost 40% of the participants were Internet users spending 11.5 weekly hours on average and they connect to the Internet mostly at home or through mobile devices. The dominant purposes for their usage were to get general information and to follow social networking sites. Participants indicated the complexity of Internet usage, security problems, and lack of supporting person for their usage as the most important barriers to Internet usage. They sufficiently perceived both positive impacts of the Internet as wells as negative consequences due to its unconscious consumption. As far as demographics were concerned, time spent online differed significantly in terms of educational level whereas it did not differ by gender and retired profession.

Key words: retired persons, Internet usage, perceptions, demographic characteristics, survey.

EMEKLİLERDE İNTERNET KULLANIMI: ALIŞKANLIKLAR VE ALGILAR

ÖZET: Teknolojideki hızlı gelişme neticesinde insan gücü makine gücüyle desteklenmekte ve bu da barınmadan, beslenmeye, eğitime ve sağlığa birçok alanda yaşam standardını yükseltmektedir. Teknolojik gelişmeler sayesinde yaşlı nüfus oranının artması ve buna paralel olarak bu grubun sorunlarının artması bu konuya olan bilimsel ilgiyi de artırmıştır. Bu çalışmada emekli insanların interneti ne düzeyde ve hangi amaçlara yönelik kullandıkları ve internet hakkındaki algıları araştırılmıştır. Araştırma deseni olarak ilişkisel tarama modeli benimsenmiştir. Çalışmanın evrenini Isparta il merkezinde yaşamakta olan emekli insanlar oluşturmaktadır. Bu kişilerin yoğun olarak bulunduğu il merkezindeki cami, kıraathane, öğretmenevi, polis evi ve huzurevi gibi mekânlar ziyaret edilerek 109 (77 erkek ve 32 kadın) emekli insana ulaşılmıştır. Çalışmada veriler iki adet bilgi formundan oluşan anket yoluyla toplanmıştır. Anket formunda emeklilerin demografik özellikleri (cinsiyet, eğitim durumu, emekli olunan meslek) ve internet kullanım profilleri (kaç yıldır internet kullandığı, internete nereden bağlandığı, interneti ne kadar kullandıkları, internette hangi aktiviteleri gerçekleştirdiği, vb.) hakkında açık ve kapalı uçlu sorular yer almıştır. Elde edilen bulgulara göre katılımcıların çoğunluğunun (%70) evlerinde bilgisayar bulunmakla birlikte yarısından biraz fazlasının (%55) evlerinde internet bağlantısı vardır. Internet kullanım oranı %40 olup, haftada ortalama 11,5 saat harcanmakta ve ağırlıklı olarak ev veya mobil araçlar üzerinden bağlantı gerçekleşmektedir. Başat kullanım amacının genel bilgi edinmek ve sosyal paylaşım ağlarını takip etmek olduğu görülmüştür. Emekliler internet kullanımlarının önündeki en önemli bariyerler olarak internet kullanımının karmaşıklığı, güvenlik sorunları ve internet kullanımını destekleyecek kişilerin olmamasını göstermiştir. Ayrıca, internetin olumlu katkıları ve bilinçsiz kullanıldığında oluşabilecek riskleri hakkında yeterli algı düzeyine sahip oldukları görülmüştür. Cinsiyete göre kıyaslandığında, kadın emekliler ve erkek emekliler arasında internet kullanım süresi bakımından anlamlı fark bulunamamıştır. Eğitim düzeyine göre kıyaslandığında, yükseköğretim mezunu emeklilerin ilk veya ortaöğretim mezunlarından daha fazla internette süre harcadıkları görülmüştür. İnternete bağlanma sürelerinde emekli oldukları mesleklere göre anlamlı farklılık bulunamamıştır.

Anahtar sözcükler: emekliler, internet kullanımı, algılar, demografik özellikler, tarama.

GİRİŞ

Son yüzyıla kadar yaşlılık alanındaki araştırmalara bakıldığında çalışma alanlarının edebiyat ve sanat alanlarında yoğunlaştığı görülmektedir. Günümüzde ise teknolojinin ilerlemesine paralel olarak yaşlılık, bütün yönleriyle bilimsel bir ilgi alanı haline gelmiştir ve bu konu üzerinde çalışılmaya başlanmıştır (Er, 2009). Teknolojideki bu hızlı gelişme neticesinde insan gücü yerine makine gücünün ön plana çıktığı görülmektedir ve bu da barınmadan beslenmeye, hijyenden sağlığa birçok alanda yaşam standardını yükseltmiştir. Yaşam kalitesindeki bu artış ise ortalama yaşam süresini uzatmaktadır. Teknolojik gelişmeler sayesinde yaşlı nüfus oranının artması ve buna paralel olarak bu nüfusun sorunlarının artması bu konuya olan bilimsel ilgiyi de artırmıştır.

Dünya Sağlık Örgütüne göre yaşlılığın sınırı 64 yaşının bitimi ve 65 yaşının başlamasıdır ve (a) erken yaşlılık evresi (65-75 yaşlar), (b) orta yaşlılık evresi (75-85 yaşlar) ve (c) ileri yaşlılık evresi (85 ve ötesi) şeklinde 3 evresi bulunmaktadır (Tümerdem, 2006). Türkiye'de bazı meslek grupları haricinde (Asker, Polis gibi) emeklilik yaşı 65 olarak referans alınmaktadır. Bu yaşlarda emeklilik sürekli bir sorunlar döngüsü olarak algılanmaktadır (Harte, 1972). Aylık gelirlerdeki azalmalara bağlı olarak finansal problemler, sosyal kapital ve mesleki bağlılıklardaki kayıplara bağlı olarak psiko-sosyal sorunlar ve yaşlanma il birlikte fiziksel değişimler yaşanmaktadır (Başaran, 2008; Blakeley ve Ribeiro, 2008; Fulks ve Fallon, 2001). Dolayısıyla bu kayıplar emeklilerin daha önce alıştıkları yaşam standartlarından ödün vermelerini gerektirir.

İnsan hayatının her evresinde farklı özellikleri kendisinde barındırdığı gibi emeklilik döneminde de kendine has özellikler bulundurmaktadır. Atchley'e (1989) göre bu döneme ait özellikler beş evreye ayrılmaktadır ve birey her bir evrede büyük değişimler yaşar. Birinci evre balayı evresidir ve emekliler kendilerini sağlıklı, enerji dolu, istekli ve mutlu hissettikleri ve daha önce yaptıkları planları uygulamaya koyduğu dönemdir. Bireylerin herhangi bir planı yoksa ikinci evreye geçiş daha hızlı olur. İkinci evre, düş kırıklığı evresidir ve sıkıntı ve bunalım belirtileri gözlemlendiği evredir. Üçüncü evre olan yeniden uyum evresinde, öncelikler yeniden düzenlenir ve sınırlanmalar kabul edilir. Dördüncü evre olan denge evresinde ise yeniden uyum evresindeki kabullenme ile birlikte emekliliğe olan bakış daha gerçekçidir ve bu evre emeklilik döneminin rahatlık evresi olarak ta düşünülür. Son olarak emekliliğin sonlanma evresinde, ağır kronik hastalıklar ya da ölüm beklenir.

Bilgi ve iletişim teknolojilerinin (BIT) günlük yaşamın her alanına nüfuz etmesi ve toplumsal ve ekonomik önemi göz önünde bulundurulduğunda emekli insanların da BIT kullanıcısı olmaları kaçınılmaz bir gerçektir (Jamieson ve Rogers, 2000). Esasen BIT kullanımı emekli insanlar için dış dünya ile yeniden bağ kurma ya da iletişimlerini geliştirme (White vd., 1999) ve yüksek kalitede yaşamın tadını alma (Irizarry ve Downing, 1997) anlamını taşır. BIT yaşlı insanlar için hayatı geliştirme, sağlık açısından uygun öğrenme, arkadaş ve ailelerle iletişim kurma hatta iş sınırlılığından dolayı topluma dahil olmada kaynak olabileceği tartışılmaktadır (White vd., 1999; White ve Weatherall, 2000). Emekli insanların internete katılımını artırmak küresel bir çaba haline gelmiştir. İnternet sadece devlet sistemleri ya da hizmetleri için değil ayrıca yaşlıların günlük yaşamlarına da katkıda bulunmak ve daha iyi bir şekilde toplumsal yaşama entegre olabilmek için de kullanılabilir. Ancak, yaşlı insanlar genç insanlara göre daha az internet kullanımı eğilimindedirler.

İnternet emekli insanlar için bağımsızlıklarını sürdürme fırsatları sağlayabilir (Kiel, 2005). Örneğin daha önce yapabildikleri gibi seyahat edemeyen yaşlılar için internet dünyayı onların ayaklarına getirebilir ve onlara sınırsız bilgi, elverişlilik, eğlence ve aileleriyle iletişim olanağı sağlar (Federal Interagency Forum on Aging-Related Statistics, 2000). BIT kullanımı yaşlı insanların boş zaman aktivitelerini çeşitlendirmekte ve yeterlilik ve öz saygı düzeylerini artırabilmektedir. Lansdale'e (2002) göre internet yaşlılara yaşam boyu öğrenmede yardımcı olmaktadır.

Emeklilerin internet kullanımını etkileyen bazı faktörler mevcuttur. Coğrafi ve fiziksel kısıtlamalar, hastalıklar, ulaşım eksikliği ya da uzun süreli bakıma muhtaç olma durumları yüzünden emekli insanlar çevrimiçi etkileşime uzak kalmaktadırlar. Yaşlı insanlar internette gezinirken, bilgi donanımı bakımından da engellerle karşılaşabilirler. Yaşlı bir bireyin çevrimiçi araştırma becerisi ve strateji eksikliği önemli bir engeldir (Swindell, 2002; Xie, 2008). Jaeger ve Xie (2009) web site tasarlayıcılarının ve geliştiricilerinin yaşlıların kullanmakta güçlük çekmeyeceği web siteleri oluşturmakta sorumlu olmaları gerektiğini ve onlar için çevrimiçi toplulukların kolay anlaşılabilir olmadıklarını vurgulamaktadır. İnternete karşı sosyal çevrede küçük düşme psikolojisi yaşlıları internet kullanıcısı olmaktan alıkoyabilir. Millward' a (2003) göre emekli insanlar internet hakkında bilgi karmaşalarını ya da yetersizliklerini saklamak için BIT kullanımları hakkında yalan söylemeye meyillidirler.

Alanyazında önceki yapılan çalışmalarda yaşlı nüfusun arttığı ve yaşlıların internet kullanımı için istekli olmaları gerektiği görülmektedir (Daulerio, 2001; Guynn, 2002). Yaşlı insanların internet kullanımını etkileyen belli başlı faktörler arasında referans/örnek gruplar ve sosyal çevredeki etkiler (Guynn, 2002; Trocchia ve Janda, 2000), tutum ve davranışlar (hazır bulunuşluluk, küçük düşme kaygısı) (Guynn, 2002; Modahl, 2000; Trocchia ve Janda, 2000), fiziksel ve pragmatik sorunlar (fiziksel rahatsızlıklar, kişisel bilgisayar eksikliği) (Hill, 2000; Hopkins, 2002; Polyak, 2000) yer almaktadır. İnternet kullanımının yaşlılar için zihinsel uyarıları geliştirme (Berbeo, 1999), sağlık konularında araştırma yapma ve bilgilenme (Daulerio, 2001; DeCrescenzo ve BayButt, 1999; Gervey ve Lin, 2000), sosyal hizmetlerden yararlanma (çevrimiçi devlet hizmetlerini kullanma ve bilgilenme) (Carpenter, 2000), güncel ve finansal konuları takip etme (Gervey ve Lin, 2000) gibi faydalarının olduğu ortaya konulmuştur.

Çalışmanın Amacı

İnternet son yıllarda emekli insanların yaşamlarında da vazgeçilmez bir araç haline gelmiştir. Günümüzde internette birçok işlem yapılabilmektedir. Ayrıca devlet politikaları, sağlık ve iş hizmetlerinde maliyeti düşük olduğundan internet ortamına yoğun bir talep oluşturmak istenmektedir. İnternetin yaşam içerisindeki gerekliliğinin gittikçe artması emeklilerin de internet kullanımı doğrultusundaki önemini gittikçe artırmıştır. Alanyazın incelendiğinde Türkiye'de yaşayan emekli insanların internet kullanım durumu hakkında herhangi bir çalışmaya rastlanmamıştır. Dolayısıyla bu çalışmada emekli insanların internet kullanım profillerinin tespit edilmesi ve internetin günlük yaşamlarındaki yeri ve öneminin belirlenmesi amaçlanmaktadır. Bu doğrultuda aşağıdaki araştırma sorularına cevap aranmaktadır:

1. Emekliler interneti ne düzeyde kullanmaktadır?
2. Emekliler internete en sık nerelerden bağlanaktadırlar?
3. Emeklilerin internet kullanımı için ihtiyaç duyduğu destekler nelerdir?
4. Emekliler interneti hangi amaçlara yönelik kullanmaktadırlar?
5. İnternet kullanım düzey ve amaçlarında demografik özelliklere göre farklılık var mıdır?
6. Emekliler internetin kendilerine ne tür faydalar ve zararlar sağladığını düşünmektedirler?

YÖNTEM

Araştırma Deseni

Emeklilerin internet kullanım alışkanlıklarını ve bazı değişkenlerle ilişkisini inceleyen bu araştırmanın deseni olarak ilişkisel tarama modeli kullanılmıştır. İlişkisel tarama modeli, iki ya da daha çok sayıdaki değişken arasında birlikte değişim varlığını veya derecesini belirlemeyi amaçlayan modeldir (Karasar, 2012). Çalışmada internet kullanım değişkenlerinin sosyolojik ve demografik özelliklerle ilişkileri araştırılmaktadır.

Evren ve Örneklem

Çalışmanın evrenini Isparta il merkezinde yaşamakta olan emekli insanlar oluşturmaktadır. Katılımcılar uygun (elverişli) örnekleme yöntemi ile belirlenmiştir. Araştırmacılar emeklilerin yoğun olarak bulunduğu il merkezindeki cami, kıraathane, öğretmenevi, polis evi ve huzurevi gibi mekânları ziyaret ederek buradaki emeklileri çalışmaya davet edilmiştir. Katılımcıların toplam sayısı 109 olup bunların 77'si erkek (%70,6) 32'si kadındır (%29,4). Katılımcıların emekli oldukları kurumların dağılımı 61 memur (%56), 19 işçi (%17,4), 15 esnaf (%13,8) ve 14 çiftçi (%12,8) iken çalışmaya katılan emeklilerin eğitim durumlarının dağılımı ise 40 lise (%36,7), 31 üniversite ve üstü (%26,4), 26 ilkokul (%23,9) ve 12 ortaokul (%11) şeklindedir.

Verilerin Toplanması

Veriler anket yoluyla toplanmıştır. Çalışmada emeklilerin demografik ve internet kullanımıyla ilgili özelliklerinin sorgulandığı bilgi formu kullanılmıştır. Bu form 3 ana bölümden oluşmaktadır. Birinci bölümde emeklilerin demografik özelliklerini (cinsiyet, eğitim durumu, emekli olunan meslek vb.) içeren sorular bulunmaktadır. İkinci bölümde internet kullanım profilleriyle ilgili sorular bulunmaktadır. Bu sorular kaç yıldır internet kullandığı ve interneti ne kadar kullandıkları gibi olmak üzere açık uçlu, evde bilgisayar sahipliği, evde internet bağlantısı sahipliği ve internete nereden bağlandıkları gibi olmak üzere kapalı uçlu şeklindedir. Bunun yanında internette hangi aktiviteleri gerçekleştirdikleri ile ilgili sorular da yer almaktadır. Bunlar Likert tipi bir ölçekte olup katılımcıların her bir madde için "1=Hiç" ve "5=Çok sık" aralığındaki seçeneklerinden birini işaretlemesi istenmektedir. Üçüncü bölümde ise katılımcıların internete karşı sahip oldukları düşüncelerini ve görüşlerini ortaya çıkarmak amacıyla bazı ifadeler yer almıştır. Bu ifadeler Likert tipi ölçekle "1=Kesinlikle katılmıyorum" ve "5=Kesinlikle katılıyorum" aralığındaki seçeneklerden birisi işaretlenecek şekilde yapılandırılmıştır. Bu ifadelerin oluşturulmasında ilgili litertürde bulunan internet kullanımıyla ilgili çalışmalardan yararlanılmıştır (Ewing ve Thomas, 2010; Koc, 2006). Bu form daha sonra uzman görüşü alınarak tekrar revize edilmiştir. Hazırlanan anket formu birinci yazar tarafından yukarıda bahsedilen mekânlardaki emeklilere uygulanmıştır. Anketler emekliler tarafından cevaplanmadan önce araştırmanın amacı, form ve ölçeklerin nasıl cevaplandırılacağı hakkında gereken bilgi verilmiştir. Araştırmaya katılmayı sözlü olarak kabul ettiğini belirten emeklilere anketler dağıtılmıştır. İstedikleri takdirde anketi araştırmacının dolduracağı seçeneği de sunularak anketler doldurulmuştur.

BULGULAR

Katılımcıların internet kullanım desenleri frekans ve yüzde istatistikleri ile çözümlenmiş ve Tablo1 'de verilmiştir. Buna göre katılımcıların çoğunluğunun (%70) evlerinde bilgisayar bulunmaktadır. Yarısından biraz fazlasının (%55) evlerinde internet bağlantısı vardır. İnternet kullanım sıklıkları incelendiğinde, katılımcıların %11'i günlük, %19,3'ü haftalık, %10,1'i aylık internet kullanıcısı iken yaklaşık olarak %60'ı interneti kullanmamaktadırlar. İnternet kullananların internete en çok bağlandıkları ortam ise ev (%63,6), mobil araçlar (%20,5), tanıdıkların mekânı (%11,4) ve internet kafe (%4,5) şeklinde dağılım göstermektedir.

Tablo 1. İnternet Kullanımına Ait Bulgular

Değişken	Düzey	f	%
Evde bilgisayar	Var	76	69,7
	Yok	33	30,3
Evde internet bağlantısı	Var	60	55
	Yok	49	45
İnternet kullanım sıklığı	Hiç	65	59,6
	Ayda birkaç kez	11	10,1
	Haftada birkaç kez	21	19,3
	Her gün	12	11,0
Başat internet kullanım yeri	Ev	28	63,6
	Mobil	9	20,5
	Tanıdıklar (akraba, komşu)	5	11,4
	İnternet kafe	2	4,5

Tablo 2'de emeklilerin interneti hangi amaçlara yönelik kullandıklarına ait bulgular sunulmuştur. En sık kullanım amaçları sağlık, teknoloji, hobi, hukuk vb. konularda genel bilgi edinmek, sosyal paylaşım ağlarını takip etmek ve oyun oynamak şeklindedir. Öte yandan yatırım işlemleri yapmak, alışveriş yapmak ve temel bankacılık işlemlerini yapmak gibi ticari işlemler ise en nadir kullanım amaçları arasındadır.

Tablo 2. İnternet Kullanım Amaçları

Amaç	$\overline{X}$	Ss
Genel bilgi edinmek (sağlık, hobi, teknoloji, hukuki vb.)	4,32	0,74
Sosyal paylaşım ağlarını takip etmek (Facebook, Twitter vb.)	4,20	1,05
Oyun oynamak	3,52	1,53
Vakit geçirme/eğlence amaçlı sörf yapmak	3,32	1,14
Kamu işlemlerini yapmak (e-devlet uygulamaları, belediye, SGK, vb.)	3,07	1,50
Müzik dinlemek (şarkı, türkü, ilahi vb.)	3,05	1,26
Güncel olayları ve haberleri takip etmek	2,57	1,13
Elektronik posta okumak ve göndermek	2,18	0,79
Vakit geçirme/eğlence amaçlı sörf yapmak	2,07	1,59
Temel bankacılık işlemlerini yapmak (havale, EFT, fatura işleri)	2,05	1,14
Alış veriş yapmak	1,80	0,82
Yatırım işlemlerini takip etmek (borsa, döviz, fon, gayrimenkul)	1,00	0,00

Emeklilerin internet kullanırken karşılaştıkları başlıca engeller internet kullanmanın karmaşık olması (%56,8), virüsler, kişisel bilgi hırsızlığı, dolandırıcılık vb. güvenlik sorunları (%52,3) ve etraflarında internet kullanımını destekleyecek kişilerin olmaması (%34,1) şeklindedir (Tablo 3).

Tablo 3. İnternet Kullanımı Önündeki Bariyerler

Bariyer	f	%
İnternet kullanmanın karmaşık olması	25	56,8
Güvenlik sorunları (virüsler, kişisel bilgi hırsızlığı, dolandırıcılık vb.)	23	52,3
İnternet kullanımını destekleyecek kişilerin olmaması (aile bireyleri, arkadaş vb.)	15	34,1
İnternet kullanım bilgi ve becerisinde yetersizlik	13	29,5
İnternet erişiminin pahalı olması	9	20,5
İlgimi çekecek içerik yetersizliği	6	13,6
Fiziksel engeller (el-kol hareket rahatsızlıkları, görme bozuklukları vb.)	5	11,4
Yeterli zamanın olmaması	2	4,5

Emeklilerin internet kullanma düzeyleri haftalık internette geçirdikleri süre olarak da ölçülmüştür. Buna göre haftalık internette harcadıkları toplam süre 1 saat ile 30 saat arasında değişmekte olup ortalama 11,48 saattir (Ss=6,95). Demografik özelliklere göre internette harcanan haftalık süreye ait betimsel istatistikler Tablo 4'te sunulmuştur. Bu özelliklere göre anlamlı farklılıkların olup olmadığını belirlemek için bağımsız örneklemler t-testi ve tek faktörlü varyans analizi (ANOVA) yapılmıştır. Süre değişkeninin incelenmesinde, çarpıklık (0,84) ve basıklık (-0,16) katsayılarının ±1 arasında olması ve Normal Q-Q grafiğinde noktaların bir doğru üzerinde dağılmasından dolayı değişkenin normal dağılıma sahip olduğu görülmüştür (Büyüköztürk, 2009).

Tablo 4. Demografik Özelliklere Göre İnternette Harcanan Süre

Değişken/Düzey	N	$\overline{X}$	Ss
Cinsiyet			
Kadın	15	13,70	5,56
Erkek	29	10,33	7,39
Öğrenim düzeyi			
İlk veya ortaöğretim	14	8,32	5,24
Yükseköğretim	30	12,95	7,23
Emekli olunan meslek			
Memur	34	12,03	7,06
İşçi	7	10,50	7,49
Esnaf	3	7,50	3,91

Tablo 5. İnternet Kullanımı Hakkında Düşünceler

Madde	$\overline{X}$	Ss
Uygun olmayan ve bozucu içerikler (cinsel yayınlar, terör, kumar vb) toplumu olumsuz etkiler	4,91	0,29
Bilinçsiz internet kullanımı fiziksel rahatsızlıklara (bel ağrısı, görme bozuklukları vb.) neden olur	4,82	0,45
Bilinçsiz internet kullanımı psikolojik rahatsızlıklara (bağımlılık, uyku bozukluğu vb.) neden olur	4,70	0,51
İnternet kullanmak kişinin toplumdaki sosyal statüsünü artırır	4,48	0,90
İnternette sayesinde ilgi çeken konularda bilgi edinmek zevklidir	4,36	0,49
İnternet üzerinden aranan bilgiye kolayca ulaşılır	4,32	0,67
İnternette güvenli veya doğru olmayan bilgiler kolayca yayılır	4,05	0,75
İnternet emeklilerin can sıkıntısını veya yalnızlığını giderir	3,89	1,02
İnternet farklı kültürleri tanımaya ve anlamaya yardımcı olur	3,70	0,59
İnternet dünyada neler olup bittiğini takip etmeye yardımcı olur	3,66	0,48
İnternet sayesinde bazı işler daha ekonomik yapılır (telefon görüşmesi vb.)	3,59	0,62
İnternet demokrasi ve insan haklarını güçlendirir	3,45	1,44
İnternet günlük hayatı kolaylaştırır	3,45	0,59
İnternette insan kendini daha rahat ifade eder	3,16	0,43
İnternet kişilerin daha verimli kullanacakları zaman ve gücü çalar	2,61	0,72

Cinsiyete göre kıyaslandığında, erkek ve kadın emekliler arasında internet kullanım süresi bakımından anlamlı fark bulunamamıştır [$t(42)=1{,}55$, $\eta^2=0{,}05$, $p>0{,}05$]. Eğitim düzeyine göre kıyaslandığında, yükseköğretim mezunu emeklilerin ilk veya ortaöğretim mezunlarından daha fazla internette süre harcadıkları görülmüştür [$t(42)=2{,}14$, $\eta^2=0{,}10$, $p<0{,}05$]. Katılımcıların emekli olduğu mesleğe göre yapılmış tek faktörlü gruplararası ANOVA sonuçları haftalık internete bağlanma sürelerinin emekli olunan mesleklere göre anlamlı farklılaşmadığını göstermiştir [$F(2, 41)=0{,}66$, $\eta^2=0{,}03$, $p>0{,}05$].

Tablo 5'de emeklilerin internet hakkında ne düşündüklerine ait bulgular sunulmuştur. Katılımcılar arasındaki en yaygın düşünceler uygun olmayan ve bozucu içeriklerin (cinsel yayınlar, terör, kumar vb.) toplumu olumsuz etkilediği, bilinçsiz internet kullanımının fiziksel rahatsızlıklara (bel ağrısı, görme bozuklukları, vb) ve psikolojik rahatsızlıklara (bağımlılık, uyku bozukluğu, yalnızlık vb.) neden olduğu şeklindedir.

SONUÇ

Araştırmanın bulguları genel olarak incelendiğinde araştırmaya katılan emeklilerin yaklaşık olarak %60'nın interneti kullanmadığı görülmektedir. Türkiye İstatistik Kurumunun (TÜİK) 2013 yılı hane halkı bilişim teknolojileri kullanım araştırma sonucuna göre internet kullanım oranı ise yaklaşık olarak %50 civarındadır (TUİK, 2013). Emeklilerin var olan teknolojiyi kullanma kapasiteleri ve yetenekleri yüksek değildir. Çalışmanın bulguları arasında da internet kullanımını karmaşık bulmaları ve interneti kullanırken yardım alacak bireylerin olmadığını düşünmeleri bu görüşü desteklemektedir. Diğer taraftan emeklilerin internet kullanım oranlarının düşük olmasının sebeplerinden bir tanesi de teknolojiye karşı duyulan kaygı düzeyinin yüksek olmasıdır. Literatürde bu kaygı düzeyinin yüksek olması "teknofobi" ya da "teknostress" olarak adlandırılmaktadır. Teknofobi, teknolojiyi kullanma korkusu olarak adlandırılmakla birlikte gençlere göre yaşlılarda daha fazla görülmektedir (Laguna ve Babcock, 1997; Levin ve Gardon, 1989; Rosen ve Weil, 1995). Araştırma kapsamında elde edilen bulgular incelendiğinde bunu destekleyici nitelikte olduğu görülmektedir. Bu bulgulara göre katılımcılar internete kuşkucu ve şüpheci baktıkları, interneti çekinerek kullandıkları, internetin bilinçsiz kullanıldığında toplumu olumsuz yönde etkilediğini, fiziksel ve psikolojik açıdan da sağlığa zararlı olduğu görüşüne sahiptir. Bu sebeplerden dolayı internet kullanımının yaygınlaştırılması için gerekli bilgilendirmeler kamu kuruluşları ve özel sektörün gündemine alınmalıdır. Bu kapsamda emeklilere bilinçli internet kullanımıyla ilgili ücretsiz halk eğitim kursları verilmelidir. Web site tasarlayıcılarının tasarladıkları web sitelerin emeklilerin kullanımına uygun olacak şekilde tasarlamaları konusunda yasal düzenlemeler getirilmelidir.

Bilişim teknolojilerinin hızla gelişmesi akıllı telefonların kullanımının yaygınlaşmasını da beraberinde getirmiştir. TUİK' in 2013 yılı hane halkı bilişim teknolojileri kullanımı araştırması sonuçlarına göre %65,6 ile ev internet kullanılan mekânlar arasında en çok kullanılan bağlantı türüdür. Mobil bağlantı ise tüm hanelerin %20,1'inde kullanılmaktadır (TUİK, 2013). Bu oranın araştırma bulgularına da yansıdığı görülmektedir. Başat internet kullanım yeri ev (%63,6) iken mobil (%20,5) ise ikinci sırada yer almaktadır. Mobil hizmetlerin yaygınlaşması emeklilerin internet kullanımını da artırıcı yönde etkileyebilir. Bu yaygınlaşma ile mobil teknoloji kullanımının daha da artması beklenmektedir.

Bu çalışmada emeklilerin interneti yoğun kullanma amaçları genel kültür amaçlı bilgi edinme, sosyal sitelerde vakit geçirme ve eğlence amaçlı kullanımlar olarak belirlenmiştir. Literatürde internetin çoğunlukla eğlence amaçlı kullanıldığına ilişkin bulgular vardır (Bayraktar ve Gün, 2007; Taşkın, 2002). Emeklilerin kullanım amaçlarına baktığımızda diğer yaş gruplarıyla benzer şekilde interneti kullandığı görülmektedir. Diğer taraftan araştırma bulgularında katılımcıların alışveriş yapma, temel bankacılık işlemleri gibi para ile ilgili etkinlikleri tercih etmedikleri saptanmıştır. Bu da yine araştırma bulgularından katılımcıların güvenlik unsurları yüzünden internet kullanmaya çekindikleri bulgusunu desteklemektedir. Emeklilerin bu gibi işlemleri internet üzerinden daha az enerji ve zamanda yapabilecekleri konusunda ve güvenlik açıkları hakkında bilgilendirilerek bu konu hakkında kamu spotu çalışmaları yapılmalıdır.

Emeklilerin internet kullanma süreleri cinsiyet yönünden incelendiğinde anlamlı bir fark bulunamamıştır. Literatürde erkeklerin kadınlara göre internette daha fazla süre harcadıkları ile ilgili çalışmalar mevcuttur. Fakat teknolojinin hızla gelişmesi ve yayılması ile bu iki cinsiyet arasındaki bulunan farklılığın ortadan kalktığı da iddia edilmektedir. Araştırmada emeklilerin internete bağlanma süreleri eğitim seviyesi bakımından incelendiğinde anlamlı bir fark bulunmuştur. Eğitim durumu yükseköğretim ve üstü olan emekliler diğerlerine nazaran daha fazla internete bağlanma süresinin olduğu görülmüştür. Bu durum beklenen bir sonuçtur zira eğitim seviyesi yüksek olan kişilerin yeniliklere ve teknoloji kullanımına daha çok eğilimlidirler. Diğer taraftan, emekli olunan mesleğin internet kullanma süresi üzerine bir etkisi olmadığı gözlemlenmiştir. Bu sonuç şaşırtıcıdır. Çalışmanın başlangıcında emekli olunan mesleğin internete bağlanma sürelerini etkileyeceği düşünülmekteydi. Memur emeklilerinin devlet dairelerinde çalışmalarından dolayı diğerlerine kıyasla daha fazla BİT kullanmalarından hareketle daha çok internete bağlanma sürelerinin olması bekleniyordu. Oysa elde edilen bulgulardan da anlaşılıyor ki emeklilerin emekli olduğu meslek grubu internete bağlanma sürelerini etkilememektedir.

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MEASURING PERIMETER AND AREA WITH WEB-BASED TEACHING

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ABSTRACT: This study is an action research which aims to determine and eliminate misconceptions of the 6th grade students in the fields of measurement units, periphery and area. Two web-assisted activity applications were prepared and applied to the students. In the first activity, a problem scripted for length measurement and area measurement was presented. Computer means through which the students will utilize internet was supplied to all the groups and the problem was presented in the computer environment. The region, the area of which was asked, was presented on a chequered ground in the computer environment and these squares were used as nonstandard area measurement unit, and approximate area measurement was requested. As a result of the first application, problems such as confusing the periphery and area concepts, incomprehensibility of length and area measurement units and use of incorrect units were encountered. With the development of the methods and techniques in the first application, the second web-assisted activity was planned and applied. In this study, in addition to the first activity, as nonstandard measurement units rectangular materials were used. In this study, use of ruler was also supplied for the length measurement. According to the results of the interview with the students, the students found the second activity more useful in terms of acquiring the area and periphery concepts. Use of rule for length measurement and use of nonstandard concretized measurement units for area measurement in the second activity made the subject more comprehensible. The student could easily focus on the subject by increasing the visual features of the scripted problems by means of the computer. However, it is concluded that use of technology alone is not adequate for understanding the concepts and it is absolutely necessary to include the activities through which active participation of the student will be provided.

Key words: area, perimeter, mathematics education, measurement, web-based teaching

WEB-DESTEKLI ÖĞRETIM ILE ÇEVRE VE ALAN ÖLÇÜMÜ

ÖZET: Bu çalışma, ortaokul 6. Sınıf öğrencilerinin; ölçme birimleri, çevre ve alan konularındaki kavram yanılgılarını belirleyip gidermeyi amaçlayan bir eylem araştırmasıdır. Öğrencilere web destekli iki etkinlik uygulaması hazırlanmış ve uygulanmıştır. İlk etkinlikte uzunluk ölçme ve alan ölçme konusuna yönelik senaryolaştırılmış bir problem sunulmuştur. Bütün gruplara internet kullanabilecekleri bilgisayar aracı sağlanmış ve problem bilgisayar ortamında sunulmuştur. Alanı istenilen bölge, kareli bir zeminde bilgisayar ortamında sunulmuş ve bu kareler standart olmayan alan ölçme birimi olarak kullanılıp tahmini alan ölçümü yapmaları istenmiştir. İlk uygulama sonucunda; çevre ve alan kavramını karıştırma, uzunluk ölçme ve alan ölçme birimlerini anlamlandıramama ve yanlış birim kullanma gibi sorunlarla karşılaşılmıştır. İlk uygulamadaki yöntem ve teknikler geliştirilerek ikinci web destekli etkinlik planlanmış ve uygulanmıştır. Bu çalışmada ilk etkinliğe ek olarak standart olmayan alan ölçme birimleri olarak dikdörtgen şeklindeki materyaller ve uzunluk ölçümü için cetvel kullanılmıştır. Öğrencilerle yapılan görüşme sonuçlarına göre öğrenciler alan ve çevre kavramının kazandırılmasında ikinci etkinliği daha faydalı bulmuştur. İkinci etkinlikte uzunluk ölçümünde cetvel kullanmaları, alan ölçümünde somutlaştırılmış standart olmayan ölçü birimlerini kullanmaları konuyu daha anlaşılır hale getirmiştir. Hazırlanan senaryolaştırılmış problemlerin bilgisayar yardımıyla görsellik özellikleri artırılarak öğrencinin konuya kolayca odaklanması sağlanmıştır. Fakat kavramları anlamada sadece teknoloji kullanımının yeterli olmadığı mutlaka öğrencinin aktif katılımının sağlanacağı etkinliklere yer verilmesi gerektiği sonucuna ulaşılmıştır.

Anahtar sözcükler: alan, çevre, matematik eğitimi, ölçme, bilgisayar destekli öğretim

GİRİŞ

Ülkemizde de 2005-2006 yılından itibaren MEB Talim ve Terbiye Kurulunun hazırladığı yapılandırmacı yaklaşıma göre hazırlanan matematik öğretim programı kullanılmaktadır. Matematik öğretim programı incelediğinde önemli bir kısmını ölçme konusunun oluşturduğu görülmektedir. Geçmişten günümüze ölçme günlük hayatta kullandığımız ve sürekli karşımıza çıkan bir kavramdır. Yapılan araştırma ve değerlendirmelere baktığımızda günlük hayatımızda bu kadar sık kullandığımız ölçme konusunun öğrencilere yeterince kazandırılamadığı görülmektedir.

Yeni matematik programına göre öğrencilerin önce sezgiye dayalı karşılaştırma ve sıralama yapmaları, sonrasında standart olmayan ve olan birimler kullanarak ölçme yapmaları hedeflenmiştir. Öğretim programında 3. sınıfa kadar uzunluk ölçme, paralarımız, zaman ölçme, tartma ve sıvı ölçme alt başlıklarına ait kazanımlar bulunurken 3. sınıfta bu alt başlıklara alan ölçme ve çevre ölçme kazanımları eklenmektedir. (MEB,2015). Öğrencilerin 3. Sınıftan itibaren çevre ve alan kavramlarıyla tanışmalarına rağmen birçok ortaokul öğrencisinin çevre ve alan kavramlarını tanımlamada zorlandığı yapılan çalışmalar sonucunda görülmektedir.

Ölçme öğrencilerin anladıkları kolay bir konu değildir. TIMMS ve NAEP gibi uluslararası çalışmaların sonuçlarından elde edilen bulgular sürekli olarak öğrencilerin öğretim programındaki konular içerisinde ölçme alanında daha zayıf olduklarını göstermektedir. (Thompson & Preston, 2004). Her ne kadar metrik ve geleneksel ölçme sistemlerinin beraber öğrenimi buna etken olabilse de bu düşük performansın sebebi, büyük ihtimalle konunun öğretimi ile ilgilidir. (Van de Walle, 2014)

Ortaokul sınıflarında ilkokuldaki gibi, kesme, yırtma, yapıştırma, ayırma, birleştirme ve modellerden yararlanma ön planda düşünülmelidir. Öğretim metodu olarak buluş ve kılavuzlanmış buluş en çok başvurulan yollar olmalıdır. Ortaokul geometri çalışmalarında geometrik şekillerin özellikleri analiz edilmeli, aralarındaki ilişkiler buldurulmalı; ispata hazırlayıcı akıl yürütme çalışmalarına ağırlık verilmelidir; bu çalışmalarda yine yırtma, kesme, yapıştırma vb. etkinliklerden yaralanılmalıdır. Sebep-sonuç ilişkileri çıkarılmaya başlanılmalıdır (Baykul, 2014).

Ölçme alanındaki literatür incelendiğinde, genel olarak öğrencilerin ölçme ile ilgili kavramları anlamada, bu kavramları ilişkilendirmede ve problem çözme sürecine dahil edebilmede sıkıntılar yaşadıkları; alan, çevre ve hacim gibi kavramların anlamlarını bilmeden ve mantığını anlamadan, ezbere öğrenilen formüller ile sonuca ulaşmaya çalıştıkları görülmektedir (Chappell & Thompson, 1999; Grant & Kline, 2003; Martin & Strutchens, 2000 Stephan & Clements, 2003: Akt. (Şişman & Aksu, 2009)).

Dağlı ve Peker'in (2012) ilköğretim 5. Sınıf öğrencilerinin geometrik şekillerin çevre uzunluğunu hesaplamaya ilişkin bilgilerini araştırdığı çalışmasında öğrencilerin çevre ve alan hesabını birbirine karıştırma, çevre uzunluğunu açılarla ilişkilendirme gibi kavram yanılgılarına sahip oldukları sonucuna ulaşmıştır. Ayrıca öğrencilerin, aynı parçalardan oluşturulan farklı şekillerin çevre uzunluklarını hesaplamada zorlandıkları görülmüştür. Bu sonuç doğrultusunda öğrencilerin farklı düşünme becerilerinin geliştirilmesi gerektiği vurgulanmıştır.

Küçük ve Demir'in (2009) ilköğretim 6-8. Sınıflarda matematik öğretiminde karşılaşılan bazı kavram yanılgılarını araştırdığı çalışmasında öğretmenlere ''Matematik derslerinde, öğrencilerin anlamada ve uygulamada güçlük çektikleri konular'' sorulmuş ve geometrik kavramlar 3. sırada yer almıştır.

Yenilmez ve Demirhan'ın (2013) altıncı sınıf öğrencilerinin bazı temel matematik kavramları anlama düzeylerini araştırdığı çalışmasında öğrencilerin kavramları tam olarak tanımadıkları halde kavramla ilgili işlemleri yaptıkları görülmüş ve bu durum öğrencilerin kavramı anlamadan formülleri ezberleyerek işlem yaptıkları şeklinde açıklanmıştır.

Şişman ve Aksu'nun (2009) yedinci sınıf öğrencilerinin alan ve çevre konularında ki başarılarını araştırdığı çalışmasında öğrencilerin çoğunun çevrenin ne anlama geldiğini yüzeysel olarak açıklayabildikleri ve aynı parçalar kullanılarak oluşturulan şekillerin çevre uzunluğunun değişebileceği konusunda kavram yanılgıları olduğu görülmüştür. Ayrıca öğrencilerin yarıya yakın bir kısmının alan ve çevre hesabını karıştırdıkları ve alan korunumu kazanılmadığı sonucuna ulaşılmıştır. Yedinci sınıf öğrencilerinin alan ve çevre konularındaki başarılarını ölçmek için uygulanan testte gösterdikleri performans değerlendirildiğinde öğrencilerin kavram bilgisi gerektiren sorularda başarılarının düştüğü fakat hesaplamaya dayanan sorularda başarılarının arttığı görülmüştür. Alan ve çevre hesaplarının formüle dayalı olarak değil öncelikle kavram olarak ne olduğu öğretilmeli, kesme-katlama yeniden düzenlemeyi içeren etkinlikler yapılarak çevre uzunluğunun değişebilirliği ve alanın korunumu geliştirilmeli, alan-çevre hesaplamalarında sonuçların uygun ölçme birimleriyle ifade etmenin önemi vurgulanmalı gibi öneriler vurgulanmıştır.

Problem Cümlesi

1) Ortaokul 6. sınıf öğrencilerinin uzunluk ve alan ölçme birimlerine yönelik kavram yanılgıları nasıl giderilir.
2) Ortaokul 6. Sınıf öğrencilerinin alan ve çevre kavramlarına yönelik kavram yanılgıları nasıl giderilir.

AMAÇ

Matematik soyut kavramlar içeren bir alan olması nedeniyle zaman zaman öğrenciler kavram yanılgıları yaşamaktadırlar. Öğrencilerin anlamada zorlandıkları alanlardan biriside ölçme konusudur.

Ölçme konusu, günlük hayatımızda oldukça önemli bir yer tutmasına rağmen derslerde yeterince günlük hayatımızın bir parçası olarak aktarılamamakta ve birçok öğrencide kavram yanılgıları oluşmaktadır. Uzunluk ölçmede olduğu gibi alan ölçmede de birimlere ihtiyaç duyulduğu bu birimlerin alanın bir parçası olması gerektiğinin öğrencilere kazandırılmasında zorluklar yaşandığı görülmektedir. Literatür incelendiğinde 8. Sınıf dâhil ortaokulun tüm kademelerinde alan ve çevre kavramlarını kazanamayan ve kavram yanılgıları olan öğrenciler olduğu görülmektedir.

Bu çalışmanın amacı ortaokul 6. Sınıf öğrencilerinde; ölçme birimleri, çevre ve alan konularında oluşan kavram yanılgılarının nasıl giderilebileceğini öğrenmektir.

YÖNTEM

Bu araştırmada nitel araştırma deseninin eylem araştırması yöntemi kullanılmıştır. Eylem araştırmaları uzman araştırmacıların yürütücülüğünde, uygulayıcıların ve probleme taraf olanların da katılmasıyla, var olan uygulamanın eleştirel bir değerlendirmesini yaparak, durumu iyileştirmek için alınması gereken önlemleri belirlemeyi amaçlayan araştırmalardır (Karasar, 1999.s.27).

Bu çalışmada 6. Sınıf öğrencilerinin uzunluk ve alan ölçme konusunda var olan bilgileri gözlemlenmiş ve sahip oldukları kavram yanılgıları nedenleriyle birlikte derinlemesine belirlenmeye çalışılmıştır. Elde edilen bulgular sonucunda yeni yöntem ve teknikler kullanılarak var olan kavram yanılgıları giderilmeye çalışılmıştır.

Çalışma Grubu

Araştırma grubu 2015-2016 eğitim-öğretim yılının güz döneminde Artvin ili, merkez Gazi Ortaokulundaki 6. sınıfta öğrenim gören 16 öğrenci oluşturmaktadır. Bu 16 öğrenci 4 kişilik gruplara ayrılmıştır. Grupların oluşturulmasında her gruba akademik başarı yönünden dengeli bir dağılımın yapılması dikkate alınmıştır. Aktif öğrencilerle pasif öğrencilerin birlikte çalışması sağlanmıştır.

Çalışma Ortamı

Yaptığımız bu çalışma seçmeli ders saatlerinde boş dersliklerden faydalanılarak yapılmıştır. Sınıf ortamı öğrencilerin işbirlikli çalışacağı şekilde düzenlenmiştir. Öğrenciler 4 kişilik gruplara ayrılmış ve sınıf oturma düzeni buna göre tasarlanmıştır. Sınıf teknolojik anlamda donatılmaya çalışılmıştır. Bilgisayar sınıfı grup çalışmasına uygun olacak şekilde düzenlenemediği için kullanılmamıştır. 3 okul bilgisayarı 3 grubun masasına kurulmuş diğer grubun da akıllı tahtayı çalışmalarında kullanmaları sağlanmıştır. Gerçek hayattan uyarlanan senaryolaştırılmış problemler öğrencilere akıllı tahta ve bilgisayarlar aracılığıyla aktarılmış ve öğrencilerin çalışmalarında okul internet bağlantısından faydalanmaları sağlanmıştır.

Veri Toplama Araçları

Öğrencilere günlük hayattan uyarlanan problemler webquest formatında uygulanmış ve sınıf ortamında video çekimi yapılmıştır. Her uygulamadan sonra öğrencilerle görüşülmüş ve uygulamanın olumlu-olumsuz tarafları öğrencilere sorulmuştur. Bu görüşmeler video kayıtlarına alınmıştır. Öğrencilerin uygulama sırasında çalıştıkları çalışma kağıtları uygulama sonrası öğretmen tarafından toplanmıştır. Uygulama sonunda grupların çözümlere nasıl ulaştıkları sorulmuş ve video çekimi yapılmıştır.

Öğrenmeyi öğretme üzerine bir çalışma

'Webquest' öğrencinin etkileşim içinde olduğu bilginin belli bir ölçüde veya tamamen internet üzerindeki kaynaklardan veya video konferans aracılığıyla sağlandığı araştırma yönelimli bir aktivitedir.'(Berni Dodge, 1997). Sorgulamaya yönelik bu öğretim tekniği, öğrencilerin anlamlı bir şekilde bilgilerin ayrımını yapabilmelerini, kendilerine ait problem çözme uygulamaları geliştirmelerini ve internet kaynaklarının etkileşimli bir şekilde kullanmalarını sağlar (Lim ve Hernandez, 2007). Webquestler temelde yapılandırmacı yaklaşıma uygun olarak hazırlanmaktadır. Ayrıca Webquest ile öğretim, sosyal yapılandırmacılığın eğitimde uygulanmasında ideal bir yoldur (Simina 2005).

Uygulama Süreci

Araştırma 16 kişiden oluşan 6. Sınıf öğrencilerine uygulanmıştır. 6. Sınıf öğrencilerinin çevre, alan ve birimlerine yönelik kavram yanılgılarını anlamak ve mevcut durumu belirlemek için 1. çalışma yapılmıştır. Birinci uygulama matematik öğretmeni tarafından hazırlanan webquest çalışması ile yapılmıştır. Uzunluk ölçme birimlerini dönüştürme ve alan hesaplama konusuyla ilgili günlük yaşamdan tasarlanan bir problem, bilgisayarlar aracılığıyla öğrencilere sunulmuştur. Öğrencilerden öncelikle webquest çalışmasında yer alan linkler yardımıyla uzunluk ölçme ve alan hesabı konusuyla ilgili bilgi toplamaları ve konuları hatırlamaları istenmiştir. Her grupta bulunan bilgisayarlar ve internet bağlantısı yardımıyla problem çözme sürecinde öğrencilere farklı kaynaklara ulaşma imkânı sağlanmıştır. Birinci uygulamaya 2 gün devam edilmiştir. 1. Gün problem tanıtılarak farklı ölçü birimlerinde verilen uzunlukların önce metre ölçü birimine dönüştürülmesi istenmiştir. Grupların çalışma kâğıtları ders bitiminde toplanarak 2. Gün probleme kalındığı yerden devam edilmiş ve alan hesabı çalışmasına geçilmiştir. Verilen şekil standart olmayan ölçü birimi kullanabilmeleri için kareli kâğıda çizilerek verilmiştir ve buradan alan tahmini yapmaları istenmiştir. Bu uygulama sonunda öğrenci çalışma kâğıtları ve video kayıtları matematik öğretmeni tarafından incelenmiştir. Öğrencilerin sahip olduğu kavram yanılgılarının iyileştirilebilmesi için bu yanılgıların kaynakları belirlenmeye çalışılmıştır. Belirlenen hatalar doğrultusunda etkisiz kalan yöntem ve teknikler belirlenip geliştirilerek 2. çalışma uygulanmıştır.

1.çalışmada, standart olmayan ölçü birimi olarak kareli kâğıttaki kareler kullanılmıştır. Öğrencilerin alan kavramını anlamada hala eksiklerinin olduğunun gözlemlenmesi bu yöntemin değiştirilerek daha dikkat çekici bir materyale yönelme gereği duyulmuştur. Elle tutulur ve istedikleri şekilleri elde edebilecekleri renkli dikdörtgenlerin standart olmayan ölçü birimi olarak kullanılması tercih edilmiştir. Uzunluk ölçmek için öğrencilerden cetvel getirmeleri istenmiştir. İkinci webquest çalışmasında her gruba 100 tane birbirine eş dikdörtgen materyalleri verilmiştir. Birinci gün, gruplardan bu dikdörtgenlerden çevresi en küçük olacak şekilde bir dikdörtgensel bölge oluşturmaları istenmiştir. Öğrencilere çeşitli denemeler yapmaları için zaman tanınmıştır. 2. Günde ellerinde ki materyallerle farklı çevrelere sahip dikdörtgensel bölgeler oluşturmaya devam etmişlerdir. Oluşturdukları her dikdörtgenin kısa kenar, uzun kenar ve çevre uzunluklarını ölçerek tablo oluşturmaları istenmiştir. Aynı parçalardan oluşan şekillerin çevre uzunluklarının değişebileceği sonucuna ulaşmaları beklenmiştir. Uygulamanın 3. gününde ise en küçük çevreye ulaşmada kenar uzunluklarıyla çevre arasın da ilişki kurmaları ve alan hesabı yapmaları istenmiştir. Öncelikle alan kavramına standart olmayan birimlerden yola çıkarak ulaşmaları istenmiştir. Aynı parçalardan oluşturulacak farklı şekillerde alanın değişmeyeceğini anlamaları beklenmiştir.

Her iki çalışmada da grup çalışması kullanılmıştır. 1.çalışmada bazı gruplardaki öğrenciler arası olumsuz ilişkilerden kaynaklanan sıkıntılar yaşanmış ve 2. çalışmada bu öğrencilerin grupları değiştirilmiştir.

BULGULAR

6. sınıf öğrencileri, müfredat incelendiğinde uzunluk ölçülerini dönüştürme kazanımını 5. Sınıfta öğrenmiştir. Alan ölçme birimlerini dönüştürmeyi ise 6. Sınıfın 2. Döneminde öğreneceklerdir. Çalışma, 6. Sınıfın 1. Döneminde yapıldığı için öğrenciler henüz alan ölçme birimlerini dönüştürmeyi bilmemektedirler. 1. Çalışmada, önce öğrencilerden farklı birimlerde verilen uzunlukların önce metreye çevrilerek daha sonra dikdörtgen şeklindeki bahçenin alanını metre cinsinden bulmaları istenmiştir. Birçok öğrenci, kenar uzunluklarını santimetre cinsine çevirip kısa kenar ve uzun kenar uzunluklarını çarptıktan sonra buldukları sonuçtan 2 sıfır silerek metrekareye çevirdiklerini söylemişlerdir. Öğrenciler, uzunluk ölçme birimlerini dönüştürme formüllerini alan ölçme birimlerine dönüştürmek için de kullanabileceklerini düşünmektedirler. Bu sonuç öğrencilerin uzunluk ve alan kavramlarını zihinlerinde yeterince oluşturamadıklarını göstermektedir.

Alan kavramının ne anlama geldiği öğrencilere sorulduğunda genelinin işlemsel olarak açıklamaya çalıştıkları görülmüştür. Alan hesaplayan öğrencilerin bir kısmının sonucu ifade ederken alan birimi kullanmadığı, bir kısmının da alan birimi yerine uzunluk birimi kullandığı rastlanılan hatalar arasındadır. Bu sonuç öğrencilerin uzunluk ve alan kavramlarını hesaplarken kullandığımız birimleri anlamlandıramadıkları yönünde fikir vermiştir. Alan kavramını tanımlamaya çalışan bazı öğrenciler alanı ‘’bir şeklin iç bölgesi’’ olarak ifade etmişlerdir.

Bazı öğrencilerde uzunluk ölçme birimlerini işlemsel olarak doğru bir şekilde metreye dönüştürmüş fakat buldukları sonucun birimini metre yerine metrekare olarak belirtmiştir. Öğrencilerin daha çok işlemlere yönelmesi birimleri önemsememeleri üzerine yapılan çalışmalarda birimlerin ne anlama geldiğini bilmedikleri veya zihinlerinde somutlaştıramadıkları sonucunu ortaya çıkarmıştır.

2. çalışmaya 3 gün devam edilmiştir. 1.gün grupların 100 dikdörtgeni nasıl dizerek bir dikdörtgensel bölge oluşturacakları gözlemlenmiştir. Hazır bulunuşluğu olan öğrencilerin kolayca dikdörtgensel bölgeleri oluşturabildikleri görülmüştür. Hazır bulunuşluğunda eksikler olan öğrencilerin, dikdörtgenleri kenarları çakışmayacak şekilde dikdörtgenin özelliklerini göz önünde bulundurmadan dizdikleri fark edilmiştir. Bazı öğrencilerde elindeki 100 dikdörtgenin tamamını kullanmadan dikdörtgensel bölge oluşturdukları görülmüştür. Dikdörtgenler dizildikten sonra her bir dikdörtgenin sayılması yerine bir sırada kaç dikdörtgen olduğunun belirlenmesinden sonra toplam sıra sayısıyla bu sayının çarpımının 100 olması gerektiği sonucuna yönlendirmeler sonucunda varmışlardır. Öğrencilere çevre kavramının anlamı sorulduğunda bazı öğrenciler ‘’iki kenarın çarpımı’’ şeklinde ifadelerde bulunmuş ve alan kavramıyla çevre kavramını karıştırdıkları gözlemlenmiştir. Bazı öğrencilerde çevre kavramını ‘’şeklin etrafı’’ olarak tanımlamışlardır.

2.günde grupların aynı parçaları kullanarak farklı dikdörtgensel bölgeler oluşturmaları sağlanmış ve çevre uzunluklarını hesaplamaları istenmiştir. Öğrencilere bu çalışmalar yaptırıldıktan sonra aynı parçalardan oluşturdukları dikdörtgenlerin çevrelerinin değişip değişmediği sorulmuş ve bütün öğrenciler değiştiği yönünde cevap vermiştir.

3. günde aynı parçaları kullanarak tasarladıkları dikdörtgensel bölgelerden hangisinin en kısa çevre uzunluğuna sahip olduğu soruldu. Tasarladıkları dikdörtgensel bölgelerin kısa, uzun kenar ve çevre uzunluklarını tablo şeklinde sunarak yorumlamaları istenmiştir. Gruplar en kısa çevreye ulaşmış fakat buna neden olan kenar ilişkisini yorumlamada zorlanmışlardır. Öğretmen rehberliğinde sonuca ulaşmaları sağlanmıştır.

Öğrenciler, en kısa çevreye ulaştıktan sonra alan hesabına geçmiştir. Öğrencilere aynı parçaları kullanarak oluşturdukları dikdörtgensel bölgelerin alanlarının değişip değişmediği sorulmuştur. Bazı öğrenciler alanın değişeceğini bazıları da değişmeyeceğini söylemiş ve tartışma ortamı yaratılmıştır. Değişeceğini söyleyen öğrencilere ellerindeki standart olmayan alan birimleri yardımıyla aynı parçalardan oluşan farklı şekillerin alanlarını ölçmeleri sağlanmıştır. Alan korunumu standart olmayan birimler yardımıyla somutlaştırılarak öğrencilerin kavram yanılgıları giderilmeye çalışılmıştır. Çalışmanın sonunda öğrencilerin işlemsel olarak doğru sonuçlara ulaştıkları görülmüştür. Görseller ve materyallerin alan ve çevre kavramlarını açıklamada ve somutlaştırmada öğrenciler üzerinde oldukça etkili olduğu gözlemlenmiştir.

SONUÇ

Birinci webquest çalışması 6. Sınıf öğrencilerinin ölçme konusundaki kavram yanılgılarını ve sebeplerini araştırma amacıyla yapılmıştır. Bu çalışmadan alınan bilgiler doğrultusunda öğrencilerin ölçme konusundaki kavram yanılgılarını iyileştirmek için yöntem ve teknikler geliştirilerek ikinci webquest çalışması uygulanmıştır. Birinci çalışma da öğrencilere senaryolaştırılmış bir problem verilmiş ve internet ortamından yararlanarak problemi çözmeleri istenmiştir. Öğrencilerin uzunluk ve alan birimlerini kullanmada kavram yanılgılarının bulunduğu gözlemlenmiştir. Birçok öğrencinin alan ve çevre kavramını daha çok işlemsel olarak açıklamaya çalıştıkları ve bazı öğrencilerinde alan ve çevre kavramını karıştırdığı görülmüştür. Öğrencilerin kavramları anlamadan ezbere işlem yaptıkları bulgusu elde edilmiştir. Bu bulgular literatürdeki çalışma sonuçlarıyla paralellik göstermektedir(Chappell & Thompson, 1999; Grant & Kline, 2003; Martin & Strutchens, 2000 Stephan & Clements, 2003) Öğrencilerin kavramları net olarak açıklayamamalarına rağmen işlem yapabilmeleri kavramsal öğrenmenin gerçekleşmediği ve formüllerle sonuca ulaşmaya çalıştıklarını göstermektedir. Bu sonuç, Yenilmez ve Demirhan’ın (2013) öğrencilerin kavramları tam olarak tanımadıkları halde kavramla ilgili işlemleri yaptıkları görülmüş ve bu durum öğrencilerin kavramı anlamadan formülleri ezberleyerek işlem yaptıkları bulgusuyla paralellik göstermektedir. Bu çalışma sonucunda kavram yanılgılarının giderilmesinde sadece internet kaynağının ve bilgisayar ortamında bulunan görsellerin kullanılmasının yeterli olmadığı görülmüştür. Ayrıca çalışma sonunda öğrencilerin görüşleri alınmıştır. Öğrenciler hazırlanan senaryolaştırılmış problemden çok etkilendiklerini ve kendilerini gerçekten bir mimar gibi hissederek problemi çözdüklerini ifade etmişlerdir. Birinci çalışma iki gün, 1 er saat uygulanmıştır. Öğrencilere evde çözmeleri için problem verilmemiştir sadece okulda çalışma yapılmıştır. Buna rağmen bazı öğrenciler evde problemi zihinlerinde canlandırıp çözmeye çalıştıklarını söylemiştir. Bu etkinin yaratılmasında bilgisayar aracının kullanılması ve hazırlanan problemdeki görsellerin katkısı çok belirgindir. Öğrencilerin gerçekten bir mimar gibi parke taşı seçmeleri ve internetten parke satış mağazalarından fiyatlara ulaşmaları problemi hiç sıkılmadan çözmelerini sağlamıştır. Öğrenciler problemi sevdiklerini ve daha önce çözümü bu kadar uzun süren bir problem çözmediklerini belirtmişlerdir. Problemin birçok adımının olmasına rağmen sıkılmadıklarını fakat verilen sürenin biraz daha uzatılması gerektiğini vurgulamışlardır.

İkinci çalışmada da tekrar görselliğe dayalı senaryolaştırılmış bir problem kullanılmıştır. Yine öğrencilerin internet kaynağını kullanmaları sağlanmıştır. Alan ve çevre kavramını zihinlerinde yapılandırabilmelerini sağlayacak renkli ve eş dikdörtgenler standart olmayan alan birimleri olarak bütün gruplara verilmiştir. Ayrıca uzunluk ölçümleri için öğrencilerin cetvel kullanmaları sağlanmıştır. İkinci çalışmada aynı parçalardan farklı dikdörtgenler oluşturmaları sağlanmıştır. Oluşturdukları dikdörtgenlerin çevre uzunluklarını hesaplanmış ve aynı parçalardan oluşan şekillerin farklı çevre uzunluklarına sahip olabilecekleri çıkarımında bulunmuşlardır. Aynı parçalarla oluşturulan farklı şekillerin alanları üzerinde düşünmeleri sağlanmış ve tahminleri alınmıştır. Alan korunumu için dikdörtgensel bölgeyi oluşturan dikdörtgenler standart olmayan alan ölçme birimi olarak kullanılmış ve alan ölçümlerinde önce dikdörtgenleri saymaları istenmiştir. Böylece oluşturdukları dikdörtgenlerin alanlarını eş bulmuş ve alan korunumu kazandırılmıştır. Öğrencilerin, çevre ölçümünde cetvel kullanmaları, alan ölçümünde ise dikdörtgenlerin sayısını dikkate almaları, çevre ve alan kavramlarını zihinlerinde kolaylıkla canlandırmalarını sağlamıştır. Ayrıca uzunluk ve alan ölçme birimlerini anlamlandırma somutlaştırılmıştır. Bu bulgular ışığında öğrencilerin çevre ve alan kavramlarını algılamada mutlaka kendilerinin oluşturabileceği şekiller için ortam sağlanması gerektiği sonucu ortaya çıkmıştır. Yaparak-yaşayarak öğrenmenin önemi ve etkisi bu çalışma sonucuna da yansımıştır. Bu bulgu, Şişman ve Aksu'nun (2009) alan ve çevre hesaplarının formüle dayalı olarak değil öncelikle kavram olarak ne olduğu öğretilmeli, kesme-katlama yeniden düzenlemeyi içeren etkinlikler yapılarak çevre uzunluğunun değişebilirliği ve alanın korunumu geliştirilmeli, alan-çevre hesaplamalarında sonuçların uygun ölçme birimleriyle ifade etmenin önemi vurgulanmalı önerileriyle paralellik göstermektedir.

Çalışma sonunda öğrencilerin birinci ve ikinci çalışmayı değerlendirmeleri istenmiştir. Bu konuda ki öğrenci görüşlerinden alıntılar şöyledir:

"Birinci çalışmaya göre ikinci çalışma daha iyiydi. Çünkü şekilleri görerek yaptık. O yüzden daha rahat oldu işimiz. İkinci çalışmayı daha iyi anladık ve kendimiz yaptık şekilleri."

"Birinci çalışmada sadece bilgisayar kullandık. İkinci çalışmada elimizde şekillerimizde vardı. Elimizde şekillerimizin olması bizim için daha iyi oldu.*"*

Öğrencilerin görüşü ikinci çalışmayı daha faydalı buldukları yönündedir. Kullandıkları şekilleri problem çözmede kolaylaştırıcı özellikte bulmuşlardır. Özellikle alan ve çevre kavramlarının kavranmasında öğrencilerin materyal kullanmaları gerektiği sonucu ortaya çıkmıştır. Hacıömeroğlu ve Apaydın'ın öğrencilerin tangram seti kullanılarak alan ve çevre hesabına alternatif bir yol sunduğu çalışmasında, öğrencilerin kendilerinin oluşturduğu şekillerin çevre ve alan hesabını yapmada fikir alışverişinde bulunma ve değerlendirme yapabilme fırsatı sağlanmış ve öğrencilerin elde ettikleri sonuçları karşılaştırarak farklı çözüm yöntemlerini paylaşabilmeleri amaçlanmıştır. Bu amaç doğrultusunda yapılan çalışma ile öğrencilerin çevre ve alan kavramını daha iyi anladıkları vurgulanmıştır.

ÖNERİLER

- Çevre ve alan kavramlarının öğretiminde öğrencilerin somut materyallerle çalışma yapacakları ortamlar düzenlenmelidir.

- Uzunluk ölçümlerinde mutlaka öğrencilerin cetvel kullanmaları sağlanmalıdır.

- Kullanılan materyaller öğrencilerin dikkatini çekecek özellikte olmalıdır.

- Alan ölçümünde öğrencilerin standart olmayan alan ölçme birimleri oluşturmaları ve kullanmaları sağlanmalıdır.

- Etkinlikleri uygulamanın klasik soru çözme yöntemine göre daha çok zaman alması öğretmenleri, kavramların öğretinden çok işlemleri öğretme yoluna itmektedir. Etkinliklerin uygulanabilirliğini artırmak için matematik müfredatı oldukça sadeleştirilmelidir.

- Öğrencilere internet ortamından çalışma yöntemleri öğretilerek kendi kendilerine öğrenmelerine olanak sağlanmalıdır.

- Grup çalışmalarıyla öğrencilerin fikir alışverişinde bulunarak farklı çözüm yolları geliştirmeleri sağlanmalıdır.

- Senaryolaştırılmış problemler öğrencilerin dikkatini konuya yoğunlaştırmakta ve uzun süre etkisini sürdürmektedir. Uzun ve sıkıcı ödevler yerine, senaryolaştırılmış, uygulama basamakları olan problemler ödev olarak öğrencilere sunulabilir.

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ANALYSIS OF BIOLOGY CONTENT KNOWLEDGE TEST ACCORDING TO COGNITIVE PROCESS DIMENSION OF REVISED BLOOM TAXANOMY

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ABSTRACT: The aim of this study was to analyze questions of 2013 biology content knowledge test in civil servant selection examination (KPSS) according to knowledge and cognitive processes dimensions in revised Bloom taxonomy. Following research questions were guided the study: To what extend 2013 biology content knowledge test in civil servant selection examination (KPSS) represents knowledge and cognitive processes dimensions of revised Bloom taxonomy? This is a qualitative research in which descriptive content analysis approach was employed and data was collected through document analysis. During data analysis, descriptive analysis techniques have been used to answer the research question. Biology teaching content knowledge test's questions have been classified according to the criteria presented in the book A Taxonomy for Learning, Teaching, and Assessing-A Revision of Bloom's Taxonomy of Educational Objectives'. 2013 biology content knowledge test questions were coded using performance indicators and revised Bloom taxonomy separately. According to the research findings questions in 2013 KPSS biology content knowledge test did not homogenously represent levels of knowledge and cognitive processes dimensions of revised Bloom taxonomy. In cognitive processes dimension questions were mostly in category of understanding (42%) and there was not any question in either categories evaluate or create. In knowledge dimension questions were mostly in conceptual category (75%) and there was not any question that required metacognitive knowledge. Since standardized testing has a significant importance on the appointment of teachers to the public schools and plays a crucial role for pre-service biology teachers' social and professional well-being both performance indicators and knowledge levels should be better considered in preparation of such a high stake exam.

Key words: kpss, revised bloom taxonomy, biology content test.

BİYOLOJİ ALAN BİLGİSİ TESTİNİN BİLGİ VE BİLİŞSEL SÜREÇ BOYUTLARI AÇISINDAN İNCELENMESİ

ÖZET: Bu çalışmanın amacı, Kamu Personeli Seçme Sınavı'nın bir basamağını oluşturan ve ilk defa 2013 yılında uygulanan Biyoloji Alan Bilgisi Testinde yer alan soruların Yenilenmiş Bloom Taksonomisinin bilgi ve bilişsel süreç boyutlarına göre incelemektir. Bu amaç doğrultusunda "2013 KPSS'de sorulan biyoloji öğretmenliği alan bilgisi soruları Yenilenmiş Bloom Taksonomisinin bilgi ve bilişsel süreç boyutlarını ne düzeyde temsil etmektedir?" sorusuna cevap aranmıştır. Bu araştırmada karşılaştırmalı eğitim çalışmalarında sıklıkla kullanılan betimsel analiz ve içerik analizi teknikleri kullanılmıştır. Araştırma verileri nitel araştırma yöntemlerinden biri olan doküman incelemesi ile elde edilmiştir. Araştırma sonucunda 2013 KPSS Biyoloji Öğretmenliği Alan Bilgisi Testinde sorulan alan bilgisi sorularının Yenilenmiş Bloom Taksonomisinin bilgi ve bilişsel süreç boyutlarının her evresini homojen olarak yansıtmadığı görülmüştür. Bilişsel süreç boyutunda en çok sorunun Anla basamağında olduğu; Değerlendir ve Yarat basamaklarına yönelik soru sorulmadığı; bilgi boyutunda ise en çok sorunun Kavramsal Bilgi türünden geldiği buna karşılık Üstbilişsel Bilgi türüne ait hiçbir sorunun sorulmadığı belirlenmiştir. Çalışma sonunda biyoloji alan bilgisi soru sayısının artırılması ve soruların hazırlanırken biyoloji öğretmenliği öğretim programları, biyoloji özel alan yeterlikleri ve Yenilenmiş Bloom Taksonomisinin göz önünde bulundurulması önerilmiştir.

Anahtar sözcükler: kpss, biyoloji alan bilgisi testi, yenilenmiş Bloom taksonomisi.

GİRİŞ

Dünyadaki öğretmen seçme sistemlerine bakıldığında genel olarak iki yaklaşımın kullanıldığı görülmektedir. İlk yaklaşımda, öğretmenlik programlarına ihtiyaç duyulan öğretmen sayısı göz önünde bulundurularak öğrenci alınmaktadır. Dolayısıyla bu programlardan mezun olan öğretmen adayları pek istihdam sıkıntısı çekmemektedir. İkinci yaklaşımda ise, öğretmenlik programlarına genellikle ihtiyaçtan fazla öğrenci alındığından istihdam için ikinci bir seçme yapılmaktadır. Türkiye'de hali hazırdaki öğretmen seçme süreci yukarıda belirtilen ikinci yaklaşımla benzerlik göstermektedir. (Erdem ve Soylu, 2013). Nitekim Türkiye'de eğitim fakültelerinden mezun olan öğretmen sayısı ile Milli Eğitim Bakanlığı tarafından istihdam edilen öğretmen sayısı arasındaki arz talep dengesizliği nedeniyle kamu okullarına alınacak öğretmenler için sınav yapma zorunluluğu da beraberinde gelmiştir (Baştürk, 2008). Bu bağlamda Milli Eğitim Bakanlığı (MEB) öğretmen adayları arasından seçme yapmak amacı ile 2001 yılından itibaren Ölçme, Seçme ve Yerleştirme Merkezi (ÖSYM) tarafından merkezi olarak yürütülen Kamu Personeli Seçme Sınavını (KPSS) uygulamaktadır. Bu bakımdan ihtiyaç dâhilindeki öğretmen adayının atanabilmesi için KPSS, Türkiye'de önemli bir sınav olup pek çok araştırmaya da konu edilmiştir (Can ve Can, 2011).

Öğretmen adayları için KPSS adı altında yürütülen bu sınavın içeriği genel kültür, genel yetenek, eğitim bilimleri ve bazı bölümler için öğretmenlik alan bilgisi testinden oluşmaktadır. 2013 yılından itibaren MEB kendi beklentileri doğrultusunda bazı alanlara yönelik alan bilgisi ve alan eğitiminden oluşan alan sınavı yapacağını belirtmiş ve sınavın amacının alanında iyi öğretmen yetişmesini sağlamak ve alanında yeterli bilgiye sahip olan bireyleri görevlendirmek olduğunu açıklamıştır (MEB, 2013). Yapılan bu düzenleme ile MEB yapılacak atamalarda öğretmen adaylarının üç ayrı oturumda GYT (Genel yetenek Testi), GKT (Genel Kültür Testi), EBT (Eğitim Bilimleri Testi), ÖABT (Öğretmenlik Alan Bilgisi Testi) olmak üzere dört ayrı testten elde ettikleri KPSS P121 puanını esas almaktadır. KPSS P121 puanının hesabında GYT %15, GKT %15, EBT %20 ve ÖABT %50 oranında katkı sağlamaktadır (ÖSYM, 2013).

Alan bilgisi sınavı uygulanan alanlardan bir tanesi de biyolojidir. Biyoloji alan bilgisi testi 50 sorudan oluşmaktadır. Bu sorulardan 40 tanesi biyoloji alan bilgisine, 10 tanesi ise biyoloji alan eğitimi bilgisine dayanmaktadır. Biyoloji öğretmenlik alan bilgisi testi 2013 yılında ilk defa uygulanmıştır. Yıllara göre net ortalamalarına bakıldığında; 2013 yılında 16,208 ortalama ile 15 alan arasından 11. sırada, 2014 yılında 19,44 ortalama ile 16 alan arasından 11. sırada, 2015 yılında ise 12,8 ortalama ile 16 alan arasından 16. sırada yer aldığı görülmektedir. Biyoloji alan bilgisi testi ortalamalarının diğer alan ortalamalarının oldukça gerisinde kalması ve bu testten elde edilen puanın KPSS puanına %50 oranında etki ediyor olması biyoloji ÖABT soru kapsamını incelenmeye değer bir durum haline getirmektedir.

Öğretmen adaylarını yakından ilgilendiren ve mesleğe başlama konusunda eşik görevi üstlenen bu sınavda öğretmenlerin karşısına getirilen soruların belli ölçütlere göre hazırlanması gerekir. Bu sınavın uygulanmasının bir diğer nedeni de öğretmen yeterliklerine sahip bireylerin seçiminde geçerli, güvenilir ve nitelikli ölçme araçlarının kullanılmak istenmesidir. Youngs, Odden ve Porter'a (2003) göre öğretmen olarak atanmada önkoşul olan sınavların geçerliğinin bir kanıtı, bu sınavların içeriği ile öğretmen yetiştirme programlarında öngörülen yeterliklerin ilişkili olmasıdır (Aktaran: Deryakulu, 2011). Öğretmenlerin, görevlerini etkili ve verimli bir biçimde yerine getirebilmeleri için sahip olmaları gereken bilgi, beceri ve tutumlar olarak tanımlanan, öğretmenlik mesleği genel yeterlikleri MEB tarafından tespit edilmiştir. Daha sonrasında ise değişen eğitim felsefesinin eğitim ve öğretim etkinliklerine yansıtılabilmesi amacıyla alanlara özgü özel alan yeterlikleri belirlenmiştir. Biyoloji öğretmeni özel alan yeterlilikleri 3 ana yeterlilik, 19 alt yeterlik ve 119 performans göstergesinden oluşmaktadır. Araştırmaya konu olan biyoloji alan bilgisi ana yeterlik alanında ise 6 alt yeterlik ve 34 performans göstergesi yer almaktadır. Burada incelenmesi gereken nokta KPSS'nin Milli Eğitim Bakanlığı'nın bu uzun yeterlik listesinde belirtilen niteliklere sahip öğretmen adaylarını seçmede ne derece başarılı olduğudur. İyi bir biyoloji öğretmeninde bu yeterliklerin bulunması gerektiği göz önüne alınırsa, öğretmen seçiminde kullanılan soruların yeterlikler ışığında geliştirilmesi önem taşır. Tanımlanan bu yeterliklerin biyoloji alan bilgisi testinde yoklanıyor olması yapılan ölçme-değerlendirme işleminin niteliğini artıracaktır.

Çalışmanın Amacı

Ülkemizde öğretmen istihdamında, Milli Eğitim Bakanlığı ÖSYM'nin hazırlamış olduğu çoktan seçmeli bir sınav olan Kamu Personeli Seçme Sınavı (KPSS) sonuçlarını esas almaktadır. Öğretmen seçimi için uygulanmakta olan KPSS'nin içeriğine genel kültür, genel yetenek ve eğitim bilimlerine ek olarak 2013 yılında biyoloji alanı da dâhil olmak üzere birçok öğretmenlik alanına alan bilgisi testi eklenmiştir. Ancak öğretmen seçimi işleminde kullanılacak olan ve öğretmenlerin alan bilgisini ölçecek soruların belli ölçütleri taşıması önemlidir.

Bu çalışmada 2013 KPSS' ye eklenen biyoloji alan bilgisi sorularının MEB'in belirlemiş olduğu biyoloji öğretmenliği alan bilgisi yeterlikleriyle örtüşme düzeylerine, yenilenmiş Bloom Taksonomisinin bilişsel süreç basamaklarındaki 'hatırla, anla, uygula, analiz et, değerlendir, yarat' evrelerine ve bilgi boyutundaki 'olgusal, kavramsal, işlemsel ve üst bilişsel bilgi' türlerine göre incelenmesi amaçlanmıştır.

Araştırma Soruları

2013 KPSS'de çıkan biyoloji öğretmenliği alan bilgisi soruları:

1. Yenilenmiş Bloom Taksonomisinin hangi basamağında yer almaktadır?
2. Yenilenmiş Bloom Taksonomisinin bilgi ve bilişsel süreç boyutlarının her evresini temsil etmekte midir?
3. MEB'in belirlemiş olduğu biyoloji öğretmenliği alan bilgisi yeterliği performans göstergelerini ne derece temsil etmektedir?

Çalışmanın Önemi ve İlgili Alan Yazın

Öğretmen seçimi gibi önemli bir seçme işlemi için gerçekleştirilen ölçme-değerlendirme sürecinde hazırlanan sorular üniversitelerin program içerikleri, öğretmenlerin alan bilgisi yeterlikleri ve bilişsel gelişim seviyeleri ile uyumlu olmalıdır. Bireylerin bilişsel alandaki başarılarını ölçmek amacıyla geliştirilen birçok sınıflandırma sistemi bulunmaktadır (Filiz, 2004). Fakat eğitim hedeflerinin ve soru seviyelerinin sınıflandırılmasında en fazla faydalanılan yaklaşım Bloom tarafından geliştirilen bilişsel gelişim seviyeleridir. Öğretmen seçimi işleminde kullanılan ölçme aracında yöneltilen soruların bilişsel olarak hangi seviyelerde yer aldığı ve tüm bilişsel seviyeleri temsil edip etmediği önemli bir sorundur.

KPSS'nin yapılmaya başlandığı tarihten itibaren bu uygulamayı destekleyici ve eleştirici görüşler ortaya konulmuş, bu konuda çalışmalar yapılmıştır. İlgili alan yazın incelendiğinde KPSS'ye ilişkin çeşitli açılardan ele alınmış birçok araştırma görülmektedir. Sınavın içeriğine (Başkan ve Alev, 2009; Şahin, 2007), sınav kaygısına (Baştürk, 2007; Tümkaya, Aybek ve Çelik, 2007; Ekici ve Kurt, 2012; Karaçanta, 2009; Şahin ve Arcagök, 2010, Can ve Can, 2011), öğretmen adaylarının sınava yönelik tutumlarına (Karaca, 2011; Özsarı, 2008), görüşlerine (Çimen ve Yılmaz, 2011; Çoban, Gündoğdu ve Zirek, 2009; Döş ve Sağır, 2012; Gündoğdu, Çimen ve Turan, 2008; Kablan ve Turan, 2006; Karataş ve Güleş, 2013; Kılıçkaya, 2009; Atav ve Sönmez, 2013) dair çalışmalar bulunmaktadır. Bu çalışmaların yanı sıra üniversiteye giriş puanı, üniversite mezuniyet başarı puanı ile KPSS başarı puanı arasındaki ilişkiyi farklı değişkenlerle ele alan çalışmalar da vardır (Açıl, 2010; Atasoy, 2004; Bahar, 2006; Bahar, 2011; Ercoşkun ve Nalçacı, 2009; Ergün, 2005; Kablan, 2010; Özkan ve Pektaş, 2011; Yeşil, Korkmaz ve Kaya, 2007).

Yüksel (2004), 'Öğretmen Atamalarında Merkezi Sınav Uygulamasının (KPSS) Değerlendirilmesi' adlı çalışmasında belirlenen öğretmen kontenjanlarından çok fazla sayıda mezun olması nedeniyle eleme amacıyla yapılan KPSS' de yer alan soruların niteliklerini incelemiş ve KPSS'nin adaylar arasında bir yarışma sınavı hâline geldiği savunmuştur. Alan yazında 2013 yılında ilk kez uygulanmış olan ve biyoloji öğretmen adayları için KPSS'nin son basamağını oluşturan biyoloji öğretmenlik alan bilgisi testi ile ilgili bir çalışmaya rastlanmamıştır.

Candeğer (2013), yapmış olduğu çalışmada tarih öğretmeni özel alan yeterlikleri ile tarih öğretmeni yetiştiren üniversitelerin öğretim programlarında yer alan zorunlu dersleri karşılaştırmıştır. Yapılan inceleme sonucunda tarih öğretmeni yetiştiren kurumların programlarında verilen derslerin bazı yeterlikleri karşılayamadığı fakat yeterlikte olmayan bazı içeriklerin ise programda yer aldığı görülmüştür. Bunların bir kısmının seçmeli derslerle dolduruluyor olması ancak tüm öğrencilerin aynı dersleri seçmiyor olması araştırmanın dikkat çeken bir diğer bulgusunu oluşturmaktadır.

Özkan (2014), 2013 KPSS Türkçe Öğretmenliği Alan Bilgisi Testinin Türkçe öğretmenliği özel alan yeterlikleri açısından uygunluğunu incelediği çalışmasında ölçme aracında yer alan soruların özel alan yeterliklerini yeterli düzeyde yoklamadığını, elli sorudan oluşan alan bilgisi testinde sadece on yedi sorunun özel alan yeterlikleri ile uyumlu olduğunu ortaya koymuştur. Bundan sonraki yıllarda uygulanacak olan alan bilgisi testinin hazırlanırken özel alan yeterliklerinin de göz önüne alınması gerektiği önerilmiştir.

Köse (2015), biyoloji öğretmen adaylarının görüşlerine göre biyoloji öğretmenlik alan bilgisi testini incelediği araştırmasında biyoloji ÖABT sorularının alan bilgisini orta düzeyde ölçecek nitelikte olduğu, bu testi çözen bir öğretmeninin alanında yeterli bir öğretmen olamayacağı sonucuna ulaşmıştır. Ancak ilgili alan yazında biyoloji öğretmenliği özel alan yeterlikleri ve bu yeterliklerin KPSS biyoloji alan bilgisi testinde temsil edilme düzeyi ile ilgili çalışmaya rastlanılmamıştır.

Yenilenmiş Bloom Taksonomisi

Forehand (2005) revize edilen yeni taksonominin farklılıklarını üç grupta incelemiştir. Bunlar; 1) Terimsel Değişim: Bloom' un 6 önemli kategorisi isimden fiile çevrilmiş, en düşük seviye olan bilme kategorisi hatırlamak, kavrama kategorisi anlamak olarak yeniden adlandırılmış, sentez kategorisi değerlendirmek kategorisiyle yer değiştirmiş ve yaratmak adı altında en üst basamağa alınmıştır. 2) Yapısal Değişim: Bloom' un orijinal taksonomisi tek boyutluyken geliştirilen taksonomi ise bilgi ve bilişsel süreç olarak iki boyutludur. 3) Amaçsal Değişim: Bloom taksonomisine göre, genişletilmiş yeni taksonomi daha geniş gruplara hitap etmektedir (Krathwohl, 2002, Arı, 2011).

Yenilenmiş taksonomideki en dikkat çeken değişiklik taksonominin tek boyutlu bir yapıdan iki boyutlu bir yapıya dönüştürülmesidir. Orijinal taksonomide Bilgi basamağı hem isim hem fiil hallerini bir arada bulunduruyordu. İsim ile konu alanı öğesi bilginin içinde alt basamaklarda açıklığa kavuşturulmaktaydı. Fiil öğesi ise kişinin hatırlama ve tanımasını gerektiren öğedir ve taksonomideki diğer basamaklarda böyle bir durum olmadığından bu tek boyutluluk taksonomide bir ikilik yaratmaktaydı. Bu çelişki, yenilenmiş taksonomide giderilmiş, isim ve fiil öğelerinden iki farklı boyut oluşturulmuştur. Bunlardan birincisi içeriği gösteren bilgi (knowledge) ve ikincisi de içeriğin nasıl gerçekleşeceğini gösteren bilişsel süreç (cognitive processes) boyutudur. İsim, bilgi boyutuna temel oluştururken; fiil, bilişsel süreç boyutuna temel oluşturmuştur (Krathwohl, 2002; Anderson, 2005).

Revize edilmiş taksonomide, her hedefin iki boyutta gösterilebileceği gerçeği Taksonomi Tablosu olarak adlandırılan iki boyutlu bir tablo oluşturma imkânı vermiştir. Bilgi boyutu tablonun dikey eksenini oluştururken, Bilişsel süreç boyutunu tablonun yatay eksenini oluşturmaktadır. Bilgi ve bilişsel süreç kategorilerinin kesişme noktaları hücreleri oluşturmaktadır (Amer, 2006; Anderson, 2005; Krathwohl, 2009). Tablo 1'de doldurulmamış bir taksonomi tablosu görülmektedir:

Tablo 1. Taksonomi Tablosu (Anderson ve diğerleri, 2001).

Bilişsel Süreç Boyutu / Bilgi Boyutu	1. HATIRLAMA	2. ANLAMA	3. UYGULAMA	4. ÇÖZÜMLEME	5. DEĞERLENDİRME	6. YARATMA
A. OLGUSAL BİLGİ						
B. KAVRAMSAL BİLGİ						
C. İŞLEMSEL BİLGİ						
D.ÜSTBİLİŞ BİLGİSİ						

Yenilenmiş Bloom taksonomisinin bilgi ve bilişsel süreç boyutlarına göre biyoloji öğretmenliği özel alan yeterliklerini oluşturan performans göstergeleri örnek olarak Tablo 2'de sınıflandırılmıştır.

Tablo 2. Biyoloji Öğretmenliği Özel Alan Yeterliklerini Oluşturan Performans Göstergelerinin Yenilenmiş Bloom Taksonomisine Göre Sınıflandırılması

Örnek performans göstergeleri	*Bilgi Boyutu / Bilişsel Süreç Boyutu*
Canlı, hücre, doku, organ, sistem, enerji, homeostasi, kalıtım, evrim, biyolojik çeşitlilik, fotosentez, sınıflandırma, solunum, tür, ekosistem gibi temel kavramları tanımlar. (A1.2)	Olgusal Bilgi / Hatırla
Biyolojinin alt dallarına örnekler vererek bu alt dalların çalışma alanlarını açıklar. (A2.2)	Kavramsal Bilgi / Anla
Monohibrit-dihibrit çaprazlamaya yönelik problemleri çözer. (A3.2)	İşlemsel Bilgi / Uygula

Biyoloji laboratuvar yöntem ve teknikleri arasındaki benzerlikleri ve farklılıkları teşhis eder. (A2.5)	İşlemsel Bilgi / Analiz et
Çevresindeki biyolojik olayları kuram, ilke, genelleme ve modellere göre muhakeme eder. (A5.3)	Kavramsal Bilgi / Değerlendir
Biyoloji öğretim programının uygulanması sırasında karşılaşılan sorunlara çözüm önerileri sunar. (B1.4)	Üst-biliş Bilgisi / Yarat

YÖNTEM

Bu çalışmada nitel araştırmada kullanılan yöntemlerden biri olan içerik çözümlemesiyle belli bir metnin, belgenin özelliklerini sayısallaştırarak incelenmesini sağlayan doküman incelenmesine başvurulmuştur. Madge' ye (1965) göre doküman incelenmesi, araştırılması hedeflenen olgu veya olgular hakkında bilgi içeren yazılı materyallerin analizini kapsar (Yıldırım ve Şimşek, 2005).

Araştırma problemi ve alt problemlerine cevap vermek amacı ile öncelikle MEB' in belirlemiş olduğu biyoloji öğretmenliği alan bilgisi yeterliği performans göstergeleri doğrultusunda 2013 KPSS' de çıkmış biyoloji öğretmenliği alan bilgisi sorularının bu yeterlikleri temsil etme düzeyleri belirlenmiştir. Daha sonra 2013 KPSS biyoloji öğretmenliği alan bilgisi soruları 'Yenilenmiş Bloom Taksonomisinin bilgi ve bilişsel süreç boyutlarında aldıkları yere bir matrise yerleştirilmiştir (Kratwohl, 2002; Anderson, 2005). Bu matriste 2013 KPSS biyoloji öğretmenliği alan bilgisi soruları bilgi boyutunun bulunduğu satır ile bilişsel süreç boyutunun bulunduğu sütunun kesişimi olan hücrelerde gösterilmiştir. Bu tablodan yararlanarak elde edilen veriler grafiklere aktarılmıştır. Revize edilmiş taksonomi matrisi Tablo 3'te gösterilmiştir.

Tablo 3. Yenilenmiş Bloom Taksonomi Tablosu

	BİLİŞSEL SÜREÇ BOYUTU					
BİLGİ BOYUTU	1.Hatırla	2. Anla	3.Uygula	4.Analiz et	5.Değer-lendir	6.Yarat
A.Olgular Bilgisi						
B.Kavramlar Bilgisi						
C.İşlemler Bilgisi						
D.Biliş Ötesi Bilgi						

(Krathwohl, 2002, 216; Anderson, 2005, 105)

Verilerin Toplanması

Bu araştırmada verilerin toplanması aşamasında belgesel tarama tekniği kullanılmıştır. Var olan kayıt ve belgeleri inceleyerek veri toplamaya belgesel tarama denir. Belgeler, nitel araştırmalarda veri kaynağı olarak sıklıkla yararlanılan önemli bilgi kaynaklarındandır. Belgesel tarama, belli bir amaca dönük olarak, kaynakları bulma, okuma, not alma ve değerlendirme işlemlerini kapsar (Karasar, 2005).

KPSS 2013 biyoloji öğretmenliği alan bilgisi sorularına ÖSYM (2013)' nin resmi internet sitesinden, biyoloji öğretmenliği özel alan yeterliklerine MEB' in web sayfasından, biyoloji öğretmeni yetiştiren üniversitelerin öğretim programlarına ise üniversitelerin dekanlıkları ve eğitim ağlarının elektronik sayfalarından ulaşılmıştır.

Verilerin Analizi

Araştırma sorusu ve alt sorularına cevap oluşturabilmek için verilerin analizi noktasında betimsel analiz tekniğinden yararlanılmıştır. Betimleme ile araştırmada toplanan verilerin probleme ilişkin olarak hangi sonuçları ortaya koyduğu ön plana çıkmaktadır. Betimsel analiz tekniğinde elde edilen veriler daha önceden belirlenmiş konulara göre özetlenmektedir. Bu tür analizde amaç verileri düzenlenmiş ve yorumlanmış bir şekilde sunmaktır (Şimşek ve Yıldırım, 2006).

Araştırmanın veri analiz sürecinde:

a. 2013 KPSS' de çıkan biyoloji öğretmenliği alan bilgisi sorularının biyoloji alan bilgisi yeterliklerini temsil etme düzeyinin belirlenmesi için her bir soru ayrı olarak ele alınmış, yeterliklerde belirtilen ilgili olduğu performans göstergeleri ile eşleştirilmesi yapılmıştır.

b. Araştırma kapsamına alınan sorular Yenilenmiş Bloom Taksonomisi' ne göre tablonun dikey eksenini oluşturan bilgi boyutunda olgusal bilgi, kavramsal bilgi, işlemsel bilgi ve biliş ötesi bilgi kategorilerinde; yatay eksenini oluşturan bilişsel süreç boyutunda hatırla, anla, uygula, analiz et, değerlendir ve yarat kategorilerinde sınıflandırılmıştır. Her soru bu iki boyutta sınıflandırıldıktan sonra tablodaki kesişim hücrelerine yerleştirilmiştir.

BULGULAR

Biyoloji Öğretmenliği Alan Bilgisi Testinde yer alan biyoloji alan bilgisini ölçmeye yönelik 40 soru Yenilenmiş Bloom Taksonomisinin her bir basamağının özellikleri göz önüne alınarak oluşturulan temel esaslar doğrultusunda analiz edilmiş, soruların bilgi ve bilişsel süreç boyutlarına göre hangi seviyelerde olduğu tespit edilmiştir. Soruların analizi aşamasında yenilenmiş taksonominin basamakları arasında esnek geçiş dikkate alınmıştır.

Soruların YBT'nin Bilgi ve Bilişsel Süreç Boyutlarına Göre Sınıflandırılması

Bu aşamada her soru bilgi boyutunun niteliklerine göre tabloda dört temel bilgi kategorisinden uygun olana, bilişsel süreç boyutunun niteliklerine göre ise tabloda altı bilişsel süreç kategorisinden uygun olana yerleştirilmiştir. Bu noktada, bilgi boyutunun alt kategorileri ve bilişsel süreç boyutunun alt basamakları sorunun doğru hücreye yerleştirilebilmesi için iyi bir ipucu niteliği taşımaktadır (Anderson ve diğerleri, 2001).

Örneğin biyoloji alan bilgisi testinde yer alan birinci soruda omurgalı hayvanlar ve bu hayvan gruplarında yer alan yapıların eşleştirilmesi istenmiştir. Bu soru sınıflama ve kategorilere yönelik bilgi gerektirdiği için bilgi boyutunun 'kavramsal bilgi' kategorisinde ve bir özelliğin veya durumun hangi sınıf içinde yer aldığının bilinmesine yönelik bir süreci içerdiği için bilişsel süreç boyutunun 'anla' kategorisine yerleştirilmiştir. Bu nedenle bu soru iki boyutlu taksonomi tablosunda 'B. Kavramsal Bilgi' satırı ile '2. Anla' sütunun kesişimi olan B2 hücresine yerleştirilir. Aynı zamanda bir soru çoklu bir bilgi ve bilişsel süreç ihtiva ediyorsa, bu soru YBT' de en karmaşık ve soyut kategoriye yerleştirilir. Örneğin bir soru hem 'anla' hem de 'analiz et' kategorisine yerleştirilebiliyorsa, bu soru 'analiz et' kategorisine yerleştirilir. Bu yolla toplam 40 sorunun YBT basamaklarına göre dağılımı Tablo 4.1' de taksonomi tablosu üzerinde gösterilmiştir.

Tablo 4 Alan Biyoloji Alan Bilgisi Sorularının Sınıflandırılması

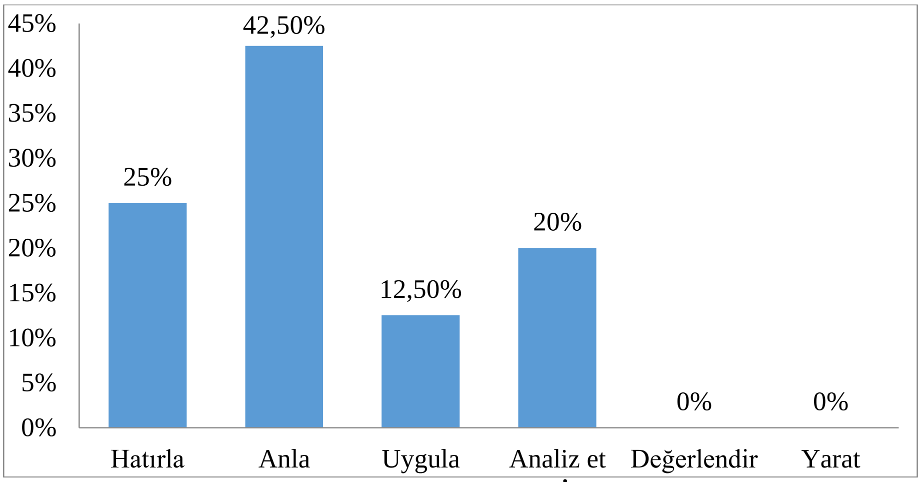
	BİLİŞSEL SÜREÇ BOYUTU					
BİLGİ BOYUTU	**1.Hatırla**	**2.Anla**	**3.Uygula**	**4.Analiz et**	**5.Değerlendir**	**6.Yarat**
A. Olgusal Bilgi	11.soru 28.soru 30.soru	14.soru				
B. Kavramsal Bilgi	6.soru 13.soru 23.soru 27.soru 31.soru 36.soru	1.soru 2.soru 3.soru 4.soru 7.soru 10.soru 12.soru 15.soru 22.soru 25.soru 26.soru 29.soru 32.soru 33.soru		8.soru 9.soru 16.soru 18.soru 21.soru 24.soru 37.soru 39.soru		

		35.soru 40.soru				
C. İşlemsel Bilgi	38.soru		5.soru 17.soru 19.soru 20.soru 34.soru			
D. Üstbilişsel Bilgi						

Olgusal Bilgiyi Hatırla basamağında 3, Olgusal Bilgiyi Anla basamağında 1, Kavramsal Bilgiyi Hatırla basamağında 6, Kavramsal Bilgiyi Anla basamağında 16, Kavramsal Bilgiyi Analiz Et basamağında 8, İşlemsel Bilgiyi Hatırla basamağında 1 ve İşlemsel Bilgiyi Uygula basamağında 5 sorunun yer aldığı görülmektedir.

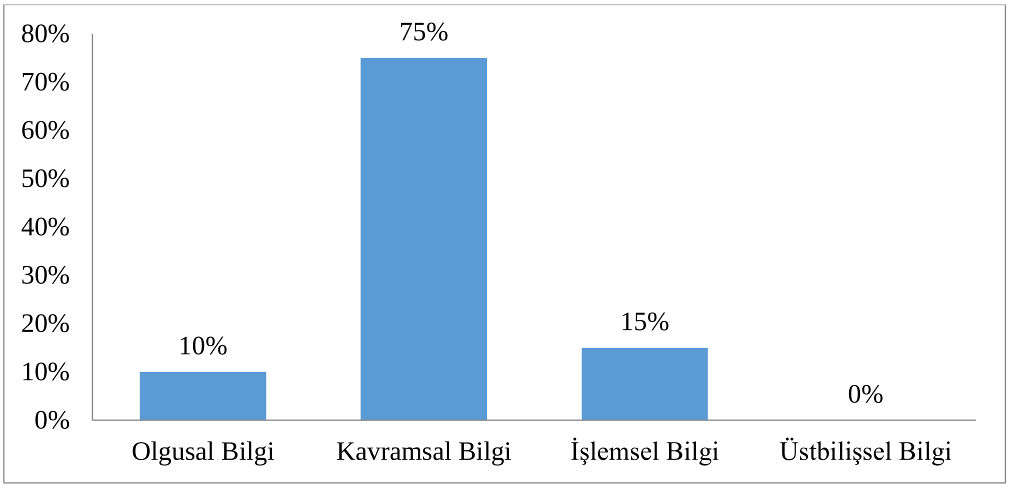
Oransal olarak bakıldığında ise, Olgusal Bilgiyi Hatırla basamağında %7,5, Olgusal Bilgiyi Anla basamağında %2,5, Kavramsal Bilgiyi Hatırla basamağında %15, Kavramsal Bilgiyi Anla basamağında %40, Kavramsal Bilgiyi Analiz Et basamağında %20, İşlemsel Bilgiyi Hatırla basamağında %15 ve İşlemsel Bilgiyi Uygula basamağında %12,5 oranında sorunun yer aldığı görülmektedir.

Bilişsel süreç boyutunda Hatırla basamağında 10, Anla basamağında 17, Uygula basamağında 5, Analiz Et basamağında 8 soru yer alırken Değerlendir ve Yarat bilişsel süreçlerine ait soru bulunmadığı görülmektedir. Oransal olarak bakıldığında ise, %25' inin Hatırla, %42,5' unun Anla, %12,5' unun Uygula, %20' sinin Analiz Et bilişsel sürecinde sınıflandırıldığı görülmektedir. Şekil 1'de biyoloji alan bilgisi testinde yer alan soruların bilişsel süreç boyutlarına göre yüzdelik dağılımları verilmiştir.



Şekil 1. Soruların Bilişsel Süreç Boyutuna İlişkin Yüzdelik Dağılımı

Bilgi boyutunda Olgusal Bilgi basamağında 4, Kavramsal Bilgi basamağında 30, İşlemsel Bilgi basamağında ise 6 soruya rastlanırken Üst bilişsel Bilgi basamağında her hangi bir soru yer almamaktadır. Oransal olarak bakıldığında ise, %10' unun Olgusal Bilgi, %75' inin Kavramsal Bilgi ve %15' inin İşlemsel Bilgi basamağında sınıflandırıldığı görülmektedir. Şekil 2'de biyoloji alan bilgisi testinde yer alan soruların bilgi boyutuna göre yüzdelik dağılımları verilmiştir.



Şekil 2. Soruların Bilgi Boyutuna İlişkin Yüzdelik Dağılımı

Biyoloji Öğretmenliği Alan Bilgisi Yeterliklerinin 2013 KPSS Biyoloji Alan Bilgisi Sınavındaki Temsil Edilme Durumu

MEB'in belirlemiş olduğu özel alan yeterliklerinden biyoloji alan bilgisi yeterlik alanında yer alan performans göstergeleri dikkate alınarak 2013 KPSS' de biyoloji alan bilgisini ölçen 40 soru analiz edilmiş, soruların performans göstergelerini temsil etme durumu incelenmiştir. Elde edilen bulgular tablolarla özetlenmiştir.
MEB'in belirlemiş olduğu biyoloji öğretmenliği özel alan yeterliklerinde yer alan biyoloji alan bilgisi yeterlik alanında 6 alt yeterlik ve 34 performans göstergesi yer almaktadır. Tablo 5'te biyoloji alan bilgisini ölçen 40 soru ve bu soruların temsil ettiği performans göstergeleri verilmiştir.

Tablo 5. Soruların Temsil Ettiği Performans Göstergeleri

Soru No	Soruların Temsil Ettiği Performans Göstergeleri
1	A1.1. ,A2.1.
2	A1.1. ,A2.1. ,A2.7. ,A4.5.
3	A1.1. ,A2.1. ,A4.5.
4	A1.1. ,A2.1. ,A4.5.
5	A1.1. ,A2.1. ,A2.7. ,A2.8. ,A3.1. ,A3.2. ,A4.1. ,A4.4. ,A4.5.
6	A1.1. ,A1.2.
7	A1.1. ,A2.1. ,A2.7. ,A4.5.
8	A1.1. ,A2.1. ,A2.7. ,A4.1. ,A4.4. ,A4.6.
9	A1.1. ,A2.1.
10	A1.1. ,A2.1. ,A4.6.
11	A1.1. ,A2.1. ,A2.7. ,A2.8.
12	A1.1. ,A2.1. ,A2.7. ,A2.8. ,A3.1. ,A4.1. ,A4.2. ,A4.6.
13	A1.1. ,A2.1. ,A2.7. ,A3.1. ,A4.1.
14	A1.1. ,A1.2. ,A1.4. ,A4.1.
15	A1.1. ,A2.1. ,A2.7. ,A3.1. ,A4.1. ,A4.2. ,A4.6.
16	A1.1. ,A2.1. ,A2.7. ,A3.1. ,A4.1. ,A4.2. ,A4.3. ,A4.4. ,A5.3. ,A5.4. ,A5.7.
17	A1.1. ,A2.1. ,A2.7. ,A3.1. ,A3.2. ,A4.1. ,A4.2. ,A4.6. ,A5.4. ,A5.7.
18	A1.1. ,A2.1. ,A2.7. ,A2.8. ,A3.1. ,A4.1. ,A4.2. ,A4.4. ,A4.6. ,A5.4. ,A5.7.
19	A1.1. ,A2.1. ,A2.7. ,A2.8. ,A3.1. ,A3.2. ,A4.1. ,A4.2. ,A4.4. ,A4.6.
20	A1.1. ,A2.7. ,A3.1. ,A3.2. ,A4.1. ,A4.2. ,A5.7.
21	A1.1. ,A2.1.
22	A1.1. ,A2.1. ,A3.1. ,A4.1. ,A4.4. ,A4.6. ,A5.4. ,A5.7.
23	A1.1. ,A2.1. ,A2.7. ,A2.8. ,A4.5.
24	A1.1. ,A2.1. ,A3.1. ,A4.1. ,A4.2.
25	A1.1. ,A1.2.
26	A1.1. ,A3.1. ,A4.1. ,A4.4.
27	A1.1. ,A2.1. ,A2.8. ,A3.1. ,A4.1. ,A4.4.
28	A1.1. ,A1.2. ,A2.1. ,A2.8.
29	A1.1. ,A2.1. ,A2.7. ,A2.8. ,A3.1. ,A4.1. ,A4.2. ,A4.4. ,A4.6. ,A5.4.

30	A1.1. ,A1.2. ,A2.1. ,A2.7. ,A3.1. ,A4.1. ,A4.2. ,A4.4. ,A4.6. ,A5.7.
31	A1.1. ,A1.2. ,A2.1. ,A2.8. ,A3.1. ,A4.1. ,A4.2. ,A4.4. ,A4.5.
32	A1.1. ,A2.1. ,A2.7. ,A2.8. ,A3.1. ,A4.1. ,A4.2. ,A4.4. ,A5.4. ,A5.7.
33	A1.1. ,A1.2. ,A2.1. ,A2.7. ,A2.8. ,A3.1. ,A4.1. ,A4.2. ,A4.4. ,A4.5. ,A5.7.
34	A1.1. ,A2.1. ,A2.7. ,A3.1. ,A4.1. ,A4.2. ,A5.7.
35	A1.1. ,A1.2. ,A1.4. ,A3.1. ,A4.1. ,A4.2. ,A4.4. ,A4.5. ,A5.7.
36	A1.1. ,A1.2. ,A2.8.
37	A1.1. ,A2.1. ,A2.7. ,A2.8. ,A3.1. ,A4.1. ,A4.2. ,A4.3. ,A4.4. ,A5.4. ,A5.7.
38	A1.1. ,A1.2. ,A1.4. ,A2.1. ,A2.7. ,A3.1. ,A4.1. ,A4.4.
39	A1.1. ,A1.2. ,A1.4. ,A2.1. ,A2.7. ,A2.8. ,A3.1. ,A4.1. ,A4.2. ,A4.4. ,A4.5. ,A4.6. ,A5.4. ,A5.7.
40	A1.1. ,A1.2. ,A1.4. ,A2.1. ,A2.7. ,A3.1. ,A4.1. ,A4.4. ,A4.5.

Tablo 5'te görüldüğü üzere her soru aynı anda birden fazla performans göstergesini ölçmektedir. Bununla birlikte bazı performans göstergeleri birkaç soru içerisinde temsil edilirken bazı performans göstergeleri ise hiçbir soruda temsil edilmemektedir. 6 alt yeterlik içerisinde yer alan 34 performans göstergesinden 17 tanesi biyoloji alan bilgisi testinde ölçülürken geri kalan 17 performans göstergesini ölçen herhangi bir soruya rastlanılmamıştır. A1.3. , A1.5. ,A2.2. , A2.3. , A2.4. , A2.5. ,A2.6. ,A3.3. , A4.7. , A5.1. ,A5.2. ,A5.5. ,A5.6. , A6.1. ,A6.2. ,A6.3. ,A6.4. kodlu performans göstergelerine yönelik soruların biyoloji alan bilgisi testinde yer almadığı belirlenmiştir. Yapılan analize göre 2013 KPSS biyoloji alan bilgisi testi MEB'in belirlemiş olduğu yeterliklerde yer alan performans göstergelerinden %50'sini temsil edebilmiştir.

Aynı zamanda altı alt yeterlik içerisinde ilk beş alt yeterlik alanına ait sorular biyoloji alan bilgisi testinde yoklanırken altıncı sırada yer alan Biyolojinin Diğer Bilim Dalları ile Olan İlişkisini Kurabilme alt yeterliğine ait hiçbir sorunun bulunmadığı da tespit edilmiştir. Bununla birlikte biyoloji laboratuvarı, yöntem ve teknikleri, deney ve etkinlik tasarlama gibi laboratuvar bilgisini ifade eden performans göstergelerini temsil eden hiçbir sorunun biyoloji alan bilgisi testinde yer almaması dikkati çeken bir diğer noktadır.

TARTIŞMA VE SONUÇ

2013 KPSS biyoloji alan bilgisi sınavında çıkan soruların Yenilenmiş Bloom Taksonomisindeki dağılımı homojen olarak yapılmamıştır. Soruların taksonomi tablosuna yerleştirilmesi sonucu her hücreye eşit oranda soru düşmemektedir. Bununla birlikte bazı hücrelerde soruların yığıldığı görülürken bazı hücrelerde ise hiçbir sorunun yer almadığı tespit edilmiştir. En çok soru Kavramsal Bilgiyi Anla hücresine yerleştirilmiştir. Soruların analizinden elde edilen taksonomi tablosuna bakıldığında en yüksek oranda temsil edilen bilişsel süreç boyutunun Anla olduğu belirlenmiştir. Bununla birlikte Değerlendir ve Yarat bilişsel süreç boyutlarına ait soru bulunmamaktadır. Ölçme aracında yer alan soruların öğretmen adaylarının yaratıcı, eleştirel ve çok yönlü düşünme becerilerini gösterebileceği nitelikte olmadığı, daha çok hatırlama becerilerini ölçmeye yönelik soruların hazırlandığı tespit edilmiştir. Bu durum soruların Yenilenmiş Bloom Taksonomisinin bilişsel süreç boyutunun dikkate alınmadan hazırlandığına işaret etmektedir. Hatırla, Anla, Uygula ve Analiz et bilişsel süreç boyutlarına ait soruların biyoloji alan bilgisi sınavında temsil edilme yüzdeleri birbirine yakın değerlerden oluşmamaktadır. Alan yazında taksonominin ilk üç basamağının düşük bilişsel seviye, son üçünün ise üst düzey bilişsel seviyeye karşılık geldiği dikkate alındığında biyoloji alan bilgisi testinde yer alan biyoloji alan bilgisi sorularının alt düzey basamaklarda yığıldığı ve üst düzey düşünme becerilerini yoklayacak nitelikte olmadığı ifade edilebilir. Buna karşın Anderson vd. (2001), Analiz et, Değerlendir ve Yarat basamaklarının daha genellenebilir olduğunu, daha karmaşık bilişsel süreçlerin çok çeşitli alanlara uygulanabilir olması dolayısıyla bu basamakların daha alt basamaklarda kazanılması istenen hedeflere ulaşmada kullanılabileceğini vurgulamışlardır. Aynı zamanda Colletta ve Chiappetta (1989), ölçme ve değerlendirme faaliyetleri sonunda kişilerin gerçek başarı seviyelerinin belirlenebilmesi için sınavlarda hem düşük hem de yüksek bilişsel seviyelere karşılık gelen soru tiplerine yer verilmesi gerektiğini ifade etmektedir.

Bilgi boyutunda en yüksek oranda temsil edilen bilginin türünün Kavramsal Bilgi olduğu tespit edilmiştir. Bununla birlikte bilgi boyutunda kişinin kendisinin düşünmesine yönelik bilgi olan Üst bilişsel Bilgi'ye ait soruya yer verilmemiştir. Olgusal Bilgi, Kavramsal Bilgi ve İşlemsel Bilgi türüne ait soruların biyoloji alan bilgisi sınavında temsil edilme yüzdeleri birbirine yakın değerlerden oluşmamaktadır. Bu bulgular doğrultusunda bilgi türlerini temsil eden soruların homojen olarak dağılmadığı, ölçme aracındaki soruların bu yönüyle yetersiz kaldığı görülmektedir.

Yiğit, Alev ve Devecioğlu (2005), KPSS' de sorulan ölçme-değerlendirme konularına yönelik soruların Bloom Taksonomisinin hangi seviyelerinde olduğunu belirlemek için yaptıkları çalışmada alt düzey öğrenme seviyelerine dair sorulara rastlarken, üst düzey öğrenme seviyelerine yönelik soruların olmadığını tespit etmişlerdir. Başol ve Türkoğlu (2006), yaptıkları çalışmada 2001 yılından itibaren KPSS eğitim bilimleri sorularını incelemiş ve bu soruları Bloom Taksonomisinin bilişsel seviyelerine göre analiz etmiştir. Çalışma sonuçları, soruların yoğun olarak alt düzey bilişsel seviyelerde toplandığı ve ağırlıklı olarak 'Kavrama' düzeyindeki sorulara yer verildiği yönündedir.

Biyoloji öğretmenliği özel alan yeterliklerinden biyoloji alan bilgisi yeterliğine ait performans göstergelerinin yarısı 2013 KPSS biyoloji alan bilgisi testinde temsil edilirken yarısı ise alan bilgisi sınavında temsil edilmemektedir. Bu durum gerçekleştirilen sınavın sadece bazı biyoloji bilgilerinin ölçülmesine uygun olarak yapıldığını göstermekte, öğretmenliğe hazır olup olmamayı yeterli düzeyde ölçemediğine işaret etmektedir. Biyoloji alan bilgisi alt yeterliklerinden ilk beş alt yeterlik alanına ait sorular biyoloji alan bilgisi testinde yer alırken altıncı sırada yer alan Biyolojinin Diğer Bilim Dalları İle Olan İlişkisini Kurabilme alt yeterliğine dair hiçbir sorunun sınavda yer almadığı tespit edilmiştir. Bazı performans göstergeleri birkaç soru içerisinde temsil edilirken bazı performans göstergeleri ise hiçbir soruda temsil edilmemektedir. Diğer bir ifade ile soru sayıları performans göstergelerine eşit bir şekilde dağıtılmamıştır. Bu durum bu performans göstergelerinden soru üretmenin daha kolay olduğu şeklinde yorumlanabilir. Biyoloji laboratuvarı, yöntem ve teknikleri, deney ve etkinlik tasarlama gibi laboratuvar bilgisini ifade eden performans göstergelerini temsil eden hiçbir soru biyoloji alan bilgisi testinde yer almamaktadır.

ÖNERİLER

Biyoloji alan bilgisi sorularının hazırlanması aşamasında Yenilenmiş Bloom Taksonomisi göz önüne alınarak taksonominin bilgi ve bilişsel süreç boyutlarının tüm basamaklarını temsil eden sorulara yer verilmelidir. Hazırlanan sorular sadece alt düzey bilişsel davranışları değil aynı zamanda üst düzey bilişsel davranışları da ölçecek nitelikte olmalıdır. Öğretmen adaylarını daha üst düzey düşünmeye teşvik etmek, özgün ve orijinal örnekler ortaya koymasını sağlamak amacıyla Yarat seviyesinde yer alan sorulara biyoloji alan bilgisi sınavında yer verilmelidir. Aynı zamanda kişinin kendi düşüncesinin farkına varmasını ifade eden Üst biliş Bilgisi'ne ait sorular da ölçme aracında yer almalıdır. Biyoloji alan bilgisi soruları biyoloji öğretmenliği özel alan yeterliklerinde yer alan tüm performans göstergelerini yoklar nitelikte hazırlanmalıdır. Aynı zamanda performans göstergeleri test içerisinde homojen bir dağılım ile temsil edilmelidir. Biyoloji alan bilgisi sınavında laboratuvar bilgisi, yöntem ve tekniklerine yönelik sorulara da mutlaka yer verilmelidir. Daha kapsamlı ve nitelikli bir ölçme işlemi için biyoloji alan bilgisi sınavında yer alan soru sayısı artırılabilir.

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MIDDLE SCHOOL STUDENTS' SELF-EFFICACY SOURCES IN MATHEMATICS: A QUALITATIVE STUDY

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ABSTRACT: According to Bandura's social cognitive theory, self-efficacy beliefs are being fed from four sources. These are mastery experience, vicarious experience, social persuasions and physiological states. Purpose of this research is determining the sources of middle school students' self- efficacy beliefs in mathematics, within the frame of Bandura's social cognitive theory. For this aim, semistructured interviews are going to be held with nine, 8th grade students. The students are going to be chosen from the groups classified according to situation that having low, normal and high self- efficacy beliefs in mathematics. For data analysis Nvivo 11 program is going to be used. The data is collection and analysis stage.

Keywords: self-efficacy beliefs in mathematics, interview, qualitative data analysis, middle school, sources of self-efficacy

ORTA OKUL ÖĞRENCİLERİNİN MATEMATİK ÖZ YETERLİK İNANCI KAYNAKLARI: NİTEL BİR ARAŞTIRMA

ÖZET: Bandura'nın sosyal bilişsel teorisine göre öz yeterlik inancı 4 temel kaynaktan beslenmektedir. Bunlar; doğrudan yaşantılar, dolaylı yaşantılar, sosyal iknalar ve fizyolojik durumlardır. Bu araştırmanın amacı, ortaokul öğrencilerinin matematiğe ilişkin öz yeterlik algılarını oluşturan kaynakları, Bandura'nın sosyal bilişsel teorisi çerçevesinde belirlemektir. Bu amaçla 9 ortaokul 8. sınıf öğrencisi ile yarı yapılandırılmış görüşme yapılacaktır. Öğrenciler; matematiğe ilişkin yüksek, normal ve düşük düzeyde öz yeterlik inancına sahip olma durumuna göre sınıflandırılan gruplardan seçilecektir. Görüşmelerden elde edilen veriler nitel analizle çözümlenecektir. Verilerin analizinde Nvivo 11 programı kullanılacaktır. Veriler toplanma ve analiz aşamasındadır.

GİRİŞ

Bireyin davranışlarını bireye ait inançlar (algılar veya yargılar) belirlemektedir. Öz yeterlik de bireyin bir görevi başarmasına yönelik inancı olup, Bandura'nın sosyal bilişsel öğrenme kuramında yer alan temel ve anahtar kavramlardan birisidir. Bandura'ya (1997; s.3) göre öz yeterlik; "kişinin belirlenen hedefleri gerçekleştirmek için gereken etkinlikleri planlama ve başarılı olarak yapma becerisine veya kapasitesine olan inancıdır. Bir diğer ifadeyle bir görevi yerine getirmede kişinin kendi yeterliklerine, potansiyeline ve göstereceği performansa ilişkin algısıdır.

Öz yeterlik algısı ile birlikte 'matematik öz yeterliği' kavramı da dikkat çekmektedir. Hackett ve Betz (1989) matematik öz yeterliğini, bireyin matematiksel bir durumu, görevi ya da problemi başarıyla gerçekleştirmede ya da başarmada yeteneklerine olan güvenini değerlendirmesi olarak tanımlarken; Özgen ve Bindak (2011) bireyin matematiksel yeteneklerine olan kişisel yargısı olarak tanımlamıştır.

Bir bireyin öz yeterlik düzeyi şartlar, ortam, görevin çeşidi ve zorluk derecesi vb. faktörlere göre farklılaşabilmektedir (Bandura 1997). Bandura'ya (1997) göre öz yeterlik inancı dört temel kaynaktan beslenmektedir. Bunlar; başarıya ilişkin doğrudan yaşantılar (kişisel deneyimler), gözleme dayalı dolaylı yaşantılar, sosyal ikna ve duygusal ve fizyolojik durumlardır.

Araştırma sonuçlarına göre bireylerin öz yeterlik algısını en fazla etkileyen ve yordayan bireyin başarılı veya başarısız deneyimlerini içeren doğrudan yaşantılarıdır (Arslan, 2012; Butz & Usher, 2015; Usher & Pajares, 2006). Bandura'ya (1997) göre öz yeterliğin en önemli ve en güçlü kaynağıdır. Doğrudan yaşantılar, bireyin öz yeterliğinde kalıcı ve uzun ömürlü etkiyi oluşturmaktadır (Usher & Pajares, 2006). Öğrencilerin geçmiş (önceki) başarılarından veya başarısızlıklarından oluşturdukları yorumlar, öz yeterliklerine ilişkin önemli bir bilgi kaynağı olmaktadır (Bandura, 1997). Bireyler alt becerileri tam öğrendiklerini hissettiklerinde, zorlu görevleri başarıyla tamamladıklarında ve performanslarını başarılı olarak değerlendirdiklerinde kişisel yeterliklerine ilişkin sağlam bir inanç geliştirmektedir (Bandura, 1997).

Öz yeterlik algısını etkileyen bir diğer kaynak gözleme dayalı dolaylı yaşantılardır. Bireyler çevrelerinde yer alan arkadaşları, öğretmenleri, ebeveynleri, kardeşleri vb. bireyleri gözlemlemekte ve bu gözlem sonuçları öz yeterlik inançlarını etkileyebilmektedir. Örneğin bir görevde başarılı olan arkadaşını gözlemleyen bir bireyin aynı görevde kendisinin de başarılı olacağına ilişkin inancı kuvvetlenir. Bu durumun tersi de geçerli olabilmektedir. Başarısızlık yaşayan bir bireyi gözlemleyen kişinin aynı görevi başarılı olarak gerçekleştirmeye ilişkin inancı azalabilir. Model alma ve sosyal karşılaştırmalar, bireylerin öz yeterlik inançlarının gelişiminde güçlü rol oynamaktadır.

Sosyal iknalar, öz yeterlik algısını etkileyen bir diğer kaynaktır. Bireyin çevresinin (aile, öğretmen, kardeşler, arkadaşlar vb. kişiler) vermiş olduğu dönütler, takdir etme, beğenme, onaylama vb. davranışlar sosyal ikna kapsamında olup bireylerin öz yeterlik inançlarını etkilemektedir. Bireyin yaşına ve bulunduğu ortama göre sosyal iknada bulunan kişinin etkileme düzeyi değişmektedir. Öz yeterlik algısını etkileyen kaynaklardan birisi de duygusal ve fizyolojik durumlardır. Bandura (1997)'ya göre, bir çok faktör duygusal ve fizyolojik durumu etkileyebilmektedir. Örneğin; içinde bulunulan ruh hali, beden sağlığı ve sıkıntı düzeyi. kötü ruh hali, kaygı, stres gibi duygusal durumlar bireylerin öz yeterlik inançlarını olumsuz etkilemektedir.

Bu araştırmada kritik bir dönem olan orta okul 8. sınıftaki öğrencilerin matematik öz yeterliğini oluşturan ve besleyen kaynakları ve durumları Bandura'nın sosyal bilişsel öğrenme kuramı doğrultusunda belirlemek amaçlanmıştır. Araştırmadan elde edilen bulgular doğrultusunda; eğtim ve öğretim etkinlikleri ve öğretmenlerin uygulamaları öğrencilerin matematik öz yeterliğini besleyen kaynakları güçlendirecek şekilde düzenlenebilir.

YÖNTEM

Araştırma, nitel araştırma deseni olan olgu bilim deseninde yapılmıştır. Araştırmanın çalışma grubunu 6 kız (%67), 3 erkek (%33) olmak üzere toplam 9, sekizinci sınıf öğrencisi oluşturmaktadır. Görüşme yapılacak öğrenciler matematiğe ilişkin yüksek, normal ve düşük düzeyde öz yeterlik inancına sahip olma durumuna göre sınıflandırılan üst, orta ve alt guruptan seçilmiştir. Araştırmada veri toplama yöntemi olarak görüşme kullanılmıştır. Öğrencilerin görüşleri görüşme formu ile elde edilmiştir. Görüşme formunun kapsam geçerliğini sağlamak için yedi uzmandan görüş alınarak forma nihai şekli verilmiş ve form uygulamaya hazır hale getirilmiştir. Ayrıca araştırma kapsamı dışında bırakılan bir öğrenci ile ön görüşme yapılmıştır. Görüşme esnasında elde edilen veriler gönüllülük esasına dayanarak, ses kayıt cihazıyla kaydedilmiştir. Daha sonra elde edilen veriler yazılı metin haline çevrilmiştir. Veriler betimsel analiz ile çözümlenmiştir

BULGULAR VE TARTIŞMA

Bu bölümde görüşme formunda yer alan sorular doğrultusunda başlıklar oluşturularak öğrencilerin görüşlerine yer verilmiştir. Ayrıca öğrencilerden her bir öz yeterlik kaynağına ilişkin derinlemesine bilgi edinebilmek amacıyla görüşme formunda yer alan sorular sırasıyla öğrencilere sorulmuştur. Öğrencilerin cevapları alıntı olarak verilmiş ve alan yazınla ilişkilendirilerek yorumlanmıştır.

Matematik öz yeterliği yüksek olan öğrencilerin en sevdiği ve en başarılı olduğu derslerin matematik olduğu buna karşılık matematik öz yeterliği düşük olan öğrencilerin en sevmediği ve en zayıf olduğu derslerin matematik olduğu görülmektedir. Matematikte başarılı olan öğrencilerin matematik öz yeterlik algılarının yüksek olduğu, başarı durumu düşük olan öğrencilerin ise öz yeterlik algılarının görece daha düşük olduğu görülmüştür. Bu durumun tersi de geçerlidir. Yani matematik öz yeterliği yüksek olan öğrencilerin matematik başarılarının, matematik öz yeterliği düşük olanlardan daha yüksek olduğu görülmüştür. Benzer bulguya Usher (2009)'da ulaşmıştır. Bu sonuç matematik öz yeterliği ile matematik başarısı arasında karşılıklı ilişki olduğunu göstermektedir.

Elde edilen bulgular doğrultusunda öğrencilere göre doğrudan yaşantıların en önemli öz yeterlik kaynağı olduğu, duygusal ve fizyolojik durumlar ile sosyal iknaların benzer bir şekilde ikinci en önemli öz yeterlik kaynağı olduğu, dolaylı yaşantıların ise öz yeterlik kaynakları arasında en az önemli olan olduğu görülmüştür. Bandura'ya (1997) göre öz yeterliğin en önemli ve en güçlü kaynağı bireylerin deneyimlediği doğrudan yaşantılardır. Araştırma sonuçlarına göre de bireylerin öz yeterlik algısını en fazla etkileyen ve yordayan bireyin başarılı veya başarısız deneyimlerini içeren doğrudan yaşantılarıdır (Arslan, 2012; Butz ve Usher, 2015; Usher ve Pajares, 2006). Bireyin başarılı yaşantıları, öz yeterlik inancını olumlu yönde etkileyerek sonraki benzer deneyimlerdeki başarı beklentisini artırmaktadır. Nitekim yapılan görüşmelerde öğrencilerin büyük çoğunluğu yaşadığı başarılı deneyimin öz yeterlik inancını artırdığını belirtmiştir.

Öğrencilerden elde edilen görüşlerden öz yeterliği yüksek olan öğrencilerin matematikte başarısızlıkla karşılaştıklarında öz yeterlik inançlarının bu olumsuz durumdan etkilenmediği tersine bu durumun onları çalışmak yönünde motive ettiği ve çabalarını artırdığı görülmüştür. Bu durum Bandura (1997)'nın teziyle örtüşmektedir. Bandura, (1997)'ya göre yüksek öz yeterliğe sahip bireyler bir konu üzerinde çalışırken daha fazla çaba sarf etme ve zorluklarla karşılaştıklarında daha çok sebat etme eğilimi taşımaktadır. Öz yeterlik inancının; hedef belirlemeyle, içsel motivasyonla, görev tercihiyle, görev değerleriyle ve sebat ile pozitif yönde ilişkili olduğu görülmüştür (Bong & Skaalvik, 2003).

Matematik öz yeterliği düşük olan öğrencilerin ise başarısızlık karşısında öz yeterlik inançlarının azaldığı görülmüştür. Başarısız deneyimler bireyin öz yeterlik algısını düşürerek başarı beklentisini azaltabilmektedir. Bu durumun özellikle öz yeterliği düşük olan öğrenciler için daha fazla geçerli olduğu düşünülmektedir. Çünkü bu araştırmada da görüldüğü üzere başarısız durumlar veya yaşanan aksaklıklar öz yeterlik inancı yüksek ve sabitleşmiş olan bireyleri olumsuz anlamda etkilememektedir. Alan yazında da bu araştırmadan elde edilen bulguyu destekleyen ifadeler yer almaktadır. Schunk (1989)'a göre öz yeterlik inancı yeterince güçlendikten sonra arada yaşanan başarısızlıklar kişinin öz-yeterliğinde önemli bir etkiye yol açmamaktadır. Yüksek öz yeterliğe sahip bireyler, karşılaşılan bir zorluğu tehdit değil bir mücadele süreci olarak görmektedir (zajacova, lynch & espenshade, 2005).

Bandura (1997)'ya göre bireylerin kişisel deneyimleri öz yeterlik inançlarını olumlu veya olumsuz olarak etkilemektedir. Bu gerçekten hareketle matematikte olumlu yaşantılar geçiren öğrencilerin öz yeterlik inançlarının daha yüksek olduğu düşünülebilir. Nitekim yapılan görüşmelerden elde edilen sonuçlar bu durumu desteklemektedir. Örneğin matematikte hep başarılı olduğunu söyleyen öğrencinin öz yeterlik inancı da yüksektir. Başarılı deneyimler veya olumlu yaşantılar öz yeterlik inancını artırmaktadır. Böylece bireyin artan öz yeterlik inancıyla karşılaştığı benzer yeni durumlarda başarılı olma beklentisi artmaktadır. Bu şekilde başarılı deneyimler ile öz yeterlik inancı arasında karşılıklı ilişkinin olduğu doğurgan bir döngü veya süreç oluşmaktadır.

Öz yeterliği düşük olan öğrencinin (Sema) kendisinden şüphe ettiği görülmektedir. Yaşadığı başarısızlıklardan dolayı bildiği bir konuda bile kendine güvenemediği ve derse katılmaktan kaçındığı görülmektedir. Williams ve Williams (2010), öğrencilerin matematik öz yeterliği ile matematik dersine katılımları arasında karşılıklı (çift taraflı) ilişki bulmuştur.

Görüşme sonuçlarından görüldüğü gibi öz yeterliği yüksek, orta ve düşük düzeyde olan tüm öğrenciler öğrenme ortamından özellikle arkadaşlarından olumlu veya olumsuz anlamda etkilenmektedir. Başarılı öğrencilerle aynı ortamda bulunan öz yeterliği yüksek öğrenciler onları örnek almakta, onlara benzemeye çalışmakta ve bu yönde çaba göstermektedir. Ayrıca öğrencilerin görüşlerinden sessiz bir öğrenme ortamı istedikleri anlaşılmıştır. Schunk (1990)'a göre belirtilen 4 öz yeterlik kaynağının dışında sosyal ortam özellikleri, öğretim yöntemleri ve bireysel tutumlar ve yüklemeler de bireylerin öz yeterlik inançlarını etkileyebilmektedir. Öğrencilere göre ideal sınıf ortamı, dersi öğrenmelerini sağlayacak sessizlikte olmalı, kendilerini rahat hissetmelerini sağlamalıdır. Ayrıca öğrencilere göre; aynı sınıftaki öğrencilerin seviyeleri benzer olmalı, dersler eğlenceli olmalı, öğretmen anlayışlı ve sıcak olmalı, matematiği ezbere değil mantığa uygun anlatmalıdır.

Görüşme sonuçlarından görüldüğü gibi öğrencilerin çevrelerinde yer alan matematikte başarılı olan bireyleri gözlemledikleri, onları örnek aldıkları, onlar gibi olmaya çalıştıkları ve çalışmaya yöneldikleri görülmüştür. Öz yeterliği yüksek olan öğrenciler başarılı kişileri gözlemlediklerinde motive olduklarını ve öz yeterlik inançlarının arttığını söylerken öz yeterliği düşük olan öğrenciler başarılı kişileri gözlemlemenin öz yeterlik inançlarını etkilemediğini belirtmiştir.

Öğrenciler genel olarak çevrelerinde yer alan bireylerin vermiş oldukları olumlu dönütlerin, onaylamanın, başarabilirsin yapabilirsin şeklindeki söylemlerin kendilerini mutlu ettiğini, öz güvenlerini, motivasyonlarını ve öz yeterliklerini artırdığını, çalışmaya sevk ettiğini belirtmiştir. Tam tersi durumlar, etraftan gelen olumsuz söylemler ve dönütler ise öğrenciler için moral bozucu olmaktadır. Öğrencilerin çoğunluğu bu durumda öz yeterlik inancının azaldığını söylemiştir.

Öğrencilerin ifadelerinden matematikle uğraşırken rahat olmanın, olumlu duygular ve düşünceler içerisinde olmanın öğrenciler üzerinde olumlu etkilerinin olduğu, onları her anlamda olumlu etkilediği, öğrencilerin öz yeterlik inancını beslediği ve artırdığı görülmüştür. Tam tersi durumda ise örneğin kaygılı ve endişeli olma, stres yaşama, gerginlik duyma, olumsuz duygu ve düşünceler de öğrencileri her yönden (özellikle başarı ve performanslarını) olumsuz anlamda etkilemekte; öz yeterlik inancını azaltmaktadır. Genel olarak beden sağlığının iyileştirilmesi, öznel iyi oluşların artırılması ve stres, kaygı ile olumsuz duygu ve düşüncelerin azaltılması bireylerin öz yeterlik inançlarını yükseltebilir.

SONUÇ VE ÖNERİLER

Öğrencilere göre doğrudan yaşantıların en önemli öz yeterlik kaynağı olduğu, fizyolojik, psikolojik durumlar ile sosyal iknaların benzer bir şekilde ikinci en önemli öz yeterlik kaynağı olduğu, dolaylı yaşantıların ise öğrencilerce öz yeterlik kaynakları arasında en az önemli olan olduğu görülmüştür. Öğrenciler Bandura'nın kuramında yer alan belirtilen kaynaklar dışında öz yeterlikle ilişkili olarak öğrenme ortamı ile ilgili faktörleri, matematiğe ilişkin tutumlarını ve kendi çalışma alışkanlıklarını sıralamıştır. Elde edilen bulgular Bandura'nın sosyal bilişsel öğrenme kuramını ve belirtilen öz yeterlik kaynaklarını doğrulamaktadır ve genişletmektedir.

Bu araştırma kapsamında bazı öneriler sunulabilir. Aynı konuya yönelik nicel, deneysel ve meta analiz çalışmaları yapılabilir. Bu araştırma özel okul öğrencileriyle gerçekleştirilmiştir. Benzer bir araştırma devlet okuluna giden öğrenciler ile gerçekleştirilebilir.

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PRIMARY SCHOOL TEACHER EDUCATION STUDENTS' VIEWPOINTS ON VEGETATIVE STATE

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ABSTRACT: Vegetative state known as a medical event is usually confused with brain death and coma. It is widely seen among the public. Therefore, this study mainly based on the Primary School Teacher Education Students' (PSTES) Viewpoint on vegetative state. The study was applied to the 18 PSTES attending at Ağrı İbrahim Çeçen University. They are at the fourth grade of their bachelores degree. The participants wrote their opinion on a sheet. The analysis to reach valuable categories was made according to this written data using content analsis technique cited in literatüre as one of qualitative methods. With the evaluation of the data obtained from 18 PSTES, it is understood that only 4 participants explained that the brain could not perform the mental ability as the cortex could not perform the basic anatomic rule during the vegetative state. 9 of PSTES identified that it is related to movement of the human body. 10 students have the idea that it has a relation with the functions of brain. 13 of 18 PSTES explain the vegetative state using with inactive feature of plants in general. Vegetative staate is explained in Turkish dictionary as an unconscious and static state of the body as well as medical literature. PSTES use neural system instead of mevment known as a comman feature of living things as plants has not got a nervous system.

Key words: vegetative state, misconception, brain death, coma

SINIF ÖĞRETMENLİĞİ PROGRAMI ÖĞRENCİLERİNİN BİTKİSEL HAYAT İLE İLGİLİ GÖRÜŞLERİ

ÖZET: Bitkisel hayat, koma hali ve beyin ölümü durumları ile sıklıkla karıştırılan tıbbi bir olaydır. Bu karmaşa toplumun hemen her katmanında görülmektedir. Bu çalışmada Sınıf Öğretmenliği Programında öğrenim gören öğrencilerin bitkisel hayata yönelik görüşleri üzerinde durulmaktadır. Çalışma, 2015 yılında Ağrı İbrahim Çeçen Üniversitesi Eğitim Fakültesi Sınıf Öğretmenliği 4. öğrencilerine uygulanmıştır. Çalışmanın örnekleminde 18 öğrenci yer almıştır. Çalışmada, paragraf yazımı yolu ile katılımcıların düşüncelerinin analiz edildiği bir model uygulanmıştır. Nitel araştırma kurgusuna sahip bu çalışmada katılımcıların yazılı ifadelerine dayalı olarak, içerik analizi yolu ile kategoriler oluşturulmuştur. 18 katılımcıdan sadece 4'ü bitkisel hayatı, beynin kabuk bölgesi korteksin görevini yerine getirememesi nedeni ile düşünme fonksiyonunun yerine getirememesi olarak belirtebilmiştir. Temel yaşam fonksiyonlarının yerine getirildiğini 8 kişi ifade etmiştir. Bitkisel hayatı, hareket ile açıklamaya çalışan katılımcı sayısı 9'dur. Beynin fonksiyonları ile açıklamaya çalışan katılımcı sayısı ise 10'dur. Yani katılımcılar bu durumu öncelikli olarak beyin ile açıklamaya çalışırken, hareket edebilme yönünden de bitkisel hayatı zihninde yapılandıranlar da önemli bir oranı teşkil etmektedir. 18 katılımcının 13'ü bitkisel hayat ifadesinin bitkilerin genel olarak hareketsiz olma hali ile ilgili olarak açıklamıştır. TDK Genel Türkçe Sözlük, bitkisel hayatı bilinçsiz ve hareketsiz olma hali olarak ifade ederken, tıp literatürü de bu anlamı desteklemektedir. Sınıf Öğretmenliği Programı öğrencileri canlıların ortak özelliklerinden biri olarak bilinen hareket edebilme yerine sinir sistemini kullanmalıdır. Çünkü bitkiler sinir sistemine sahip değildir.
Anahtar sözcükler: bitkisel hayat, yanlış kavramlar, beyin ölümü, koma hali

GİRİŞ

Bitkisel hayat, toplumda sıklıkla kullanılan, beyin ölümü ve koma hali ile sıklıkla karıştırılan bir konudur. Dış dünya ile bağlantının kesildiği, herhangi bir ağrının veya acının hissedilmediği bitkisel hayat, bilincin minimum düzeyde seyrettiği süreklilik gösteren bir durumdur (Machado, Estêvêz, Rodriguez, Pêrez-Nellar, Gutiêrez, Carballo, Olivares, Felitas, Pando & Bletrán, 2012;). Kişinin farkındalığa sahip olamaması, etrafı ile amaçlı iletişim kuramaması olarakta ifade edilir (Giulio vd, 2008).

Bitkisel hayattaki hastaların solunum fonksiyonları devam etmektedir ve ağrılı uyarana yanıt verebilirler (Çil ve Görkey, 2013:3). Çünkü beynin kabuk ve istemli hareket eden kasları yöneten bölümleri haricinde kalan kısımlar fonksiyonlarını yerine getirmektedir. Türk Dil Kurumu'na göre ise bitkisel hayat, hastalık veya kaza sebebiyle bilinçsiz ve hareketsiz duruma gelme olarak ifade edilmektedir (TDK, 2016).

Yoğun bakımlarda özellikle yaşam destek sistemlerinin kullanılması sonucu ölümün meydana gelişi daha da geciktirilmiş, yeni klinik tablolar tanımlanmıştır. Bu tablolar bitkisel hayat, beyin ölümü, dissosiye kalp ölümüdür (Akpir, 2010). Bitkisel hayattaki hastalar koma halinin tipik özelliklerini gösterirler ve uyanık oldukları şeklinde görünürler. Fakat kendilerinin ya da çevrelerinin farkında değillerdir (Jennett & Plum, 1972).

Bahar ve Aktin'e (2001) göre bilinçli olma hali (consciousness) kişinin uyanık, kendisi ve çevresinden haberdar olduğu durum anlamına gelir. Koma durumu ise bunun tam tersidir. Hasta dış etkilerle uyandırılamaz. Hafif ve orta dereceli komada hasta ağrılı uyaranı lokalize edip eliyle uzaklaştırmak ister. Veya, yüz buruşturma gibi genel bir yanıt verir. Derin komada ise bütün uyarılara refleks düzeyde bile bir cevap alınamaz. Sadece vejetatif fonksiyonlar korunmuştur (Ünsel, 2008:2).

Koma, bilinç durumundaki ciddi bir değişikliktir. Hafif düzeyde koma halinde uyanıklık yoktur. Ağrılı uyaranlara amaçlı tepkiler verebilir. Koma halinde ise tepkiler amaçsızdır. Derin koma halinde tepki vermez (Sepit, 2005). Gözün otomatik hareketi ve bazı reflekslerde olduğu gibi, süreklilik gösteren bitkisel hayat durumu ile koma halinin bazı çeşitlerinde daha az karmaşık hareketler meydana gelir (Morsella, 2005). Bitkisel hayat durumundan koma haline ve en son aşama olarak kabul edilen beyin ölümüne ilişkin benzer ve farklı durumlar Tablo-1'de görülmektedir.

Tablo-1: Bilincin Zarar Görme Durumları (Zeman, 2003).

Durum	**Bitkisel Hayat**	Minimum Bilinç Düzeyi	Locked in Syndrome (Şuuru Yerinde Ancak Bedenen Felç Olma, Kendini Dil ve Hareket ile İfade Edememe	**Koma Hali**	Beyin Sapı Testi ile Doğrulanmış **Beyin Ölümü**
Bilinçli Olma	Yok	Var	Var	Yok	Yok
Uyku-Uyanıklık Arası	Var	Var	Var	Yok	Yok
Zararlı, Acılı Uyaranlara Cevap Verebilme	Var/Yok	Var	Var/Sadece Gözlerde	Var/Yok	Yok
Psikomotor Beceriler	Amaçlı Hareket Yok	Bazı tutarlı/tutarsız, sözlü veya maçlı motor davranışlar	Gözün dikey yönlü istemli hareketi veya gözün hızlı açılıp kapanması	Amaçlı hareket yok	Yok ya da sadece omurilik refleks hareketi
Solunum Yapabilme	Genellikle Var	Genellikle Var	Genellikle Var	Değişken	Yok

Tablo-1'de görüldüğü gibi, beyin ölümü nihai yani son aşamadır. Koma halinde, uyku-uyanıklık arası bir duruş ve amaçlı hareket yok iken, bitkisel hayatta bunlar mevcuttur. Koma hali ve bitkisel hayat durumunda zararlı uyaranlara cevap verebilme durumu benzer iken, solunum olayı koma halinde düzensizlik göstermektedir. Her ikisinde de bilinçli olma durumu yoktur.

Tıp ile ilgili bilimsel çalışmalarda bile koma ve bitkisel hayat durumları hakkında kesin bir ayrımın yapılabilmesi sorunu literatüre yansımıştır. Örneğin Zeman (2003), koma halinde amaçlı hareketin olamayacağını ifade ederken, Sepit (2005), basit düzeyde seyreden koma halinde amaçlı tepkiler verilebileceğini ifade etmektedir. Bu karmaşanın topluma yansıması da beklenen bir durumdur. Bu nedenle bu çalışmada, bitkisel hayatın nasıl algılandığı üzerinde durulmaktadır.

YÖNTEM

Bu çalışma, 2015 yılında Ağrı İbrahim Çeçen Üniversitesi Eğitim Fakültesi Sınıf Öğretmenliği Programı 4. öğrencilerine uygulanmıştır. Çalışmada 18 öğrenci yer almıştır ve kompozisyon yazımı yolu ile düşüncelerin analiz edildiği Yıldırım ve arkadaşları (2015) ile Ural, Umay ve Argün (2008) tarafından gerçekleştirilen çalışmalarda uygulanan model kullanılmıştır. Nitel araştırma kurgusuna sahip bu çalışmada katılımcı ifadelerinin içerik analizi yolu ile kategoriler oluşturulmuştur.

Öğrencilerden *bitkisel hayat* odaklı açık uçlu bir soruya cevap olmak üzere bir paragraf yazmaları istenmiştir. Bu paragrafta *bitkisel hayatın tanımına, beyin ölümü durumuna, koma haline, bunlar arasındaki farka, neden bu tabirin yaygın olarak "beyin ölümü* ya da *koma hali" gibi ifadelerle karşılandığına* yönelik olarak görüşlerini yazılı olarak ifade etmeleri istenmiştir. Paragrafın içeriğinde ilgili açık uçlu sorulara cevap olabilecek tüm kelime ya da kelime grupları kodlanmıştır. Bu kodlamalardan içerik analizine gidilmiş, kategoriler ve alt kategoriler oluşturulmuştur. Bu kategorilerin geçerliliğini artırmak için öncelikle kodlama ve kategori oluşturma süreci araştırmacı tarafından, ilk içerik analizi sürecinden üç ay sonra tekrarlanmıştır. Ayrıca iki farklı alan uzmanının da görüşlerine başvurulmuştur. Böylece kategorilere son şekli verilmiştir.

BULGULAR

18 katılımcı öğrencinin yazmış olduğu paragraflarda tespit edilen *bitkisel hayat*, *koma hali ve beyin ölümü*ne ilişkin görüşler Tablo-2'de verilmiştir.

Tablo 2: Bitkisel hayat, koma hali ve beyin ölümüne ilişkin görüşler

Kategoriler	Alt Kategoriler	Katılımcılar	Frekans
Canlılık Özellikleri	Canlılık Özelliklerinin Kaybedilmesi	1,4,16	3
	Hareketsiz ve Yardıma Muhtaç Olma	4,6,10,11,14,17	6
	Bitkilerde Hareket Gözlemlenmez	4,6,7,13,14,16	6
	Temel Hayati Fonksiyonların Devam Etmesi	1,2,3,8,11,16,17,18	8
Beyin Fonksiyonları	Çalışmıyor, Beyin Ölümü Gerçekleşmiş	2,3,4,16,17,18	6
	Düşünme Yetisini Kaybetme Durumu	5,6,7,8	4
Sosyal Bağlam	Ot Gibi Yaşamak (Dolaylı Yoldan Bitkilerin Hareketine Gönderme Yapılıyor.)	9,10,12,14,15,18	6
	Bitkilerle Beslenme	9,18	2

Tablo-2'ye göre 18 katılımcıdan sadece 4'ü bitkisel hayatı, beynin kabuk bölgesi korteksin görevini yerine getirememesi nedeni ile düşünme fonksiyonunun yerine getirememesi olarak belirtebilmiştir. Temel yaşam fonksiyonlarının yerine getirildiğini 8 kişi ifade etmiştir. Bitkisel hayatı, hareket edebilme yönü ile açıklamaya çalışan katılımcı sayısı 9'dur. Beynin fonksiyonları ile açıklamaya çalışan katılımcı sayısı ise 10'dur. Yani katılımcılar bu durumu öncelikli olarak beyin ile açıklamaya çalışırken, hareket edebilme yönünden de bitkisel hayatı zihninde yapılandıranlar da önemli bir oranı teşkil etmektedir.

Sınıf Öğretmenliği programı öğrencilerinin eğitimleri sürecinde bu ayrıntı ile karşılaşmamış olmaları beklenen bir durumdur. Ancak onların her üç ifade ile güncel yaşamdan, medyadan veya başka kanallardan tanışmış oldukları açıktır. Çünkü 18 katılımcının tamamı açıklamalarını, *bitkisel hayat*ı özellikle *beyin ölümü* ile ilişkilendirerek açıklamaya çalışırken, kendilerince canlılık özelliklerine, hareket durumuna, hayati fonksiyonlara, beynin işlevine ve sosyal içerikli ifadelere yer vererek desteklemeye çalışmaktadırlar.

Katılımcıların koma haline ayrıntılı olarak yer vermemiş olması ilginç bir durumdur. Bu durum onların bilgi birikimi ile açıklayamayacağı bir nitelik taşıyabilir. Ancak, yazdıkları paragrafta *bitkisel hayat, koma hali* ve *beyin ölümü* terimlerini bu sıra ile kullanmışlar, ve koma halini, beyin ölümü ile bitkisel hayat arasına konumlandırmışlardır. Onlara yöneltilen açık uçlu soruda bu sıralamaya dair bir ip ucu oluşturacak bir içerik yer almamaktadır. Buna rağmen onların koma halini bitkisel hayat ile beyin ölümü arasına yerleştirmeleri, bu sıralamada bir amaçlarının olabileceği ipucunu vermektedir.

SONUÇ

18 katılımcı öğrenciden 13'ü (4,6, 7, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18) bitkisel hayatı hareket edebilme durumu ile açıklama eğilimindedir. Çünkü bitkiler hayvanlar gibi özellikle insanlar kadar aktif hareket etmezler. Böcek kapan, turgor basıncı ya da irkilme hareketlerinde olduğu gibi bitkilerde genel olarak yoğun bir hareket gözlemlenmez. Özellikle bitki bağlamında halk arasında ağaçlar ve otlar gibi tek ve çok yıllık otsu ve odunsu nitelikte ve yeşil olan canlıların bitki olarak kabul edilmesi (Çeken, 2014), insandaki bu tıbbi durumun bitkilere benzetilerek açıklanmasına zemin oluşturmuştur.

Yapılan bir araştırmaya göre Amerika'da nörologların ve hasta bakıcıların yüzde 50'den fazlasının 'beyin ölümü' ile 'geri döndürülemez bitkisel hayat' arasındaki ayırımı yapamadığı ortaya çıkmıştır (Adanalı, 2007:140). Sağlıkla ilgilenenlerin sahip olduğu bu kavram karmaşası, onları dinleyen halk tarafından da doğru bilgi olarak kabul edilebilmektedir.

Bilgin (1968:28-29), Akıncı, (1996:115) ve Özsunay(1979:215)'e göre beyin ölümünde beyinsel ölüm ile bitkisel hayata girme hali birbiriyle karıştırılmamalıdır. Bitkisel hayata beyin ölümü belirtileri bulunmaz ve hastanın gözleri kendiliğinden ya da sesli bir uyaran sonucunda açılabilir ancak hastanın izleme hareketleri yoktur. Hastanın uyku-uyanıklık döngüsü ile kan basıncı ve solunumu kendiliğinden sürmektedir. Bu kişiler yıllarca yaşayabilir. Fakat beyin ölümde bu belirtiler yoktur. Bu yüzden de bitkisel hayata girmiş kişiler ölü sayılmaz (Akt. Özel, 2002:51).

TDK, bitkisel hayatı bilinçsiz ve hareketsiz olma hali olarak ifade ederken (TDK, 2016), tıp literatürü de bu anlamı desteklemektedir. Ancak bilinç durumu beynin tüm fonksiyonları, hareket hali de bitki ve hayvanlarla ilişkilendirilecek şekilde genellemeler yapılarak, ilgili kavramlar zihinde yanlış yapılandırılmış olabilir.

ÖNERİLER

Gerçekleştirilen bu çalışma ile Sınıf Öğretmenliği Programına devam eden öğrencilerin önemli bir kısmının, bitkisel hayatı, bitkilerin hareket hali ile açıklamaya çalıştıkları tespit edilmiştir. Ancak bilinç düzeyine yeteri kadar değinmemişlerdir. Bitkisel hayatın bilinç durumu ile ilişkilendirilmemiş/ilişkilendirilememiş olması, katılımcı grubun ön bilgi düzeyi ile yakından ilgili olabilir. Bu nedenle ilgili kavramların başka alanlarda eğitim alan bireylerde ya da genel halk kitlesi arasında nasıl algılandığına ilişkin farklı gruplar ile çalışılabilir. Yine de Sınıf Öğretmenliği Programı öğrencileri ve araştırmacılarının, ilgili konu ve kavramları uygun konular ile eş zamanlı olarak ele almalarında fayda olabilir. Ayrıca Sınıf Öğretmenliği Programı Öğrencileri bitkisel hayat ifadesini yapılandırırken, canlıların ortak özelliklerinden biri olarak bilinen hareket edebilme yerine, bitkilerde olmayan ve bitkisel hayata giren hastalarda da önemli oranda devre dışı kalan sinir sistemi ile bağlantı kurmalarında yarar vardır. Yine de koma hali, bitkisel hayat ve beyin ölümü konularının benzer ve farklı özellikleri ile birlikte ele alınması gerekir.

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PRE-SERVICE ELEMENTARY MATHEMATICS TEACHERS' CONCEPT IMAGES FOR SEQUENCES

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ABSTRACT: A sequence is defined as a function on the positive integers into real numbers. The concept of a sequence and its limit has significant impact on the related concepts in mathematics. In the research literature, there are also a few studies related to the students' understanding about the concept of sequences. In this context, the aim of this study is to determine preservice elementary mathematics teachers' concept images for sequences. The study was conducted with 38 freshmen preservice elementary mathematics teachers with the use of a two-part open-ended questionnaire consisting of 10 questions prepared through a literature review. Two dimensions of preservice elementary mathematics teachers' concept images are examined: determining of the sequences, finding limit of a sequence.The data were categorized in terms of descriptive analysis and analyzed qualitatively. As a result of the study, while freshmen preservice elementary mathematics teachers have not difficulty about defining and determining of the sequences; they had wrong concept images for exploring the limit of the sequences.

Key words: sequences, concept image, preservice elementary mathematics teachers

İLKÖĞRETİM MATEMATİK ÖĞRETMENİ ADAYLARININ DİZİLERE YÖNELİK KAVRAM İMAJLARI

ÖZET: Doğal sayılar kümesinden reel sayılar kümesine tanımlanmış fonksiyonlara dizi denir. Dizi kavramı ve dizilerin limiti, bu kavramlarla bağlantılı matematikteki diğer kavramlar üzerinde önemli bir yere sahiptir. Bununla birlikte literatürde, öğrencilerin diziler kavramını anlamalarına yönelik az sayıda çalışma mevcuttur. Bu bağlamda, çalışmanın amacı ilköğretim matematik öğretmeni adaylarının diziler kavramına yönelik kavram imajlarını belirlemektir. Araştırmanın örneklemini Ege bölgesindeki bir devlet üniversitesinin eğitim fakültesi ilköğretim matematik öğretmenliği bölümü birinci sınıfı 2015-2016 öğretim yılı bahar döneminde öğrenim gören 38 öğretmen adayı oluşturmaktadır. Veriler açık uçlu on sorudan oluşan bir soru seti yardımıyla toplanmıştır. Soru setinde yer alan sorular öğretmen adaylarının diziyi tanıma ve dizinin limitini bulmaya yönelik kavram imajlarını ortaya çıkarmak amacıyla hazırlanmıştır. Veriler betimsel olarak analiz edilmiştir. Araştırmanın sonucunda, Öğretmen adaylarının dizileri tanıma ve tanımlamaya yönelik bir problem yaşaadıkları görülürken; dizilerin limitini bulmada yanlış kavram imajlarına sahip oldukları tespit edilmiştir.

Anahtar sözcükler: diziler, kavram imajı, ilköğretim matematik öğretmeni adayları

GİRİŞ

Diziler ve dizilerin limiti, analiz dersinin önemli konularından biridir (Roh, 2010). Ancak ilgili literatür incelendiğinde, özel bir fonksiyon olan dizilere yönelik öğretmen adaylarının anlamalarını belirleyen sınırlı sayıda çalışma bulunmaktadır (Akgün & Duru, 2007; Alcock & Simpson, 2004; Cheng & Leung, 2015; Çiltaş & Işık, 2012). Bu bağlamda, çalışmada ilköğretim matematik öğretmeni adaylarının diziler kavramına yönelik kavram imajlarını belirlemek amaçlanmıştır.

Kavram İmajı

Bir matematiksel kavramın bireyin zihninde oluşumunda tanımlar ve kavrama ait olan ve olmayan örnekler önemli bir yere sahiptir. Matematiksel kavramların bireylerin zihinlerinde nasıl yapılandığını ortaya koymak üzere Tall ve Vinner (1981) kavram tanımı (concept definition) ve kavram imajı (concept image) yapılarını ortaya koymuştur. Kavram tanımı bir kavramı diğerinden ayırmak için kullanılan kelimeler bütünüyken; kavram imajı zihinde o kavram ile ilgili olarak uyananları içermektedir. Kavram imajı terimi "kavram ile birleşen işlemleri ve özellikleri birleştiren bütün zihinsel resimleri içeren bilişsel yapıyı" tasvir etmek için kullanılır (Tall & Vinner, 1981).

Matematiksel anlamda dizi nedir?

Matematiksel kavram olarak, f : N→R fonksiyonuna dizi denir. Diziler için f yerine n→ f(n) = a_n gösterilişi kullanılır. an, dizinin genel terimi adını alır. an genel terimli dizi (a_n), {a_n }, $\{a_n\}_{n\in N}$ biçiminde gösterilirken; (a_n) dizisinin görüntü kümesi {a_1,a_2,a_3,…,a_n,…} şeklindedir (Dernek, 2009).

Bir dizinin genel terimden hareketle dizinin istenilen terimi bulunabilir. Ancak elemanları verildiğinde bir dizinin genel teriminin elde edilmesi tahmine dayalı bir süreçtir. Yani (1,2,3,…) şeklinde verilen bir dizinin dördüncü elemanı 4 veya farklı bir sayı olabilir. (a_n) = n = (1,2,3,4,…) dizisinin 4. elemanı 4'tür; ancak, (a_n) = ($(n-2)^3+2$) = (1,2,3,10…) dizisinin 4. elemanı 10'dur (Bozkurt, 2013). Bu nedenle tanım göz önünde bulundurularak; dizinin elemanlarının belirlenmesinde genel terimden yola çıkılmalıdır.

Bir dizinin limiti

dizilerin limitinden bahsedebiliyor olabilmemiz için; fonksiyonlarda olduğu gibi, $\lim_{x\to a} f(x)$' in olabilmesi için a noktasının f(x) fonksiyonunun tanım kümesinin yığılma noktası olması gerekir. Ancak, pozitif tam sayılar kümesindeki hiçbir eleman bu kümenin bir yığılma noktası olmadığından; f(n)= a_n gibi bir dizinin a bir pozitif tam sayı olmak üzere, $\lim_{n\to a} a_n$ den bahsedemeyiz. Sadece, n → +∞ için dizilerin limitinden söz edilebilir (Bozkurt, 2013).

Türk eğitim sisteminde dizilerin öğretimi

Ülkemizde matematik dersi öğretim programı (5.-12. Sınıflar) incelendiğinde; diziler konusunun öğretimine 11. ve 12. sınıflarda yer verildiği görülmektedir. Bu sınıflar seviyesinde diziler konusuna ait kazanımlar aşağıda sunulmuştur (MEB, 2011):

Tablo 1. Diziler Konusuna Yönelik Sınıf Düzeyine Göre Kazanımlar

Sınıf Düzeyi	Kazanımlar
11. Sınıf	• Dizi, sonlu dizi ve sabit diziyi açıklar, dizilerin eşitliğini ifade eder ve verilen bir dizinin grafiğini çizer. • Verilen (a_n), (b_n) gerçek sayı dizileri ve c∈R için (a_n)+(b_n), (a_n)-(b_n), c.(a_n), (a_n).(b_n) ve ∀n ∈ N^+ için $b_n \neq 0$ olmak üzere (a_n):(b_n) dizilerini bulur. • Artan, azalan, azalmayan ve artmayan dizileri açıklar.
12. Sınıf	Bir dizinin limitini açıklar ve uygulamalar yapar.

YÖNTEM

Çalışma nitel araştırmalarda kullanılan özel durum çalışması yöntemiyle yürütülmüştür. Özel durum çalışması yöntemi kullanılmasının sebebi özel durum çalışmalarının araştırmacıya çok özel bir konunun veya durumun üzerinde yoğunlaşarak incelenen özel durumları en ince ayrıntılarıyla tanımlama ve değişkenler arasındaki sebep-sonuç ilişkilerini açıklayabilme fırsatı vermesidir (Patton, 2005; Yin, 2003).

Çalışma grubu

Araştırmanın örneklemi, seçkisiz olmayan örnekleme yöntemlerinden uygun örnekleme yöntemi (convenience sampling) ile belirlenmiştir. Araştırmada uygun örnekleme yönteminin seçilmesinin nedeni zaman, para ve işgücü açısından var olan sınırlılıklar nedeniyle incelenecek grubun ulaşılabilir ve uygulama yapılabilir olmasıdır (McMillan & Schumacher, 2014). Araştırmanın örneklemini Ege bölgesindeki bir devlet üniversitesinin eğitim fakültesi ilköğretim matematik öğretmenliği bölümü birinci sınıfı 2015-2016 öğretim yılı bahar döneminde öğrenim gören 38 öğretmen adayı oluşturmaktadır.

Veri toplama aracı

Veriler açık uçlu on sorudan oluşan bir soru seti yardımıyla toplanmıştır. Soru setinde yer alan sorular öğretmen adaylarının diziyi tanıma ve dizinin limitini bulmaya yönelik kavram imajlarını ortaya çıkarmak amacıyla hazırlanmıştır.

Verilerin analizi

Veriler betimsel olarak analiz edilmiştir. Öğretmen adaylarının vermiş oldukları cevaplar öncelikle "doğru cevaplar", "kısmen doğru cevaplar", "yanlış cevaplar" ve "boş" olmak üzere dört ana kategoride sınıflandırılmış. Daha sonra bu kategoriler alt kategorilere ayrılıp frekans ve yüzdelerle ifade edilmiştir. Elde edilen verilerin bu şekilde kodlanmasında araştırmacılar dışında başka bir matematik eğitimi uzmanından da yardım alınmıştır. Oluşturulan kategori ve alt kategorilerin uygunluğu için bu uzmandan uzman görüşü alınmıştır. Böylece elde edilen sonuçların güvenirliği sağlanmaya çalışılmıştır.

BULGULAR

Öğretmen adaylarının *"Aşağıda verilen ifadelerin hangisi/hangileri bir dizi belirtir? Nedenini açıklayınız."* sorusuna vermiş oldukları cevaplar Tablo 2'de verilmiştir.

Tablo 2. Öğretmen Adaylarının Diziyi Tanımaya Yönelik Yapıkları Açıklamalar

İfade	Kategori	Örnek İfade	f	%
$\frac{1}{2}, \frac{1}{3}, \frac{1}{4}, \frac{1}{5}, \ldots$	Doğru	Reel sayılardan oluşan bir örüntü ama kuralı verilmemiş. Dizi olmanın şartlarından biri kuralının verilmesi. Bu nedenle dizi değil. (S12) Genel terim verilmediğinden dizi diyemeyiz. (S7) Son terimden sonra hangi reel sayının geleceği tahmin edilse de belli değil. Kuralı belli olmadığından dizi değil. (S15)	10	% 26.32
	Kısmen Doğru	$\frac{1}{n+1}$ kuralına göre dizildiğinden bir dizi belirtir (S2)	23	% 60.53
	Yanlış	Verilen reel sayılar 1'den küçük olamaz (S11) $\frac{1}{n+1}$ kuralına göre n= -1 için tanımsızdır (S29)	2	% 5.26
	Boş		3	% 7.89
1,3,5,7,9,…	Doğru	Genel kural bilinmediğinden dizi diyemeyiz. (S26) Genel terimi olmadığından dizi değil. (S38)	6	% 15.79
	Kısmen Doğru	Belli bir kurala göre artış var. Aritmetik dizidir. (S1) 2n-1 kuralını sağlayan dizidir (S3)	28	% 73.68
	Yanlış	n+2 kuralına göre oluşturulmuş dizi (S2)	4	% 10.53
	Boş		-	
$\frac{3}{1}, \frac{5}{2}, \frac{7}{3}, \ldots, \frac{2n+1}{n}, \ldots$	Doğru	a_n genel terimi verilmiş bir dizidir. (S10)	26	% 68.42
	Kısmen Doğru		-	-
	Yanlış	n=0 için tanımsız olduğundan dizi değildir.(S7) Pay ve payda arasında sabit bir oran olmadığından dizi değil. (S19)	11	% 28.95
	Boş		1	% 2.63
3,3,3,3,…	Doğru	Genel terimi kuralı bilinmediğinden dizi diyemeyiz. (S15)	2	% 5.26
	Kısmen Doğru	Sabit bir dizidir.(S31)	35	% 92.1
	Yanlış	Tüm terimler aynı sayı olduğundan dizi değildir. (S3)	1	% 2.63
	Boş		-	-
-2,-1,0,1,…,n-3,…	Doğru	Belli bir kurala göre verilmiş dizidir. (S33) n-3 kuralına uygun verilmiş bir dizidir. (S30)	28	% 73.68
	Kısmen Doğru		-	-
	Yanlış	Dizinin tanımına göre negatif sayıları dahil edemeyiz. Bu yüzden bu bir örüntü. (S8) Kural verilmiş ancak negatif sayılar bulundurduğundan dizi değildir. (S12)	10	% 26.32
	Boş		-	-

Tablo 2'ye göre, öğretmen adaylarının büyük çoğunluğu genel terimi verilen bir ifadenin dizi olduğunu kabul ederken; kuralı verilmemiş olan bir örüntünün kuralı varmış gibi düşünüp, dizi olduğunu belirtmektedir. Bununla birlikte, bir ifadenin dizi olup olmadığını belirlemede yanılgıya düşen öğretmen adaylarının dizinin tanım ve görüntü kümesini karıştırdıkları görülmektedir.

Öğretmen adaylarının *"Aşağıda verilen dizilerin limitlerini bulunuz. Limiti nasıl bulduğunuzu kısaca açıklayanız."* sorusuna vermiş oldukları cevaplar Tablo 3'de verilmiştir.

Tablo 3. Öğretmen Adaylarının Dizinin Limitine Yönelik Yapmış Oldukları Açıklamalar

İfade	Kategori	Örnek İfade	f	%
$\lim_{n\to\infty} \frac{2n+2}{n+1}$	Doğru	∞/∞ belirsizliğinde katsayılar oranına bakıldığında, limit 2'dir. (S10) Katsayılar oranı 2 olduğundan limit 2'dir. (S31)	38	% 100
	Kısmen Doğru		-	-
	Yanlış		-	-
	Boş		-	-
$\lim_{n\to 2} \frac{1}{n}$	Doğru		-	-
	Kısmen Doğru		-	-
	Yanlış	n=2 için lim değeri ½ 'dir. (S35)	36	% 94.74
	Boş		2	% 5.26
$\lim_{n\to 3} 2n+2$	Doğru		-	-
	Kısmen Doğru		-	-
	Yanlış	n yerine 3 yazılırsa 2n+2=8 olduğundan limit 8'dir. (S16)	37	% 97.37
	Boş		1	% 2.63
$\lim_{n\to\infty} 3n$	Doğru		-	-
	Kısmen Doğru	n→∞'a yaklaşırken limit sonsuza gider. (S29) 3.∞=∞ olduğundan limit sonsuzdur. (37)	32	% 86.49
	Yanlış	Limit 0'dır. (S23) n'nin katsayısı 3 olduğundan limit 3'tür. (S3)	5	% 13.16
	Boş		1	% 2.63
$\lim_{n\to 1} -4n^3 - 3n^2 + 5$	Doğru		-	-
	Kısmen Doğru		-	-
	Yanlış	n=1 yazarsak -4-3+5=2 olur. O halde lim 2'dir.(S27)	37	% 97.37
	Boş		1	% 2.63

Tablo 3'e göre öğretmen adaylarının tümü verilen ilk dizinin limitini doğru bulmuştur. Bununla birlikte dördüncü dizinin limitinin sonsuz olduğunu belirtmişlerdir. Buradan, öğretmen adaylarının limitin sonsuza eşit olması durumunun sadece bir gösterim olduğunu; aslında limitin olmadığını bilmedikleri görülmektedir. Öğretmen adaylarının neredeyse tamamı diğer diziler için n'nin herhangi bir sayıya yaklaşması durumunda limit değerini hesapladıkları görülmektedir. Bu durum, öğretmen adaylarının dizilerin limitini hesaplarken dizilerin tanım kümelerini dikkate almadıklarını göstermektedir. Nitekim dizilerin tanım kümesi doğal sayılar olduğundan bu kümede yığılma noktasından söz edilemez.

SONUÇ

Araştırmadan elde edilen sonuçlara göre, öğretmen adaylarının genel terimi verilen bir ifadenin dizi olup olmadığını tespit etmede başarılı oldukları görülmektedir. Bununla beraber; öğretmen adaylarının büyük çoğunluğu genel terimi verilmeyen bir ifadeyi genel terimini tahminde bulunup; dizi olarak kabul ettikleri görülmektedir. Bazı öğretmen adaylarının da ifadenin dizi olup olmadığını belirlerken; tanım ve görüntü kümelerini karıştırmalarından kaynaklanan hatalar yaptığı görülmektedir.

Öğretmen adayları dizinin limitini bulurken n→∞'a yaklaşması durumunda limit değeri hesaplamışlardır. Öğretmen adaylarının neredeyse tümünün limitin ∞'a eşit olmasının bir matematiksel gösterim olduğunu; bu durumda limitin var olmadığını bilmedikleri ortaya çıkmıştır. Son olarak, öğretmen adayları bir dizinin limitinin ancak n→∞ iken mümkün olduğunu; diğer durumda dizinin tanım kümesi doğal sayılar olduğundan limit durumun olmayacağını bilmedikleri görülmektedir. Bu bağlamda öğretmen adaylarının bir dizinin limitini belirlemede yanlış kavram imajlarına sahip olduğu söylenebilir. Araştırmadan elde edilen sonuçlara paralel olarak; Çiltaş ve Işık (2012), Cheng ve Leung (2015) tarafından yapılan çalışmalarda da üniversite öğrencilerinin dizilerin limitiyle ilgili yanlış kavramsal anlamalara sahip oldukları belirlenmiştir.

ÖNERİLER

Öğretmen adaylarının dizilere yönelik kavram imajlarını belirlemeyi amaçlayan bu çalışmanın sonucu; lisede matematik ve üniversitede analiz dersleri içerisinde yer alan bu konunun öğretimine kavramsal olarak ağırlık verilmesi gerektiğini göstermektedir. Bu bağlamda dizi kavramının tanımı üzerine yoğunlaşılmalıdır. Bununla birlikte, diziler ve dizilerin limiti kavramlarının görselleştirilmesi adına, bilgisayar destekli öğretim programlarından yararlanılabilir.

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TRAINING EQUIPMENT OF LABORATORIES USING IN VOCATIONAL SCHOOLS OF TECHNICAL SCIENCE FOR ELECTRICAL AND ELECTRONICS EDUCATION

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ABSTRACT: Nowadays, especially countries such as Turkey has huge gap of in qualified personnel for industry.Technical and science education especially in vocational school in Turkey has a curial role in view ofprovide qualified personnel for industry. To achieve this aim education in technical science and vocational school has not only be based on theories, it also has to be a practical parts that is called as laboratory applications such as electrical machine, power electronics, measurements equipment laboratory application … etc. In this paper it is proposed laboratory equipment that are used in University of Dicle Department of Electrical and Energy of Diyarbakır Technical Science and vocational school laboratories and it tries to investigated effect of laboratory training equipment on courses in departments of electrical-electronics of vocational schools.

Key words: Training Equipment, Education in Electrical & Electronics, Technical Science vocational school

MESLEK YÜKSEK OKULLARI ELEKTRİK VE ELEKTRONİK BÖLÜMLERİ İÇİN LABARATUVAR EĞİTİM SETLERİNİN KULLANIMI

ÖZET: Günümüzde, Türkiye gibi özellikle endüstriyel ülkelerin mesleki eğitimleri önemlidir. Türkiye'de meslek okulu endüstrisi için kalifiye personel eğitiminde önemlidir. Özellikle de teknik eğitiminde büyük boşluk vardır. Teknik bilim ve meslek okulunda bu amaç eğitime ulaşmak için sadece teoriler dayalı değil, aynı zamanda bu tür bu vb elektrikli makine, güç elektroniği, ölçümler laboratuvar donatımı uygulaması ... gibi laboratuar uygulamaları olarak adlandırılan bir pratik parçaları olmak zorunda elektrik ve Diyarbakır Teknik Bilim Enerji ve meslek lisesi laboratuvarlarının Dicle Üniversitesi, kullanılan ve meslek okullarının elektrik-elektronik bölümlerinde dersler laboratuar eğitim ekipmanları etkisi araştırılmıştır çalışır kağıt o önerilen laboratuvar ekipmanı.

Anahtar Kelimeler: Eğitim seti, Elektrik-elektronik eğitimi, Teknik ve mesleki okul

GİRİŞ

Laboratuar öğrencilerin tecrübe kazanacağı eğitimin önemli bir bileşenidir. Geleneksel laboratuar çalışması herhangi bir eğitim programının tamamlayıcı bölümünü oluşturur. Bu deneysel çalışmalar öğrencilere pratik beceri kazandırır ve onları gerçek yaşam durumlarına hazır hale getirmekte yardımcı olur. Bununla birlikte geleneksel deneylerin değişik kısıtlamaları nedeniyle daha uygun alternatiflerin aranma zorunluluğu ortaya çıkabilmektedir. Bilgisayarların maliyet verimliliği ve çok yönlülüğünün yanında ağlarla haberleştirilmesi ile tüm dünyada geleneksel laboratuarlara uygun bir alternatif olarak sanal laboratuarların oluşturulması yaygınlaşmıştır [1].

Sanal laboratuar, eğitimde uygulama deneyimi kazanmak için yapılması gereken deneylerde etkileşimli bir gerçek zamanlı simülasyon olanağı sağlayan bilgisayar ortamı olarak tanımlanabilir. Günümüzde tüm mühendislik dallarında matematiksel model tabanlı paket program kullanımı standartlaşmaya başlamıştır. Bu durumun göstergelerinden biri de, bu yazılımlarla ilgili basılan kitap sayılarının, geleneksel ders kitaplarının sayısından oldukça fazla olmasıdır. Böylece sanal laboratuarlar ile bilgisayar benzetimli sistemler üzerinde deneyleri gerçekleştirme olanağı büyük ilgi kazanmıştır [2,3].

Üniversite yüksekokul öğrencileri için güç elektroniği laboratuar deneyleri çok zordur. Bundan dolayı böyle deneyler için internet tabalı gerçek zamanlı gerçek laboratuar ortamları webde gerçekleştirilmiştir. Öğrenciler karmaşık kavramların anlaşılmasını ilerletmek kadar faydalı ve interaktif web tabanlı sanal laboratuar bulmuşlardır. Sanal laboratuar bu yaklaşımlar kullanılarak geliştirilmiştir [4].

Geleneksel Laboratuarlar ve Sanal Laboratuarların Karşılaştırılması

Tipik bir geleneksel laboratuar cihaz veya gereçler üzerinde direkt olarak çalışan öğrenci veya öğrencilerden ve laboratuar amaçları ve prosedürlerini içeren ana noktalardan oluşur. Laboratuarlar genellikle eğiticiler, laboratuar teknisyenleri ve/veya öğretmenlerden uzman görüşler altında yapılır.
Geleneksel laboratuarlar birçok farklı problemlerle ortaya çıkarlar.

- Maliyet: cihazların, depolamanın ve bakımın maliyeti önemli miktarda yüksektir.
- Kaynak sınırlaması: Öğrencilerin genellikle sadece laboratuar saatleri sırasında olmak üzere laboratuarlara erişimi sınırlandırılmıştır.
- Yetersiz eğitim: Bazı durumlarda görülmüştür ki laboratuarlar birçok faktörlerden dolayı öğretimde önemli bir kayıpla sonuçlanmıştır. Ölçülen veriyi el ile işlemek ve aynı tekrarlanan ölçümleri sıkıcı prosedürler ile almak öğrenciler için önemli bir zaman almaktadır ve sonuçları tartışmak için öğrencilere çok küçük bir zaman kalmaktadır.
- Güvenlik: Öğrencilerin yaygın olarak elektrik-elektronik bölümleri gibi potansiyel olarak tehlikeli cihazlarla çalışması gerekebilir.

Bir sanal laboratuar tipik olarak bir bilgisayar üzerinde direkt olarak çalışan öğrenci veya öğrencilerden oluşur. Yazılan notlar ve uzman denetimleri hala kullanılabilirdir, bununla birlikte onun bilgisayar içerisine birleştirilmesi de mümkündür. Laboratuarlara bilgisayarları birleştirmek için kullanılan iki temel gerçekleştirme modeli vardır.

1. Bilgisayar yardımcılı laboratuarlar
2. Bilgisayar benzetimli laboratuarlar

Daha verimli yürütme gösteren laboratuar sistemlerinin oluşturulmasında yardımcı olarak bilgisayarları kullanan laboratuarlar bilgisayar yardımcılı laboratuarlar olarak adlandırılır. Öğrencilerin istekleri üzerine gerçek zamanlı giriş çıkış gösteren ve geleneksel laboratuar cihazlarının tamamı veya bir kısmı direkt olarak bilgisayarları kullanır. Bilgisayarlar cihazlardan anlamlı şekillere veri formatlama, ölçme ve işleme görevlerini alır. Böyle sistemlerin donanım ve yazılımı yüksek olarak cihazların tipine bağlıdır ve bundan dolayı genellikle isteğe göre yapılır. Bununla birlikte örneğin LabView gibi elektronik cihazlar ile haberleşmek için yaygın olarak kullanılan ticari yazılımlar da vardır. Bazı durumlarda öğrencilerin bilgisayarı ve cihaz arasındaki bağlantıyı uzaktan kontrol etmek bir ağ ile yapılabilir. Bilgisayar yardımcılı laboratuarların bu değişikliği popüler olarak uzaktan laboratuar olarak bilinir. Benzetimli laboratuarlarda bilgisayarlar geleneksel laboratuarlarla tamamen yer değiştirerek laboratuar cihazlarının çalışmasını simüle eder. Simülasyonlar geleneksel laboratuar sistemlerinin eşdeğer matematiksel modelleridir. Tipik olarak dördüncü üretim diller kullanılarak daha kompleks simülasyonlar yazılabilirken Delphi veya Java gibi üçüncü üretim diller kullanılarak daha basit simülasyonlar yazılabilir.

İyi tasarlanmış sanal laboratuarlar ile sunulan değişik avantajlar vardır. Geleneksel laboratuarlara göre bu potansiyel yararlar bilgisayar temelli cihazların oluşturulmasına doğru gitmektedir. Bu pozitif görünüşlerden bazıları şunlardır.

1. Maliyet verimliliği: Sanal laboratuarlar laboratuar gereçlerinin bir kısmı veya tamamı ile yer değiştirebilirler. Bundan dolayı satın alma maliyetleri, bakım ve depolama maliyetleri yoktur.
2. Kullanılabilirlik: Bilgisayarlar ve bilgisayar ağları herhangi bir zamanda ve herhangi bir yerde laboratuar hazırlamak için yardımcıdır. Eğiticiler, denetleyiciler ve bilgisayarlar içeren tam bir laboratuar sisteminin birleşimi istendiği zaman ve yerde laboratuar oluşturulmasında yardımcıdır.
3. Etkin öğrenme: Çoğu prosedürler ölçme ve formatlama gibi öğrenciler üzerine yükümlülük getiren prosedürü azaltmak için bilgisayarlar kullanılabilir. Böylece kaliteli olarak zaman artırımı sağlanır.
4. Güvenlik: Bilgisayarlar potansiyel tehlike durumlarının engellenmesini sağlayarak öğrencileri korur. Hatta öğrencilerin laboratuar cihazı ile direkt etkileşimini azaltır veya yok eder. Böylece çoğu kazalardan korunma sağlanır.
5. İdari faydalar: Sanal laboratuarların faydaları not, kayıt tutma ve geri besleme gibi online değerlendirmelerde öğreticilere yardımcı olabilir.

Herhangi bir teknoloji gibi sanal laboratuarlar da simülasyonların gerçekçi olmayan doğallığı, ikinci derece tasarım ve öğrenci kontrolünün eksikliği gibi belirli dezavantajlara sahiptir.

Sanal Laboratuar Uygulama Örnekleri

Şu andaki eğitim yaklaşımları öğrenme süreci sırasında öğrenciye anlık grafiksel geri besleme sunan ve görsellik kavramlarında öğrencilere yardımcı olan simülasyonlardır. Sanal öğrenim sistemi eğitim teknolojisine dayanılarak geliştirilmiştir. Öğrenme aracı ardıl modüllerin birleştirilmesidir. Her modülün bilgi içeriği bilginin optimum iletimi için ayarlanmıştır. Bütün modüller benzer yapıya sahiptir ve aşağıdaki kısımlardan oluşurlar.

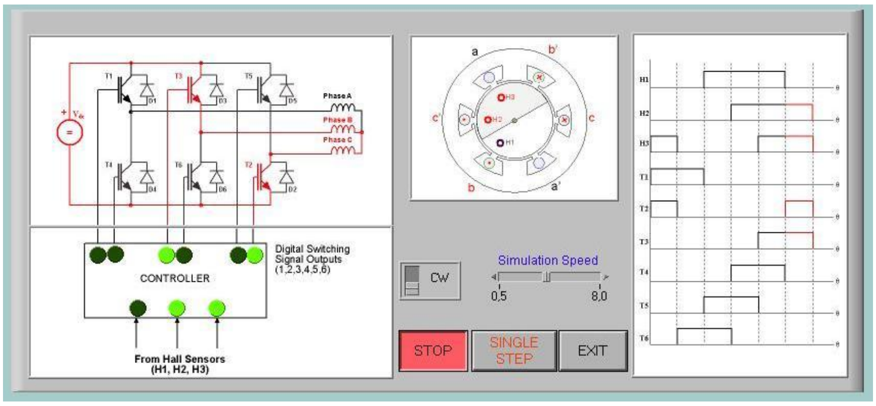
- *Açıklama katmanı*, temel gösterimlerle ilişkili bilgi ile öğrencileri tanıştırır.
- *İnceleme katmanı*, bir sınıfta gösterilen örnek problem için karşılaştırma yapar ve öğrenci pratik örnek için gereken bilgiyi uygular.
- *Eğitimsel katman*, iki amaca sahiptir. İlki hiyerarşik bir yapı ile interaktif bir öğrenme alt modülü sunmaktır. Her seviyede bir soru sorulur ve birçok cevap verilir. Öğrenci bir cevap seçecektir ve interaktif öğrenme alt modülü doğru cevabın seçilip seçilmediğini gösterecektir. Modüldeki bütün konular görülünceye kadar işlem devam edecektir. Bazı konular çok seçimli biçimden farklı olarak bir problemi şekillendirebilecektir. İkinci amaç öğrenciye zaman testi uygulamak ve öğrencinin sonraki seviyeye hazır olup olmadığını kurmaktır. Bu yaklaşım klasik öğrenim yaklaşımının sınav bölümüne karşılık gelir.

Bu eğitsel kurallara göre oluşturulan ve oluşturulabilecek sanal laboratuarlar hiç kuşku yok ki öğrenciler için yüksek performans sağlayacaklardır. Sanal Laboratuarların oluşturulmasında kullanılabilecek bazı paket programlar özellikleri ile şöyle verilebilir.

- MATLAB (MATrix LABoratory); ilk defa 1985'de C.B Moler tarafından matematik ve özellikle de matris esaslı matematik ortamında kullanılmak üzere geliştirilmiş etkileşimli bir paket programlama dilidir. MATLAB mühendislik alanında; sayısal hesaplama, veri çözümleri ve grafik işlemlerinde kullanılabilecek genel amaçlı bir program olmakla beraber birçok özel amaçlı modüler paketlere de sahiptir. Ayrıca WINDOWS ortamında çalışan SIMULINK paketi, etkileşimli benzetim programlarının hazırlanması ve çalıştırılmasında büyük kolaylıklar sağlamaktadır.
- LABVIEW (LABoratuary Virtual Instrument Engineering Workbench); yüksek performanslı bilimsel ve mühendislik uygulamalarında ölçme ve otomasyon için tasarlanan grafiksel bir geliştirme ortamıdır. Bir ön panel ve blok diyagramı yapısından oluşur.
- EWB (Electronic Work Bench); elektrik ve elektronik eleman ve entegrelerini içeren bir paket program olup grafiksel bir ortam sunan başarılı bir simülasyon aracıdır.
- CISCO Lab Activity; Bilgisayar ağları üzerine dünya çapında kalitesi standart olan CISCO tarafından yapılan yazılım uygulamaları sanal laboratuar oluşturmak için çok faydalı yazılımlardır.
- PSPICE, VLEM, Mathcad, Ansys, Mathematica ve daha onlarca paket program sanal laboratuar oluşturmak için kullanılabilecek güçlü programlardır.

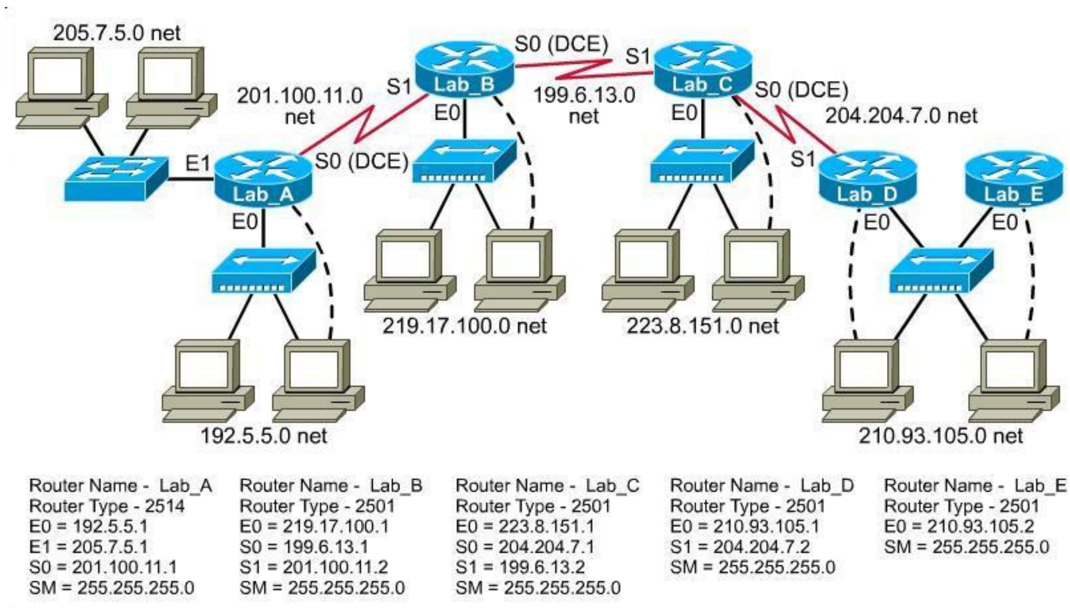
Özellikle meslek yüksekokullarında kullanılan elektrik makinelerinin uygulama laboratuarlarının sanal olarak gerçekleştirilmesi bütün yapının kavranılması açısından önemlidir. Şekil 1'de görüldüğü gibi bir makinenin sürücü ile birlikte çalışması LabView programı ile oluşturulmuş ve böylece sistemin bütün ayrıntılarının incelenebilmesi sağlanmıştır. Bu, gerçek laboratuarda kapalı bir kutu olarak kalabilen araçlar için çok daha anlaşılır bir yapıyla çalışmayı getirecektir. Böylece bir bütün elektrik makinelerinin bu tür benzetimi gerçekleştirilerek kurulacak bir sanal laboratuar özellikle maliyet açısından çok büyük fayda sağlayacağı gibi deneyin öğrenciler açısından daha anlaşılır olmasını sağlayacaktır [5,6].

Şekil 1'deki gibi bir sistemin gerçekte oluşturulması için motor, deney inverteri, osiloskop, ölçüm uçları ve cihazları, mikrodenetleyici ve ayrıca moment, hız gibi sistem büyüklüklerini ölçmek için duyargalar gerekir. Ancak böyle bir sistemin sanal laboratuardaki ihtiyacı bir PC ve paket programdır. Bunun yanında gerçekte 2 veya 4 saat zaman ile sınırlı bir laboratuar, sanal laboratuar ile sınırsız hale gelebilmektedir. Bunun dışında öğrenci transistör gibi malzemelerin üzerindeki gerilimleri ölçmek istediğinde risk alması gerekirken bilgisayarda istediği noktadaki gerilimi ölçme, görme, işleme ve değerlendirme fırsatı bulacaktır.



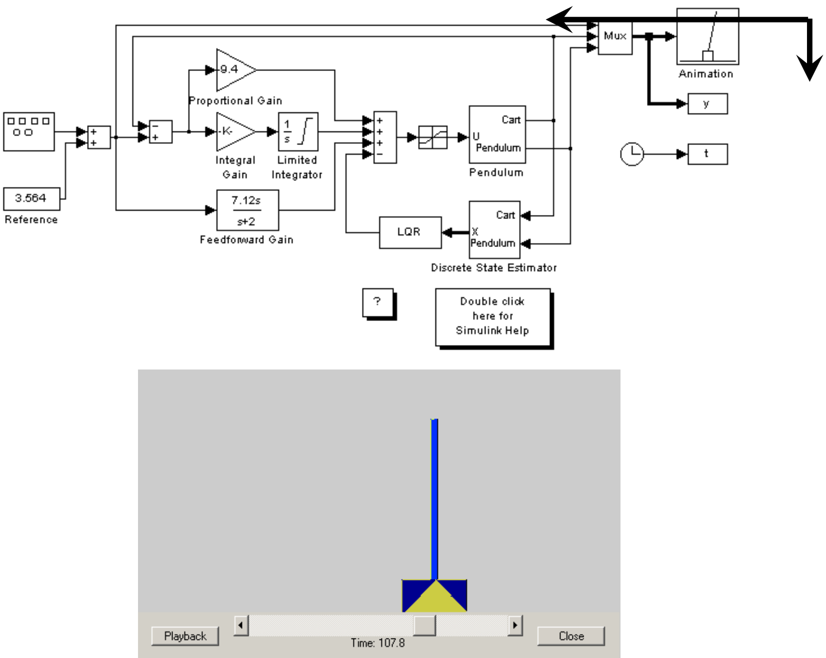
Şekil 1. Sanal elektrik makine laboratuarında bir elektrik makine deney yapısı

Elektronik bölümlerinde önemli bir yeri olan bilgisayar ağlarının sanal olarak oluşturulması ve konfigürasyonu için Şekil 2 bir örnek teşkil etmektedir [7]. Bilgisayarlar, anahtarlar ve yönlendiricilerden oluşan böyle bir ağ yapısı sanki gerçek bir ağ üzerinde çalışıyormuş gibi bilgisayar üzerinde oluşturularak her türlü konfigürasyonu yapılabilmektedir. Sadece bilgisayar üzerinden ağ üzerinde görülen herhangi bir eleman seçilerek bunun üzerinde çalışmak mümkün olacaktır. Ayrıca çok büyük mesafeler gerektiren büyük bilgisayar ağlarının sanal laboratuarda gerçekleştirilmesi de kolay olduğu gibi öğrencilerin laboratuar zamanını yararlı kullanmayı engelleyecek problemler de olmayacaktır. Böyle bir yapı özellikle maliyet bakımından yarar getireceği gibi aynı zamanda görsel olarak bütün yapıyı anlama kolaylığı sağlayacaktır. Ayrıca yapılabilecek yanlış konfigürasyonların hiçbir zararı olmaması yanında öğrenciye tecrübe ve kavrama olanağı sağlayacaktır. Elektronik bölümü için mikroişlemciler, sayısal elektronik ve kontrol gibi donanım gerektiren tüm laboratuarların sanal olarak da gerçekleştirilmesinin katkıları çok fazladır.



Şekil 2. Sanal bilgisayar ağ laboratuar yapısı

Şekil 3, Matlab/Simulink kullanılarak gerçekleştirilmiş bir doğrusal olmayan kontrol sistemini göstermektedir. Matlab, tüm mühendislik alanları ile birlikte kimya, matematik, ekonomi, fizik, biyoloji ve dünya bilimi uygulamalarını da bir bilgisayar ortamına taşıyarak laboratuar ortamı oluşturmakta yazılımlar arasında önemli bir avantaja sahiptir. Şekil 3'deki gibi bir ters sarkaç deneyi matematiksel modeliyle sanal ortama taşınarak animasyonla görsellik kazandırılmıştır. Blok diyagram yapısı oldukça kolaylık sağlayan bu programın, sanal laboratuar oluşturmak için etkinliği ön plandadır. Etkileşimli bir kullanıcı ara yüzü sunarak anlaşılırlığı kolaylaştırmaktadır [8,9].



Şekil 3. Ters sarkaç problemi için Simulink diyagramı ve animasyonu

Üniversitelerimizdeki Laboratuarlar İçin Genel Durum

Elektrik ve elektronik bölümlerinin her biri, oldukça pahalı olan birçok laboratuar oluşturmaları gereklidir. Bu laboratuarlardan bir kısmı hem elektrik hemde elektronik ortak olarak kullanılabilmektedir. Bu bölümlerin kullandığı laboratuarlar teknolojik gelişmelerin en fazla görüldüğü deney setlerine sahip olduklarından cihazların sıkça değiştirilmesi gerekmektedir ve dolayısıyla maliyetleri de orantılı olarak artmaktadır. Bu iki bölüm dalı kendi alanında tüm eğitim süresi boyunca yaklaşık 10-15 kadar laboratuara sahiptir. Bu laboratuarların bazıları Temel Elektrik Lab., Temel Elektronik Lab., Elektrik Makinaları ve Sürücüler Lab., Mantık Tasarımı Lab., Mikrobilgisayar Lab., Süreç Denetimi Lab., Elektronik ve Telekominükasyon Araştırma Lab., Anten ve Yayılım Lab., Mikrodalga Lab., Güç Sistemleri Lab., Robotik Lab., Yüksek Gerilim Lab., Biomedikal Lab., Görüntü İşleme Lab., Örüntü Tanıma Lab., Paralel Bilgisayarlar Lab., Bilgisayar Sistemleri Lab., Mikroişlemciler Lab. olarak sıralanabilir. Örneğin ileri araştırma çalışmalarının da yapılabildiği ve 100 öğrenciye hizmet edebilecek bir Elektrik Makinaları Laboratuarının yaklaşık kurulum maliyetinin 250.000-500.000 $ olduğu düşünüldüğünde her üniversitenin her laboratuarı kurmaya mali gücünün yeterli olmayacağı ve üniversiteler arası eğitim düzensizliğinin oluşacağı aşikardır. Oysa Matlab veya benzer paket program tabanlı sanal bir laboratuarın diğer gereksinimleri ile birlikte yaklaşık 15.000-25.000 $'lık maliyete sahip olacağı göz önüne alındığında her üniversitede istenilen laboratuarların oluşturulması, eğitim düzeninin sağlanması, yatırım fırsat eşitliğinin düzeltilmesi ve etkin bir laboratuar kullanımının yakalanması mümkün olabilecektir. Ülkemizde bazı üniversitelerdeki laboratuar sayıları şöyledir.

Sonuçlar

Burada bir sanal laboratuar sisteminin geliştirilmesi için temel kavramlar sunulmuş ve elektrik ve elektronik kontrol ve tasarım problemleri için sanal laboratuar kullanımı destekçi bir yaklaşımla önerilmiştir. Sanal laboratuar, sisteminin katmanları, malzeme, öğrenci performansı ölçme ve deney oluşturma amaçları için birçok avantaja sahiptir. Sistem pratisyen stajyer için bir donanım eğitici veya öğrenciler için bir laboratuar kursu için kullanışlı bir alternatif olarak görülebilir. Sanal ortamın kullanılması özellikle maliyetler bakımından çok avantajlıdır çünkü bir laboratuar için ihtiyaç duyulan donanım devresi ve cihazların maliyeti çok büyük oranlarda azalmaktadır.

Sınırlı bir ekonomiye sahip olan ülkemizde özellikle üniversitelerde her bölüme laboratuar alınması önemli ölçüde bir bütçe payı gerektirmektedir. Ancak ülke genelinde bir proje kapsamında geliştirilecek sanal laboratuar önemli ölçüde maliyet azaltacak, eğitim kalitesini artıracak ve kolayca güncellenebilecektir. Hatta bir ürün olarak başka ülkelere pazarlanabilecektir.

Şüphesiz ki gerçek ortamlar tecrübe oluşumu ve bilgi pekişimi için vazgeçilmezdir. Ancak bu çalışmada açıklanan meslek yüksek okulu eğitimi için sanal laboratuarların kullanılmalarının gerekleri ve faydaları göz önüne alındığında, sanal laboratuarlar oluşturmanın özellikle ülkemiz için çok daha yararlı olacağı düşünülmektedir.

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APPLICATION OF PLC BASED LABORATORY EDUCATION SET IN TECHNICAL SCIENCE AND VOCATIONAL SCHOOL

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ABSTRACT: Power electronics equipment and application has important role in industry. It effects most of are in electrical-and electrical engineering such as, power generation, transmission, electrical machine, renewable energy. Therefore it is necessary in electrical and electronics education, the course are based on power electronics have to be learned well by student in vocational school of technical science or electrical and electronics engineering. The aim of his paper is to investigate the effects of power electronics laboratory and experiments on learning of power electronics course and try to give vision to faculty of electrical- electronics engineering and vocation schools.

Key words: Power electronics experiments, Education in Electrical & Electronics, Technical Science vocational school

TEKNİK BİLİMLER MESLEK YÜKSEK OKULLAR için PLC BAZLI LABORATUVAR UYGULAMALRI

ÖZET: Genel kullanımlı bilgisayarların aksine PLC birçok girişi ve çıkışı olacak şekilde düzenlenir ve elektriksel gürültülere, sıcaklık farklarına, mekanik darbe ve titreşimlere karşı daha dayanıklı tasarlanırlar. PLC'lere denetleyeceği sistemin işleyişine uygun programlar yüklenir. PLC programları, giriş bilgilerini milisaniyeler mertebesinde hızla tarayarak buna uygun çıkış bilgilerini gerçek zamanlıya yakın, cevap verecek şekilde çalışırlar.

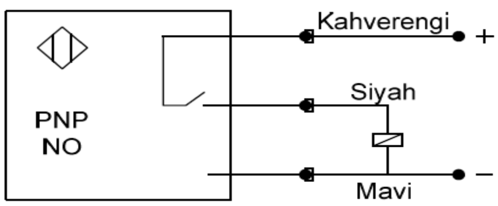
Anahtar sözcükler: PLC, Elektrik-Elektronik Eğitimi, Teknik Bilimler Meslek Yüksek Okulları.

GİRİŞ

Sistemde kullanılan PLC’nin; 10 bit sayısal çıkısı, 14 bit sayısal girisi bulunmaktadır. Sayısal çıkısları yarıiletken çıkıslıdır. Sayısal giris/çıkıs sinyalleri 0/+24V’luk gerilim seviyelerini kullanmaktadır. 4096 word kullanıcı program hafızası, kalıcı olarak saklanabilen 2560 word veri hafızası bulunmaktadır. PLC, 24 VDC gerilimle beslenmekte ve yük durumuna göre max 700 mA akım çekmektedir. PLC’nin programlanması için bir adet seri portu bulunmaktadır. Port 0’a programlama kablosu bağlanarak PLC programlanır.

PLC programlama kablosu (PPI) ile Siemens PLC‘ler programlanmakta ve PLC programı on-line izlenebilmektedir. 1 numara ile gösterilen kısım bilgisayarın USB portuna takılan konnektörüdür. 2 numara ile gösterilen konnektör PLC’nin Port 0 konnektörüne takılan kısımdır. 3 numara ile gösterilen kısım kablonun üzerinde ki elektronik devrenin bulunduğu kısımdır. Bu kısım PLC-PC haberlesmesini sağlayan bilgilerin birbirine çevrildiği kısımdır.

Endüktif sensörler Metal’e duyarlılık gösterdiğinden bu sensörlere bir metal nesne yaklastırıldığında çıkış sinyali üretecektir. Sensörün bu özelliğinden yararlanarak Asansör kabininin hangi katta olduğu anlasılmaktadır. Asansör Kabinine yerlestirilen metal nesne katlarda bulunan sensörlerin önünden geçerken sensörlerin sinyal üretmesine neden olur. Böylece kabinin konum bilgisi anlaşılmaktadır.

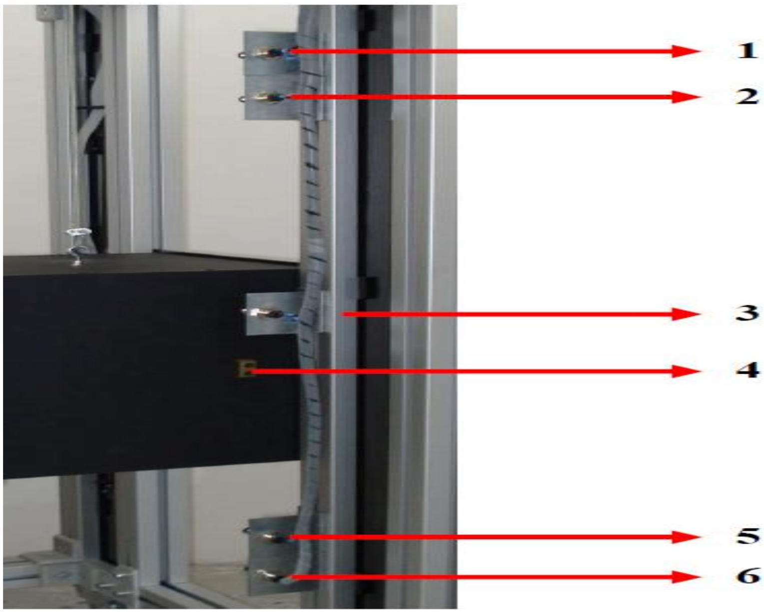


Şekil 1. Asansör Eğitim Setinde Kullanılan Sensörün Bağlantısı

YÖNTEM

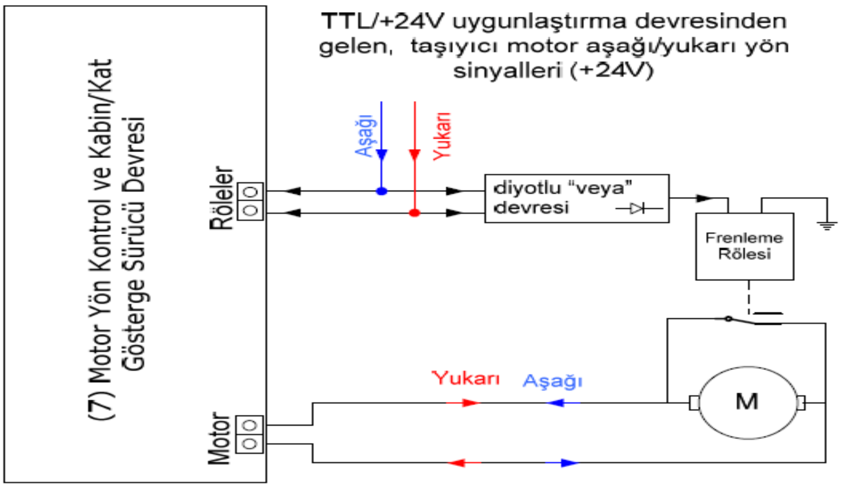
Kullanılan sensörlerin çalısma voltaj aralığı 10-30 Vdc'dir. 24 V'da 200 mA akım çekmektedir. Sinyal çıkısı siyah uçtan alınmaktadır. Sinyal ucu Normalde Açık seklindedir. Sensör metal bir nesne algıladığında üzerindeki kırmızı led yanar ve sinyal ucunda +24v görülür. Endüktif sensörlerin algılama mesafesi metalin tipine bağlı olduğundan, her cismi aynı mesafeden algılayamamaktadır. Bunun için kullanılan sensörün karakteristik özelliklerine dikkat etmek gerekir. Kullanılabilecek sensorler şunlardır

1. Ust Sınır Sensoru
2. 3. Kat Sınır Sensoru
3. 2. Kat Sınır Sensoru
4. Sensor Uyarıcı Metal
5. 1. Kat Sınır Sensoru
6. Alt Sınır Sensoru



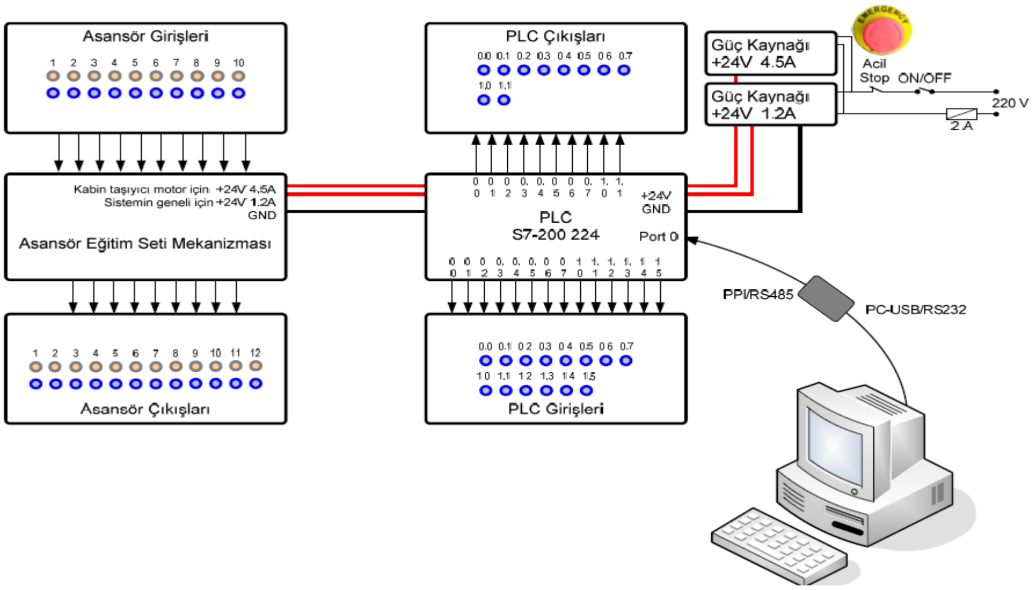
Şekil 2. Kat sensörleri ve alt sınır/üst sınır sensörleri

Tasıyıcı motorun enerjisi kesildiğinde kabini, istenen noktada durdurabilmek için frenleme devresi kullanılmıstır. Şekil 3'de görülen röle bu frenleme devresinde kullanılmaktadır. Asağıda frenleme devresinin prensip şeması görülmektedir.



Şekil 3. Tasıyıcı Motor Fren Rolesi

BULGULAR



Şekil 4. Asansör Eğitim Seti Blok Seması

Motor Yön Kontrol Devresinin, Röleler klemensine bir sinyal geldiği anda “veya” devresi üzerinden Frenleme Rölesi enerjilenecek ve Motor uçlarına bağlı Normalde kapalı kontak açılacaktır. Veya devresi ile Tasıyıcı motorun her iki yönündeki hareketi için de frenleme devresi çalıstırılacaktır. Böylece tasıyıcı motor enerjilendiğinde frenleme rölesi motor uçlarını serbest bıraktığından yukarıya veya asağıya hareketi gerçeklesecektir. Rölelere gelen asağı/yukarı sinyali kesildiği anda Tasıyıcı Motorun Enerjisi kesilecek ve aynı anda frenleme rölesi kontakları kapanacaktır. Bu anda tasıyıcı motor üzerindeki enerji hızlı bir sekilde desarj olacaktır. Böylece kabinin istenen noktada durması sağlanmıs olmaktadır. Aksi halde motorun enerjisi kesildiğinde serbest kalan motor ve asansör kabininde, ataletten dolayı kaymalar yasanabilmektedir. Gerçek asansörlerde frenleme sistemi mekanik (balatalı), değisken devirli motorlar veya elektronik devreler yardımı ile (invertör) yapılmaktadır.

SONUÇ

Asansör kabininin asağı/yukarı hareketi, bağlı olduğu çelik halat ile sağlanmaktadır. Asansör kabininin üzerinde, gerçek asansörlerde olduğu gibi tus takımı bulunmaktadır. Ayrıca kabin içi aydınlatma ve kapı güvenlik kilidi mekanizmaları mevcuttur. Tüm bu birimler PLC ile kontrol edilebilmektedir.

Bosaltım ve Tasıma İstasyonunu için PLC programı gelistirmek/düzenlemek ve sistemin giris/çıkıslarını bilgisayar ortamında izleyebilmek için kullanılan orijinal yazılımdır. Step 7-Micro/WIN programının bir bilgisayara kurulumu için gerekli minimum özellikleri;

- Windows 98 ve üzeri isletim sistemi
- En Az 50 Mb Hard Disk alanı
- En Az 128 Mb RAM
- Fare

Table 1. Asansör Eğitim Seti Giris/Çıkıs Bağlantı Noktaları

	Lift Inputs	Connection	PLC Outputs	
1	Data A	X	Q 0.0	Digital Outputs
2	Data B	X	Q 0.1	
3	Floor1 Led	X	Q 0.2	
4	Floor2 Led	X	Q 0.3	
5	Floor3 Led	X	Q 0.4	
6	Emergency Led	X	Q 0.5	
7	Door Open	X	Q 0.6	
8	Lighting	X	Q 0.7	
9	Cabin Down	X	Q 1.0	
10	Cabin Up	X	Q 1.1	
	Lift Outputs	**Connection**	**PLC Inputs**	
1	Start Button	X	I 0.0	Digital Inputs
2	Stop Button	X	I 0.1	
3	Floor 1 Calling	X	I 0.2	
4	Floor 2 Calling	X	I 0.3	
5	Floor 3 Calling	X	I 0.4	
6	Emergency Button	X	I 0.5	
7	Door Control (Limit Switch)	X	I 0.6	
8	Bottom Limit (Inductive Sensor)	X	I 0.7	
9	Top Limit (Inductive Sensor)	X	I 1.0	
10	Floor 1 Limit (Inductive Sensor)	X	I 1.1	
11	Floor 2 Limit (Inductive Sensor)	X	I 1.2	
12	Floor 3 Limit (Inductive Sensor)	X	I 1.3	
13	Empty		I 1.4	
14	Empty		I 1.5	

Asansor Eğitim Setinin, gelen demo yazılıma uygun olarak calıstırılması istenirse, PLC giris/cıkısı ile sistem giris/cıkıslarının, tabloya gore (X) verilen ara kablolar ile bağlanması gerekmektedir.

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APPLICATION OF LABORATORY EQUIPMENT FOR POWER ELECTRONICS IN VOCATIONAL SCHOOL OF TECHNICAL SCIENCE

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ABSTRACT: Today PLC, servo motors, conveyor and pneumatic systems are necessary equipment and topics for industrial automation. Therefore for that issue is very popular for vocal schools and engineering faculties. The course are based on electrical-electronics and mechanical engineering have to support by additional practical materials. The aim of that paper is focused on PLC based training education such as Elevator training set, the conveyor training set and servo - pneumatic training set. The paper propose a brief usage of mentioned PLC based sets and their effects on electrical course education in vocational school of technical science.

Key words:PLC, servo motors,pneumatic systems, education in Electrical & Electronics, Technical Science vocational school

GİRİŞ

Öğrenme-öğretme süresi boyunca bireyin ön plana çıkarılması, öğretme ve öğrenmenin öğrenci merkezli olması, bu süre boyunca uygulanacak tekniklerin çağdaş bir anlayışla zamanın gerekliliklerine uygun biçimde tasarlanması, uygulanması, değerlendirilmesi ve geliştirilmesi ile mümkün olacaktır (Boynak, 2004). Bilgisayar teknolojisinin sunduğu imkânlardan yararlanmasını bilen, bilgiye erişebilen, kullanabilen ve en önemlisi de bilgi üretebilen nesillerin yetiştirilmesi gerekliliği eğitim alanında bilgisayar teknolojisinin kullanılmasını zorunlu hale getirmiştir (Arıcı ve Dalkılıç, 2006). Hangi amaçla olursa olsun bilgisayar teknolojisinin yeri ve öneminin anlaşıldığı günümüzde artık asıl mesele onun etkin ve verimli kullanımı meselesidir (Çekbaş, Yakar, Yıldırım ve Savran, 2003). Aynı zamanda daha çok sayıda bireye daha kısa sürede daha fazla bilginin kalıcı şekilde aktarılması da bu tanıma girmektedir (Tekiner ve Korkut 2001). Literatürde Bilgisayar Destekli Öğretim olarak tanımlanan bu öğretim biçiminin öğrenme-öğretme sürecine sağlayacağı faydalar pek çok araştırma ve geliştirilen eğitim yazılımı uygulamaları ile kanıtlanmaya çalışılmıştır (Semerci, 2001). Bilgisayar Destekli Öğretim sürecinin başarısını doğrudan etkileyen eğitim yazılımları hazırlanmasında görsel yazılım tekniklerine sıkça başvurulmaktadır. Çünkü bu teknikler öğrencinin bütün duyu organlarına hitap edebilme imkanı sağlamaktadır (Arıcı ve Dalkılıç, 2006). Üniversitelerde ve mesleki-teknik eğitim veren liselerin ilgili bölümlerinde uygulanabilmektedir (Ekiz, Bayam ve Ünal, 2003). Bu konunun geleneksel yollarla öğretiminde devrenin işleyiş mantığının açıklanması sırasında gerçekleşen soyut iş adımlarının görselleştirilmesinde güçlüklerle karşılaşılmaktadır (Güzelbey ve Bayseç). Bunun için öğretici onlarca tablo hazırlamak zorunda kalmakta, öğrenci ise olayları kafasında canlandırmakta ve bütünleştirmekte zorlanmaktadır. Halbuki bilgisayar destekli ve kartlarda gerçekleşen işlemlerin görselleştirilmesi, konunun açıklanmasını ve anlaşılmasını kolaylaştıracaktır.

YÖNTEM

Bu uygulamada ana bilgisayar dediğimiz bir bilgisayara bağlı sayı sınırlaması olmamakla birlikte öğreticinin takip edebileceği sayıda bilgisayarın bağlanması mümkündür. Ana bilgisayar hem bilgisayarları kontrol etmekte hem de farklı veya aynı deney kartlarını ayrı olarak kontrol etmektedir.

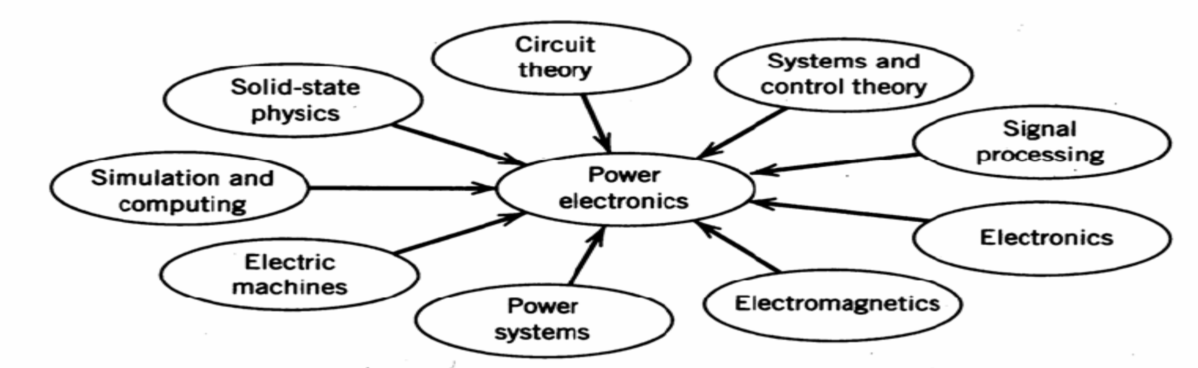
Ana bilgisayar üzerinden hangi işlemlerin yapılacağını şöyle sıralayabiliriz:

1. Bilgisayarları kontrol etmek
2. Kartları, bağlantı portları üzerinden kontrol etmek
3. Kartlara arıza göndererek öğrenciye problemler sunabilmek
4. Arızaların algoritma yöntemiyle bulunmasını sağlamak
5. Ayrı öğrenme düzeyine sahip öğrencilere ayrı hız ve öğretim yöntemlerini sunabilmek
6. Elektriksel büyüklüklerin grafik ve simülasyonlarını öğrenci bilgisayarlarında gösterebilmek

7. Süreyi ayarlayabilmek, uzun zaman alan deneylerin kaydedilerek birden çok haftada işlenmesini sağlamak
8. Her öğrencinin ayrı ayrı deneylerini kaydederek tüm performanslarını zaman ve grafiksel olarak görebilmek
9. Deney sırasında bilgisayarların sadece deneysel amaçlı kullanımlarını sağlamak
10. İhtiyaç halinde başka programlar ile bağlantı kurularak (internet dahil) problemin optimum çözümünü sağlamak

Öğrenci bilgisayarları ise;
1. Kartların görüntüsünü bilgisayarda görebilir
2. Deneyin çalışmasını adım adım izleyebilir
3. Devreye bağlı elemanlar ile ilgili dokümanlara istediği zaman bakabilir
4. Ana bilgisayarda verilen arızayı tespit için işlemler yapabilir, arızayı giderebilir
5. Devrenin elektriksel grafik ve eğrilerini görebilir
6. Ana bilgisayar ve diğer bilgisayarlar ile iletişim kurabilir
7. Yaptığı deneyleri kaydedebilir
8. Öğrenme hızına göre arkadaşlarından farklı deneylere bakabilir
9. Gerektiğinde başka programlar çalıştırarak işlemler yapabilir

Bunların yanında daha sayamadığımız birçok işlem ve görevi yaptırmamız mümkündür. Bunlarla ilgili daha açıklayıcı olması için şekil 1'de bağlantılar ve durumlar verilmiştir.



Şekil 1: Bilgisayar Destekli Deney Kartlarının Tümleşik Kontrol Edilmesi

Bilgisayar kontrollü deney kartlarının yapımı ve uygulaması konusunda birçok şirket ve üniversite çalışıyor olsa dahi, profesyonel anlamda ve dünya çapında referansları iyi sayılan 3 önemli isim vardır. Bu üç isimde birbirine yakın özelliklerde işlemleri sunabilmektedirler. Lucas Nülle Labsoft Unitrain Deney Kartları ve Programı ile yapılmış bir örnek çalışma sunmak, konunun daha açıklayıcı ve anlaşılır olabilmesini sağlayacaktır.

Uygulama için gerekli 5 temel öğe vardır. Bunlar; bilgisayar, program, modül, deney kartları ve bağlantı modemidir. Bu öğelerin bağlantı durumları Şekil.2'de blok olarak gösterilmiştir. Bu öğeleri inceleyecek olursak;

Bilgisayar
Programı çalıştırabilecek hızda ve portları mevcut olmalıdır. Her bilgisayar ağa bağlı ve modüle sahip olmalıdır.

Program

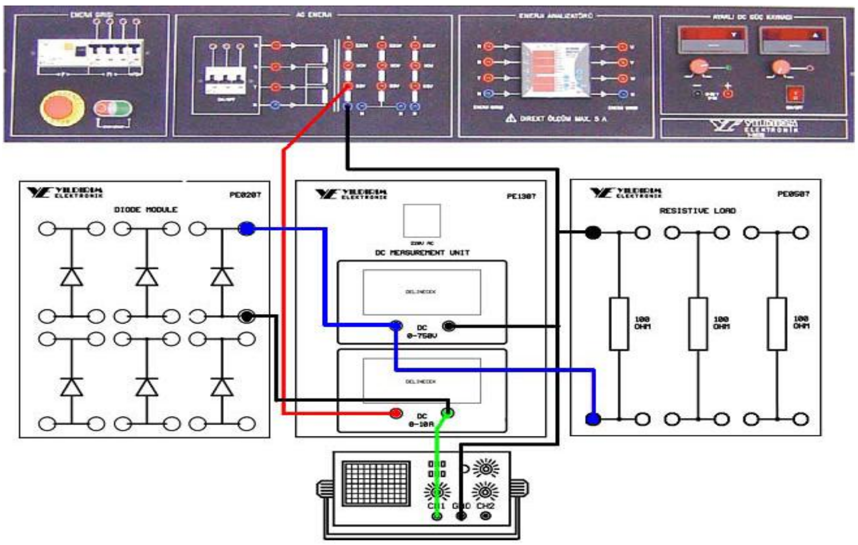
Tüm işletim sistemleri ile uyumlu çalışabilen, flash ve animasyonlar ile desteklenmiş görsel bir programdır. Bunun içerisinde bulunan önemli bazı öğeler;
a) Bağlantı modülünün gerçek görüntüsü
b) Bağlanacak kartın gerçek görüntüsü
c) Deney hakkında teorik bilgi
d) Deneyde kullanılacak elemanların gerçek görüntüsü ve karakteristikleri
e) Deneyin sembolik görüntüsü
f) Ölçü aletlerinin gerçek ve sanal görüntüsü
g) Deneydeki bağlantıların animasyon görüntüsü
h) Yanlış bağlantıların gösterimi ve hataların düzeltilmesi için yol gösterimi
i) Güç kaynakları

j) Not tutabilme, kayıt ve çıktı
k) Aşamalı olarak tüm deneylerin simülasyon gösterimi
l) Deneyde elde edilen veriler ile grafik çizimleri
m) Konu ile alakalı teorik bilgi ve problemler

Experiment Sets

Deney kartlarını yerleştirdiğimiz ve bilgisayara paralel port ile bağlı kısımdır. Bilgisayar kart ile bağlantıyı bu modül ile sağlar.Şekil.3'te modül görüntüsü mevcuttur.

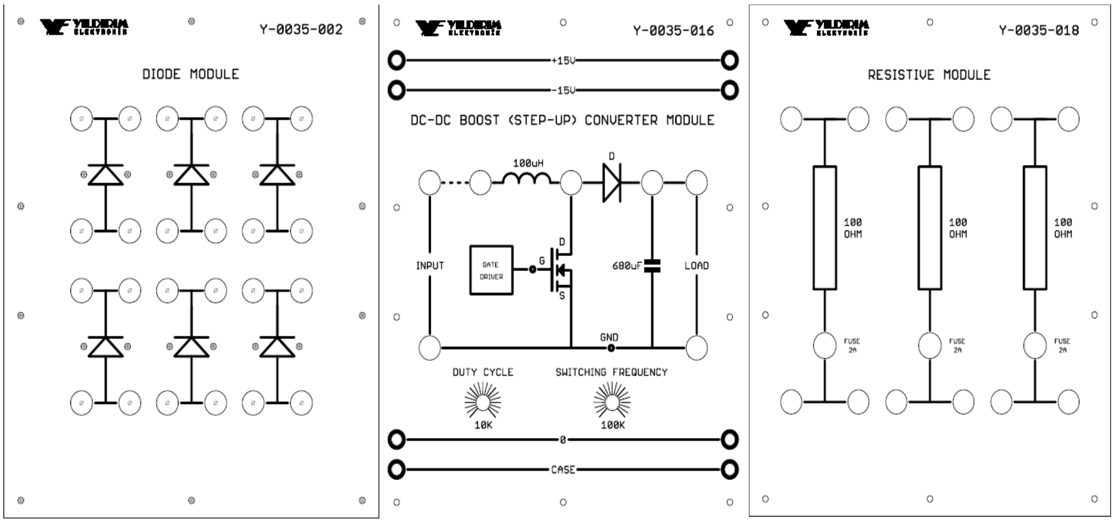
Şekil 2. Power Electronics Experiments Training Set



Şekil 3. Some Experiments in Power Electronics

Deney Kartları

Birden çok deneyin yapılabildiği, takıp çıkarılabilen portatif elektronik devrelerdir. Bir kartta birden çok deney yapmak mümkündür. Programda yapılacak deneye göre kart seçilir ve modüle yerleştirilir. Şekil.4' te farklı amaçlı kartlar görülmektedir.



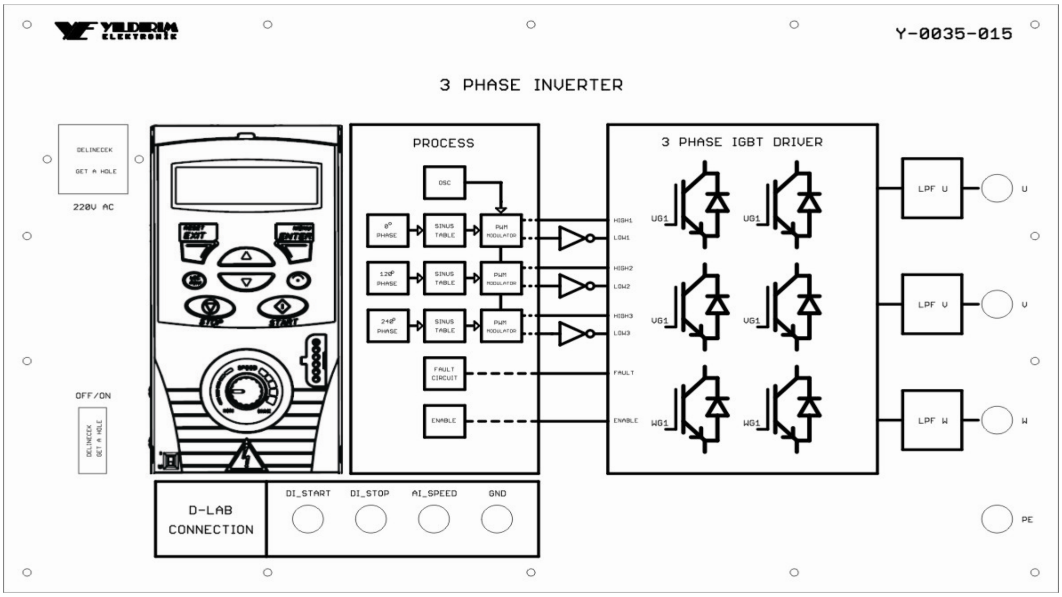
Şekil 4. Farklı özellikteki bazı deney kartları

Bağlantı Modemi

Tüm bilgisayarların bağlandığı ve ana bilgisayarın buradan bilgisayarlara kontrol sağladığı birimdir. Port sayısı bilgisayar sayısına göre seçilir.

Sistemin Çalıştırılması

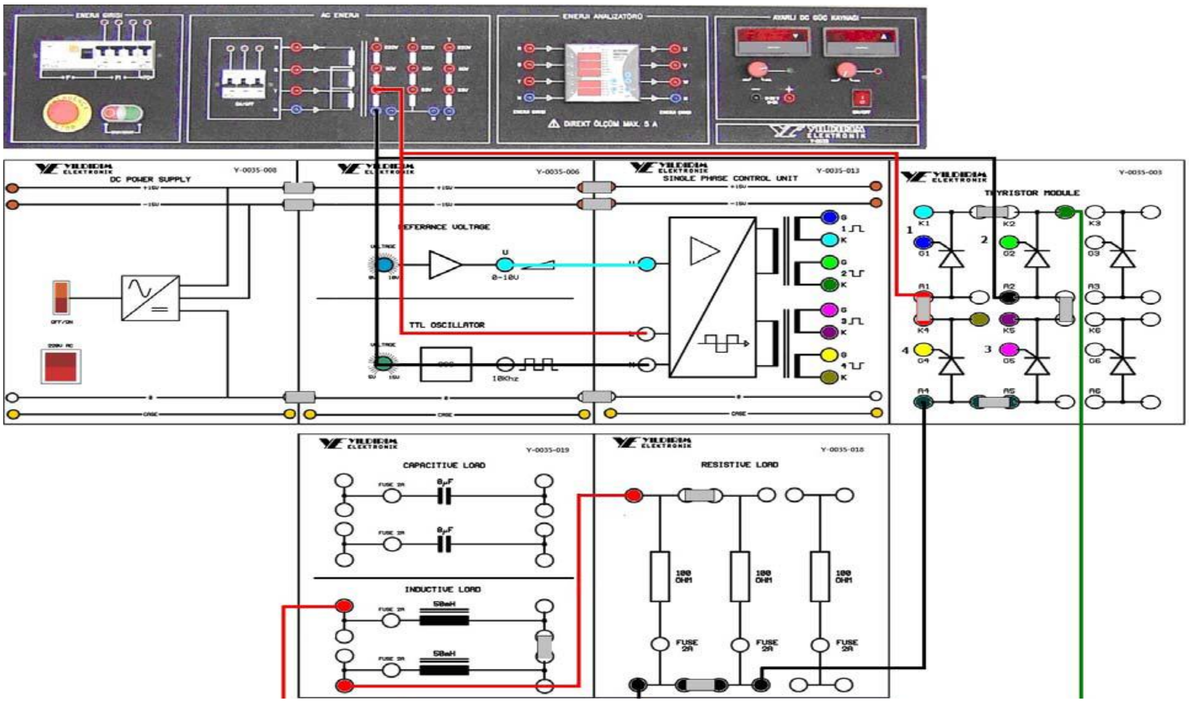
Bunun için örnek bir deney uygulaması yapalım. Yapacağımız deney bir yükseltici devresi(Amplifikatör) olsun. Devrenin şeması programımızda mevcuttur (Şekil.5).



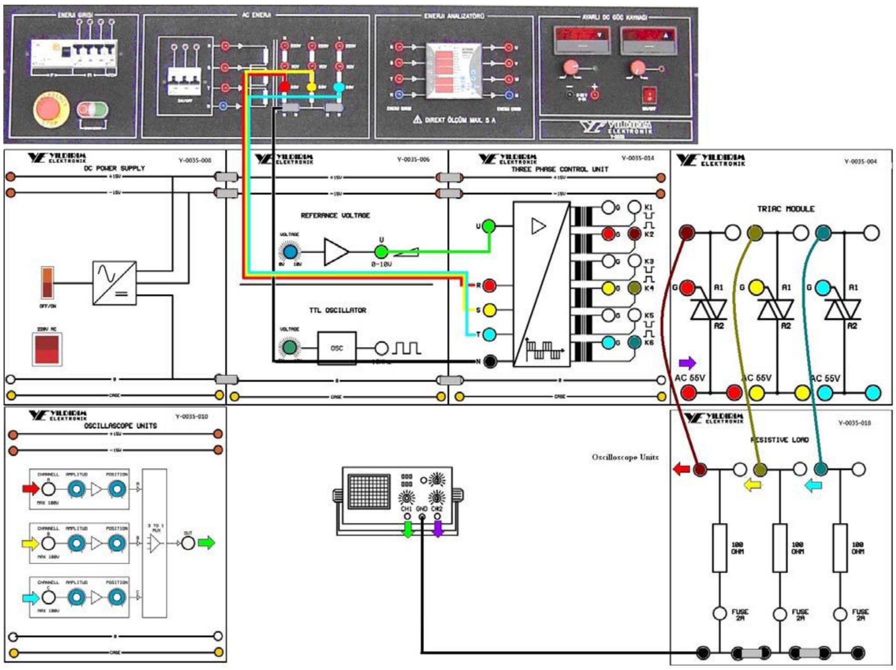
Şekil 5. Power Electronics three phase inverter module

Deney, program çalıştırıldıktan sonra menüden yapılacak deney ve deney kartı seçimi ile devam eder (Şekil.4). Daha sonra yapılacak deney kartı modüle takılarak istenirse programın yönlendirmesi ile bağlantıları yapılır (Şekil.5, 6 ve 7).

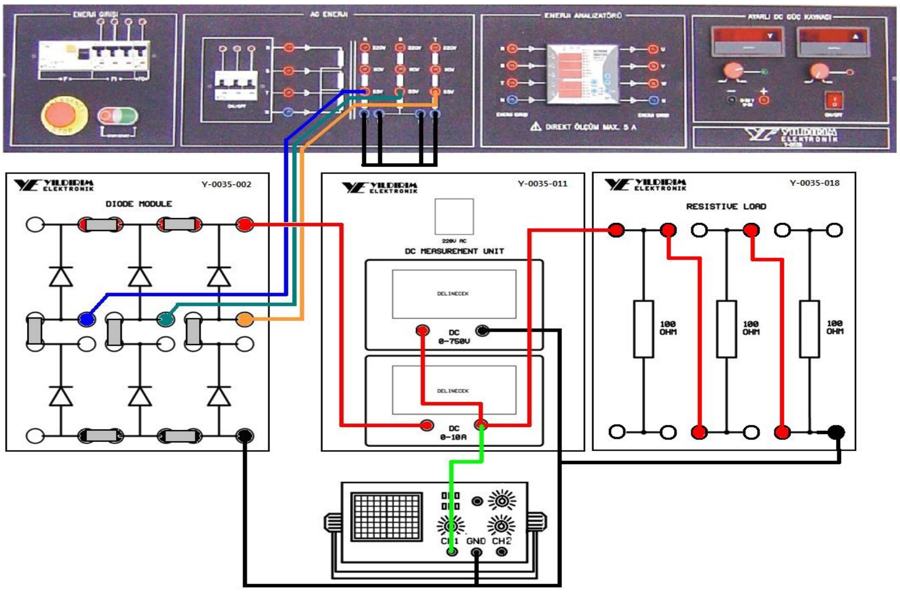
Bağlantı işleri tamamlandıktan sonra gerekirse bu konu ile ilgili teorik bilgiye bakılır (Şekil7 ve 8). Gerekirse konu program içindeki problemler ile daha da pekiştirilir.



Şekil 6. Singel Phase Full controlled Rectifier (With ohmic load)



Şekil 7. Three Phase Full controlled AC-AC converter (With ohmic load)



Şekil 8. Three Phase Full Wave Rectifier (With ohmic load)

Daha sonra gerekli hazırlıklar yapıldıktan sonra devreye enerji verme işlemine geçilir. Tabiki enerji verilirken devrede oluşan olayları gözlemlememiz ancak ölçü aletleri ile mümkündür. Bunun için örnek olarak dalga şeklini gösteren hepimizin görmüş olduğu osiloskobu kullanırız. Burada kullanılan ölçü aletleri gerçek ile tamamen benzerlik göstermektedir. Devreye enerji verildikten sonra diğer ölçü aletleri ile farklı büyüklükler ölçmek mümkündür.

Devre yapılırken oluşan hataları program göstermekte, doğru çözümü de istendiği taktirde ekrana getirmektedir. Ana bilgisayardan öğrenci bilgisayarlarına müdahale edilerek gerekli düzeltmeler yapılabildiği gibi, yapılan doğru problemin hatalı duruma getirilerek öğrencinin bu hatayı bulması sağlanabilmektedir. Bunların yanı sıra anabilgisayardan öğrenci bilgisayarlarında oluşan hatalar, işlemler, grafikler görülebilmektedir.

Bunların dışında daha birçok işlem bulunmakla birlikte burada asıl anlatılmak istenen bu deney kartlarının öğretime sağladığı katkılardır. Zaman, malzeme, farklı öğrenme düzeyleri, gelişen teknolojiye adaptasyon, maddi kazançlar ve saymadığımız daha birçok nedenden dolayı bu yöndeki uygulamaların öğretime katkıları oldukça fazladır.

BULGULAR

Birçok Bilgisayar Destekli Deney Kartlarının yazılımları, öğrencinin verdiği cevaplar doğrultusunda deneyi sunar ya da öğrenciye belli aralıklarla dönüt sağlar. Bu yüzden Bilgisayar Destekli Deney, ortamındaki her öğrencinin aktif şekilde deneye katılması, deneydeki performansını gösterebilme imkanı vermesi ve öğrenciye dönüt sağlayabilmesi nedeniyle öğrencinin deneye katılımını sürekli hale getirir.

Bilgisayar Destekli Deney Kartlarının uygulanmasında, bir öğrencinin bir deney üzerinde harcadığı zaman ve gösterdiği performans, bilgisayar tarafından kayıt edilebilir ve istendiği zaman öğreticinin kullanımına sunulabilir. Öğrenci performansı hakkındaki bu bilgiler, öğreticinin öğrencileri gözlemlemesi ve onları ihtiyaçları doğrultusunda yönlendirmesi bakımından oldukça önemlidir. Klasik deneysel öğrenme ortamlarında, öğreticinin her öğrencinin performansını gözlemlemesi ve buna bağlı olarak öğrenciyi yönlendirmesi oldukça zordur.

TARTIŞMA ve SONUÇ

Klasik deneysel öğretim ortamlarındaki öğrenciler, belli deneyleri belli zaman dilimleri içinde yapmalı ve belirlenmiş öğretimsel etkinlikler yine belirli zaman dilimleri içinde gerçekleştirilmelidir. Diğer taraftan, Bilgisayar Destekli Deney Kartlarının uygulanmasında bir öğrenci istediği öğretimsel etkinlikleri istediği zaman ders saati dışında kalan zamanlarda da uygulayabilir ya da tekrar edilebilir. Bu etkinlikleri evde bilgisayar başında uygulama şansı bulabilir.

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EFFECTS OF COMPUTER BASED EXPERIMENT CARDS IN ELECTRICAL-ELECTRONIC EDUCATION

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ABSTRACT: Currently computer based training equipment are favorite part of education in vocational school of technical science and department of electrical-electronics entering. Lucas NülleUni-Train system is computer based tool that is used in laboratory for electrical-electronics engineering experiments. It is A host of multimedia courses are available for the UniTrain system in the areas of electrical engineering and electronics. Each of the courses consists of the training program, specific circuitry on one or more experiment cards and a browser (LabSoft) for the control, management and display of the training course. UniTrain courses convey practical skills by providing a theoretical basis then guiding students through numerous experimental measurements. Experiment cards are linked to the Interface and the training program via Experimenters. With the help of virtual instruments and power sources included with the system, circuits can be analyzed and results of measurements stored directly within the training program. In that paper it is focused on usage of Uni-Train set for electrical and electronics experiments and it is also revealed the effects of that set on electrical-electronics engineering

Key words: Training Equipment, Education in Electrical & Electronics, Lucas Nülle

GİRİŞ

Öğrenme-öğretme süresi boyunca bireyin ön plana çıkarılması, öğretme ve öğrenmenin öğrenci merkezli olması, bu süre boyunca uygulanacak tekniklerin çağdaş bir anlayışla zamanın gerekliliklerine uygun biçimde tasarlanması, uygulanması, değerlendirilmesi ve geliştirilmesi ile mümkün olacaktır (Boynak, 2004). Bilgisayar teknolojisinin sunduğu imkânlardan yararlanmasını bilen, bilgiye erişebilen, kullanabilen ve en önemlisi de bilgi üretebilen nesillerin yetiştirilmesi gerekliliği eğitim alanında bilgisayar teknolojisinin kullanılmasını zorunlu hale getirmiştir (Arıcı ve Dalkılıç, 2006). Hangi amaçla olursa olsun bilgisayar teknolojisinin yeri ve öneminin anlaşıldığı günümüzde artık asıl mesele onun etkin ve verimli kullanımı meselesidir (Çekbaş, Yakar, Yıldırım ve Savran, 2003). Aynı zamanda daha çok sayıda bireye daha kısa sürede daha fazla bilginin kalıcı şekilde aktarılması da bu tanıma girmektedir (Tekiner ve Korkut 2001). Literatürde Bilgisayar Destekli Öğretim olarak tanımlanan bu öğretim biçiminin öğrenme-öğretme sürecine sağlayacağı faydalar pek çok araştırma ve geliştirilen eğitim yazılımı uygulamaları ile kanıtlanmaya çalışılmıştır (Semerci, 2001). Bilgisayar Destekli Öğretim sürecinin başarısını doğrudan etkileyen eğitim yazılımları hazırlanmasında görsel yazılım tekniklerine sıkça başvurulmaktadır. Çünkü bu teknikler öğrencinin bütün duyu organlarına hitap edebilme imkanı sağlamaktadır (Arıcı ve Dalkılıç, 2006). Üniversitelerde ve mesleki-teknik eğitim veren liselerin ilgili bölümlerinde uygulanabilmektedir (Ekiz, Bayam ve Ünal, 2003). Bu konunun geleneksel yollarla öğretiminde devrenin işleyiş mantığının açıklanması sırasında gerçekleşen soyut iş adımlarının görselleştirilmesinde güçlüklerle karşılaşılmaktadır (Güzelbey ve Bayseç). Bunun için öğretici onlarca tablo hazırlamak zorunda kalmakta, öğrenci ise olayları kafasında canlandırmakta ve bütünleştirmekte zorlanmaktadır. Halbuki bilgisayar destekli ve kartlarda gerçekleşen işlemlerin görselleştirilmesi, konunun açıklanmasını ve anlaşılmasını kolaylaştıracaktır.

YÖNTEM

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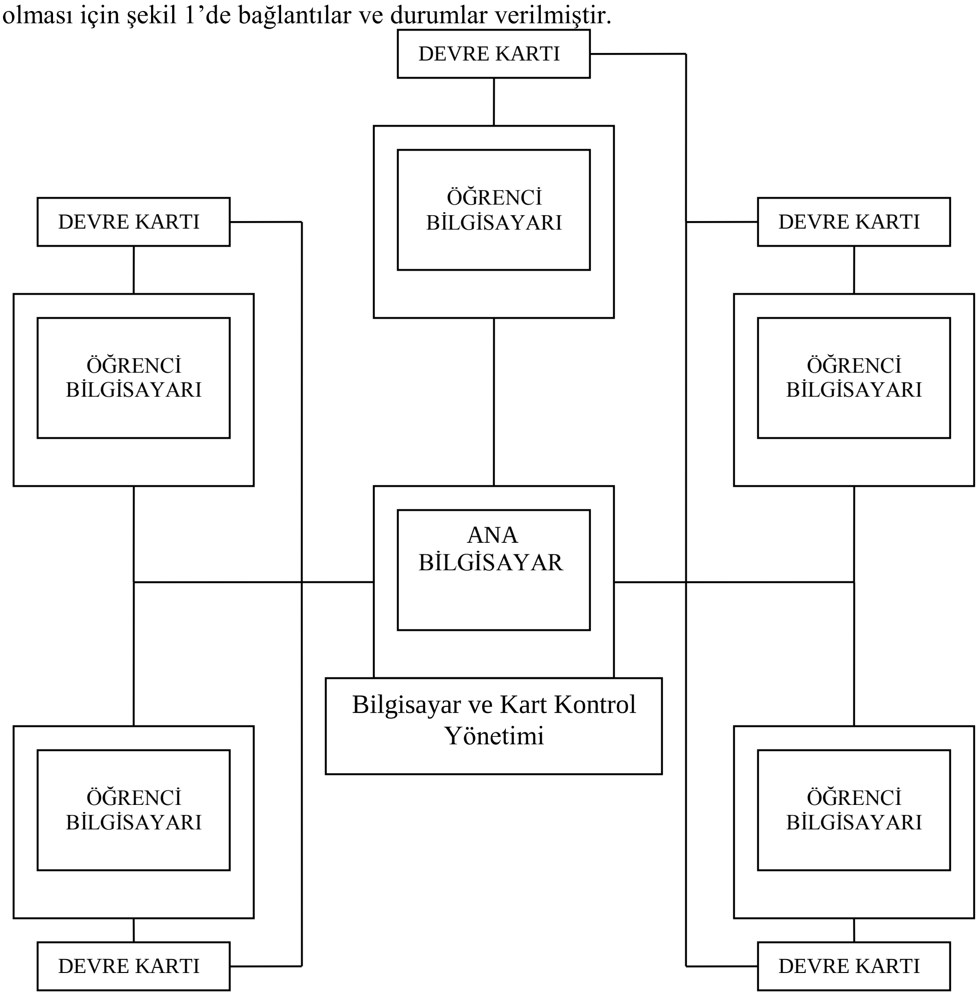
15. Ayrı öğrenme düzeyine sahip öğrencilere ayrı hız ve öğretim yöntemlerini sunabilmek
16. Elektriksel büyüklüklerin grafik ve simülasyonlarını öğrenci bilgisayarlarında gösterebilmek
17. Süreyi ayarlayabilmek, uzun zaman alan deneylerin kaydedilerek birden çok haftada işlenmesini sağlamak
18. Her öğrencinin ayrı ayrı deneylerini kaydederek tüm performanslarını zaman ve grafiksel olarak görebilmek
19. Deney sırasında bilgisayarların sadece deneysel amaçlı kullanımlarını sağlamak
20. İhtiyaç halinde başka programlar ile bağlantı kurularak (internet dahil) problemin optimum çözümünü sağlamak

Öğrenci bilgisayarları ise;

10. Kartların görüntüsünü bilgisayarda görebilir
11. Deneyin çalışmasını adım adım izleyebilir
12. Devreye bağlı elemanlar ile ilgili dokümanlara istediği zaman bakabilir
13. Ana bilgisayarda verilen arızayı tespit için işlemler yapabilir, arızayı giderebilir
14. Devrenin elektriksel grafik ve eğrilerini görebilir
15. Ana bilgisayar ve diğer bilgisayarlar ile iletişim kurabilir
16. Yaptığı deneyleri kaydedebilir
17. Öğrenme hızına göre arkadaşlarından farklı deneylere bakabilir
18. Gerektiğinde başka programlar çalıştırarak işlemler yapabilir

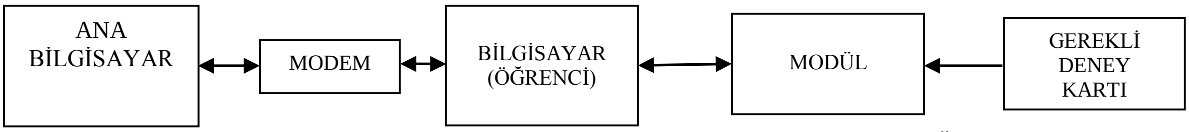
Bunların yanında daha sayamadığımız birçok işlem ve görevi yaptırmamız mümkündür. Bunlarla ilgili daha açıklayıcı olması için şekil 1'de bağlantılar ve durumlar verilmiştir.



Şekil 1. Bilgisayar Destekli Deney Kartlarının Tümleşik Kontrol Edilmesi

Bilgisayar kontrollü deney kartlarının yapımı ve uygulaması konusunda birçok şirket ve üniversite çalışıyor olsa dahi, profesyonel anlamda ve dünya çapında referansları iyi sayılan 3 önemli isim vardır. Bu üç isimde birbirine yakın özelliklerde işlemleri sunabilmektedirler. Lucas Nülle Labsoft Unitrain Deney Kartları ve Programı ile yapılmış bir örnek çalışma sunmak, konunun daha açıklayıcı ve anlaşılır olabilmesini sağlayacaktır.

Uygulama için gerekli 5 temel öğe vardır. Bunlar; bilgisayar, program, modül, deney kartları ve bağlantı modemidir. Bu öğelerin bağlantı durumları Şekil.2'de blok olarak gösterilmiştir. Bu öğeleri inceleyecek olursak;



Şekil 2. Bilgisayar Kontrollü Deney Kartlarını Oluşturan Temel Öğeler

Bilgisayar

Programı çalıştırabilecek hızda ve portları mevcut olmalıdır. Her bilgisayar ağa bağlı ve modüle sahip olmalıdır.

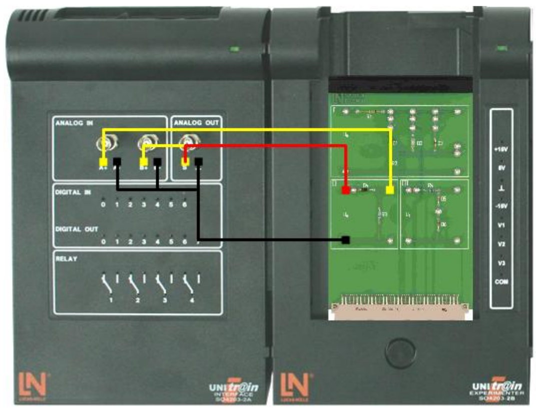
Program

Tüm işletim sistemleri ile uyumlu çalışabilen, flash ve animasyonlar ile desteklenmiş görsel bir programdır. Bunun içerisinde bulunan önemli bazı öğeler;

n) Bağlantı modülünün gerçek görüntüsü
o) Bağlanacak kartın gerçek görüntüsü
p) Deney hakkında teorik bilgi
q) Deneyde kullanılacak elemanların gerçek görüntüsü ve karakteristikleri
r) Deneyin sembolik görüntüsü
s) Ölçü aletlerinin gerçek ve sanal görüntüsü
t) Deneydeki bağlantıların animasyon görüntüsü
u) Yanlış bağlantıların gösterimi ve hataların düzeltilmesi için yol gösterimi
v) Güç kaynakları
w) Not tutabilme, kayıt ve çıktı
x) Aşamalı olarak tüm deneylerin simülasyon gösterimi
y) Deneyde elde edilen veriler ile grafik çizimleri
z) Konu ile alakalı teorik bilgi ve problemler

Modül

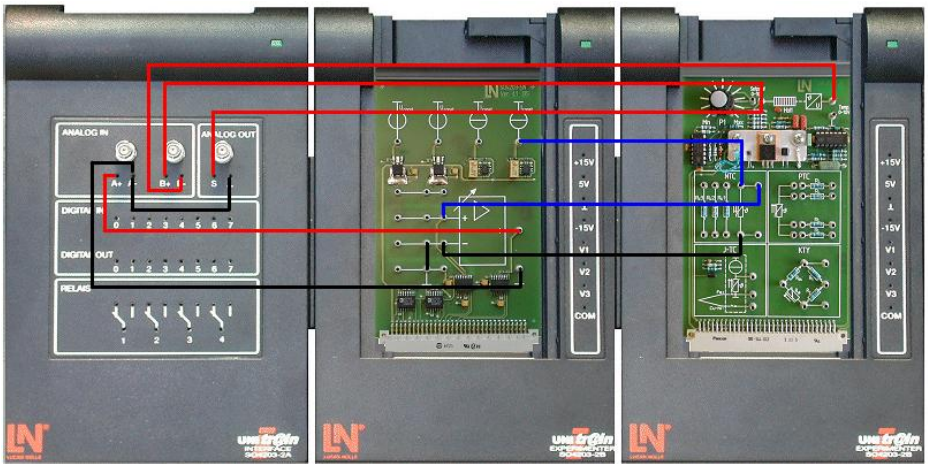
Deney kartlarını yerleştirdiğimiz ve bilgisayara paralel port ile bağlı kısımdır. Bilgisayar kart ile bağlantıyı bu modül ile sağlar.Şekil.3'te modül görüntüsü mevcuttur.



Şekil 3. Modül

Deney Kartları

Birden çok deneyin yapılabildiği, takıp çıkarılabilen portatif elektronik devrelerdir. Bir kartta birden çok deney yapmak mümkündür. Programda yapılacak deneye göre kart seçilir ve modüle yerleştirilir. Şekil.4'te farklı amaçlı kartlar görülmektedir.



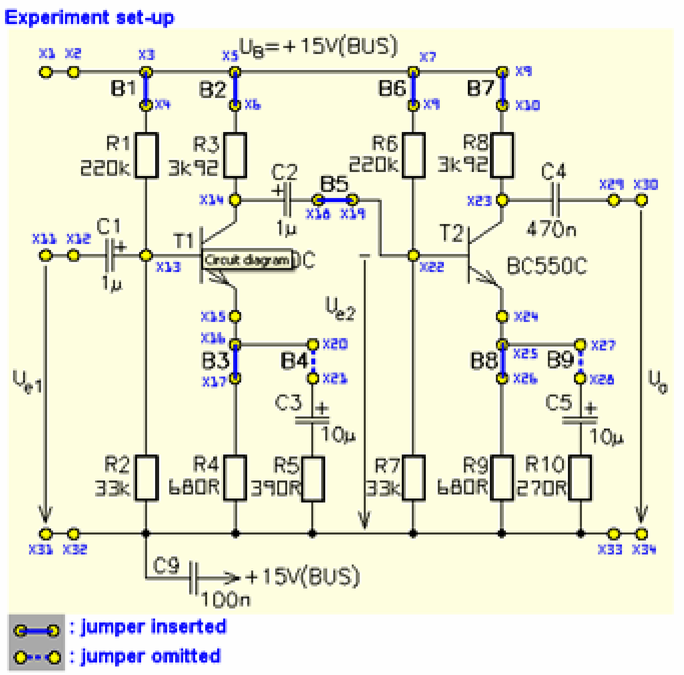
Şekil 4. Farklı özellikteki bazı deney kartları

Bağlantı Modemi

Tüm bilgisayarların bağlandığı ve ana bilgisayarın buradan bilgisayarlara kontrol sağladığı birimdir. Port sayısı bilgisayar sayısına göre seçilir.

Sistemin Çalıştırılması

Bunun için örnek bir deney uygulaması yapalım. Yapacağımız deney bir yükseltici devresi(Amplifikatör) olsun. Devrenin şeması programımızda mevcuttur (Şekil.5).



Şekil 5. Amplifikatör Devresi

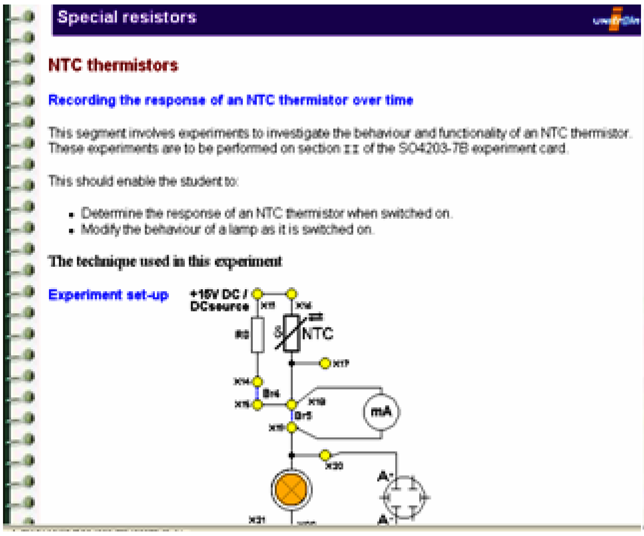
Deney, program çalıştırıldıktan sonra menüden yapılacak deney ve deney kartı seçimi ile devam eder (Şekil.4). Daha sonra yapılacak deney kartı modüle takılarak istenirse programın yönlendirmesi ile bağlantıları yapılır (Şekil.5, 6 ve 7).

a) Program menüsü

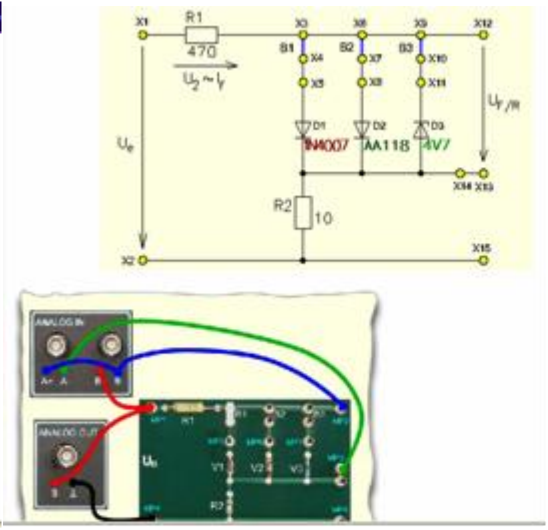
b) Deney kartının seçimi

Şekil 6. Program görüntüsünden kart seçimi

Bağlantı işleri tamamlandıktan sonra gerekirse bu konu ile ilgili teorik bilgiye bakılır(Şekil7 ve 8). Gerekirse konu program içindeki problemler ile daha da pekiştirilir.

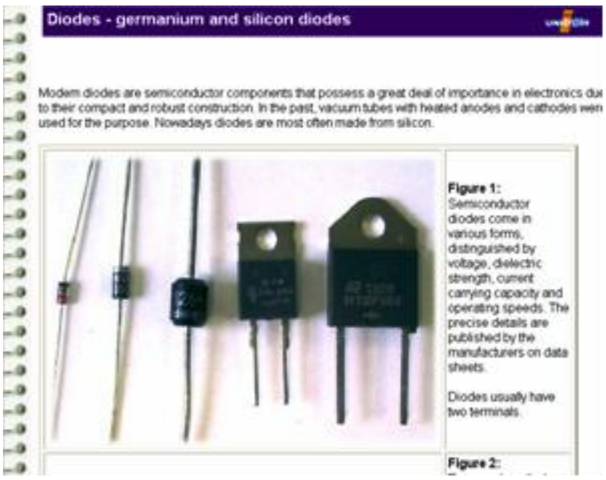


a) Devre ile ilgili teorik bilgi

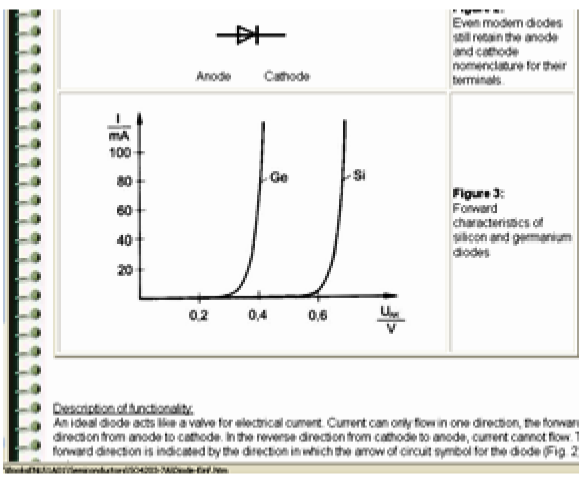


b) Deney bağlantı şekli

Şekil 7. Devrenin teorik bilgisi ve bağlantıları



a) Kullanılan elektronik elemanın gerçek görüntüsü



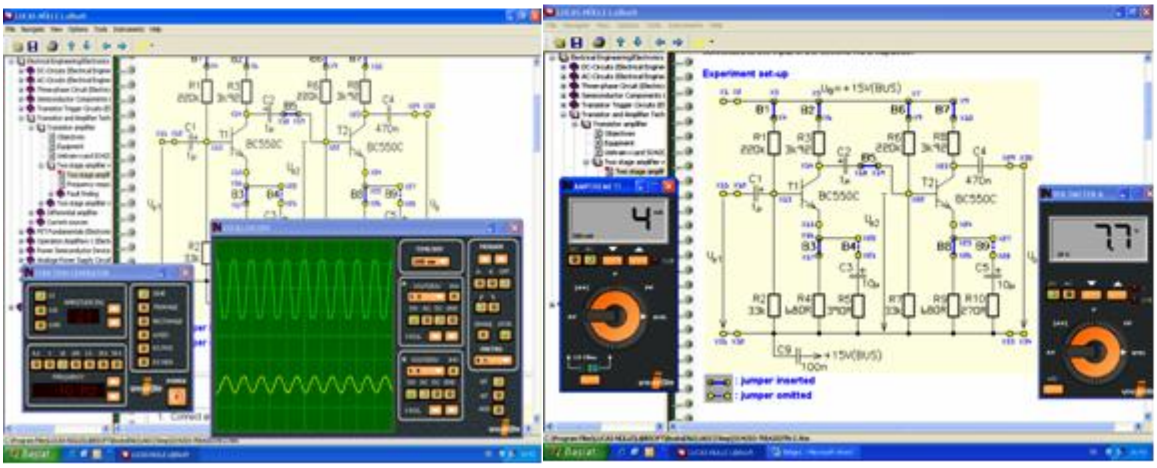
b) Elemanın karakteristiği

Şekil 8. Deneyde kullanılan elemanların gerçek görüntüleri ve karakteristikleri

Daha sonra gerekli hazırlıklar yapıldıktan sonra devreye enerji verme işlemine geçilir. Tabiki enerji verilirken devrede oluşan olayları gözlemlememiz ancak ölçü aletleri ile mümkündür. Bunun için örnek olarak dalga şeklini gösteren hepimizin görmüş olduğu osiloskobu kullanırız. Burada kullanılan ölçü aletleri gerçek ile tamamen benzerlik göstermektedir. Devreye enerji verildikten sonra diğer ölçü aletleri ile farklı büyüklükler ölçmek mümkündür (Şekil 9).

Devre yapılırken oluşan hataları program göstermekte, doğru çözümü de istendiği taktirde ekrana getirmektedir. Ana bilgisayardan öğrenci bilgisayarlarına müdahale edilerek gerekli düzeltmeler yapılabildiği gibi, yapılan doğru problemin hatalı duruma getirilerek öğrencinin bu hatayı bulması sağlanabilmektedir. Bunların yanı sıra anabilgisayardan öğrenci bilgisayarlarında oluşan hatalar, işlemler, grafikler görülebilmektedir.

Bunların dışında daha birçok işlem bulunmakla birlikte burada asıl anlatılmak istenen bu deney kartlarının öğretime sağladığı katkılardır. Zaman, malzeme, farklı öğrenme düzeyleri, gelişen teknolojiye adaptasyon, maddi kazançlar ve saymadığımız daha birçok nedenden dolayı bu yöndeki uygulamaların öğretime katkıları oldukça fazladır.



Şekil 9. Devrenin çalıştırılması sonucu elde edilen fiziksel büyüklükler

BULGULAR

Birçok Bilgisayar Destekli Deney Kartlarının yazılımları, öğrencinin verdiği cevaplar doğrultusunda deneyi sunar ya da öğrenciye belli aralıklarla dönüt sağlar. Bu yüzden Bilgisayar Destekli Deney, ortamındaki her öğrencinin aktif şekilde deneye katılması, deneydeki performansını gösterebilme imkanı vermesi ve öğrenciye dönüt sağlayabilmesi nedeniyle öğrencinin deneye katılımını sürekli hale getirir.

Bilgisayar Destekli Deney Kartlarının uygulanmasında, bir öğrencinin bir deney üzerinde harcadığı zaman ve gösterdiği performans, bilgisayar tarafından kayıt edilebilir ve istendiği zaman öğreticinin kullanımına sunulabilir. Öğrenci performansı hakkındaki bu bilgiler, öğreticinin öğrencileri gözlemlemesi ve onları ihtiyaçları doğrultusunda yönlendirmesi bakımından oldukça önemlidir. Klasik deneysel öğrenme ortamlarında, öğreticinin her öğrencinin performansını gözlemlemesi ve buna bağlı olarak öğrenciyi yönlendirmesi oldukça zordur.

TARTIŞMA ve SONUÇ

Klasik deneysel öğretim ortamlarındaki öğrenciler, belli deneyleri belli zaman dilimleri içinde yapmalı ve belirlenmiş öğretimsel etkinlikler yine belirli zaman dilimleri içinde gerçekleştirilmelidir. Diğer taraftan, Bilgisayar Destekli Deney Kartlarının uygulanmasında bir öğrenci istediği öğretimsel etkinlikleri istediği zaman ders saati dışında kalan zamanlarda da uygulayabilir ya da tekrar edilebilir. Bu etkinlikleri evde bilgisayar başında uygulama şansı bulabilir.

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GRADUATE THESIS ANALYSIS BASED MADE EFFORTS TO FATIH PROJECT: THE SAMPLE OF YÖK DATABASES

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Asım BARUT
Milli Eğitim Bakanlığı

ABSTRACT: The purpose of this research is to make a comparative analysis of the graduate thesis, made under the Fatih Project. Research data from graduate thesis written between the years 2014-2015 and YÖK (Higher Education Council of the National Thesis Center) is limited to data obtained from the database. Qualitative research approach was adopted and the data obtained by the research conducted document analysis. The data were analyzed using content analysis. According to the results obtained from the research findings; While there is generally a positive attitude about the interactive whiteboard, it has been found to be inadequate use of tablet computers. Technological problems, as well as the contents of the missing teachers Fatih project, and that the technology they need to provide educational and vocational training services in the use of aspects, one of the important findings of this study.

Key Words: Fatih project, Interaction Smart Board, Educational Technology.

FATİH PROJESİNE YÖNELİK YAPILMIŞ ÇALIŞMALARIN LİSANSÜSTÜ TEZLERE DAYALI ANALİZİ: YÖK VERİ TABANI ÖRNEKLEMİ

ÖZET: Bu araştırmanın amacı Fatih Projesine yönelik yapılmış lisansüstü tezlerin karşılaştırmalı bir analizini yaparak var olan durumu ortaya koymaktır. Araştırma verileri 2014-2015 yılları arasında yapılan lisansüstü tezlerle ve YÖK (Yüksek Öğretim Kurumu Ulusal Tez Merkezi) veri tabanından elde edilen verilerle sınırlıdır. Nitel araştırma yaklaşımı benimsenerek gerçekleştirilen araştırmanın verileri doküman incelemesi yoluyla elde edilmiştir. Araştırma verileri içerik analizi ile çözümlenmiştir. Araştırma bulgularından elde edilen sonuçlara göre; etkileşimli tahta ile ilgili genel olarak olumlu bir tutum var iken, tablet bilgisayar kullanımının yetersiz olduğu tespit edilmiştir. Teknolojik sorunların yanı sıra içeriklerin eksik olması ve öğretmenlere Fatih projesi kapsamında sağlanan teknolojileri kullanımları konusunda pedagojik ve mesleki yönden hizmet içi eğitimlere ihtiyaç duydukları, bu çalışmanın önemli bulgularındandır.

Anahtar Sözcükler: Fatih projesi, Etkileşim Akıllı Tahta, Eğitim Teknolojileri.

GİRİŞ

Sürekli gelişen ve değişen günümüz dünyasında, özellikle teknolojinin hızına yetişmek gittikçe zorlaşmaktadır. Teknoloji, hemen her alanda etkisini hızla sürdürmektedir. Teknolojinin özellikle de eğitim alanındaki gelişmesi yadsınamaz bir gerçektir. Artık eğitim ve teknoloji birlikte anılan iki kavram olmuş ve bütünleşerek eğitim teknolojileri kavramını ortaya çıkarmıştır. Eğitim teknolojileri, eğitim ve öğretimi destekleyerek, maliyeti düşürmek ve öğrencilere daha zengin yaşantılar sağlamak amacıyla teknoloji ürünlerinden faydalanılmasıdır.

Bir ulusun gelişmesindeki en büyük etken eğitimdir. Bu nedenle olumlu anlamda bir değişiklik ve gelişim göstermek isteyen bir millet öncelikle eğitimi ön planda tutmalıdır ve eğitimin gelişmesi için gerekli çabayı göstermelidir. Günümüzde özellikle gelişmiş ülkeler eğitime çok büyük miktarlarda yatırımlar yapmaktadır ve eğitimde teknoloji kullanımının eğitim-öğretimde etkililiğini ve verimliliğini artırdığını düşünmektedir. Bu nedenle dünyanın her yerinde eğitim ve teknolojinin birlikte kullanımı ile ilgili projeler uygulanmıştır. Bu duruma birkaç örnek verecek olursak bu ülkelerin en başında Amerika gelmektedir ve Amerika, 2002 yılında Maine Eyaleti'nde "Her Öğrenciye Bir Bilgisayar" sloganıyla eyalet çapında tüm ortaokul öğrencileri ile öğretmenlerine dizüstü bilgisayarlar verilerek büyük bir proje başlatmıştır. 2003 yılında North Carolina Eyaleti'nde ortaokul öğrencilerine 1700 dizüstü bilgisayar dağıtılırken, 2004 yılında New Hampshire Eyaleti'nde okulların bütün 6. sınıf öğrencilerine aynı dizüstü bilgisayarlardan verilmiştir. 2004 yılında Kentucky'de başarısı düşük ve/veya evde internet bağlantısı olmayan ortaokul öğrencileri ile öğretmenlerine 3200 adet dizüstü bilgisayar dağıtılırken, aynı şekilde 2007 yılında Louisiana Eyaleti'nde "Öğrenmeye Dönüş" projesi kapsamında 54 okulda 3530 6. sınıf öğrencisine dizüstü bilgisayar verilmiştir (News Report, 2007). Daha yakın zamanda yapılan bir projeye örnek verilecek olursa Güney Kore 2015 yılına kadar "Akıllı Eğitim" projesi adı altında 7.5 milyon ilköğretim ve ortaöğretim öğrencisine tablet dağıtılmasını ve e-ders kitaplarının geliştirilmesini amaçlamaktadır (Kim ve Jung, 2010). Yapılan bu projelerin temel hedefi ise günümüz öğrencilerinin değişen dünyada teknolojiye karşı daha donanımlı olmaları, onu en etkili şekilde kullanabilmeleri, bilgiye en kısa sürede ve kolay ulaşabilmelerini sağlamaktır.

Ülkemizde de bu adımların son yıllarda en büyüğü olan "Fırsatları Artırma ve Teknolojiyi İyileştirme Hareketi" (FATİH) adı verilen proje yürütülmeye başlanmıştır. FATİH projesi ile birlikte ülkemizin her yerindeki okullarda akıllı sınıflar oluşturulmaya, öğrenci ve öğretmenlere tabletler dağıtılmaya başlanmıştır. Bu akıllı sınıflarda etkileşimli tahtalar, internet ve tabletlerle dersler işlenmeye başlanıp teknolojiye ayak uydurulmuştur. Bu proje ile birlikte ülkemizin her yerindeki ve her kademedeki okullara ulaşılmaya çalışılmaktadır. Böylece her öğrenci eşit şartlarda ve eşit imkanlar ile eğitimine devam edecektir.

Hiç kuşkusuz ilerleyen yıllarda FATİH projesinin etkililiği ve verimliliği için hem öğretmenlerin hem de öğrencilerin bu konuda daha bilinçli olması ve teknolojiyi doğru zamanda doğru kullanmasının önemi ortaya çıkmaktadır. Bu projenin sürdürülebilir ve geliştirilebilir olabilmesi için sürekli takip edilmesi ve bir takım araştırmalar yapılması gereklidir. Bu nedenle FATİH projesi ile ilgili birçok araştırmalar yapılmaktadır. Fatih projesine yönelik yapılan araştırmalara rağmen, yapılan alan yazın incelemesi sonucunda bu alanda gerçekleştirilen araştırmaların karşılaştırmalı bir biçimde betimlemesinin yapıldığı araştırmaya rastlanılmamıştır. Bu bakımdan araştırmada, fatih projesine yönelik ülkemizde yapılan tezlerin model dağılımının nasıl olduğu, hangi örneklemler üzerinde gerçekleştirildiği ve hangi sonuçlara ulaşıldığını bütüncül bir bakış açısı ile belirlenmesi ile bundan sonra yapılacak olan araştırmalara; araştırma önceliğini ortaya koyması bakımından katkı sağlayacağı düşünülmektedir. Yapılan bu araştırmanın fatih projesi konusunda gerçekleştirilen çalışmalara ilişkin Türkiye'de genel eğilimi vermesi, eksik yönlerin ortaya çıkarılması ve bu araştırma ile bu alanda çalışma yapacak uzmanlara yeni ufuklar açılması umulmaktadır. Araştırmada Fatih Projesi üzerine ülkemizde yapılmış lisansüstü tezlerin karşılaştırmalı bir analizi yapılarak var olan durumun ortaya konulması amaçlanmıştır. Araştırmada aşağıdaki sorulara yanıt aranmıştır:

- Fatih Projesini araştırmaya yönelik yapılan tezlerin lisansüstü düzeylerine göre dağılımı nasıldır?
- Fatih Projesini araştırmaya yönelik yapılan tezler hangi amaçlarla gerçekleştirilmiştir?
- Fatih Projesini araştırmaya yönelik yapılan tezlerde kullanılan modellerin dağılımı nasıldır?
- Fatih Projesi ile ilgili çalışmaların veri toplama aracının türüne göre dağılımı nasıldır?
- Yapılan tezler hangi örneklem üzerinde gerçekleştirilmiştir?
- İlgili çalışmalarda elde edilen sonuçlar nelerdir?

YÖNTEM

Araştırmanın Modeli

Bu çalışma nitel araştırma deseni benimsenerek gerçekleştirilmiştir. Nitel araştırmalar verilerin teker teker okunması yoluyla kod ve kategorilere dayalı olarak araştırma sonuçlarının sunulmasını sağlar (Merriam, 1998, s.58). Bu bağlamda, fatih projesi alanında yapılmış lisansüstü tezlerinin tematik bakımdan durumlarının saptanmasını, derinlemesine incelenmesini ve yorumlanmasını amaçlayan bu araştırma için en uygun araştırma yönteminin nitel araştırma yöntemi olduğuna karar verilmiştir. Araştırma verileri nitel araştırma yöntemlerinden doküman incelemesi yoluyla toplanmıştır. Doküman incelemesi, araştırılması hedeflenen olgu ya da olgular hakkında bilgi içeren yazılı materyallerin analizini kapsamaktadır. Doküman incelemesi, bir araştırma problemi hakkında belirli zaman dilimi içerisinde üretilen dokümanlar ya da ilgili konuda birden fazla kaynak tarafından ve değişik aralıklarla üretilmiş dokümanların geniş bir zaman dilimine dayalı analizini olanaklı kılmaktadır (Yıldırım ve Şimşek, 2013, s.217-218).

Evren ve Örneklem

Araştırmanın evrenini; Fatih Projesi hakkında Türkiye'de yapılan lisansüstü tezler oluşturmaktadır. Araştırmanın örneklemini ise 2014-2015 yılları arasında YÖK (Ulusal Tez Merkezi) veri tabanında ulaşım izni verilen fatih projesine ilişkin hazırlanan tezler oluşturmaktadır. Araştırmada herhangi bir örnekleme yöntemine başvurulmamış, çalışma örnekleminin tamamına ulaşılması amaçlanmıştır.

Veri Toplama Süreci

Araştırmada YÖK Ulusal Tez Merkezinde yapılan tarama sonucunda fatih projesi konusunda yapılan taramalar sonucunda 1 Ocak 2014- 1 Aralık 2015 tarihleri arasında yapılmış olan 7 tez araştırmanın örneklemini oluşturmuştur. Tezler lisansüstü düzeyi, araştırmalarda benimsenen model ve kullanılan veri toplama araçları bakımından sınıflandırılmıştır. İçerik analizi yapılırken hazırlanan tezlerin hangi örneklem düzeyinde gerçekleştirildiği, hangi amaçlarla yapıldığı ve hangi temel sonuçlara ulaşıldığı da araştırmada dikkate alınan inceleme ölçütleri arasında yer almaktadır.

Verilerin Analizi ve Yorumlanması

Araştırmada doküman incelemesi yöntemi kullanılarak ulaşılan tezlerin içerik analizleri yapılmıştır. Nitel çalışmalarda dokümanların incelenmesinde içerik analizi kullanılmaktadır (Merriam, 1998, s.123). İçerik analizi genellikle çok sayıdaki metin içeriklerinin ortak yönlerini ortaya çıkarmak amacıyla, önemli olan anlamların yapılandırılmasına ve sınıflandırılmasına yönelik, nitelden nicele doğru genelleştirmeyi sağlayan bir yorum biçimidir (Gökçe, 2006, s. 17-18). İçerik analizinde yapılan temel işlem, birbirine benzeyen verileri belirli kavramlar ve temalar çerçevesinde bir araya getirmek ve okuyucunun anlayabileceği bir biçimde düzenleyerek yorumlamaktır (Yıldırım ve Şimşek, 2013). İçerik analizinin gerçekleştirilmesi seçme-indirgeme, gruplandırma, genelleştirme-soyutlaştırma ve kuramla ilişkilendirme aşamalarının izlenmesini gerektirmektedir (Früh, 2001, 73- 74, akt: Gökçe, 2006, s.59-60). Çalışmada da verilerin içerik analizinin yapılmasında aşağıdaki basamaklar izlenmiştir:

• Seçme-indirgeme aşamasında araştırma evreninden belli bir örneklem seçilerek bunların içerikleri araştırma amaçları doğrultusunda oluşturulan kategori sistemine yerleştirilmeye çalışılmıştır. Araştırmanın çalışma evrenini Türkiye fatih projesi hakkkında yapılan tezler oluştururken, örneklemini 2014 – 2015 yılları arasında yapılan YÖK veri tabanında erişim izni olan tezler oluşturmaktadır.
• Gruplandırma aşamasında araştırma örneklemi belirlendikten sonra incelenecek tezler yıl ve gerçekleştirilen lisansüstü eğitim düzeyi, benimsenen model, kullanılan veri toplama araçları, çalışma örneklemi, amaç ve sonuçlar kategorileri sistemine yerleştirilmeye çalışılmıştır.
• Genelleştirme- soyutlaştırma aşamasında incelenen tezlerde söz konusu olan anlamlar birleştirilmeye ve genelleştirilmeye çalışılmıştır.
• Kuramla ilişkilendirme aşamasında ise incelenen tezlerden yola çıkılarak Türkiye'de fatih projesinin geliştirilmesi ve iyileştirilmesi ile ilgili tartışılmaya çalışılmıştır. İçerik analizinde incelenen tez verilerinin tablolaştırılmasında frekans değerleri dikkate alınmıştır.

Geçerlik ve Güvenirlik

İçerik analizinde geçerliğin sağlanabilmesi, araştırmanın amaçları ve araçları arasındaki uyuma bağlıdır (Gökçe, 2006, s.83; Bilgin, 2006, s.17). İçerik analizinde kategorilerin tanımlarından başka geçerliği ölçme aracı yoktur. Bu nedenle içerik analizinde kategorilerin tanımlarının herkesçe paylaşılabilir nitelikte olması ve aşamaların iyi tanımlanmış olması gerekmektedir. Güvenirlik ise özellikle kategori sistemi ve buna bağlı olarak kodlama işlemiyle sağlanmaktadır. Bu bağlamda güvenirliğin en önemli belirtisi, kategori sisteminin oluşturulması ve her bir kategorinin açıkça tanımlanması işlemidir (Gökçe, 2006, s.83). Bu bağlamda gerçekleştirilen bu araştırmanın geçerlik ve güvenirliğinin sağlanması için, içerik analizi yapılarak kategorilerin belirlenmesi sağlanmıştır. Veri analizi sürecinde oluşturulan kategoriler ve kodlamalar araştırmacı dışında başka bir araştırmacı tarafından birbirilerinden bağımsız bir biçimde yapılmış, daha sonra oluşturulan kod ve kategoriler karşılaştırılmıştır. Verilerin toplanma süreci ve analizindeki işlemlere ayrıntılı olarak yer verilmiştir. Ayrıca bilgisayar ortamına aktarılan tez kayıtlarının ve çözümlemelerinin ileriki dönemlerde olası teyide yönelik olarak muhafaza edilmesi sağlanmıştır.

Bulgular ve Yorum

Fatih projesi kapsamında yapılan tezlerin karşılaştırmalı analizini amaçlayan bu araştırmadan elde edilen bulgular, araştırmanın alt amaçları doğrultusunda sunulmuştur. Araştırmanın birinci amacı; Fatih projesine yönelik yapılan tezlerin hangi lisansüstü düzeyde yapıldığının belirlenmesidir. Bu amaç kapsamında elde edilen bulgular Tablo1'de gösterilmiştir.

Tablo1. Fatih projesi ile ilgili olarak incelenen tezlerin lisansüstü düzeylerine göre dağılımı

Yüksek lisans	Doktora	f
7	0	7

Tablo1'de görüldüğü gibi, Fatih projesinde yapılan tezlerin yüksek lisans düzeyinde gerçekleştiği ortaya çıkmıştır. Fatih projesi hakkında çok az sayıda tez yazıldığı ve doktora düzeyinde bu alanda yapılan çalışmaların olmadığı, üzerinde durulması gereken bir konudur. Araştırmanın ikinci amacı; Fatih projesine yönelik YÖK veri tabanında yer alan tezlerin hangi amaçlarla yapıldığının belirlenmesidir. Bu amaç kapsamında elde edilen bulgular Tablo2'de sunulmuştur.

Tablo 2. Fatih projesine yönelik yapılan tezlerin amaçlarına göre dağılımı

Amaçları	f
FATİH Projesi çerçevesinde e-içerik geliştirme becerilerinin değerlendirilmesi(T1, T7)	2
FATiH Projesi'nin uygulandığı kurumlardan birindeki etkililiğini ortaya koyarak projenin değerlendirilmesini sağlamak(T2)	1
Ortaöğretimlerde görev yapan öğretmenlerin FATİH Projesi ile akıllı tahta kullanımının faydalı ve kolay olup olmadığına yönelik algılarında, akıllı tahtayı kullanmasının gerektiğine dair kişisel normlara yönelik ve akıllı tahtayı derslerinde kullanım niyetleri arasında cinsiyet, yaş, branş, çalıştığı kurum ve meslek deneyimlerine göre farklılaşma olup olmadığını belirlemektir. (T2, T3)	2
İzmir İli metropol ilçelerde uygulanmaya başlanan eğitimde FATİH projesine ilişkin olarak, akademik ve mesleki liselerde görev yapan okul yöneticilerinin ve öğretmenlerin projenin uygulanmasına ilişkin okul yöneticilerinin ve öğretmenlerin görüşlerinin tespit edilerek, bunların çeşitli değişkenlere göre farklılık gösterip göstermediğinin incelenmesi amaçlanmaktadır. (T2, T3)	2
FATİH Projesi kapsamındaki okullarda bilişim teknolojilerinin kullanımının sınıf yönetimi açısından etkilerini betimlemek amaçlanmaktadır (T4)	1
Lise düzeyinde eğitim veren okullarda uygulamaya konulan FATİH projesine ilişkin öğrenciler, öğretmenler, okul yöneticileri ve veliler olmak üzere katılımcı paydaşların görüşlerini almak ve alınan görüşleri incelemektir (T2, T3, T4, T5, T6)	5

Tablo2'de görüldüğü gibi gerçekleştirilen tezlerde genellikle FATİH projesine ilişkin öğrenciler, öğretmenler, okul yöneticileri ve veliler olmak üzere katılımcı paydaşların görüşlerini almak ve alınan görüşlerin incelenmesini amaçlayan tezlerin çoğunluğu (%38.46) dikkat çekmektedir. Bu durum genel olarak var olan durumun betimlenmesine ilişkin çalışmaların yogun olarak yapıldığını gösterir. Araştırmanın üçüncü amacı; Fatih projesine yönelik yapılan tezlerde kullanılan araştırma desenlerinin analizinin yapılmasıdır. Bu amaç kapsamında elde edilen bulgular Tablo3'te gösterilmiştir.

Tablo 3. Fatih projesine yönelik yazılan tezlerde kullanılan araştırma deseninin dağılımı

Araştırma Deseni	f
Betimsel tarama	4
Olgu bilim	1
İlişkisel tarama	1
Deneysel	1

Tablo 3 fatih projesi ile ilgili çalışmaların araştırma desenine göre dağılımını göstermektedir. Tablo3'e göre yapılan çalışmaların büyük çoğunluğunun (%57,14) var olan durumu betimlemeye yönelik, geniş grupları kapsayan betimsel tarama modeli benimsenerek gerçekleştirildiği, bunun yanında az da olsa deneysel (%14,29) ve ilişkisel tarama modeli (%14,29) benimsenerek gerçekleştirilen çalışmaların yapıldığı dikkat çekmektedir. Boylamsal araştırma ve kuram oluşturma Fatih projesi konusunda henüz hiç benimsenmeyen araştırma desenleri arasında yer almaktadır. Yapılan analizler, tezlerin fatih projesine ilişkin var olan durumu betimlemeye yönelik çalışmalarla sınırlı olduğunu deneysel ya da eylem araştırması ve boylamsal araştırmalar tarzındaki çalışmaların bulunmadığını göstermektedir. Araştırmanın dördüncü amacı; Fatih projesine yönelik yapılan tezlerde hangi veri toplama araçlarının kullanıldığının belirlenmesidir. Bu amaç doğrultusunda incelenen tezlerin yöntem bölümlerinde, araştırma modeli ve bu modelde kullanılan veri toplama araçları dikkate alınarak kategoriler oluşturulmuştur. Bu amaç kapsamında elde edilen bulgular Tablo 4'te gösterilmiştir.

Tablo 4. Fatih projesine yönelik yapılan tezlerin veri toplama araçlarına göre dağılımı

Tezlerde Kullanılan Veri Toplama Araçları	f
Tutum Ölçeği	5
Görüşme	1
Gözlem	1

Tablo 4 projesine yönelik yapılan tezlerde hangi veri toplama araçlarına göre dağılımını göstermektedir. Tablo 4'te görüldüğü gibi tezlerin büyük çoğunluğunda veri toplama aracı olarak tutum ölçeği (%71,42), görüşme (%14,29) ve gözlem (%14.29) kullanılmaktadır.Yapılan tezlerde tutum ölçeğinin veri toplama aracı olarak kullanılması yoluyla gerçekleştirilen araştırmalarda daha çok nicel yaklaşımların benimsendiği, gözlem, görüşme gibi veri toplama araçlarıyla nitel araştırma yaklaşımlarının az kullanıldığı görülmektedir. Oysaki fatih projesinin etkililiğini ölçmek yalnızca nicel yaklaşımlarla mümkün olmamaktadır. Var olan durumun daha derinlemesine betimlenmesini, katılımcıların görüşlerini ayrıntılı bir biçimde irdelemeyi sağlayan nitel araştırma yaklaşımlarının ve bu yaklaşımlara bağlı veri toplama araçlarının da daha çok çalışmalarda benimsenmesi gerekmektedir.

Araştırmanın beşinci amacı; fatih projesine yönelik tezlerin hangi örneklem türüne göre yapıldığının analiz edilmesidir. Bu amaç kapsamında elde edilen bulgular Tablo5'te sunulmuştur.

Tablo 5. Fatih projesine yönelik yapılan tezlerin örneklem türüne göre dağılımı

Örneklem Türü	f
Öğrenciler	2
Öğretmenler	6
Öğretmen Adayları	1
Okul Yöneticileri	4
Ebeveynler	1

Not: Çalışmalarda birden fazla örneklem türünde çalışmalar yapıldığından dolayı incelenen toplam araştırma 7 iken toplam frekans daha fazla çıkmıştır.

Tablo 5'te fatih projesine yönelik yapılan tezlerin örneklem türüne göre dağılımı incelendiğinde yapılmış tezlerin büyük çoğunluğunun (%42,85) projenin uygulayıcıları öğretmenlerin seçildiği görülmektedir. Bunu okul yöneticileri (%28,72), öğrenciler (%.14,28) ve ebeveyn ile öğretmen adayları (%7.14) izlemektedir. Yapılan inceleme sonucunda öğretmen adayları, öğrenciler ve ebeveynlerle gerçekleştirilen çalışmaların çok az sayıda olduğu görülmektedir. Araştırmanın altıncı amacı, fatih projesine yönelik yapılan tezlerin genel sonuçlarının sunulmasıdır. Bu sonuçlar içerik, alt yapı- donanım, fırsat eşitliği, hizmet içi eğitim ve sınıf yönetimi olmak üzere beş kategori altında toplanmıştır. Bu amaç doğrultusunda elde edilen bulgular Tablo 6'da sunulmuştur.

Tablo 6. Fatih projesine yönelik yapılan tezlerin sonuçları

Kategoriler	Sonuçlar
İçerik	• Öğretmenlerin e-içerik geliştirme becerileri konusunda kaygılar yaşadığı sonucuna ulaşılmıştır (T1). • Öğretmenlerin e-içerik geliştirme yetenekleri; cinsiyete göre analizlerinde erkekler lehine anlamlı farklılık göstermiştir(T1). • Hazırlanan ders içi ve ders dışı eğitim materyallerinde etkileşimin az olduğu görülmektedir(T2). • Fatih projesi kapsamında hazırlanan uygulama materyallerinin öğrenci ve öğretmenler ile etkileşimlerinin artırılmasının projenin etkililiği açısından olumlu sonuçlar doğuracağı düşünülmektedir(T2). • Etkileşimli tahta ile tablet pc arasında ileitşimin sağlanması projenin verimliliğini artıracaktır(T2). • Akıllı tahtanın öğrencilerin motivasyonlarına etkisinin proje kapsamında derslerin daha eglenceli geçmesi ve derse olan katılımın daha fazla olduğu görülmektedir(T3). • Fatih projesi kapsamında e-içeriklerin geliştirilmesinin yetersiz kalması ve öğretmenlerin içerik bulmakta zorluklarla karşılaştıkları görülmektedir(T4). • Eba web sitesi ile ilgili olarakta web sitesinin yeterli olmadığı yaşlarına uygun olmadığı ve gereksiz bir site olduğu görülmüştür(T6).
Alt Yapı Donanım	• Etkileşimli tahtaların arıza durumlarında teknik servis yetkililerine ulaşılmaya çalışıldığında okul idarecileri büyük güçlük yaşamaktadırlar(T2). • Akıllı tahtanın en büyük sorunu sık sık kalibre edilme sorunu ile karşılaşması ve akıllı tahta kaleminin sorun çıkarması gibi teknik arıza yaşanması olarak ortaya çıkmaktadır(T3). • Etkileşimli tahtanın dersin işlenişini engellediği görülmüştür(T6). • Etkileşimli tahta ve tablet pc ler için teknik destek sunulmadığı, projeden verim alınamadığı okullarda fatih projesine gerek duyulmadığı projenin eğitim amaçlı kullanılmadığı ve bu

	projenini para israfı yapılan bir proje olduğu görülmüştür(T6). • Tablet pclerin yetersiz ve kalitesiz olduğu sürekli bozulduğu görülmüştür(T6). • Fatih projesi kapsamında yeterli teknik destek saglanmadığı sonucuna ulaşılmıştır(T7). • Etkileşimli tahta ve tablet pc de internet kısıtlamaları olduğu görülmüştür(T6). • Akıllı tahtanın öğretimde kalıcılığa etkisinin yüksek olduğu elde edilmektedir(T3).
Fırsat Eşitliği	• Eğitimde fırsat eşitliği çatısı altında aynı konuların farklı eğitim uygulamalarıla işlendiği materyallerin hazırlanmasının gerçek bir eşitlik sağlayacağı düşünülmektedir(T2). • Eğitimde Fatih projesi ülkemizde batıda doguya kuzyden güneye her bölgede okulların teknolojik açıdan iyileştirmeye gidilmektedir(T2).
Hizmet İçi Eğitim	• Proje kapsamında tüm paydaşlara eğitim verilmesi projenin etkililiğini ve anlaşılırlığını artıracaktır. Mevcut planmada sadece öğretmenlere teknoloji kullanım kursu verilmektedir. Bu eğitimlerin öğrenci ve velilerede farkındalık eğitimi olarak verilmesi gerekmektedir(T2). • Hizmet içi eğitimde etkileşimli tahta ve içerisindeki programların kullanımının gösterildiği eğitimin 1-2 haftalık süre zarfında verildiği materyal hazırlama ile ilgili bilgiler verildiği belirlenmiştir (T6). • Fatih projesinin yürütülmesinde öğretmenlerin aktif olarak katılmaları kıdem yıllarına göre anlamlı bir farklılık göstermektedir. Anlamlı farklılık 1*5 yıl olanların lehinedir(T7). • Fatih projesinin uygulanmasına ilişkin görüşlerinin sadece öz yeterlik boyutunda fatih teknoloji kullanım kursu hizmet içi eğitimi alıp almama değişkenine göre anlamlı farklılık olduğu sonucuna ulaşılmıştır(T4).
Sınıf Yönetimi	• Projenin öğrenciyle temas haline geldiği her noktada ciddi yasakların bulunması projenin tüm uygulayıcı ve kullanıcıları tarafından olumsuz bir şekilde karşılanmıştır. Bu durumda fatih projesinden vazgeçmeye umutlarını kesmeye başlamışlardır(T2). • Erkek öğretmenler bayan öğretmenlere göre daha etkin bir şekilde tahtayı kullanmaktadırlar(T3). • Öğretmenlerin akıllı tahtanın özelliklerini sınıf içi etkinliklerde kullanma sıklıkları hizmet yılı az olanlar lehindedir(T3). • Fatih projesinde öğretim süreçleri değişiklik beklentisi ve özyeterlik boyutlarında okuldaki görev değişkenine göre yönetici ve öğretmenler arasında anlamlı farklılıklar bulunmadığı görülmüştür(T4). • Sınıfla ilişki ve iletişim yönetimi açısından değerlendirildiğinde öğrencinin derse olan ilgi ve tutumlarının arttığı derse dikkatlerinin meraklarının arttığı öğrencilerin derse güdülendiği ve derse katılımlarının arttığı görülmüştür (T5). • Zaman açısından degerlendirildiğinde zamandan tasarruf edilmesini ve zamanı etkin kullanılmasının ve materyallerin zanginleşmesi açısından olumlu katkıda bulunduğu görülmektedir (T5).

Tablo 6 incelendiğinde, fatih projesine yönelik yapılan tezlerde donanım, sosyo-ekonomik düzey, sınıf yönetimi, hizmetiçi eğitimler gibi değişkenlerin dikkate alındığı dikkat çekmektedir. Araştırmalar sonucunda öğretmenlere verilen hizmetiçi eğitimlerin yetersizliği, sınıf yönetimini olumsuz etkilemesi, öğrencilerin akademik başarısını olumsuz etkilediği vb. nedenlere vurgu yapılmıştır. Buna karşın yapılan tezlerin bazıları öğrencilerin öğrenmesinde fatih projesinin etkililiğine dikkat çekmektedir. Eğitim bilişim ağı (EBA), z-kitaplar, sosyal platformlar, uzaktan eğitim etkinlikleri, online sınavlar gibi farklı eğitim etkinliklerinin öğrencilerin akademik başarısını ve okula olan ilgilerini olumlu yönde etkilediği sonuçlarına ulaşılmıştır.

SONUÇ VE ÖNERILER

Fatih projesine yönelik yapılan tezlerin karşılaştırmalı bir biçimde incelenmesini amaçlayan bu araştırmada, lisansüstü düzeyde gerçekleştirilen çalışmalara yönelik genel eğilim ve farklılıklar ortaya çıkarılmaya, eksiklikler tespit edilmeye ve bu alanda çalışma yapacak uzmanlara konu ile ilgili yeni ufuklar açılmaya çalışılmıştır. Araştırma verilerinin analizinde alt amaçlar doğrultusunda kategoriler oluşturulmuştur. İncelenen tezlere ilişkin oluşturulan kategoriler tezlerin lisansüstü düzeyleri, kullanılan araştırma desenleri ve veri toplama araçları, örneklemleri, amaçları ve sonuçları olmak üzere altı kategoride incelenmiştir. Araştırma sonucunda fatih projesine yönelik yapılan tezlerin yüksek lisans düzeyinde yapıldığı ortaya çıkmıştır. Fatih projesi gibi büyük bir yatırım gerektiren proje hakkında yazılan tezlerin oldukça az sayıda ve genellikle yüksek lisans düzeyinde gerçekleştirildiği üzerinde durulması gereken bir durumdur. Araştırmada, yapılan tezlerin genellikle fatih projesinde paydaşların görüşlerini ve tutumlarını belirlemeyi amaçlayan betimsel nitelikte tarama modelinde gerçekleştiği görülmüştür. Yapılan analizler, tezlerin genellikle fatih projesinde var olan durumu betimlemeye yönelik çalışmalarla sınırlı olduğunu, fatih projesinin uygulanmasına yön verecek değişkenler arası ilişkilerin saptanmasına yönelik deneysel ya da eylem araştırması ve boylamsal araştırmalar tarzındaki çalışmaların bulunmadığını ortaya çıkarmıştır. Bu durum genel olarak var olan durumun betimlenmesine ilişkin çalışmalara önem verildiğini; fakat iyileştirmeye, geliştirmeye, öğrenme ortamlarını zenginleştirmeye ve farklı yöntem ve tekniklerin kullanımına önem verilmediğini düşündürmektedir. Araştırmada, fatih projesi hakkında yapılan tezlerde veri toplama aracı olarak anket, tutum ölçeği ve başarı testlerinin kullanıldığı, nitel araştırmaya yönelik veri toplama araç ve tekniklerinin (görüşme, gözlem vs) çok fazla benimsenmediği ortaya çıkmıştır. Oysaki fatih projesinin etkililiğini ölçmek yalnızca nicel yaklaşımlarla mümkün olmamaktadır. Var olan durumun daha derinlemesine betimlenmesini, katılımcıların görüşlerini ayrıntılı bir biçimde irdelemeyi sağlayan nitel araştırma yaklaşımlarının ve bu yaklaşımlara bağlı veri toplama araçlarının da benimsenmesi gerekmektedir. Araştırmanın önemli bulgularından biri de projenin uygulanmasında başrol oynayacak en önemli öğelerden birinin öğretmenler olduğu söylenebilir. Bu bağlamda proje uygulamalarının sürdürülebilir olması için ana uygulayıcılar olarak görülen öğretmenlere yönelik sürekli mesleki eğitimlerin sağlanması ve onların sürece etkin olarak katılımlarının sağlaması önem arz ettiği söylenebilir. Adıgüzel (2011)' de yapmış olduğu çalışmasında fatih projesine değinmiş, akıllı tahta ve diğer yeni teknolojilerde problem yaşanmaması için öğretmenlerin bu teknolojinin nasıl kullanılacağı hakkında bilgilendirilmesi, öğrencilerin ve eğitim yöneticilerinin bilgilendirilmesi, eğitim yöneticilerinin, bu teknolojiye karşı yaklaşımlarının, maddi bir yükten çok, uzun vadede eğitim kalitesini arttıracak bir teknoloji olarak benimsemesi ve gerekli eğitimlerin verilmesi ve teknik desteğin sağlanması gerektiğini belirtmiştir. Araştırmada incelenen tezlerde öğretmen adayları, okul yöneticileri ve ebeveynlerle gerçekleştirilen çalışmaların çok az sayıda olduğu görülmüştür. YÖK veri tabanından elde edilen tezler sonuçları bakımından incelendiğinde öğretmenlerin fatih projesi hakkında hizmetiçi eğitim almaları, öğrencilerin ve velilerin fatih projesi hakkında bilgilendirilmelerinin yapılması ve takip edilmesi gerekmektedir. Araştırmadan elde edilen sonuçlara dayanarak şu öneriler getirilebilir:

• Yapılacak çalışmalarda nicel veri toplama yöntemleri dışında nitel veri yöntemleriyle çeşitlendirilen araştırmalara da yer verilebilir.

• Boylamsal ve eylem araştırması gibi araştırma modelleri ile desenlenen çalışmalara önem verilmelidir.

• Örneklem boyutunda öğretmen ve öğrencilerin yanı sıra okul yöneticilerinin ve velilerin de yer aldığı araştırmalar yapılabilir.

• Bu tür karşılaştırmalı çalışmaların periyodik olarak yapılması, bu alanda çalışma yapacak araştırmacıların alandaki gelişmeleri somut olarak görmelerini sağlayabilir.

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IMPROVING PROSPECTIVE SCIENCE TEACHERS' INTEGRATED STEM TEACHING COMPETENCIES

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ABSTRACT: STEM education can be identified as an integrated teaching approach towards STEM disciplines. It is obvious that this type of education requires different competencies rather than domain specific education. For instance, integrated STEM teaching requires extended content knowledge in comparison to teaching separate disciplines. Additionally, integrated education necessitates distinctive pedagogical strategies and tools. Teachers are educated to teach separate disciplines in current teacher training programs. They specialize in their own subjects. As a consequence, integrated STEM disciplines may seem difficult for them. As in every educational reform movement, "teacher" is one of the most critical elements for STEM education. For the success of STEM education, teachers' competencies related to integrated teaching should be developed. The current study investigated the efficiency of a professional development model which was developed to promote prospective science teachers' pedagogical competencies related to integrated STEM teaching. A qualitative paradigm was used in this study, which was lasted for 14 weeks. Nine prospective science teachers participated into the educational implementation. Participants have developed several integrated STEM teaching lesson plans during professional development activity. These lesson plans have been used as a primary data source for the study. Collected data were analyzed by using constant comparative method. The analysis of data indicated that the professional development model was effective in promoting the prospective science teachers' pedagogical adaptation towards integrated STEM teaching.

Key words: integrated STEM teaching competencies, prospective science teachers, STEM education

FEN BİLGİSİ ÖĞRETMEN ADAYLARININ BÜTÜNLEŞİK FeTeMM ÖĞRETİMİNE YÖNELİK YETERLİKLERİNİN GELİŞTİRİLMESİ

ÖZET: FeTeMM eğitim yaklaşımı, en genel haliyle FeTeMM disiplinlerine yönelik bütünleşik öğretim şeklinde tanımlanabilir. Bu doğrultuda gerçekleştirilecek bir öğretimin, mevcut öğretim programlarında sınırları keskin çizgilerle belirlenmiş alana özel öğretimden farklı yeterlikler gerektirdiği açıktır. Zira FeTeMM disiplinlerine yönelik bütünleşik öğretim, hâlihazırda uygulanan disipliner öğretim için gereken alan bilgisinin sınırlarını genişletmekte ayrıca alana özel öğretime nazaran farklı pedagojik strateji ve araçları gerekli kılmaktadır. Oysa mevcut öğretmen yetiştirme programları, öğretmen adaylarının kendi disiplinlerinin uzmanı olarak yetiştirilmesi üzerine kuruludur. Bu durum, FeTeMM eğitim yaklaşımının ülkemiz bağlamında uygulanabilirliği önündeki en büyük engellerden birini oluşturmaktadır. Zira her eğitim reformu hareketinde olduğu gibi FeTeMM eğitim yaklaşımı içinde en önemli boyutlardan biri sistemin uygulayıcısı konumundaki öğretmenlerdir. Okulların, bütünleşik FeTeMM öğretimi doğrultusunda yeniden yapılandırılması için öğretmen yetiştirme politikalarında değişikliğe gidilmesi ve FeTeMM öğretmenliği programlarının açılması bir alternatif olarak düşünülse de bu hedefe ulaşılması için gerekli zaman dilimi göz önüne alındığında, fen ve matematik öğretmenlerinin hizmet öncesi ve hizmet içi programlar ile bütünleşik öğretim için gerekli yeterlikleri kazanmaları daha gerçekçi bir yaklaşım olarak görülmektedir. Bu araştırma kapsamında fen bilgisi öğretmen adaylarının bütünleşik FeTeMM öğretimine yönelik pedagojik yeterliklerinin geliştirilmesi amacıyla hazırlanan bir öğretim sürecinin etkililiği mercek altına alınmıştır. Bu doğrultuda 9 fen bilgisi öğretmen adayı ile haftalık 2 saat olmak üzere toplam 14 haftalık bir uygulama gerçekleştirilmiştir. Nitel araştırma paradigması ekseninde yürütülen araştırmanın temel veri kaynağını, uygulama boyunca öğretmen adayları tarafından geliştirilen bütünleşik FeTeMM öğretimi ders planları oluşturmuştur. Elde edilen veriler sürekli karşılaştırma yöntemi ile analiz edilmiştir. Araştırma sonucunda öğretim sürecinin, öğretmen adaylarının bütünleşik FeTeMM öğretimine yönelik pedagojik adaptasyonlarına katkı sağladığı tespit edilmiştir. Adayların süreç içerisinde hazırladıkları öğretim programlarında, alana özel öğretim hedeflerine yönelik bakış açılarının farklılaştığı, farklı FeTeMM disiplinlerine yaptıkları vurgunun arttığı, disiplinlerin entegrasyonu için düşündükleri bağlamın gerçek yaşam uygulamaları eksenine kaydığı gözlenmiştir.

Anahtar sözcükler: bütünleşik FeTeMM öğretimi yeterlikleri, fen bilgisi öğretmen adayları, FeTeMM eğitimi

GİRİŞ

Son yıllarda uluslararası eğitim reformu hareketlerinin merkezinde bulunan FeTeMM eğitiminin, Türkiye'deki popülaritesinin de gün geçtikçe arttığı görülmektedir. Alan eğitimine yönelik akademik dergilerin FeTeMM eğitimine yönelik özel sayılar yayınlanması (örn. IJEMST, 2016; TUSED, 2016), gerçekleştirilen kongre ve sempozyumlarda FeTeMM eğitiminin odağa alınması ya da ana temalar içerisinde yer alması (örn. ICEMST, 2016; IDEAL, 2016; UFBMEK, 2016) bu ilginin göstergeleri olarak değerlendirilebilir. Fakat yaklaşıma yönelik akademik düzeydeki bu ilginin eğitim politikalarına yansımış etkilerinden şu an için söz edilememektedir. Bu durum potansiyel kazanımları açısından ülkemiz için büyük önem taşıyan FeTeMM eğitiminin, Türk eğitim sisteminin mevcut yapısı içerisinde ele alınmasını gerekli kılmaktadır.

FeTeMM eğitimi, en genel haliyle FeTeMM disiplinlerine yönelik bütünleşik öğretim şeklinde tanımlanabilir (Chiu, Price & Ovrahim, 2015; Meng, Idris & Eu, 2014). Bütüncül yaklaşımın esas alındığı bu doğrultudaki öğretim, öğrenilenlerin birbiri ile bağlantılı, gerçek yaşamla ilişkili ve öğrenenler için anlamlı olmasına hizmet edecektir (Smith & Karr-Kidwell, 2000). Bunun yanı sıra bütünleşik FeTeMM öğretiminin öğrencilerin üst düzey düşünme becerilerinin gelişime, akademik öğrenmelerine, öğrendiklerini gerçek yaşam problemlerini çözme sürecine transfer etmelerine katkı sağladığını gösteren çeşitli araştırmalar (Bkz. Elliot, Oty, McArthur & Clark, 2001; King & Wiseman, 2001; Morrison, 2006) mevcuttur. Elbette bu potansiyel kazanımların elde edilmesi öğretmenlerin bütünleşik FeTeMM öğretimini sınıflarında etkili şekilde uygulayabilmelerine bağlıdır (Stohlmann, Moore & Roehrig, 2012).

FeTeMM eğitiminin doğası gereği, bütünleşik FeTeMM öğretiminin ne şekilde gerçekleştirileceğine yönelik öğretmenlere rehberlik edecek genel bir modelden söz etmek mümkün değildir (Roehrig, Moore, Wang & Park, 2012). İlgili literatürde FeTeMM disiplinlerinin entegrasyonunu hedef alan çok sayıda öğrenme bağlamı tanımlanmaktadır (Mobley, 2015). Bu durum zaten karmaşık olan bütünleşik öğretim kavramını öğretmenler için daha da zorlu bir hale getirmektedir (Wang, Moore, Roehrig & Park, 2011).

FeTeMM eğitimi önündeki temel engellerden biri de öğretim programlarının mevcut yapısı olarak göze çarpmaktadır (NAE & NRC, 2009; Williams, 2011). Zira öğretim programlarının mevcut yapısında genellikle FeTeMM disiplinlerinden yalnızca matematik ve fen dersleri okul programlarında yer almakta (Bybee, 2010; NAE, 2010) ve bu dersler diğer disiplinlerden izole bir şekilde yürütülmektedir (Roberts & Cantu, 2012). Bu problemi aşmak için öğretim programlarında yer alan matematik ve fen derslerini diğer FeTeMM disiplinlerinin entegre edildiği uygulamalar çerçevesinde yürütmek makul bir yol olarak görülmektedir (Dugger, 2010; Roberts, 2012; Sampurno, Sari & Wijaya, 2015). Fakat sınıfını FeTeMM uygulamaları çerçevesinde yeniden yapılandırması beklenen (fen ya da matematik) öğretmen(i) büyük bir olasılıkla yalnızca kendi alanının uzmanı olacak (Lederman & Lederman, 2013) ve gerçekleştirdiği uygulamalarda kendi alanına özel öğrenim çıktılarına odaklanacaktır (English, 2015; Williams, 2011). Dolayısıyla gerçekleştirilen FeTeMM eğitimi arzu edilen FeTeMM eğitiminden oldukça farklı bir hal alacaktır (Breiner, Harkness, Johnson & Koehler, 2012). Bu açıklamalar ışığında FeTeMM eğitiminin başarısı için öğretmenlerin yaklaşıma yönelik yeterliklerinin geliştirilmesinin öncelikli hedeflerden biri olduğu ifade edilebilir (Williams, 2011).

Bu doğrultuda, yürütülen bu araştırmada fen bilgisi öğretmen adaylarının bütünleşik FeTeMM öğretimine yönelik pedagojik yeterliklerinin geliştirilmesi için tasarlanan bir öğretim sürecinin etkililiği mercek altına alınmış ve aşağıda belirtilen araştırma sorusuna yanıt aranmıştır.

Seçmeli disiplinler arası fen eğitimi dersi kapsamında yürütülen öğretim süreci, öğretmen adaylarının bütünleşik FeTeMM öğretimine yönelik pedagojik yeterliklerini nasıl etkilemektedir?

YÖNTEM

Bu çalışma, araştırma probleminin doğasına uygun olacak şekilde katılımcıların belirlenmesi, veri toplama ve analiz süreçleri açısından nitel araştırma paradigması esas alınarak yürütülmüştür.

Çalışma Grubu

Araştırmanın çalışma grubunu fen bilgisi öğretmenliği 3. sınıfa devam eden ve uygulamanın gerçekleştirdiği seçmeli "Disiplinler arası fen eğitimi" dersine kayıtlı bulunan 15 öğretmen adayı arasından belirlenmiş 9 aday oluşturmaktadır. Nitel araştırmalarda çalışma grubunun belirlenmesinde genellikle amaçlı örnekleme stratejisi kullanılır (Punch, 2005). Bu strateji için öncelikle hangi katılımcıların çalışma grubunda yer alacağına yönelik seçim kriterleri belirlenmelidir (Merriam, 2013). Bu doğrultuda araştırma kapsamında "uygulama süresince tüm etkinliklere katılım gösterme", "araştırmaya katılmaya gönüllü olma" ve "yazılı veri kaynaklarında zengin bilgi akışı sağlama" şeklinde üç kriter belirlenmiştir. Bu kriterleri karşılayan 9 öğretmen adayı (8 kız ve 1 erkek) araştırmanın çalışma grubunu oluşturmuştur.

Öğretim Süreci

Seçmeli "Disiplinler arası fen eğitimi" dersi doğrultusunda tasarlanan öğretim süreci haftada 2 ders saati olmak üzere 14 hafta boyunca devam etmiştir. Bu süreçte araştırmacı tarafından gerçekleştirilen teorik sunumların yanı sıra, öğretmen adayları bütünleşik FeTeMM öğretimine yönelik Mobley (2015) tarafından sınıflandırılan çeşitli öğrenme bağlamları (Araştırma – sorgulamaya dayalı öğrenme bağlamında bütünleşik FeTeMM, Tasarım temelli öğrenme bağlamında bütünleşik FeTeMM) içerisinde yer almışlar. Ayrıca öğretim süresi boyunca öğretmen adayları tarafından hazırlanan tüm ders planları sınıf içerisinde tartışmaya açılmış ve adaylara planlarına yönelik dönüt verilmiştir. Öğretim sürecinde ele alınan içerik ve etkinlikler Tablo 1.' de özetlenmiştir.

Tablo 1. Araştırma Kapsamında Yürütülen Öğretim Süreci

Süre (Hafta)	İçerik ve Etkinlikler
1	Disiplinler arası öğretimin kuramsal temelleri
1	Disiplinler arası fen eğitimine yönelik tarihsel girişimler
1	Disiplinler arası fen eğitimi ve teknoloji
1	FeTeMM eğitim yaklaşımına yönelik kuramsal açıklamalar
1	Bütünleşik FeTeMM öğretimi ders planı sunumu
1	Mühendislik disiplini ve K-12 mühendislik eğitimi
1	Araştırma – sorgulamaya dayalı öğrenme bağlamında bütünleşik FeTeMM
2	Araştırma – sorgulamaya dayalı öğrenme bağlamında bütünleşik FeTeMM uygulama
1	Bütünleşik FeTeMM öğretimi ders planı sunumu
1	Tasarım temelli öğrenme bağlamında bütünleşik FeTeMM
2	Tasarım temelli öğrenme bağlamında bütünleşik FeTeMM uygulama
1	Bütünleşik FeTeMM öğretimi ders planı sunumu

Veri Kaynakları ve Analizi

Çalışmanın temel veri kaynağını öğretmen adaylarının fen disiplini merkezinde geliştirdikleri bütünleşik FeTeMM öğretimi ders planları oluşturmaktadır. Bu planların analizinde sürekli karşılaştırma yöntemi (Strauss & Corbin, 1994) işe koşulmuştur. Bu doğrultuda ilk olarak geçmiş araştırmalardan (Bowers, 2015; Stearns, Morgan, Capraro, & Capraro, 2012; Stohlmann, Moore, & Roehrig, 2012) yararlanılarak "kısmi çerçeve" oluşturulmuştur (Glaser & Strauss, 1967). Bu kısmi çerçeve ekseninde ortaya konulan kriter ve kategoriler, analiz sürecinde kullanılacak kod şeması için başlangıç noktasını teşkil etmiş ve veri seti bu ilk kodlar ekseninde analiz edilmeye başlanmıştır. Sürekli karşılaştırma yönteminin doğasına uygun olacak şekilde analiz süreci boyunca bu kod ve kategoriler yeniden düzenlenerek tüm ders planlarının analizinde kullanılacak nihai kod şeması elde edilmiştir. Nihai kod şeması, ilk kod şemasında yer alan içerik, yaklaşım ve ölçme kategorilerine uygulanabilirlik kategorisinin de eklenmesi ile 4 kategori ve bu kategoriler altında yatan çeşitli kodlardan oluşmuştur. Tablo 2' de nihai kod şemasından (içerik kategorisi kapsamında) bir kesit sunulmuştur.

Tablo 2. Analiz Sürecinde Kullanılan Kod Şeması

Kategori	Kodlar	Kodların anlamı
İçerik	Yalnızca fen (yal_fen)	Yalnızca fen kazanımları dikkate alınmış
	Fen ve bağımsız diğer disiplin (fenvebağ=1)	Fenin yanı sıra bir diğer FeTeMM disiplini için de öğrenim hedefleri dikkate alınmış fakat disiplinler arası bağlantılardan söz edilemez, disiplinler ayrı ayrı ele alınmış
	Fen ile bütünleşik diğer disiplin (fenilebüt=1)	Fenin yanı sıra bir diğer FeTeMM disiplini için de öğrenim hedefleri dikkate alınmış, disiplinlere yönelik alan bilgisi ve uygulamalar arasında bağlantılar kurulmuş
	Fen ve bağımsız diğer disiplinler (fenvebağ>1)	Fenin yanı sıra birden fazla FeTeMM disiplini için de öğrenim hedefleri dikkate alınmış fakat disiplinler arası bağlantılardan söz edilemez, disiplinler ayrı ayrı ele alınmış
	Fen ile bütünleşik diğer disiplinler (fenilebüt>1)	Fenin yanı sıra birden fazla FeTeMM disiplini için de öğrenim hedefleri dikkate alınmış, disiplinlere yönelik alan bilgisi ve uygulamalar arasında bağlantılar kurulmuş

Analiz sürecinin devamında rastgele belirlenen 3 ders planı araştırmacı dışında birde FeTeMM eğitim yaklaşımı ile ilgili çalışmaları bulunan bir başka araştırmacı tarafından nihai kod şemasına göre analiz edilmiş ve bu veri seti için bağımsız kodlayıcılar arasındaki uyumun % 95 olduğu tespit edilmiştir.

BULGULAR

1. İpek, Ayça ve Şule' den Oluşan Gruba Yönelik Bulgular

İpek, Ayça ve Şule'den oluşan grubun süreç boyunca hazırladıkları 3 ders planının analizi ile elde edilen bulgular Tablo 3' te sunulmuştur.

Tablo 3. İpek, Ayça ve Şule'den Oluşan Gruba Ait Bulgular

Kategori	Kodlar		
	1. Ders Planı	**2. Ders Planı**	**3. Ders Planı**
İçerik	Yalnızca fen	Fen ile bütünleşik diğer disiplin	Fen ile bütünleşik diğer disiplin
Yaklaşım	Öğretmen sunumu	Teknoloji destekli araştırma-sorgulama	Mühendislik tasarım ve bilimsel araştırma-sorgulama
	Öğrenci rolleri belirsiz	Bireysel çalışma ve belirsiz takım çalışması	Bireysel çalışma ve belirsiz takım çalışması
Ölçme-değerlendirme	Ölçme-değerlendirme planlanmamış	Ölçme-değerlendirme planlanmamış	Ölçme-değerlendirme planlanmamış
Uygulanabilirlik	Etkinlik uygulanabilir	Etkinlik düzenlenmeli	Etkinlik uygulanabilir

Grup üyeleri ilk ders planlarında ortaokul fen bilimleri dersi öğretim programında 6.3.1.1. numarası ile yer alan "katıların, sıvıların ve gazların sıkışma-genleşme özelliklerini karşılaştırır" kazanımına yönelik yalnızca öğretmenin hangi kavramları ne şekilde aktaracağının belirtildiği bir ders süreci tasarlamıştır. Ders planında ortaokul matematik dersi öğretim programında yer alan bir kazanımın da bu dersin öğrenme hedefleri kapsamında olduğu belirtilmesine rağmen plan içerisinde bu kazanımın edinimine yönelik herhangi bir etkinliğe rastlanmamıştır. Ayrıca ders planında ölçme-değerlendirme süreci ile ilgili olarak hiçbir açıklama bulunmamaktadır.

Adaylar tarafından hazırlanan 2. ders planında ise diyabet hastalığı bağlam olarak seçilmiş, bu bağlama yönelik olarak tasarlanan öğretim sürecinde öğrencilerin fen bilimleri ve matematik dersi öğretim programında yer alan ilişkili kazanımları araştırma-sorgulama sürecinde yapılandırmaları üzerine odaklanılmıştır. Ayrıca öğrencilerin veri toplama sürecinde dijital teknolojilerden yararlanmalarına yönelik fırsatlar oluşturulmuştur. Öğrencilerin bireysel çalışmaların yanı sıra takım çalışmaları da yürütecekleri vurgulanmış olmasına rağmen takım çalışmalarının ne şekilde yürütüleceği ile ilgili herhangi bir açıklamaya yer verilmemiştir. İlk ders planında olduğu gibi bu ders planı için de öğretmen adayları ölçme-değerlendirme süreci ile ilgili herhangi bir bilgi vermemişlerdir.

Son planda ise öğretmen adayları gerçek yaşamla ilişkili bir problem bağlamında (barajların ekosistem üzerine olumsuz etkileri) mühendislik tasarım süreci ekseninde bir öğretim süreci yapılandırmışlardır. Dersin öğrenim hedefleri içerisinde fen kazanımlarının yanı sıra mühendislik disiplinine yönelik bazı öğrenim hedeflerine (Örn. öğrenciler mühendislik tasarım sürecine yönelik bilgi ve becerileri yapılandırırlar) de yer verilmiştir. Fakat bu öğrenim hedefleri ile ilişkili bir ölçme-değerlendirme süreci öğretmen adayları tarafından yine belirtilmemiştir.

2. Fatma, Burcu ve Ali'den Oluşan Gruba Yönelik Bulgular

Tablo 4' te Fatma, Burcu ve Ali'den oluşan grubun öğretim süreci boyunca hazırladıkları 3 ders planının analiz edilmesi ile elde edilen bulgulara yer verilmiştir.

Tablo 4. Fatma, Burcu ve Ali'den Oluşan Gruba Ait Bulgular

Kategori	Kodlar		
	1. Ders Planı	**2. Ders Planı**	**3. Ders Planı**
İçerik	Fen ve bağımsız diğer disiplin	Yalnızca fen	Fen ile bütünleşik diğer disiplin
Yaklaşım	Öğretmen sunumu Öğretmen merkezli araştırma	Teknoloji destekli araştırma-sorgulama	Mühendislik tasarım ve bilimsel araştırma-sorgulama

	Öğrenci rolleri belirsiz	Öğrenci rolleri belirsiz	Öğrenci rolleri belirsiz
Ölçme-değerlendirme	Yalnızca fenle ilişkili öğretimle iç-içe	Ölçme-değerlendirme planlanmamış	Ölçme-değerlendirme planlanmamış
Uygulanabilirlik	Etkinlik uygulanabilir	Etkinlik uygulanabilir	Etkinlik uygulanabilir

Öğretmen adayları hazırladıkları ilk ders planında fen bilimleri ve matematik öğretim programında yer alan ve birbirleriyle ilişkili kazanımlar (fen: maddelerin yoğunluklarının araştırılması ve matematik: sıvı ölçme birimlerini açıklama ve dönüştürme) odağında bir öğretim süreci tasarlamışlardır. Öğretmen sunumu ve öğretmen tarafından planlanan adım adım araştırmalar şeklinde hazırlanan öğretim etkinliklerinde bütünleşik bakış açısından ziyade önce matematik kazanımlarının edinimi sonrasında ise fen kazanımlarının edinimi üzerine yoğunlaşıldığı görülmektedir. Öğretim sürecini destekleyecek şekilde sürecin tamamına yayılan ölçme değerlendirme faaliyetlerinin ise yalnızca fen kazanımlarına yönelik olduğu görülmektedir.

Adaylar tarafından geliştirilen ikinci planda günlük yaşam bağlamı ile ilişkili olarak araştırma-sorgulama temelli etkinlikler tasarlandığı görülmektedir. Fakat bu etkinliklerde yalnızca fen kazanımlarının dikkate alındığı diğer disiplinlerin ise göz ardı edildiği ifade edilebilir. Araştırma-sorgulama temelli etkinliklerde öğrencilere dijital teknolojileri kullanma fırsatları hazırlayan adayların öğrenci rollerine yönelik herhangi bir açıklama getirmediği görülmektedir. Ayrıca sürece yönelik ölçme-değerlendirme etkinliklerine de yer verilmemiştir.

Son ders planında ise adayların mühendislik tasarım süreci ile ilişkili bir ders yapılandırdıkları görülmüştür. Adaylar belirledikleri fen kazanımları ile ilişkili bir tasarım görevi kapsamında öğrencilerin araştırma-sorgulama ve tasarım etkinlikleri yürütmelerini planlamıştır. Bu süreçte ilgili fen kazanımlarının yanı sıra mühendislik disipliniyle ilişkili öğrenim hedeflerinin de göz önünde bulundurulduğu ve öğretim etkinliklerinin bu disiplinler arasındaki bağlantıları ortaya çıkaracak bir yapıda olduğu tespit edilmiştir. Adaylar planlarındaki öğrenim hedefleri arasında matematik kazanımlarına da yer vermelerine rağmen etkinliklerin bu kazanımlarla ilişkili olmadığı görülmektedir. Ayrıca adaylar, etkinliklerin bireysel mi yoksa takım çalışmasıyla mı yürütüleceğine ve süreç boyunca ne gibi ölçme-değerlendirme faaliyetleri yapılacağına da değinmemişlerdir.

3. Canan, Zeynep ve Aslı' dan Oluşan Gruba Yönelik Bulgular

Canan, Zeynep ve Aslı'dan oluşan grubun süreç boyunca hazırladıkları 3 ders planının analizi ile elde edilen bulgular Tablo 5' te sunulmuştur.

Tablo 5. Canan, Zeynep ve Aslı'dan Oluşan Gruba Ait Bulgular

Kategori	**Kodlar**		
	1. Ders Planı	**2. Ders Planı**	**3. Ders Planı**
İçerik	Fen ile bütünleşik diğer disiplin	Fen ile bütünleşik diğer disiplin	Fen ile bütünleşik diğer disiplin
Yaklaşım	Araştırma-sorgulamaya dayalı	Teknoloji destekli araştırma-sorgulama	Mühendislik tasarım ve bilimsel araştırma-sorgulama Teknoloji destekli araştırma-sorgulama
	Öğrenci rolleri belirsiz	Bireysel çalışma ve belirsiz takım çalışması	Bireysel çalışma ve formal takım çalışması
Ölçme-değerlendirme	Yalnızca fenle ilişkili öğretimle iç-içe	Ölçme-değerlendirme planlanmamış	FeTeMM alanlarına yönelik bütünleşik
Uygulanabilirlik	Etkinlik uygulanabilir	Etkinlik düzenlenmeli	Etkinlik uygulanabilir

İlk ders planlarında gerçek yaşam bağlamı (öğün oluşturma) ile ilişkili olarak araştırma-sorgulamaya dayalı öğretim süreci tasarlayan adaylar, fen ve matematik öğretim programlarında yer alan kazanımların edinimini destekleyecek, disiplinler arası bağlantıların söz konusu olduğu öğretim etkinliklerine vurgu yapmışlardır. Buna rağmen adayların ölçme-değerlendirme sürecinde yalnızca fen kazanımlarına odaklandığı görülmüştür.

İkinci ders planında grup üyelerinin yine gerçek yaşam bağlamından bir durum özelinde (ülkemizin rüzgâr santrallerinden daha etkin yararlanılması) fen ve matematik kazanımlarına yönelik araştırma-sorgulama temelli öğretim süreci oluşturdukları görülmektedir. Ayrıca ilk plandan farklı olarak bu aşamada öğrencilerin bilimsel-araştırma sürecinde dijital teknolojilerden yararlanmalarına yönelik çeşitli fırsatların sunulduğu görülmektedir. Tasarlanan öğretim etkinliklerinde gerçek yaşam verileri toplanmasını planlayan adayların bunu, çok geniş bir alana yaymış olmaları etkinliklerin uygulanabilirliği önünde bir engel olarak dursa da planın daha lokal olarak yeniden düzenlenmesi bu engeli aşmak için yeterli görünmektedir. Adayların ölçme-değerlendirme süreci ve takım çalışmalarına yönelik herhangi bir açıklamaya yer vermemeleri ders planlarının zayıf yönleri olarak tespit edilmiştir.

Son ders planlarında evsel atık ve geri dönüşüm konusu ile ilişkili olarak mühendislik tasarım süreci ekseninde bir ders yapılandıran adayların bu süreçte teknoloji destekli bilimsel araştırma-sorgulamaya dayalı etkinliklere vurgu yaptıkları görülmektedir. Mühendislik tasarım süreci ile bilimsel araştırma-sorgulama sürecini iç içe olacak şekilde işe koşan adayların fen ve mühendislik disiplini ile ilişkili öğrenim hedefleri üzerinde odaklandığı tespit edilmiştir. Bu süreçte öğrencilerin bireysel çalışmalar ve takım çalışmaları içerisindeki rolleri adaylar tarafından detaylı bir şekilde ele alınmış ayrıca öğretim süreci ile iç içe, öğrencilerin de içinde aktif olarak yer alacağı çeşitli ölçme-değerlendirme etkinliklerine vurgu yapılmıştır.

SONUÇ

Araştırma bulguları doğrultusunda, gerçekleştirilen öğretim sürecinin genel olarak öğretmen adaylarının bütünleşik FeTeMM öğretimine yönelik yeterliklerinin gelişimine katkı sağladığı sonucuna ulaşılmıştır. 14 hafta boyunca çeşitli aktiviteler içerisinde yer alan adayların hazırladıkları her yeni planda özellikle “yaklaşım” kategorisi kapsamında gelişim gösterdikleri görülmektedir. İlk ders planlarında bilginin öğretmen tarafından doğrudan aktarıldığı ya da öğrencilerin öğretmen tarafından adım adım yapılandırılan aktiviteler içerisinde yer aldıkları öğretim süreçlerine vurgu yapan adayların sürecin sonlarında hazırladıkları öğretim planlarında bütünleşik FeTeMM öğretimi için daha uygun olan mühendislik tasarım ve teknoloji destekli bilimsel araştırma sorgulamaya dayalı etkinlikleri gündeme aldıkları görülmektedir. Fakat bu etkinlikler için öğrenci rollerinin açık olarak tanımlandığı çok az sayıda planın yer alması bu kategoriye yönelik bir eksiklik olarak ifade edilebilir.

İçerik kategorisi ile ilgili olarak tüm grupların son ders planlarında fenin yanı sıra bir diğer FeTeMM disiplini için de öğrenim hedeflerini dikkate aldıkları, disiplinlere yönelik alan bilgisi ve uygulamalar arasında bağlantılar kurdukları görülmüştür. Bu durum adayların bütünleşik FeTeMM öğretimine yönelik daha doğru bir anlayışla hareket ettiklerini göstermektedir. Fakat bu entegrasyonun fen dışında yalnız bir FeTeMM disiplini ile sınırlı kalması bir diğer eksiklik olarak ifade edilebilir.

Süreç kapsamında bir kez daha değerlendirilmesi gereken en önemli eksiklik ise ölçme-değerlendirme kategorisi ile ilişkili gözükmektedir. Zira yalnızca 3. grubun son ders planında arzulanan düzey olan “Öğretim süreci ile iç-içe öğretimi destekleyici, fenin yanı sıra diğer FeTeMM disiplinleri kazanımları ile ilişkili” ölçme-değerlendirme etkinliklerine yer verdiği, diğer iki grubun ise ders planlarında bu kategoriyi hiç dikkate almadıkları gözlenmiştir. Her ders planının sunumu sonrasında gerçekleştirilen sınıf tartışmalarında vurgulanan bu eksikliğin süreç boyunca tekrar yaşanması, öğretim sürecinin bu kategori açısından yeniden ele alınmasını gerektirmektedir.

Adayların ders planlarında yer verdikleri teknoloji destekli bilimsel araştırma sorgulamaya dayalı öğretim etkinliklerinin uygulanabilirlik açısından en çok problem yaşanılan etkinlikler olduğu tespit edilmiştir. Fakat bu etkinliklerin mühendislik tasarım süreci ile birlikte ele alındığında daha uygulanabilir oldukları görülmektedir. Bu durum mühendislik tasarım yaklaşımının bütünleşik FeTeMM öğretiminin uygulanabilirliğine sağladığı katkının bir göstergesi olarak değerlendirilebilir.

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MIDDLE SCHOOL STUDENTS' ENGINEERING DESIGN EXPERIENCES: "HOW ENGINEERS SOLVE THE PROBLEMS?"

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ABSTRACT: The idea of integration is not new in science education. Integrated science and mathematics or technology has deep roots in the educational reform movements. STEM education which has become the motto for educators nowadays, appears to be different from previous attempts in the sense of emphasizing the engineering discipline. Engineering can serve as an integrator among STEM disciplines. Additionally, from the perspective of the 21st century proficiencies, students have to improve their competencies related to engineering. As a consequence, engineering has become a critical component of the STEM education. However, for a number of reasons, such as current structures of K-12 curriculum and teacher training programs, engineering education seems problematic. Although there have been several attempts to develop K-12 engineering education standards for improving current status of K-12 engineering, no such agreed upon standards have been existed yet. Even though there are several uncertainties associated with what K-12 engineering education should include or accomplish, it is clear that K-12 engineering education should emphasize engineering design. The current study investigated the impact of a design-based science learning process on 7th grade students' knowledge and comprehension related to engineering design process. A qualitative paradigm was used in this study, which was lasted for 5 weeks. 24, 7th grade students participated into the educational implementation. Writing texts and drawings which were created by students have been used as a primary data source for the study. Also, interview recordings were used for data collection process. Findings indicate that the design-based science learning process can contribute to enhancing students' knowledge and comprehension related to engineering design process.

Key words: design-based learning, engineering design process, K-12 engineering education, STEM education

ORTAOKUL ÖĞRENCİLERİNİN MÜHENDİSLİK TASARIM SÜRECİ DENEYİMİ: "MÜHENDİSLER NASIL PROBLEM ÇÖZER?"

ÖZET: Günümüzde motto haline gelen FeTeMM eğitim yaklaşımı için mühendislik disiplininin çok önemli bir boyut oluşturduğu ifade edilebilir. Mühendislik, diğer FeTeMM disiplinlerinin entegrasyonu için gerekli zemini oluşturma potansiyeline sahip olmanın yanı sıra 21. yy toplumunun gereksinimleri açısından değerlendirildiğinde de başlı başına öğrencilerin yeterlik kazanmaları gereken bir alan olarak gözükmektedir. Bu kapsamda öğrencilere disipline ilişkin yeterlikleri geliştirmeleri için fırsatlar sunulması gerektiği açıktır. Gerçekleştirilen bu araştırmada mühendislik tasarım süreci ekseninde yapılandırılan bir fen öğretim sürecinin (Tasarım Temelli Fen Öğretimi) 7. sınıf öğrencilerinin mühendislik tasarım sürecine yönelik anlayış düzeylerine etkisinin incelenmesi amaçlanmıştır. Nitel araştırma paradigması kapsamında yürütülen araştırmada veri toplama aracı olarak uygulama öncesi ve sonrasında öğrencilerin mühendislik tasarım sürecine yönelik değerlendirmelerinin yer aldığı yazılı metinler, süreç boyunca ortaya koydukları çizimler ve görüşme kayıtları kullanılmıştır. Araştırma sonucunda gerçekleştirilen öğretim sürecinin öğrencilerin tasarım sürecine yönelik anlayışlarının olumlu yönde gelişmesine katkı sağladığı tespit edilmiştir. Süreç sonrasında öğrencilerin uygulama öncesinden farklı olarak tasarım sürecinin döngüsel, dinamik, sistematik ve yaratıcı yapısını vurgulayan değerlendirmeler yaptıkları ayrıca tasarım süreci aşamalarına yönelik daha doğru ifadeler kullandıkları tespit edilmiştir.

Anahtar sözcükler: tasarım temelli eğitim, mühendislik tasarım süreci, K-12 mühendislik eğitimi, FeTeMM eğitimi

GİRİŞ

Fen eğitimine yönelik reform hareketlerinin tarihsel gelişimine bakıldığında matematik ve teknoloji disiplinlerinin entegrasyonunu hedef alan çeşitli girişimlerin varlığı göze çarpmaktadır (Lederman & Lederman, 2013). Bu bağlamda günümüzde motto haline gelen FeTeMM eğitimini bu girişimlerden ayıran en önemli boyutun mühendislik disiplini üzerine yapılan vurgu olduğu ifade edilebilir (NAE & NRC, 2009). Mühendislik, diğer FeTeMM disiplinlerinin entegrasyonu için gerekli zemini oluşturma potansiyeline sahip olmasının (Cantrell, Pekcan, Itanı & Velasquez-Bryant, 2006; Householder & Hailey, 2012) yanı sıra 21. yy toplumunun gereksinimleri açısından değerlendirildiğinde de başlı başına öğrencilerin yeterlik kazanmaları gereken bir alan olarak kritik öneme sahip gözükmektedir (Purzer, Moore, Baker & Berland, 2014). Buna rağmen disiplinin K-12 düzeyinde ne şekilde ele alınacağı, öğretim programları ve öğretmen yetiştirme programlarının mevcut yapısı açısından problemli bir görünüm sergilemektedir (Moore et al. 2014). K-12 mühendislik eğitiminin durumunu iyileştirmek adına gerçekleştirilen girişimlerde mühendislik disiplinine yönelik öğrenme hedeflerinin ortaya konulması öncelikli konulardan biri olarak ele alınmaktadır. Bu doğrultuda atılan ilk adım Massachusetts Eğitim Departmanı (MDOE) tarafından 2001 yılında yayınlanan öğretim standartlarının tanımlandığı raporda fen ve teknoloji ile birlikte mühendislik kazanımlarına da yer verilmesi olarak nitelendirilebilir (2006 ve 2010 yıllarında bu rapor revize edilmiştir). Bu rapordan sonra Pennsylvania ve Oregon Eğitim Departmanları da fen, teknoloji ve mühendislik eğitimi için akademik kazanımların tanımlandığı birer rapor yayınlamıştır (PDOE, 2009; ODE, 2009). Ulusal Mühendislik Akademisi (NAE, 2010) yayınladığı "K-12 için Mühendislik Standartları" adlı çalışmada mevcut fen, matematik ve teknoloji öğretim programlarında mühendislik eğitimi ile ilişkili kazanımların tespiti sağlanmış ve standartlar için temel teşkil edecek mühendislik konuları belirlenmiştir. "Teknoloji ve Mühendislik Okuryazarlığı Çerçevesi" adlı taslak raporda ise (NAGB, 2010) K-12 düzeyinde teknoloji ve mühendislik kazanımlarının ulusal bağlamda tanımlanması üzerine odaklanılmıştır.

Bu girişimler arasında gösterilebilecek bir diğer raporda ise (Bkz. NAE & NRC, 2009) mühendislik disiplininin ilkokul ve ortaokul düzeyinde konumlandırılmasına yönelik kapsamlı bir çerçeve sunulmuştur. İlkokul ve ortaokul düzeyi için mühendislik eğitiminin genel prensiplerinin tanımlandığı bu raporda, "K-12 mühendislik eğitiminin mühendislik tasarımını vurgulaması gerektiği" 3 temel prensip arasında yer almıştır. 2013 yılında Birleşik Devletler' de uygulamaya konulan yeni fen öğretim standartları (NGSS, 2013) kapsamında da öğrencilere mühendislik tasarım süreci çerçevesinde çalışma fırsatları sunulması ve öğrencilerin mühendislik tasarıma yönelik bilgi ve becerilerini yapılandırmaları gerekliliği üzerinde durulmuştur.

Mühendislik Tasarım Süreci

Mühendislerin problem çözme yaklaşımı olarak tanımlanan tasarım, problemin belirlenmesi ile başlayıp arzulanan performansa yönelik ortaya konulan kısıtlama ve başarı kriterlerini karşılayan çözüm ile tamamlanan bir süreçtir (NAE & NRC, 2009). Mühendislik tasarım problemleri için tek bir doğru çözümden söz etmek mümkün değildir (NAE, 2010). Bu problemler için genellikle birden fazla çözüm yolu bulunmaktadır (Jonassen, 2012). Bu sebeple mühendislik yaratıcı bir çaba olmak zorundadır (NAE & NRC, 2009). Dolayısıyla mühendislik tasarım sürecinin, hangi uygulama adımlarının hangi sıra ile izlenmesi gerektiğinin açıkça belirtildiği doğrusal bir süreci yansıtmaması son derece olağandır (NRC, 2012). Bununla birlikte mühendislerin tasarım sürecinde yararlandıkları birçok karakteristik adım bulunmaktadır. Mühendisler karşı karşıya kaldıkları tasarım problemi doğrultusunda bu adımları önceden tanımlanmış bir düzen içerisinde değil en uygun çözüm neyi gerektiriyorsa o haliyle kullanırlar (ITEA, 2007). NAGB (2010) tarafından yayınlanan "Teknoloji ve Mühendislik Okuryazarlığı Çerçevesi" adlı raporda mühendislik tasarım sürecinin tek bir yöntemle sınırlı olmaması gerektiği vurgulanmakta, sürecin kullanılacağı bağlam doğrultusunda farklı adımlarla gerçekleştirilebileceği açıklanmaktadır. Buna rağmen aynı raporda özellikle ilkokul ve ortaokul düzeyinde sürecin belirli aşamalar kapsamında sistematik şekilde ele alınmasının öğrenciler açısından daha uygun olduğu ifade edilmektedir.

Tasarım Temelli Fen Eğitimi (TTFE)

"Tasarım Temelli Fen Eğitimi (TTFE)" mühendislik tasarım problemlerinin gerçekleştirilecek fen eğitimi için gerekli bağlamı oluşturduğu bir yaklaşım olarak ifade edilmektedir (Kolodner, 2002; Wendell, 2008). Daugherty (2012) bu yaklaşımda fen kavram ve süreçlerine yönelik öğretimin, mühendislik problemleri doğrultusunda bilimsel araştırma ve mühendislik tasarım süreci yoluyla gerçekleştiğini belirtmektedir. Apedoe, Reynolds, Ellefson ve Schunn (2008) bu yapıyı vurgulayacak şekilde TTFE'yi bilimsel araştırma ve mühendislik tasarımının kombinasyonu olarak tanımlamaktadır. Bu doğrultuda gerçekleştirilecek bir öğretim sürecinin, fene yönelik akademik başarıyı desteklemenin yanı sıra öğrencilerin mühendislik disiplinine yönelik bazı öğrenim hedeflerini edinmelerine de katkı sağlayacağı çok sayıda araştırmacı (Bkz. Apedoe, Reynolds, Ellefson &

Schunn, 2008; Ercan, 2014; Fortus, Dershimer, Krajcik, Marx & Mamlok-Naaman, 2004; Ryan, Camp & Crismond, 2001) tarafından ifade edilmiştir.

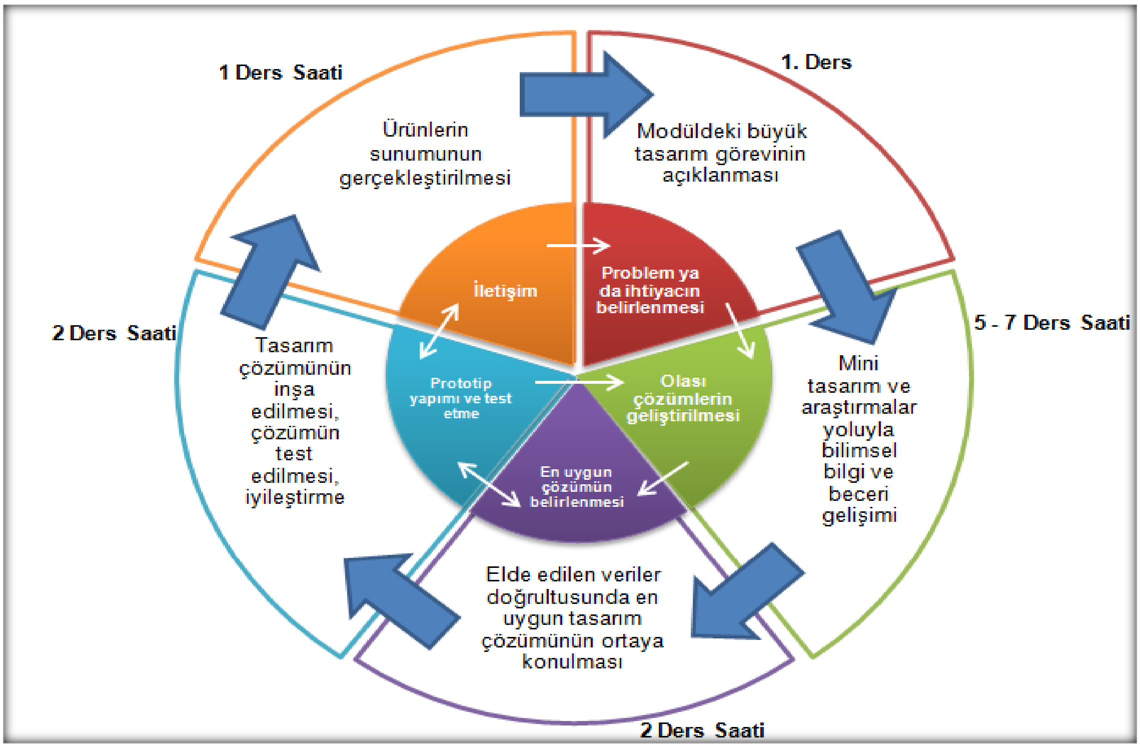
Bu doğrultuda gerçekleştirilen bu araştırmada ortaokul 7. sınıf öğrencilerinin mühendislik tasarım sürecine yönelik anlayışları üzerine odaklanılmış ve TTFE kapsamında yürütülen bir öğretim sürecinin öğrencilerin bu anlayışlarını nasıl etkilediği araştırılmıştır.

YÖNTEM

Nitel araştırma paradigmasına uygun olarak tasarlanan bu araştırmanın çalışma grubunun belirlenmesinde öğretim süreci boyunca hiç devamsızlık yapmama ve veri toplama süreci uygulamalarının tamamında yer alma kriterleri esas alınmıştır. Bu doğrultuda okul dışı bir uygulama olarak yürütülen sürece katılım gösteren 30 ortaokul 7. Sınıf öğrenci arasından 22 (16 kız ve 6 erkek) öğrenci çalışma grubunda yer almıştır.

Öğretim Süreci

Haftalık 3 ders saati olmak üzere 5 hafta boyunca devam eden öğretim süreci, ortaokul fen bilimleri dersi öğretim programında yer alan "7.3.5.1. Evsel atıklarda geri dönüştürülebilen ve dönüştürülemeyen maddeleri ayırt eder." ve "7.3.5.2. Evsel katı ve sıvı atıkların geri dönüşümüne ilişkin proje tasarlar." kazanımları esas alınarak geliştirilmiştir. Öğretim sürecinin yapılandırılmasında Ercan (2014) tarafından kullanılan (Bkz. Şekil 1) TTFE modelinden yararlanılmıştır.



Şekil 1. Araştırmada Kullanılan TTFE Süreci

Model kapsamında ilk olarak öğrencilere içerisinde çeşitli katı evsel atıkların bulunduğu kutular verilmiş, büyük tasarım görevi olarak öğrencilerin bu atıkları el değmeden ayıracakları mekanik bir sistem geliştirmeleri ve bu malzemelerin geri dönüşümü ile bir poşet tasarlamaları istenmiştir. 3-4 kişilik gruplar içerisinde çalışmalarını yürüten öğrenciler olası çözümlerin geliştirilmesi aşaması kapsamında internet üzerinden çeşitli araştırmalar yürütmüşler, basit malzemeler ile mekanik sistemler geliştirmeye çalışmışlar, çeşitli poşet tiplerinin avantaj ve dezavantajlarını gözden geçirmişlerdir. Sürecin devamında grup olarak en uygun çözüme karar veren öğrenciler mekanik sistem ve geri dönüşüm poşetlerinin prototiplerini hazırlamışlar ve poşetlerini test etmişlerdir. Öğretim süreci öğrenci gruplarının tasarım çözümlerine yönelik sunumları ve sınıf tartışmaları ile son bulmuştur.

Veri Kaynakları ve Analizi

Araştırmada veri toplama aracı olarak, öğrencilerin mühendislik tasarım süreci aşamalarına ve bu sürecin yapısına yönelik düşüncelerini açığa çıkartmak üzere araştırmacılar tarafından oluşturulan soru formu kullanılmıştır. Uygulamalar öncesi ve sonrasında öğrencilere dağıtılan soru formunda ilk olarak öğrencilere "Mühendisler tasarım problemlerini nasıl çözer?" sorusu yöneltilmiştir. Daha sonra öğrencilere çeşitli akış şemaları gösterilerek, aynı soruyu bu kez bir çizimle cevaplandırmaları istenmiştir. Soru formları ilk kez dağıtılmadan önce mühendislik ve mühendislik tasarım süreci ile ilişkili kısa bir sınıf içi tartışma gerçekleştirilmiş ve öğrencilerin mühendislik tasarımlarına yönelik vermiş oldukları doğru örnekleri vurgulanarak veri toplama sürecinin daha sağlıklı şekilde yürütülmesi hedeflenmiştir.

Elde edilen verilerin analizinde sürekli karşılaştırma yöntemi (Strauss & Corbin, 1994) kullanılmıştır. Bu doğrultuda ilk olarak ortaokul öğrencilerinin mühendislik tasarım süreci aşamaları ve sürecin yapısına yönelik düşüncelerinin hangi boyut ve kriterler çerçevesinde analiz edileceğinin belirlenmesi için var olan raporlar (NAE & NRC, 2009; NAE, 2010; NAGB, 2010; NGSS, 2013) ve geçmiş araştırmalardan (Ercan, 2014; Gaskins, Kukreti, Maltbie & Steimle, 2015) yararlanılmıştır. Mühendislik tasarım sürecinin farklı kaynaklarda farklı aşamalar kapsamında sınıflandırılması analiz sürecinin hangi boyutlar ekseninde ele alınacağına yönelik problem oluşturmuştur. Bu doğrultuda yeni nesil fen standartlarında gösterilen yapının esas alınması (Bkz. NGSS, 2013) daha uygun görülmüştür. Devam eden aşamada oluşturulan kısmi çerçeve ekseninde hazırlanan ilk kod şeması ile veriler tüm araştırmacılar tarafından ayrı ayrı analiz edilmeye başlanmış, veri analiz sürecinde meydana çıkan yeni kodlar dikkate alınarak araştırmacılar kod şemalarını yeniden düzenlemiştir. Daha sonra araştırmacılar tarafından bağımsız olarak ortaya konulan kod şemaları karşılaştırılmış, eklenen kodlar ve bunlara atfedilen anlam tartışılarak üzerinde uzlaşıya varılan nihai kod şeması (Bkz. Tablo 1.) oluşturulmuştur.

Tablo 1. Analiz Sürecinde Kullanılan Kod Şeması

<table>
<tr><th></th><th>Boyut</th><th>Kodlar</th><th>Kodların anlamı</th></tr>
<tr><td rowspan="12">Mühendislik tasarım süreci aşamalarına yönelik</td><td rowspan="3">Problemin belirlenmesi</td><td>pb_yok</td><td>Açıklama yok</td></tr>
<tr><td>pb_genel</td><td>Genel ifadeler ile aşamanın vurgulanması</td></tr>
<tr><td>pb_detay</td><td>Aşama ayrıntılı ele alınmış</td></tr>
<tr><td rowspan="7">Olası çözümlerin geliştirilmesi</td><td>çöz_yok</td><td>Açıklama yok</td></tr>
<tr><td>çöz_arş</td><td>Çözüme yönelik araştırma yapma</td></tr>
<tr><td>çöz_tek</td><td>Tek bir çözümün vurgulanması</td></tr>
<tr><td>çöz_çok</td><td>Birden fazla çözümün vurgulanması</td></tr>
<tr><td>çöz_karar</td><td>En uygun çözüme karar verilmesi</td></tr>
<tr><td>çöz_mod</td><td>Çözüme yönelik model oluşturulması</td></tr>
<tr><td>çöz_test</td><td>Oluşturulan modelin test edilmesi</td></tr>
<tr><td rowspan="2">Tasarımın iyileştirilmesi</td><td>iyi_yok</td><td>İyileştirmeye yönelik vurgu yok</td></tr>
<tr><td>iyi_vurgu</td><td>iyileştirme vurgulanmış</td></tr>
<tr><td rowspan="6">Mühendislik tasarım sürecinin yapısına yönelik</td><td rowspan="2">Döngüsel - tekrarlı</td><td>dt_değil</td><td>Döngüsel-tekrarlı yapıya vurgu yok</td></tr>
<tr><td>dön_tek</td><td>Döngüsel-tekrarlı yapı vurgulanmış</td></tr>
<tr><td rowspan="2">Sistematik</td><td>sist_değil</td><td>Sistematik yapıya vurgu yok</td></tr>
<tr><td>sistematik</td><td>Sistematik yapı vurgulanmış</td></tr>
<tr><td rowspan="2">yaratıcı</td><td>y_değil</td><td>Yaratıcı yapı vurgulanmamış</td></tr>
<tr><td>yaratıcı</td><td>Yaratıcı yapı vurgulanmış</td></tr>
</table>

Tüm veri seti nihai kod şeması doğrultusunda iki araştırmacı tarafından Tablo 2'de belirtilen kod cetveli yardımıyla ayrı ayrı analiz edilmiş ve aralarındaki uyum karşılaştırılmıştır. Tüm veri seti için bağımsız araştırmacılar arasındaki uyumun % 90' ın üzerinde olduğu tespit edilmiştir.

Tablo 2. Kod Cetveli

pb_yok	pb_genel	pb_detay	çöz_yok	çöz_arş	çöz_tek	çöz_çok	çöz_karar	çöz_mod
çöz_test	iyi_yok	iyi_vurgu	dt_değil	dön_tek	sist_değil	sistematik	y_değil	yaratıcı

Veri analizine bağlı olarak kodların ortaya konulmasından sonra bu kodlar, Tablo 3.' te belirtilen kategorilere yönelik kriterlerle karşılaştırılmış ve çalışma bulguları bu kategoriler doğrultusunda sunulmuştur.

Tablo 3. Kod Cetveli

	Kategoriler	Kriterler
Problemin belirlenmesi	Dikkate alınmamış	Aşamaya yönelik herhangi bir açıklamaya yer verilmemiş
	Yüzeysel bakış açısı	Aşama genel ifadelerle (problemi inceleme gibi) ele alınmış
	Ayrıntılı bakış açısı	Aşama kriter ve kısıtlamaların belirlenmesiyle ilişkili olarak ele alınmış
Olası çözümlerin ortaya konulması	Dikkate alınmamış	Aşamaya yönelik herhangi bir açıklamaya yer verilmemiş
	Yüzeysel bakış açısı	Aşama kapsamında yalnızca "bir çözüm geliştirilmesi" vurgulanmış
	Kısmi farkındalık	Model geliştirme ve test etmeye birlikte yer verilmemiş fakat aşamayla ilişkili diğer bazı işlemler tanımlanmış
	Derin anlayış	Model geliştirme ve test etme birlikte vurgulanmış
Tasarımın iyileştirilmesi	Dikkate alınmamış	Aşamaya yönelik herhangi bir açıklamaya yer verilmemiş
	Yüzeysel bakış açısı	Test sonuçlarının analizi ile ilişki kurulmadan aşama genel ifadeler ile vurgulanmış
	Ayrıntılı bakış açısı	Test sonuçlarına bağlı olarak modelin iyileştirilmesi vurgulanmış
Mühendislik Tasarım sürecinin yapısı	Döngüsel - tekrarlı değil	Test etme - analiz - iyileştirme sürecinin tekrarlı yapısı vurgulanmış
	Döngüsel - tekrarlı yapı	Test etme - analiz - iyileştirme sürecinin tekrarlı yapısı vurgulanmış
	Sistematik değil	Tek bir aşamaya vurgu yapılmış ya da birden fazla aşama arasında ilişki kurulmamış
	Sistematik yapı	Tasarım süreci aşamalarından en az ikisi doğru şekilde ilişkilendirilmiş
	Yaratıcı değil	Olası çözümlerin geliştirilmesinde yaratıcılığa vurgu yok
	Yaratıcı yapı	Olası çözümlerin geliştirilmesi aşaması hayal gücü, yenilik, yaratıcılık gibi kavramlarla ilişkilendirilmiş

BULGULAR

Öğrencilerin tasarım sürecine yönelik uygulama öncesinde ve sonrasındaki değerlendirmeleri aynı kod şeması ile (Bkz Tablo 1.) analiz edilmiştir. Bu durum uygulama öncesi ve sonrasına yönelik olarak elde edilen bulguların karşılaştırılmasına zemin hazırlamıştır. Devam eden bölümde araştırma bulguları bu karşılaştırmaya imkan sağlayacak şekilde bir arada sunulmuştur.

Tablo 4. Problemin Belirlenmesi Aşamasına Yönelik Bulgular

	Uygulama Öncesi		Uygulama Sonrası	
Kategoriler	f (N)	%	f (N)	%
Dikkate alınmamış	8	36	6	27
Yüzeysel bakış açısı	14	64	14	64
Ayrıntılı bakış açısı	-	-	2	9

Tablo 4'te problemin belirlenmesi aşamasına yönelik bulgulara yer verilmiştir. Gerek uygulama öncesinde gerekse sonrasında öğrenci değerlendirmelerinin büyük oranda yüzeysel bakış açısı kategorisinde olduğu görülmektedir. Uygulama sonrasında aşamayı dikkate almayan öğrenci değerlendirmelerinin az miktarda da olsa düşüş göstermesi ve ayrıntılı bakış açısını yansıtan değerlendirmelerde aynı oranda artış görülmesi (f=2), uygulamanın aşamaya yönelik gelişim sağlama potansiyelinin göstergeleri olarak değerlendirilebilir.

Tablo 5. Olası Çözümlerin Geliştirilmesi Aşamasına Yönelik Bulgular

	Uygulama Öncesi		Uygulama Sonrası	
Kategoriler	f (N)	%	f (N)	%
Dikkate alınmamış	1	4	-	-
Yüzeysel bakış açısı	13	60	9	41
Kısmi farkındalık	8	36	8	36
Derin anlayış	-	-	5	23

Olası çözümlerin geliştirilmesine aşamasına yönelik bulguların sunulduğu Tablo 5. incelendiğinde uygulama sonrasında aşamayı dikkate almayan ve yüzeysel bakış açısı kategorisinde değerlendirilen öğrenci görüşlerinin sayısında azalma olduğu görülmektedir. Kısmi farkındalık kategorisinde yer alan değerlendirmelerin oranında değişme olmazken uygulama öncesinde hiç gözlenmeyen "derin anlayış" kategorisinde uygulama sonrasında öğrenci değerlendirmelerinde artış olduğu (f=5) görülmektedir.

NGSS (2013) kapsamında tasarım sürecinin son aşaması olarak ifade edilen tasarımın iyileştirilmesi aşaması ile ilgili olarak bulgular Tablo 6' da sunulmuştur.

Tablo 6. Tasarımın İyileştirilmesi Aşamasına Yönelik Bulgular

	Uygulama Öncesi		Uygulama Sonrası	
Kategoriler	f (N)	%	f (N)	%
Dikkate alınmamış	21	95	14	64
Yüzeysel bakış açısı	-	-	2	9
Ayrıntılı bakış açısı	1	5	6	27

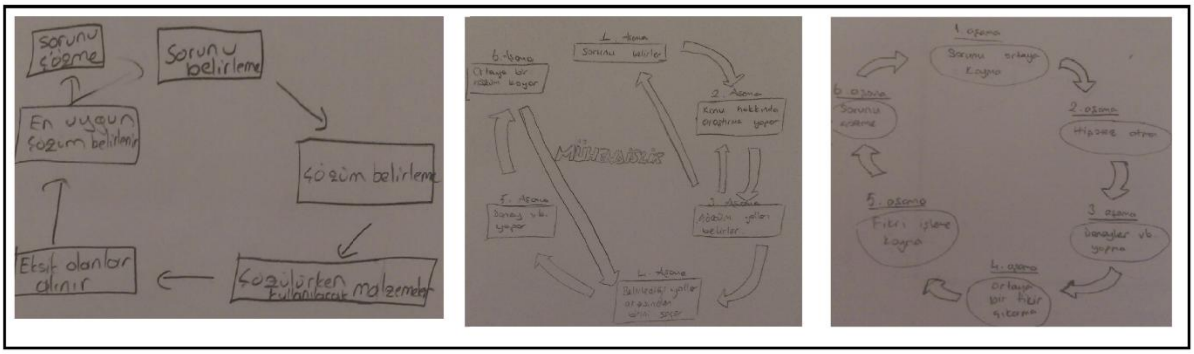
Tablo 6 incelendiğinde uygulama öncesinde öğrencilerin çok büyük oranda (% 95) bu aşamayı dikkate almadıkları görülmektedir. Uygulama sonrasında ise aşamayı dikkate almayan öğrencilerin sayısının azaldığı, bu öğrencilerin çoğunun da (f=6) aşamaya yönelik ayrıntılı bakış açısı sergiledikleri görülmektedir.

Son olarak Tablo 7' de öğrencilerin mühendislik tasarım sürecinin yapısına yönelik değerlendirmeleri ile ilgili bulgulara yer verilmiştir.

Tablo 7. Tasarım Sürecinin Yapısına Yönelik Bulgular

	Uygulama Öncesi		Uygulama Sonrası	
Kategoriler	f (N)	%	f (N)	%
Döngüsel - tekrarlı değil	21	95	14	64
Döngüsel - tekrarlı yapı	1	5	8	36
Sistematik değil	9	41	5	23
Sistematik yapı	13	59	17	77
Yaratıcı değil	22	100	20	91
Yaratıcı yapı	-	-	2	9

Tablo 7 incelendiğinde uygulama öncesinde öğrencilerin tasarım sürecinin döngüsel-tekrarlı ve yaratıcı yapısı ile ilişkili değerlendirmelerde bulunmadıkları görülmektedir. Sürecin sistematik yapısı ise uygulama öncesinde öğrencilerin çoğunluğu (% 59) tarafından vurgulanmıştır. Uygulama sonrasında her üç kategori kapsamında da yapılan doğru değerlendirmelerinin oranının arttığı tespit edilmiştir. Fakat sürecin yaratıcı yapısının uygulama sonrasında yalnızca iki öğrenci tarafından vurgulanması dikkat çekici bir bulgu olarak göze çarpmaktadır.



Şekil 2. Örnek Öğrenci Çizimleri

SONUÇ

Mühendislik tasarım süreci aşamalarına yönelik uygulama öncesi ve uygulama sonrası bulgular bir arada değerlendirildiğinde tasarım temelli fen eğitimi sürecinin öğrencilerin bu aşamalara yönelik anlayışlarının gelişimine genel anlamda katkı sağladığı görülmektedir. Buna rağmen özellikle tasarımın iyileştirilmesi aşamasının uygulama sonrasında öğrencilerin çoğunluğu (% 64) tarafından dikkate alınmamış olması sürecin bu kapsamda yeniden değerlendirilmesi gerekliliğini doğurmaktadır. Zira bu aşamada gerçekleştirilecek test etme -

sonuçları analiz etme - iyileştirme süreci mühendislik tasarım sürecinin en karakteristik uygulamaları arasında yer almaktadır (Crismond & Adams, 2012). Ayrıca aşama kapsamında sergilenecek bu karakteristik uygulamaların dikkate alınmaması, öğrencilerin mühendislik tasarım sürecinin tekrarlı-döngüsel yapısını tam olarak kavrayamadıklarının da bir göstergesidir. Sürecin yapısal özellikleri ile bulgular incelendiğinde bu tespit açık bir şekilde görülmektedir.

Tasarım sürecinin yapısal özellikleri ile ilgili bulgular incelendiğinde sürecin yaratıcı boyutunun uygulama öncesinde hiçbir öğrenci tarafından vurgulanmadığı, uygulama sonrasında ise yalnızca 2 öğrenci tarafından vurgulandığı görülmektedir. Bu doğrultuda yürütülen sürecin öğrencilerin tasarım sürecinin yaratıcı yapısına yönelik anlayışlarının gelişimine çok az düzeyde katkı sağladığı ifade edilebilir. Esasında mühendislik tasarım problemlerinin hemen her zaman birden fazla çözümünün bulunması özellikle olası çözümlerin geliştirilmesi aşamasını yaratıcı girişimlere uygun hale getirmektedir (NAE & NRC, 2009). Fakat TTFE' nde bu aşama belirlenen kazanımlar doğrultusunda öğretmenler (araştırmacılar) tarafından yapılandırılmaktadır. Mühendislik tasarım sürecinin doğasına aykırı olan bu durum TTFE sürecinde belirli fen kazanımlarına yönelik öğretim için bir gerekliliktir. Dolayısıyla TTFE kapsamında yürütülen tasarım süreci belirli düzeyde profesyonellerin uygulamalarından farklılaşmış ve bu durum öğrencilerin sürecin yaratıcı yapısına yönelik değerlendirmelerini etkilemiştir.

Araştırma kapsamında ortaya konulan bu sonuçlar, gerçekleştirilen uygulamaların öğrencilerin K-12 mühendislik eğitiminin en önemli kazanımları arasında gösterilen tasarım sürecine yönelik anlayışlarının geliştirilmesi için gerekli potansiyele sahip olduğunu göstermektedir. Bu doğrultuda K-12 mühendislik eğitimine yönelik öğrenim hedeflerine ulaşılması için TTFE uygulamalarının daha yaygın olarak kullanılması gerektiği ifade edilebilir.

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INVESTIGATION OF THE PROPORTIONAL REASONING LEVELS IN SEVENTH GRADE STUDENTS

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ABSTRACT: The purpose of this study is the determination of the proportional reasoning levels of 7th grade students. Descriptive analysis, a qualitative research method, was employed. The data prepared by the researcher was incorporated into four problems and was gathered in a one page document in order to be solved by the students in a classical way. The participants of this study are consistent of 146 seventh grade students from two public schools located in the central cities of Van. The data was analysed in accordance with the levels specified in the studies of Langrall and Swafford (2000). The results of the study demonstrated low levels of proportional reasoning attitudes in most of the 7th grade students. We suggest that, more problem situations which are supportive of the proportional reasoning levels of the students have to be incorporated into the education system.

Key words: proportional reasoning levels, problem solving, 7th grade

YEDİNCİ SINIF ÖĞRENCİLERİNİN ORANTISAL MUHAKEME DÜZEYLERİNİN İNCELENMESİ

ÖZET: Bu çalışmanın amacı 7. sınıf öğrencilerinin orantısal muhakeme düzeylerini belirlemektir. Çalışmada nitel araştırma yöntemlerinden betimsel analiz kullanılmıştır. Veriler araştırmacı tarafından hazırlanan 4 adet problemi öğrencilerin klasik tarzda çözmelerinin istendiği 1 sayfalık bir dokümanla toplanmıştır. Çalışmanın katılımcılarını Van'ın merkez ilçelerinden birinde bulunan 2 devlet okulunda 7. sınıfta öğrenim gören 146 öğrenci oluşturmaktadır. Veriler Langrall ve Swafford (2000) çalışmalarında belirledikleri düzeyler doğrultusunda analiz edilmiştir. Araştırmanın sonuçları 7.sınıf öğrencilerinin çoğunun orantısal muhakeme yaklaşımlarının düşük düzeyde olduğunu göstermiştir. Öğretimde öğrencilerin orantısal muhakeme yaklaşımlarını destekleyici problem durumlarına daha çok yer verilmesi gerektiği düşünülmektedir.

Anahtar sözcükler: orantısal muhakeme düzeyleri, problem çözme, 7.sınıf

GİRİŞ

Orantısal muhakeme matematiksel muhakeme türlerinden biridir (Martinez Ortiz, 2015). Akkuş Çıkla ve Duatepe (2002) orantısal muhakemeyi, orantısal durumlar içindeki çarpımsal ilişkili matematiksel yapıları anlamak olarak tanımlamışlardır. Orantısal muhakeme ortaöğretimde geliştirilebilecek en önemli kabiliyetlerden biridir (Langrall & Swafford, 2000; National Council of Teachers of Mathematics [NCTM], 2000). Bunun en önemli nedeni öğretimde orantısal muhakeme yeteneğinin cebirde ve geometride birçok soru çözümünde etkili bir şekilde kullanılabilmesi olarak ifade edilebilir. NCTM (2000) orantısal muhakemenin yüzde, benzerlik, ölçekleme, lineer denklemler, göreceli sıklık histogramları ve olasılık gibi konularda kullanılabileceğini vurgulamıştır. Örneğin d=90t bir aracın saatte 90 km/sa hızla t saatte aldığı yol olarak koordinat ekseninde düşünüldüğünde, bu durum orantısal ilişkinin grafiksel temsili şeklinde incelenebilir (Usiskin vd., 2003). Burada d ve t değişkenleri arasında orantısal bir ilişki bulunmaktadır. Görüldüğü üzere bu ilişki d ile t arasında çarpımsal bir ilişkidir. Yani bu ilişkide t değişkeniyle herhangi bir sayı çarpıldığında d değişkeni de aynı miktarla çarpılmış demektir.

Orantısal muhakemenin kovaryasyonel anlama, çarpımsal karşılaştırma, zihinsel depolama kabiliyeti ve bazı bilgi parçalarının işlenmesi gibi kavramları içerdiğini belirtilmiştir (Lesh, Post & Behr, 1988). Lamon (1993) orantıyla ilgili dört farklı problem çeşidi tanımlamıştır. Bunlar: 1. Parça-parça-bütün, 2. İlişkili kümeler, 3. İyi bilinen ölçüler[10], 4. Büyüme[11] (germe ya da büzülme durumları) şeklinde ifade edilmiştir.

[10] well-known measures anlamında kullanılmıştır.
[11] growth kelimesine karşılık kullanılmıştır.

Orantısal Akıl Yürütmenin Düzeyleri

Langrall ve Swafford (2000) çalışmalarında orantısal akıl yürütmeyi düşükten yükseğe doğru olacak şekilde 4 düzeyde ifade etmişlerdir.
Düzey 0: Bu düzeydeki stratejiler orantısal muhakeme içermemektedir. Buradaki stratejiler çarpımsal karşılaştırmalardan ziyade toplamsal olarak karekterize edilebilir. Problemlerde sayılar ya da işlemler rasgele kullanılmaktadır. Tahmin ya da görsel ipuçları (Örneğin bir problemle ilgili "Yanıt 5 gibi görünüyor" şeklindeki ifadeler) şeklinde de görülebilmektedir. Son olarak iki ölçünün bağlantısız bir şekilde kullanımını da içerebilmektedir.

Düzey 1: Bu düzeyde öğrenciler orantısal durumla ilgili informel muhakemelerde bulunabilirler. Yani öğrenciler problem durumunu anlamlandırmak için resimler, modeller ve manipulatifler kullanabilirler. Ayrıca bu düzeyde öğrenciler nitel karşılaştırmalarda da bulunabilirler.

Düzey 2: Bu düzey nicel muhakemeler olarak ifade edilebilir. Daha ayrıntılı olarak bu düzeyde öğrenciler: a) Birimleştirme ya da farklı durumlarla ilgili birimlerin birleşimini kullanabilirler. b) Birim oran bulur ve kullanabilirler. c) Durumlarla ilgili çarpımsal sayıyı belirler ya da tablo kullanabilir. d) Denk kesirleri kullanır. e) Problemle ilgili farklı ölçüler arasındaki ilişkiyi artan ya da azalan durumlarda uygulayabilir.

Düzey 3: Bu düzey formel muhakeme olarak ifade edilebilir. Bu düzeyde öğrenciler değişken kullanarak orantı kurabilir. İçler dışlar çarpımı ya da denk kesirleri kullanarak problemi çözebilirler. Ayrıca değişmeyen ilişkileri ve kovaryasyonel ilişkileri tamamen anlamışlardır.

Literatür incelendiğinde orantısal akıl yürütmeyle ilgili birçok çalışma yapıldığı görülmektedir. (Langrall & Swafford, 2000; Lesh, Post, & Behr, 1988; Miyakawa & Winsløw, 2009; Tjoe & Torre, 2014; Akkuş Çıkla & Duatepe, 2002; Duatepe, Akkuş Çıkla & Kayhan, 2005). Akkuş Çıkla ve Duatepe (2002) ilköğretim matematik öğretmen adaylarıyla orantısal muhakeme içeren orantı problemleri için geliştirdikleri çözüm stratejileri görüşmeler yoluyla ortaya çıkarmayı amaçlamışlardır. Sonuç olarak öğretmen adaylarının orantı konusunu kavramsal düzeyde anlayamadıkları belirtilmiştir. Langrall ve Swafford (2000) çalışmalarında ortaokul öğrencilerinin orantısal muhakeme düzeylerini incelemişlerdir. Çalışmada orantısal muhakemenin karmaşık bir yapıya sahip olduğu ifade edilmiştir. Ayrıca orantısal muhakemenin kısa sürede geliştirilemeyeceğini ancak uzun bir sürece yayılarak farklı konularda ele alındığında geliştirilebileceği ifade edilmiştir.

Ortaokul matematik dersi öğretim programında sayılar ve cebir öğrenme alanında oran ve orantı alt öğrenme alanı içerisinde 7. sınıf seviyesinde bu konunun öğretiminin gerçekleştirildiği görülmektedir. Burada öğrencilerden oranları verilen çoklukları belirlemeleri, orantısal durumları tespit edebilmeleri (gerçek yaşam bağlamında, tabloda ya da grafik üzerinde), doğru ve ters orantı içeren problemleri çözebilmeleri beklenmektedir (Milli Eğitim Bakanlığı [MEB], 2013).

Orantısal akıl yürütmenin matematiğin birçok konusuyla ilişkisinin olduğu görülmektedir. Ancak ülkemizde orantısal akıl yürütme içeren problem çözümlerinde 7. sınıf seviyesinde öğrencilerin bu yeteneği hangi düzeyde kullanabildiklerine ilişkin sınırlı sayıda çalışma olduğu görülmektedir. Bu yüzden bu çalışmada 7. sınıfta öğrenim gören öğrencilerin orantısal muhakeme düzeyleri belirlenmeye çalışılmıştır.

YÖNTEM

Bu çalışmada nitel araştırma yöntemlerinden betimsel analiz kullanılmıştır. Betimsel analizde elde edilen veriler daha önceden belirlenen temalara göre özetlenir ve yorumlanırlar. Veriler araştırma sorularının ortaya koyduğu temalara göre düzenlenebileceği gibi, görüşme ve gözlem süreçlerinde kullanılan sorular ya da boyutlar dikkate alınarak da sunulabilir (Yıldırım & Şimşek, 2011).

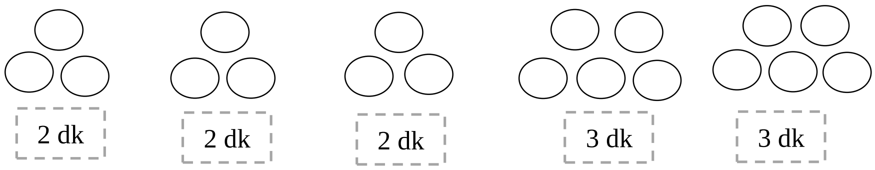
Veriler araştırmacı tarafından hazırlanan 4 adet problemi öğrencilerin klasik tarzda çözmelerinin istendiği 1 sayfalık bir dokümanla toplanmıştır. Bu problemler Lamon'un (1993) çalışmasında ifade ettiği problem tiplerinden ilişkili kümeler kategorisinde olduğu belirtilebilir. Çalışmanın katılımcılarını Van'ın merkez ilçelerinden birinde bulunan 2 devlet okulunda 7. sınıfta öğrenim gören 146 öğrenci oluşturmaktadır. Uygulama 1 ders saatinde gerçekleştirilmiştir. Veriler Langrall ve Swafford (2000) çalışmalarında belirledikleri düzeyler doğrultusunda analiz edilmiştir. (Ayrıntılar için literatüre bakınız)

Araştırmada kullanılan problemler problem 1 (P1), problem 2 (P2), problem 3 (P3) ve problem 4 (P4) şeklinde ve katılımcılar öğrenci 1(Ö1), öğrenci 2(Ö2),…vs şeklinde kodlanmıştır. Aşağıda çalışmada kullanılan orantısal muhakeme içeren bir problem, bu problemin farklı muhtemel stratejilerle çözümleri ve bu çözümlerin orantısal muhakeme düzeylerinden hangisine denk geldiği verilmiştir.

P1. Burak 2 dakikada 3 soru çözerken, Elif 3 dakikada 5 soru çözmektedir. Hangi öğrenci daha hızlı soru çözmektedir**?**

Strateji 1: "Elif daha hızlı çözer." Bu çözüm yaklaşımı bir tahmin içerdiğinden düzey 0 olarak ifade edilebilir.

Strateji 2: Belirtilen zamanlara göre Burak ve Elif'in çözdüğü sorular modellenerek karşılaştırılabilir.



Şekil 1. Burak (solda) ve Elif'in (Sağda) 6 Dakikalık Bir Zamanda Muhtemel Çözüm Yaklaşımları

Burada öğrenciler aynı zaman diliminde (örneğin 6 dakikada) Elif'in Burak'tan daha fazla soru çözdüğünü ifade edebilir. Bu strateji belli zaman dilimleri için öğrencilerin çözdüğü soruların bir modellemesini içerdiğinden düzey 1 şeklinde ifade edilebilir.

Strateji 3: Burak 2 dakikada 3 soru çözerse 1 dakikada 1,5 soru çözebilir. Benzer şekilde Elif 3 dakikada 5 soru çözerse 1 dakikada 1,66… soru çözebilir. 1 dakikalık zamanda Elif daha hızlı soru çözebilmektedir. Bu stratejide birimleştirme yaklaşımıyla çözüm yapıldığından düzey 2 olarak açıklanabilir.

Strateji 4: Burak 2 dakikada 3 soru çözerse bir dakikada 3/2 soru çözebilir. Elif 3 dakikada 5 soru çözerse bir dakikada 5/3 soru çözebilir. Daha sonra denk kesirler kullanılarak bu iki değer karşılaştırılabilir. $3/2 \equiv 9/6$ ve $5/3 \equiv 10/6$ sonuçta $9/6 < 10/6$ olduğundan Elif daha hızlı soru çözebilir. Bu stratejide denk kesirler kullanılarak çözüm tamamen gerçekleştirildiğinden düzey 3 olarak ifade edilebilir.

BULGULAR

Yedinci sınıf öğrencilerinin orantısal muhakeme düzeylerinin belirlenmeye çalışıldığı araştırmanın sonuçları her bir soru için ayrı ayrı tablolar şeklinde sunulmuştur. Bazı tablolardan sonra tablodaki verileri destekleyecek şekilde ilgili probleme ilişkin bazı öğrencilerin kullandıkları çözüm stratejileri kağıtlarından direkt alıntılar yapılarak sunulmuştur. Aşağıda tablo 1'de P1 problemi için öğrencilerin orantısal muhakemelerinin farklı düzeyleri için frekans ve yüzdeleri verilmiştir.

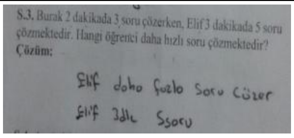
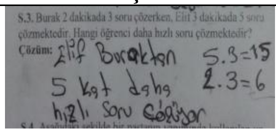
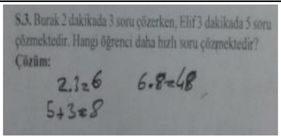
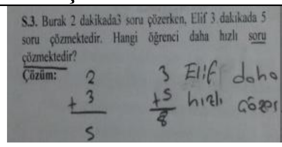
Tablo 1. P1 Problemiyle İlgili Öğrencilerin Muhakeme Düzeyleri

Orantısal Muhakeme Düzeyleri	f	Yüzde
Düzey 0	127	86.9
Düzey 1	1	0.7
Düzey 2	13	8.9
Düzey 3	5	3.5
Toplam	146	100

Tablo 1'de orantısal muhakeme kabiliyetine ilişkin 7. sınıf öğrencilerinin %86.9'unun düzey 0 kategorisinde, %0.7'sinin düzey 1 kategorisinde, %8.9'unun düzey 2 kategorisinde ve %3.5'inin düzey 3 kategorisinde olduğu görülmektedir. Bu problemde dikkat çeken önemli bir nokta düzey 1 de sadece 1 öğrencinin bulunması olarak ifade edilebilir. Buradan öğrencilerin orantısal muhakeme yeteneği açısından P1 problemi için çok düşük düzeyde muhakemeler ürettikleri söylenebilir.

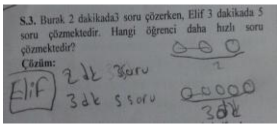
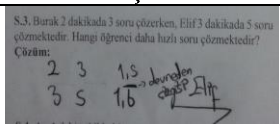
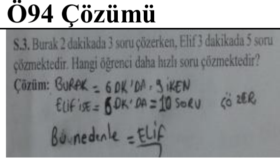
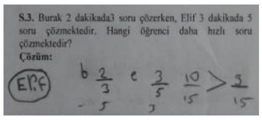
Tablo 2 ve tablo 3'de bazı öğrencilerin P1 probleminin çözümü için ürettikleri çözüm stratejileri verilmiştir. Bu sayede tablo 1'de sunulan farklı düzeylerde orantısal muhakeme yeteneğine sahip öğrencilerin P1 problemi için nasıl çözümler ortaya koyduklarıyla ilgili belli ölçüde fikir verilmektedir. Tablo 2'de orantısal muhakeme düzeylerinden düzey 0 içerisinde yer alan çözüm stratejilerine yer verilmiştir. Tablo 3'de ise düzey 1, düzey 2 ve düzey 3'e ait bazı çözüm stratejileri sunulmuştur.

Tablo 2. P1 Problemi İçin Bazı Öğrencilerin Düzey 0 Kategorisindeki Stratejileri

Ö78 Çözümü	**Ö112 Çözümü**	**Ö110 Çözümü**	**Ö39 Çözümü**
			

Tablo 2'de verilen P1 problemine ilişkin (Bu problem hazırlanan 1 sayfalık dokümanda S3 şeklinde geçmektedir) öğrencilerin ürettiği çözüm stratejilerin düzey 0 kategorisinde olduğu görülmektedir. Burada Ö78'in çözümü sadece bir tahmin içermekte, Ö112'nin ve Ö110'nun çözümü verilen sayılarla rasgele işlem yapma durumunu içermekte ve Ö39'un çözümü ise toplamsal bir yaklaşım içermektedir. Görüldüğü üzere öğrencilerin tablo 2'de kullandığı stratejilerde orantısal muhakeme gözlenmemektedir.

Tablo 3. P1 Problemi İçin Bazı Öğrencilerin Düzey 1 Dışındaki Kategorilerdeki Stratejileri

Ö25 Çözümü	**Ö115 Çözümü**	**Ö94 Çözümü**	**Ö32 Çözümü**
			

Tablo 3'de P1 problemine ilişkin bazı öğrencilerin orantısal muhakeme düzeylerinden düzey 1, düzey 2 ve düzey 3 ile ilgili çözüm stratejileri verilmiştir. Burada Ö25'in soruları yuvarlak küçük çemberlerle modelleyerek çözümü gerçekleştirdiği görülmektedir. Dolayısıyla bu öğrencinin orantısal muhakeme düzeylerinden düzey 1'de olduğu anlaşılmaktadır. Ö115'in birimleştirmeye başvurduğu görülmektedir. Bu açıdan orantısal muhakeme düzeylerinden düzey 2'de olduğu görülmektedir. Ö94 farklı ölçüm uzaylarında ilişkili olan 2 değişkenle ilgili artan bir durumu doğru bir şekilde kullandığı belirlenmiştir. Bu yönüyle Ö94'ün orantısal muhakeme düzeylerinden düzey 2'de olduğu belirlenmiştir. Son olarak Ö32'nin önce birimleştirme başvurarak 2 kesir elde ettiği daha sonra denk kesirleri kullanarak, bu kesirlerin belli bir doğrultuda karşılaştırılması neticesinde çözümünü gerçekleştirdiği belirlenmiştir. Bu açıdan bu öğrencinin orantısal muhakeme düzeylerinden düzey 3'de olduğu görülmektedir. Tablo 4'te P2 problemiyle ilgili öğrencilerin ürettiği orantısal muhakemelerin farklı düzeylerdeki frekans ve yüzdeleri verilmiştir.

Tablo 4. P2 Problemiyle İlgili Öğrencilerin Muhakeme Düzeyleri

Orantısal Muhakeme Düzeyleri	f	Yüzde
Düzey 0	95	65.1
Düzey 1	0	0
Düzey 2	40	27.4
Düzey 3	11	7.5
Toplam	146	100

Tablo 4 incelendiğinde P2 probleminde, orantısal muhakeme kabiliyetine ilişkin öğrencilerin %65.1'inin düzey 0 kategorisinde, %27.4'ünün düzey 2 kategorisinde ve %7.5'inin düzey 3 kategorisinde bulunduğu belirlenmiştir. Burada düzey 1 kategorisinde hiçbir öğrencinin bulunmaması dikkat çekici olarak ifade edilebilir. Öğrencilerin P2 probleminde orantısal muhakeme açısından düzey 0'da olanlar çoğunlukta olsa da bu problemde düzey 2 ve düzey 3 kategorisinde bulunanlar artış göstererek kabul edilebilir bir aralığa ulaştığı söylenebilir. Tablo 5'te P3 problemiyle ilgili öğrencilerin ürettiği orantısal muhakemelerin farklı düzeylerdeki frekans ve yüzdeleri verilmiştir.

Tablo 5. P3 Problemiyle İlgili Öğrencilerin Muhakeme Düzeyleri

Orantısal Muhakeme Düzeyleri	f	Yüzde
Düzey 0	109	74.7
Düzey 1	0	0
Düzey 2	11	7.5
Düzey 3	26	17.8
Toplam	146	100

Tablo 5 incelendiğinde P3 problemine ilişkin, öğrencilerin %74.7'sinin düzey 0 kategorisinde, %7.5'inin düzey 2 kategorisinde ve %17.8'inin düzey 3 kategorisinde bulunduğu görülmektedir. Yine burada da düzey 1 kategorisinde hiçbir öğrenci bulunmadığı belirlenmiştir. Öğrencilerin P3 probleminde büyük ölçüde düzey 0 kategorisinde olduğu söylenebilir. Tablo 6'da P4 problemiyle ilgili öğrencilerin ürettiği orantısal muhakemelerin farklı düzeylerdeki frekans ve yüzdeleri verilmiştir.

Tablo 6. P4 Problemiyle İlgili Öğrencilerin Muhakeme Düzeyleri

Orantısal Muhakeme Düzeyleri	**f**	**Yüzde**
Düzey 0	120	82.2
Düzey 1	0	0
Düzey 2	8	5.4
Düzey 3	18	12.4
Toplam	146	100

Tablo 6 incelendiğinde P4 problemine ilişkin, öğrencilerin %82.2'si düzey 0 kategorisinde, %5.4'ü düzey 2 kategorisinde ve %12.4'ü düzey 3 kategorisinde bulunduğu görülmektedir. Bu problemde de düzey 1'de hiçbir öğrenci bulunmadığı belirlenmiştir. Öğrencilerin P4 probleminde büyük oranda düzey 0 kategorisinde olduğu söylenebilir.

Tablolarda görüleceği üzere 7. sınıf öğrencilerinin çoğunun orantısal muhakeme yeteneği açısından düşük düzey olarak ifade edilebilecek düzey 0'da olduğu görülmektedir. Bazı öğrencilerin orantısal muhakeme yeteneği açısından yüksek düzey olarak ifade edilebilecek düzey 2 ve düzey 3'te olmalarına rağmen bu oransal anlamda genellikle kabul edilebilir düzeyde olmadığı tespit edilmiştir. Son olarak düzey 1'de neredeyse hiç kimsenin bulunmaması beklenmeyen bir sonuç olarak ifade edilebilir.

SONUÇ

Yedinci sınıf öğrencilerinin orantısal muhakeme düzeylerinin incelendiği bu araştırmada, öğrencilerin çoğunlukla düşük düzeyde orantısal muhakeme yeteneğine sahip oldukları belirlenmiştir. Diğer yandan az da olsa yüksek düzeyde bazı öğrencilerin bulunduğu söylenebilir.

Bu araştırmada beklenmeyen bir sonuç, düzey 1'de neredeyse hiçbir öğrencinin bulunmaması olarak ifade edilebilir. Düzey 1 öğrencilerin resim, model ve somut materyaller kullanarak problem durumunu anlamasını içermektedir. Ancak bu tür yaklaşımları öğrenciler problem çözümlerinde kullanmamışlardır. Böyle bir sonucun ortaya çıkmasında öğretim yaklaşımlarında resim ya da somut materyallerden yeterince yararlanılmaması neden olmuş olabileceği düşünülmektedir.

Bu araştırmada kullanılan düzeyler düzey 0'dan düzey 3'e doğru ardışık bir sıra takip etmektedir. Bu anlamda düzey 0'da oluşan yığılma ve düzey 1'de hiçbir öğrencinin bulunmaması orantısal muhakeme yeteneğinin geliştirilmesi açısından bir boşluk oluşturduğu söylenebilir. Bu yüzden öğretimde problem çözümlerimde resim, model ve somut materyal gibi araçlardan yararlanılması önemli görülmektedir. Ayrıca öğretimde öğrencilerin orantısal muhakeme yaklaşımlarını destekleyici problem durumlarına daha çok yer verilmesi gerektiği düşünülmektedir.

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OPINIONS AND ATTITUDES OF PROSPECTIVE TEACHERS FOR THE USE OF TECHNOLOGY IN EDUCATION

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ABSTRACT: This study aims at examining the attitudes of the prospective teachers towards the role of technology and the use of technology in education. The model of this research is survey model. The study group of the research consists of 138 prospective teachers who are enrolled at Hacettepe University, Faculty of Education. As data collection tools in the research the role of technology in education-instruction activities scale and attitude towards the use of technology in education scale were used. In general, it has been found out that the attitudes of prospective teachers towards the importance of technological equipment as a teaching tool in education are positive. In other words, statistically significant differences have occurred in attitudes of prospective teachers towards the role of technology.

Key words: prospective teachers, using technology in education, attitudes.

ÖĞRETMEN ADAYLARININ EĞİTİMDE TEKNOLOJİ KULLANIMINA YÖNELİK GÖRÜŞ VE TUTUMLARI

ÖZET: Bu araştırma, eğitim öğretim faaliyetlerinde teknoloji kullanımı konusunda üniversite öğrencilerinin düşüncelerini öğrenmeyi amaçlamaktadır. Araştırmanın çalışma grubunu Hacettepe Üniversitesi, Eğitim Fakültesi'nde öğrenim gören 138 öğretmen adayı oluşturmaktadır. Araştırma, betimsel yöntemlerden tarama modelli bir çalışmadır. Araştırmada veri toplama araçları olarak teknolojinin eğitim öğretimdeki rolü ölçeği ve eğitimde teknoloji kullanımına yönelik tutum ölçeği kullanılmıştır. Araştırma sonunda elde edilen verilere göre, genel olarak öğretmen adaylarının, teknoloji kullanımına karşı yüksek düzeyde olumlu düşüncelere sahip oldukları belirlenmiştir. Ayrıca öğretmen adaylarının eğitimde teknoloji kullanımının öğretim sürecine yansımasına, kendilerini geliştirmelerine, eğitimde teknoloji kullanımını gerçekleştirmelerine ve sınıf yönetimine yönelik görüşleri irdelenmiştir.

Anahtar sözcükler: öğretmen adayları, eğitimde teknoloji kullanımı, teknolojiye yönelik tutum.

GİRİŞ

Çağımızda bilgi teknolojilerinin yoğun olarak kullanılmasının yarattığı değişiklikler, bireylerin hayatın her alanında teknoloji ile bütünleşmesini gerekli hale getirmiştir. Teknoloji her geçen gün değişmekte ve günlük yaşamda olduğu gibi eğitim ve öğretim ortamlarında da gereksinimlere cevap verebilecek bir şekilde kullanılabilmektedir (Van Wyk & Louw, 2008). Bunun bir sonucu olarak teknolojik gelişmeler eğitim kurumlarının yapı ve işlevlerini etkilemektedir. Teknoloji; günlük yaşamı eğitim ortamına taşımakta, öğrenmeyi geliştirmek için araçlar sağlamakta ve öğretmen ile öğrencilere düşünme, düzeltme ve değerlendirme için daha fazla olanak sağlamaktadır (Bransford, Brown & Cocking, 2000). Teknolojinin eğitim ile bütünleştirilmesi ve eğitim alanında kullanılan teknolojilerin kolay öğrenilebilir ve kullanılabilir olması öğrenme-öğretme sürecinde verimliliği artırmaktadır. Öğrenme-öğretme ortamında teknolojiyi kullanma konusunda olumlu fikirlerin yaygınlaşması, söz konusu eğitim teknolojilerinin kullanılması, motivasyonun artmasına da yardımcı olacaktır. Bireyler, teknolojik yenilikleri günlük hayatlarına adapte edebilmeleri için, formal ve informal eğitim yoluyla teknolojiye aşina olarak yetiştirilmelidirler (Çepni, 2005). Eğitim dünyasındaki hızlı ilerlemeler, teknolojinin eğitim ve öğretimdeki rolünü kavrayan ve yeniliklere açık öğretmen adaylarının yetiştirilmesini gün geçtikçe daha da önemli kılmaktadır. Geleceğin öğretmeni olacak öğretmen adaylarının hem teknolojiyi çok iyi derecede kullanma becerileri sergileyebilmeleri hem de bu teknolojileri öğretme-öğrenme süreçlerinde optimum verimlilik düzeyinde kullanabilmeleri gereklidir. Bu nedenle öğretmen adaylarının teknolojinin eğitim ve öğretimde aktif kullanımı konusundaki görüşlerini belirlemek ve teknoloji kullanımındaki yetersizliklerini gidermek, öğretmen yetiştiren kurumlar açısından oldukça önemlidir. Bu görüşten hareketle yürütülen araştırmanın amacı, öğretmen adaylarının eğitimde teknoloji kullanımına yönelik tutumlarını ve teknolojinin eğitim öğretim faaliyetlerindeki rolüne yönelik görüşlerini belirlemektir. Bu şekilde öğretmen adaylarının teknolojinin eğitim-öğretimde kullanımına yönelik eksikliklerinin tespit edilebileceği ve teknolojinin eğitim amaçlı kullanımının yararlarının belirlenebileceği hedeflenmektedir.

YÖNTEM

Araştırma tarama modelinde tasarlanmıştır. Araştırmanın örneklem grubunu Hacettepe Üniversitesi, Eğitim Fakültesinden öğrenim gören 138 öğretmen adayı oluşturmaktadır. Öğretmen adaylarının eğitim teknolojilerine yönelik tutumları Öztürk (2006) tarafından geliştirilen "Eğitimde Teknoloji Kullanımına Yönelik Tutum Ölçeği" ile belirlenmiştir. Ölçeğin üç alt boyutu bulunmaktadır. Bu boyutlar "Eğitimde Teknoloji Kullanımının Öğretim Süreçlerine Yansıması, Eğitimde Teknoloji Kullanımında Kendini Geliştirme, Eğitimde Teknoloji Kullanımı ve Sınıf Yönetimi"dir. Ölçeğin Cronbach alpha güvenirlik katsayısı 0.90'dır. Ölçek için örneklem verilerinden elde edilen Cronbach alpha güvenirlik katsayısı .93'tür. Öğretmen adaylarının teknolojinin eğitim-öğretim faaliyetlerindeki rolüne yönelik görüşleri Çil (2008) tarafından geliştirilen ölçek ile belirlenmiştir. Ölçeğin Cronbach alpha güvenirlik katsayısı 0.70'tir. Ölçek için örneklem verilerinden elde edilen Cronbach alpha güvenirlik katsayısı .89'dur. Araştırmadan elde edilen verilerin analizi SPSS 15 paket programı ile gerçekleştirilmiştir. Ölçeklerden elde edilen verilerin analizi gerçekleştirilirken öncelikli olarak betimsel istatistik yapılmıştır. Böylece örneklem grubunun eğitimde teknoloji kullanımına yönelik tutumları ve teknolojinin eğitim öğretim faaliyetlerindeki rolüne yönelik görüşleri belirlenmiştir. Araştırmada kullanılan Likert tipi ölçekler için kişilerin verilen önermelerle ilgili görüşlerini, çok olumludan çok olumsuza doğru belirtmeleri istenmiştir. Ölçek sonuçlarının puan genişliği hesaplanmıştır. Buna göre; ölçek ifadelerinin ve boyut puanlarının değerlendirilmesi "1.00-1.79=Çok düşük; 1.80-2.59=Düşük; 2.60-3.39=Orta; 3.40-4.19=Yüksek; 4.20-5.00=Çok yüksek" şeklinde yapılmıştır. Eğitimde teknoloji kullanımına yönelik tutum ile teknolojinin eğitim öğretim faaliyetlerindeki rolü arasındaki ilişki ise korelasyon analizi ile incelenmiştir.

BULGULAR

Eğitimde teknoloji kullanımına yönelik tutuma ilişkin bulgular;

Öğretmen adaylarının eğitimde teknoloji kullanımına yönelik tutumlarının belirlenmesine ilişkin yapılan tanımlayıcı istatistikler Tablo 1'de özetlenmiştir.

Tablo 1. Tanımlayıcı İstatistikler

		N	X	Ss
Ölçek	Eğitimde Teknoloji Kullanımına Yönelik Tutum	138	3.83	.47
Alt boyutlar	Eğitimde teknoloji kullanımının öğretim süreçlerine yansıması	138	3.90	.49
	Eğitimde teknoloji kullanımında kendini geliştirme	138	3.83	.62
	Eğitimde teknoloji kullanımı ve sınıf yönetimi	138	3.71	.66

Tablo 1 incelendiğinde öğretmen adaylarının eğitimde teknoloji kullanımına yönelik tutumlarının yüksek olduğu görülmektedir. Ölçeğin alt boyutları incelendiğinde en düşük ortalama "Eğitimde teknoloji kullanımı ve sınıf yönetimi" boyutunda iken, en yüksek ortalama ise "Eğitimde teknoloji kullanımının öğretim süreçlerine yansıması" boyutundadır.

Teknolojinin eğitim öğretim faaliyetlerindeki rolüne ilişkin bulgular;

Araştırmaya katılan öğretmen adaylarının teknolojinin eğitim öğretim faaliyetlerindeki rolüne yönelik görüşleri incelenmiştir. Analiz sonuçları Tablo 2'de görülmektedir.

Tablo 2. Tanımlayıcı İstatistikler

		N	X	Ss
Ölçek	Teknolojinin eğitim öğretim faaliyetlerindeki rolü	138	3.90	.49
Alt boyutlar	Beceri ve uygulama öğretmede teknolojinin etkisi	138	3.81	.52
	Teknolojik araçlar sınıf içinde ne kadar önemli	138	4.00	.56

Öğretmen adayları eğitim öğretim faaliyetlerinde teknolojinin rolünün oldukça etkili olduğu görüşündedirler. Teknolojik araçların, sınıf içi eğitim öğretim faaliyetlerinde özellikle önemli olduğu, teknolojinin beceri ve uygulama öğretmedeki etkisinin de önemi vurgulanmaktadır.

Eğitimde teknoloji kullanımına yönelik tutum ile teknolojinin eğitim öğretim faaliyetlerindeki rolü arasındaki ilişki

Eğitimde Teknoloji kullanımına yönelik tutum ile teknolojinin eğitim öğretim faaliyetlerindeki rolü arasındaki ilişkinin incelenmesi amacıyla yapılan korelasyon analizi sonuçları Tablo 3'te verilmektedir.

Tablo 3. Eğitimde Teknoloji Kullanımına Yönelik Tutum ile Teknolojinin Eğitim Öğretim Faaliyetlerindeki Rolü Arasındaki İlişki

		Eğitimde Teknoloji Kullanımına Yönelik Tutum	Öğretim Süreçleri ne Yansıma	Kendini Geliştirme	Sınıf Yönetimi
Teknolojinin Eğitim Öğretim Faaliyetlerindeki Rolü	Pearson Correlation	.465**	.261**	.506**	.343**
	Sig. (2-tailed)	.000	.002	.000	.000
	N	138	138	138	138

		Beceri ve Uygulama Öğretmede Teknolojinin Etkisi	Teknolojik Araçlar Sınıf İçinde Ne Kadar Önemli
Eğitimde Teknoloji Kullanımına Yönelik Tutum	Pearson Correlation	.343**	.498**
	Sig. (2-tailed)	.000	.000
	N	138	138

**Correlation is significant at the 0.01 level (2-tailed).

Tablo 3 incelendiğinde öğretmen adaylarının teknolojinin eğitim öğretim faaliyetlerindeki rolüne yönelik görüşleri ile eğitimde teknoloji kullanımına yönelik tutumları arasında pozitif yönde orta düzeyde istatistiksel olarak anlamlı bir ilişki olduğu görülmektedir ($r=0.465$; $p<0.01$). Teknolojinin eğitim öğretim faaliyetlerindeki rolü ile eğitimde teknoloji kullanımına yönelik tutum ölçeğinin alt boyutları incelendiğinde ise istatistiksel olarak anlamlı ilişkiler dikkati çekmektedir. Eğitimde teknoloji kullanımının öğretim süreçlerine yansıması ile sınıf yönetimi boyutlarındaki ilişkiler zayıf düzeyde iken kendini geliştirme boyutunda ise orta düzeyde ilişki olduğu görülmektedir. Eğitimde teknoloji kullanımına yönelik tutum ile teknolojinin eğitim öğretim faaliyetlerindeki rolü ölçeği alt boyutları arasında da yine pozitif ve anlamlı ilişkiler bulunmaktadır.

SONUÇ

Eğitimde teknoloji kullanımı, öğrenciler için yeni ve zengin öğrenme yaşantıları sağlayan önemli öğrenme ortamlarından birisidir. Öğrenenlere sınırsız bir öğrenme ortamı sunarak öğrenme çevresini genişletmekte, gerçek hayata ilişkin uygulama ve değerlendirmelerle geleneksel sınıf ortamına yeni bir boyut kazandırmaktadır. Öğrencilerin ilgileri, beklentileri ve ihtiyaçları geleneksel eğitim yaklaşımına göre büyük farklılıklar göstermektedir (Frith & Kee, 2003; Glenn, 2001). Dolayısıyla öğrencilerin problemlerine geleneksel eğitim yaklaşımları ile çözümler üretmek sağlıksız sonuçlar üretebilir. Eğitimde hedeflenen başarının sağlanması öğrencinin tanınmasıyla olanaklıdır. Teknolojinin eğitim öğretim faaliyetlerinde kullanımı bireysel farklılıkların dikkate alınmasını sağlar ve her öğrenciye hitap edebilir olanaklar sunar. Eğitimde teknoloji kullanımında öğrencinin derse aktif katılımı esastır ve öğretim daha bireysel olarak gerçekleşmektedir. Bu ortamda öğrenmenin, öğrencinin aktif katılımıyla daha üst noktaya çıkacağı konusunda fikir birliği vardır (Collins, 1998; Horton, 2000). Bu araştırma sonucunda geleceğin öğretmeni olacak öğretmen adaylarının eğitimde teknoloji kullanımına yönelik tutumlarının oldukça yüksek olduğu belirlenmiştir. Bu bulgu diğer araştırma sonuçları ile desteklenmektedir (İpek & Acuner, 2011; Metin, Birişçi, & Coşkun, 2013; Özel, 2014; Bayrakçı, Tozkoparan, Durmuş, 2014; Paşa, Bolat, & Karataş, 2015). Öğretmen adayları teknolojinin özellikle öğretim süreci ve kendini geliştirme üzerinde etkili olduğunu ifade etmişlerdir. Öğretim sürecine katkı boyutu, derslerde teknolojiden faydalanmanın öğrencileri düşünmeye sevk etmesi ve öğrencilerin ilgisini artırması ile açıklanırken, kendini geliştirme boyutu ise teknolojiyi derslerinde kullanan öğretmenlerin bu konudaki bilgileri artırmak için diğer öğretmenlerle tartışmalar yapmaları, kendi becerilerini kullanarak araç-gereç tasarlamaları ve yeni gelişmeleri takip etmeleri ile açıklanmaktadır. Ayrıca araştırma sonucuna göre teknolojik araçların sınıf içinde öğrencilerin derse aktif katılımını sağlamak ve bağımsız düşünme becerilerini geliştirmek için önemli olduğu yadsınamaz bir gerçektir. Sınıfta eğitim öğretim faaliyetleri gerçekleştirilirken beceri ve uygulama öğretmede teknolojinin katkısına vurgu yapılmıştır. Son yıllarda bilgi ve iletişim teknolojilerinin okullarda kullanım oranı oldukça artmıştır. Eğitimde teknoloji kullanımı etkinlik temelli öğrenimi beraberinde getirirken, öğrenenin bilgi ve becerisinde artış sağlanmaktadır. Öğretimde teknoloji kullanımı öğrenenlere daha görsel, etkileşimli, kendi hızlarında çalışma fırsatı sunmaktadır (Eric & Stratton, 2003). Eğitim teknolojilerinin öğrenci becerilerini daha nitelikli geliştiren bir araç olduğu (Gökalp, 2013) ve derse görsellik ve canlılık kattığı ifade edilmektedir (Konur & Ayas, 2009). Teknolojinin eğitimde kullanılması öğretmenlere; öğrencilerin ilgisini çekme, sınıfı hazırlama ve yönetme, araştırmaya yönlendirme, öğrenci gelişimini tespit etme, çok yönlü ve bireysel geri dönütler alma fırsatı sunmaktadır. Bunun yanında, öğrenciler, klasik sınıf ortamına eğitim teknolojilerinin entegre edildiği dersleri eğitsel deneyimleri için anlamlı bir gelişme olarak değerlendirmektedirler (Hitz & Turoff, 2005). Eğitim teknolojileri öğrencinin ilgisini çekme, görsel işitsel araçların kalıcılığı artırma, sınıfta öğrencinin aktif katılımını sağlama ve öğrencinin algılamasında önemli etken olma görevlerini yerine getirmek için kullanılabilir. Eğitim öğretim faaliyetlerinde bu denli önemli etkiye sahip teknolojinin, geleceğin öğretmeni olacak öğretmen adayları tarafından amacına yönelik ve etkili olarak kullanılabilmesi için hizmet öncesi dönemde yani öğretim yaşantısında uygulamalı eğitimlerin verilmesi gerekmektedir. Öğretmen adaylarının eğitimde teknoloji kullanımına yönelik tutumlarının belirlenmesi ve teknolojinin eğitim öğretim faaliyetlerindeki rolünün ortaya çıkarılması amacıyla gerçekleştirilen bu araştırma sonucunda teknolojinin öğrenme süreci, kendine geliştirme ve sınıf yönetimi üzerinde olumlu etkileri olduğu ayrıca beceri ve uygulama öğretmede de kullanılabileceği tespit edilmiştir. Bu araştırma öğretmen adaylarından oluşan bir çalışma grubu ile yürütülmüştür. Öğretmenlerden oluşan örneklem grubu ile teknolojinin eğitim öğretim faaliyetlerindeki rolü daha ayrıntılı bir şekilde belirlenebilir. Ayrıca eğitimde teknoloji kullanımının soyut bilgilerin somut temsillere ulaşması üzerine etkileri belirlenebilir. Eğitimde teknoloji kullanımına yönelik tutumun başka değişkenlerle ilişkisi incelenebilir. Bu çalışma geleceğin öğretmeni olan öğretmen adaylarının hızla gelişen ve değişen çağa ayak uydurabilmelerini sağlamak ve donanımlı bireyler yetiştirebilmeleri için yol göstermek adına büyük önem taşımaktadır.

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EXAMINATION OF HIGH SCHOOL STUDENTS' ENVIRONMENTAL ATTITUDES ACCORDING TO THEIR SELF EFFICACY BELIEFS

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ABSTRACT: The aim of this study was to examine the relationship between high school students' self-efficacy beliefs and attitudes towards environment. The study sample consists of 976 students enrolled in high schools in downtown Ankara. According to the data obtained from the study, it was seen that high school students' attitude towards environment according to their self-efficacy beliefs. When findings were examined, it was seen that students have different self-efficacy beliefs level. Moreover, it was found that there is a positive meaningful relationship between their self-efficacy beliefs and their attitude toward environment.

Key words: environmental attitudes, self-efficacy beliefs, high school students, environmental.

LİSE ÖĞRENCİLERİNİN YETKİNLİK BEKLENTİLERİNE GÖRE ÇEVREYE YÖNELİK TUTUMLARININ İNCELENMESİ

ÖZET: Bu çalışmanın amacı lise öğrencilerinin çevreye yönelik tutumları ile yetkinlik inançları arasındaki bağlantıları incelemektir. Bu araştırmanın örneklemini Ankara'da öğrenim görmekte olan 976 lise öğrencisi oluşturmuştur. Araştırmadan elde edilen verilerin analiz sonucuna göre, lise öğrencilerinin çevreye yönelik tutumları yetkinlik inançlarına göre değişiklik göstermektedir. Bulgular incelendiğinde öğrencilerin farklı yetkinlik inançlarına sahip oldukları görülmüştür. Ayrıca öğrencilerin, yetkinlik inançları ile çevreye yönelik tutumları arasında pozitif yönde anlamlı bir ilişki olduğu bulunmuştur.

Anahtar sözcükler: çevreye yönelik tutum, yetkinlik inancı, lise öğrencileri, çevre.

GİRİŞ

Kişinin bir davranışı veya kendisine verilen bir görevi başarılı bir şekilde yerine getirebilmesi için davranış veya görevle ilgili yeteneğine olan inancına "Yetkinlik Beklentisi (İnancı)" denir (Bandura, 1977). Bandura (1977)'ya göre yetkinlik; bilişsel, sosyal, duygusal ve davranışsal alt boyutları olan ve çeşitli amaçlar doğrultusunda, yönlendirilmesi ve organize edilmesi gereken kapasitedir. Yetkinlik kavramı, Sosyal Öğrenme Teorisi'nin (Bandura, 1977) en önemli kavramlarından biridir. Yetkinlik inancı Bandura (1986) tarafından, bireylerin bir performansı başarıyla yapabilmek için gerekli olan eylemleri organize edebilme ve bu eylemleri gerçekleştirebilme kapasiteleri hakkındaki yargıları olarak tanımlanmıştır. Düzey, genellenebilirlik ve güç olmak üzere üç boyuttan oluşan yetkinlik inancı (Bandura, 1997), bireylerin temel yaşantıları, dolaylı yaşantıları, yaşadığı sözel iknalar ile duygusal ve fiziksel durumlardan beslenmektedir (Bandura, 1986). İçinde bilişsel, sosyal, duygusal ve davranışsal becerileri barındıran ve sınırsız amaçlar doğrultusunda yönetilmek ve organize edilmek zorunluluğu olan genel bir kapasite olarak ele alınan yetkinlik inancı (Bandura, 1986) bireylerin bilişsel süreçlerini, güdülenme süreçlerini, duygusal süreçlerini ve seçim yapma süreçlerini etkilemektedir. Bandura (1986) yetenekleri hakkında güçlü bir inanca sahip olan insanların nasıl davranacakları konusunda, düşünce kalıplarının biçimlenmesinde ve yaşadıkları durumların gerektirdiği duygusal tepkilerinin nasıl şekilleneceği konusunda belirleyici olabildiklerini belirtmektedir (Çelikkaleli & Gündüz, 2010). Yüksek yetkinlik beklentisine sahip bireyler bilişsel araştırıcı, stratejilerinde esnek, çevreleri üzerinde etkili ve amaçlarına güdülenmiş bireylerdir. Kişinin kendini yetkin görmesi; kişinin kapasitesini, başarılarını, motivasyonunu ve kişilik özelliklerini oluşturan diğer öğelerin hepsini kapsayan çok geniş bir bakış açısıdır (Kuzgun, 2009).

"Çevre" kavramı; kapsamı çok geniş ve çeşitlilik arz eden bir kavramdır. Eğitimciler bu kavramın çevre eğitimi boyutuna odaklanarak, doğal varlıkların korunması için bireylere; çevre ile insanlık arasında bir denge sağlayabilecek kişiler haline gelebilmeleri için gerekli bilgi ve becerileri kazandırmayı hedeflerler (Steel, 2011). Çevre eğitimi, bir yandan ekolojik bilgileri aktarırken diğer yandan da bireylerde çevreye yönelik tutumlarının gelişmesini ve bu tutumların davranışa dönüşmesini sağlar (İbiş, 2009). Eğitim her kademede halkın doğayı koruması ve duyarlılık oluşturması için bir hazırlayıcı ve devam ettiricidir, fakat tüm bunlar bireylerin tutumları ile değişir (Deniş & Genç, 2010). Çevre ve çevreye yönelik konular üzerinde olumlu tutuma sahip bireylerin yetiştirilmesinde önemli bir aşama da bireylerin tutumlarının tespit edilerek buna göre eğitim verilmesidir. Bir tutum, genellikle, bireyi tutum nesnesine karşı davranışlarda bulunmaya eğilimli kılar. Bir nesneye yönelik olumlu tutumu olan birey, bu nesneye karşı olumlu davranmaya, ona yaklaşmaya, yakınlık göstermeye, onu desteklemeye, yardım etmeye eğilimli olacaktır. Bir nesneye yönelik tutumu olumsuz olan birey ise, bu nesneye ilgisiz kalma veya ondan uzaklaşma, eleştirme, hatta ona zarar verme eğilimi gösterecektir. Dolayısıyla, çevreye karşı olumsuz tutuma sahip bireylerin çevre sorunlarına duyarsız olacağı ve hatta çevreye sorun yaratmaya devam edeceği şüphesizdir (Uzun & Sağlam, 2006). Nitekim yapılan çalışmalar çevre eğitimi dersi alan öğrencilerin bu dersi almayan öğrencilere göre çevreye yönelik daha hassas ve duyarlı davranışlar sergilediklerini göstermektedir (Sever & Yalçınkaya, 2012; Çabuk & Karacaoğlu, 2003).

Uzun (2007)'a göre çevre sorunlarından kaynaklanan korkular, kızgınlıklar, huzursuzluklar, değer yargıları ve çevre sorunlarının çözümüne hazır bulunuşluk gibi çevreye yararlı davranışlara olan olumlu veya olumsuz tavır ve düşüncelerin hepsi kişinin çevreye yönelik tutumunu oluşturur. Rosenberg (1965)'e göre bireyler bütün nesnelere karşı bir tutuma sahip olurlar. Tutum, "bir bireye atfedilen ve onun bir psikolojik obje ile ilgili düşünce, duygu ve davranışlarını düzenli bir biçimde oluşturan bir eğilimdir. Tutum; bilişsel, duyuşsal ve davranışsal boyutlarıyla davranışın önemli bir açıklayıcısı olarak görülür (Kağıtçıbaşı, 2010). Bu nedenle tutumlar incelenirken bilişsel, duyuşsal ve davranışsal boyutlar ayrı ayrı incelenmelidir. Bu görüşten hareketle çalışmada öğrencilerin çevreye yönelik tutumları akademik, sosyal ve duygusal alt boyutları olan yetkinlik inançları ile beraber incelenmiştir.

YÖNTEM

Araştırmanın amacı lise öğrencilerinin çevreye yönelik tutumları ile yetkinlik inançları arasındaki bağlantıları incelemektir. Araştırma, ilişkisel tarama modeliyle gerçekleştirilmiştir. Bu araştırmanın evrenini lise öğrencileri oluştururken, çalışılabilir evrenini ise söz konusu grup içerisinden random yoluyla seçilen Ankara'da öğrenim gören öğrenim görmekte olan 976 lise öğrencisi oluşturmuştur.

Lise öğrencilerinin çevre bilinç düzeyinin belirlenmesi ve çevreye yönelik tutumlarının ölçülmesi için Ünal (2010) tarafından geliştirilen "Çevre Tutum Ölçeği" kullanılmıştır. Söz konusu ölçek öğrencilerin çevre bilinç düzeylerinin ölçüldüğü tutum, farkındalık ve davranışlarını belirleyen sorulardan oluşmaktadır. Çevre Tutum Ölçeği'nin verilerinin güvenirlilik katsayısı Ünal (2010) tarafından 0.80 olarak bulunmuştur. Çalışmada lise öğrencilerinin yetkinlik inançlarını belirleyebilmek için Muris (2001) tarafından geliştirilen ve Çelikkaleli, Gündoğdu ve Kıran-Esen (2006) tarafından Türkçeye uyarlanan "Ergenlerde Yetkinlik Beklentisi Ölçeği" kullanılmıştır. Geçerlik çalışmaları doğrultusunda yapılan faktör analizi çalışmasında ölçeğin orijinalinde olduğu gibi üç faktörlü bir yapıya sahip olduğu görülmüştür. Bu faktörler; Akademik Yetkinlik Beklentisi, Sosyal Yetkinlik Beklentisi (SYB) ve Duygusal Yetkinlik Beklentisi'dir. Toplanan verilerin istatistiksel değerlendirilmesinde SPSS 15 paket programı kullanılmıştır. Araştırmadan elde edilen veriler arasındaki ilişki, Pearson Korelasyon Katsayısı hesaplanarak incelenmiştir.

BULGULAR

Lise öğrencilerinin çevreye yönelik tutumları ile yetkinlik beklentileri arasındaki ilişkiyi belirleyebilmek için yapılan analiz sonuçları Tablo 1'de özetlenmiştir.

Tablo 1. Lise Öğrencilerinin Çevreye Yönelik Tutumlarının Yetkinlik Beklentilerine Göre İncelenmesi

		Akademik Yetkinlik	Sosyal Yetkinlik	Duygusal Yetkinlik
Çevreye	Pearson Correlation	.153**	.199**	.080*
Yönelik	Sig. (2-tailed)	.000	.000	.012
Tutum	N	976	976	976

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Tablo 1'deki bulgular incelendiğinde öğrencilerin çevreye yönelik tutumlarının, akademik yetkinlik, sosyal yetkinlik ve duygusal yetkinlik inançları ile pozitif yönde anlamlı ilişkilere sahip olduğu görülmektedir.

Öğrencilerin çevreye yönelik farkındalıklarının, yetkinlik inançları ile bağlantılarına işaret eden araştırma bulguları Tablo 3'te görülmektedir.

Tablo 3. Lise Öğrencilerinin Çevreye Yönelik Farkındalıklarının Yetkinlik Beklentilerine Göre İncelenmesi

		Akademik Yetkinlik	Sosyal Yetkinlik	Duygusal Yetkinlik
Çevreye	Pearson Correlation	.148**	.201**	.070*
Yönelik	Sig. (2-tailed)	.000	.000	,028
Farkındalık	N	976	976	976

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Öğrencilerin çevrelerine olan farkındalıklarının, akademik, sosyal ve duygusal yetkinlikleri ile pozitif ve anlamlı ilişki içerisinde olduğu Tablo 3'te dikkat çekmektedir.

Çalışmaya katılan öğrencilerin çevreye yönelik davranışlarının, akademik, sosyal ve duygusal yetkinlik boyutlarında incelenmesi sonucunda elde edilen bulgular Tablo 4'te belirtilmektedir.

Tablo 4. Lise Öğrencilerinin Çevreye Yönelik Davranışlarının Yetkinlik Beklentilerine Göre İncelenmesi

		Akademik Yetkinlik	Sosyal Yetkinlik	Duygusal Yetkinlik
Çevreye	Pearson Correlation	.214**	.169**	.103**
Yönelik	Sig. (2-tailed)	.000	.000	.001
Davranış	N	976	976	976

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Tablo 4'te görüldüğü gibi, bulgular incelendiğinde öğrencilerin çevreye yönelik davranışlarının, yetkinlik beklentileri ile anlamlı ilişkiler içerisinde olduğu ortaya çıkmıştır.

SONUÇ

Bu çalışmada öğrencilerin çevreye yönelik tutumları bilişsel, sosyal, duygusal ve davranışsal alt boyutları olan yetkinlik inançları ile beraber incelenmiştir. Literatür incelendiğinde lise öğrencileri ile yapılan çalışmaların öğrencilerin çevresel olaylarla ilgili bilgilerini araştırma, (Gambro & Switzky, 1996) ve tutumlarını değiştirmeye yönelik etkinlikler planlamaya kadar geniş bir yelpazede gerçekleştirildiği görülmektedir (Bonnet &Williams, 1998; Bradley, Waliczek, Zajicek, 1999; Mangas, Martinz, Pedauye, 1997). İlgili alanyazın çerçevesinde yapılan bu çalışmada farklı olarak lise öğrencilerinin çevreye yönelik tutumları ile yetkinlik inançları arasındaki ilişkiler irdelenmiştir. Çalışmaya katılan öğrencilerin çevreye yönelik tutum ve yetkinlik beklentileri puanları arasında Pearson korelasyon katsayısı hesaplanmıştır. Araştırmada çevreye yönelik tutum ve yetkinlik beklentileri puanları arasında çok güçlü olmasa da pozitif ilişkilerin olduğu belirlenmiştir. Burada gerçekleştirilen korelasyon çalışmaları istatistiksel olarak orta düzeyde güçlü değerler vermekte, ancak ilişkilerin varlığını ortaya koymaktadır. Araştırmada öğrencilerin akademik, sosyal ve davranışsal yetkinlik beklentileri ile çevreye yönelik tutum, farkındalık ve davranış boyutlarında anlamlı ilişkiler olduğu belirlenmiştir. Bu durum öğrencilerin bilişsel esnekliği besleyen kaynaklardan olan deneyimlere (Cañas, Quesada, Antolí, & Fajardo, 2003) benzer oranlarda maruz kalmaları sonucunda benzer bilişsel yapılar oluşturmalarından kaynaklı olabilir. Bundan yola çıkarak ergenlerin akademik, duygusal, sosyal ve kültürel olarak benzer bilişsel yaşantılar geçirdikleri söylenebilir (Çelikkaleli, 2014). Çünkü bireyler akademik ve sosyal yeterlik alanlarında benzer yaşantılara maruz kalabilmekte, benzer dolaylı yaşantılar geçirebilmekte (okul, sosyal çevre gibi), yetkinlik inancının temel bilgilendirici kaynaklarına benzer şartlarda ve benzer miktarlarda maruz kalabilmektedirler. Bu da bireylerin benzer yetkinlik inancı geliştirmelerine neden olabilir (Telef & Karaca, 2011).

Araştırma sonucunda elde edilen bulgular yapılan başka çalışmalarda da ortaya çıkmış ve yetkinlik beklentisi ile sosyal davranışlar arasında ilişki olduğu belirlenmiştir (Bandura, Barbaranelli, Caprara & Pastorelli, 1996, 2001; Bandura, Pastorelli, Barbaranelli & Caprara, 1999; Caprara, Regalia & Bandura, 2002). Bireylere çevreyle ilgili değer yargılarının ve hislerin çevrenin korunmasını ve düzeltilmesini sağlamak için gerekli güdülenmenin kazanılmasına yardımcı olan çevre tutumu, çevreye yönelik olumlu ve olumsuz tavırlar sergileme biçiminde kendini gösteren öğrenilmiş eğilimlerdir (Brause, 1995). Bu nedenle çevre eğitimi olumlu tutumlar geliştirmede oldukça önemlidir. Nitekim çevre eğitiminin bireylerin çevreye yönelik olumlu tutumlar geliştirmelerini sağladığı yararlar, çalışma sonuçlarından bilinmektedir (Grodzinska-Jurczak, Bartosiewicz, Twardowska, Ballantyne 2003; Leeming, Porter, Dwyer, Cobern, Oliver, 1997). Dolayısıyla çevre eğitimine gereken önem verilmelidir.

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ASSESSMENT OF SECONDARY SCHOOL STUDENTS' SAFE INTERNET USAGE AND METACOGNITIONS

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ABSTRACT: The increase of internet usage by people from all parts of society, especially children has increased the question of the importance of safe internet use. In the light of these, this study aims to determine the effects of student teachers' positive and negative metacognitive beliefs on their safe internet usage. The model of this research is "Based on Survey Model". As data collection tool, "Metacognitive Skills Scale" was used, this scale was designed by Çetinkaya (2000). Moreover, in order to get information about students' safe internet usage, "Safe Internet Usage Scale", which was developed by Beder (2015), was used. According to the results of research; the usage of safe internet, the awareness and metacognitions beliefs of pupils are generally higher.

Key words: secondary school students, safe internet, conscious use of internet, metacognition.

ORTAOKUL ÖĞRENCİLERİNİN GÜVENLİ İNTERNET KULLANIM DURUMLARININ VE BİLİŞÖTESİ BECERİLERİNİN BELİRLENMESİ

ÖZET: Toplumun her kesiminden insanın özellikle de çocukların internet kullanımındaki artış, internetin ne derece güvenli kullanıldığı sorusunun önemini arttırmıştır. Bu çalışmada öğrencilerin bilişüstü becerileri ve güvenli internet kullanımları incelenmiştir. Araştırma tarama modeli ile gerçekleştirilmiştir. Bu araştırmada veri toplama araçları olarak Çetinkaya (2000) tarafından geliştirilen "Bilişüstü Beceriler Ölçeği" kullanılmıştır. Ayrıca öğrencilerin güvenli internet kullanımları hakkında bilgi edinebilmek için Beder (2015) tarafından geliştirilen "Güvenli İnternet Kullanımı Ölçeği" uygulanmıştır. Araştırma sonuçlarına göre, öğrencilerin güvenli internet kullanımı ile ilgili bilinç düzeyi genel olarak yüksek çıkmıştır.

Anahtar sözcükler: ortaokul öğrencileri, güvenli internet, bilinçli internet kullanımı, bilişötesi.

GİRİŞ

İnternet kullanımının giderek artması, sınırsız, denetimsiz, yasaksız her türlü bilgiye ve kişilere erişimin kolaylığı, birçok faydasının olmasının yanında olumsuz sonuçların doğmasına da neden olabilmektedir. Teknolojinin yaygınlaşması ile birlikte bilgisayar çocukların dünyasında önemli yer edinmiştir. Teknolojinin tüm alanlarda gelişmesi ve ilerlemesiyle bilişim teknolojileri eğitim alanında gerek amaç olarak gerekse araç olarak, hem yönetimde hem de eğitim-öğretim süreci içerisinde kullanılmaya başlanmıştır (Tuti, 2005). Teknoloji, gelişmişliğin ve çağdaşlaşmanın bir ölçütü olarak insan hayatını kolaylaştırıp toplumsal gelişime olumlu katkı sağlarken diğer yandan da internetin bilinçsiz kullanımından kaynaklanan bazı sorun ve tehlikeleri de beraberinde getirmektedir (Bolışık & Muslu, 2009). Bilgisayar ve internet teknolojilerinin yaygınlaşması bilgi edinme, iletişim gibi birçok yönden günlük hayatımıza katkı sağlarken çocuklar ve gençler için tehdit oluşturmaya başlamıştır. Bilgisayar ve internet teknolojilerinin kullanımının artmasıyla birlikte çocukların ve gençlerin maruz kaldığı olumsuz durumlar çevrimiçi ortamlarda çeşitli önemler alınması gerekliliğini ortaya çıkarmış ve öğrencilerin interneti bilinçli kullanmasına nelerin etkisinin olduğu gibi birçok soruyu gündeme getirmiştir (Canbek & Sağıroğlu, 2007; Çelen, Çelik & Seferoğlu, 2011). Araştırmanın başlangıç noktası olan "Acaba bireyin sahip olduğu bilişüstü beceriler ile bilinçli internet kullanımı arasında bir bağlantı olabilir mi?" sorusu, bu sorulardan sadece bir tanesidir.

Bilişüstü kavramını ilk kez kullanan Flavell (1976) onu, bir kişinin kavraması ve öğrenmesi için kendisine gerekli olan bilişsel süreçler hakkında bilgi sahibi olması olarak özetlemiştir. Bilişüstü beceriler, kişinin kendi bilgisini bilmesini, kontrol etmesini ve haberdar olmasını sağlar (Case, 2000). Topçu ve Ubuz (2004)'e göre bilişüstü, bir öğrencinin seçimi, gelişimi, değişimi, öğrenme kabiliyeti ve ilgi çekici ne öğrendiğini içerir. Vockell (2004), kendi bilgi ve becerileri hakkında değerlendirme yapan öğrencilerin bilişüstü becerilerini kontrol etmelerinde ve kendilerini tanımlamaların da daha başarılı oldukları görüşündedir. Bu ve benzeri görüşlerden hareketle çalışmada ortaokul öğrencilerinin bilişüstü becerileri ve güvenli internet kullanımları incelenmiştir.

YÖNTEM

Bu çalışmanın amacı ortaokul öğrencilerinin bilişüstü becerileri ve güvenli internet kullanımlarını incelemektir. Araştırma tarama modeli ile gerçekleştirilmiştir. Bu araştırmada veri toplama araçları olarak Çetinkaya (2000) tarafından geliştirilen "Bilişüstü Beceriler Ölçeği" kullanılmıştır. Ayrıca öğrencilerin güvenli internet kullanımları hakkında bilgi edinebilmek için Beder (2015) tarafından geliştirilen "Güvenli İnternet Kullanımı Ölçeği" uygulanmıştır. Bu ankette öğrencilerin, güvenli internet kullanımı ile ilgili oluşturulan yirmi bir adet senaryoyu değerlendirebilecekleri bölüme yer verilmiştir. Senaryolar üç adet "Siber Zorbalık", "Sorun Olabilecek Paylaşımlar", "Şifre ve Kullanıcı Adı Kolaylığı", "Telif Hakkı İhlali", "Tuzak E-posta", "Yazılımsal Tehdit", "Sahtecilik ve Dolandırıcılık" , "İstenmeyen İçerik" ile ilgili içeriklerinden oluşmaktadır. Bu senaryolar öğrencilere teker teker gösterilmiş ve gerekli açıklamalar yapılmıştır. Öğrencilerden her senaryo sonunda davranışı değerlendirmeleri istenmiştir. Öğrencilerin internet güvenliği hakkındaki bilinçli davranışlarını seçme konusunda puanlama yapmak için, ankete verdikleri yanıtların ortalama puanı hesaplanmıştır.

BULGULAR

Güvenli İnternet Kullanımı Ölçeğine İlişkin Değerlendirmeler

Araştırma kapsamında, öğrencilerin cinsiyetlerine göre güvenli internet kullanımları arasında fark olup olmadığını belirlemek için yapılan t-testi analiz sonuçları Tablo 1'de görülmektedir.

Tablo 1. Cinsiyete Göre Güvenli İnternet Kullanımı Puanlarının Karşılaştırılması

	Cinsiyet	N	X	Ss	sd	t	p
Güvenli İnternet Kullanımı Ölçeği	Kız	111	3.8	.33	219	3.4	.00
	Erkek	110	3.7	.36			

Tablo 1'de görüldüğü gibi yapılan analiz sonucunda anlamlı bir farklılaşma gerçekleşmiştir. Ayrıca kızların erkeklere göre senaryo davranışları değerlendirme puanlarının yüksek olduğu görülmektedir. Başka bir ifadeyle kız öğrencilerin bilinç seviyesinin daha yüksek olduğu söylenebilir.

Araştırma kapsamında, öğrencilerin farklı alanlardaki güvenli internet kullanımlarını belirleyen boyutlarda cinsiyetlerine göre arasında fark olup olmadığını belirlemek için yapılan t-testi analiz sonuçları Tablo 2'de verilmiştir.

Tablo 2. Cinsiyete Göre Güvenli İnternet Kullanım Boyutları Puanlarının Karşılaştırılması

	Cinsiyet	N	X	Ss	sd	t	p
Siber Zorbalık	Kız	111	4.03	.743	219	3.8	.00
	Erkek	110	3.60	.927			
Sorun Olabilecek Paylaşımlar	Kız	111	4.24	.437	219	3.6	.00
	Erkek	110	4.02	.482			
Şifre ve Kullanıcı Adı Kolaylığı	Kız	111	3.79	.927	219	-1.6	.10
	Erkek	110	3.99	.821			
Telif Hakkı İhlali	Kız	111	2.97	.723	219	3.8	.00
	Erkek	110	2.60	.706			
Tuzak E-posta	Kız	111	3.06	1.02	219	-2.5	.01
	Erkek	110	3.43	1.08			
Yazılımsal Tehdit	Kız	111	3.45	1.10	219	0.5	.60
	Erkek	110	3.37	1.13			
Sahtecilik ve Dolandırıcılık	Kız	111	4.80	.629	219	-0.8	.90
	Erkek	110	4.80	.613			
İstenmeyen İçerik	Kız	111	4.45	.841	219	1.9	.05
	Erkek	110	4.21	.929			

Tablo 2'de görüldüğü gibi yapılan analiz sonucunda anlamlı farklılaşmalar gerçekleşmiştir. Siber Zorbalık, Sorun Olabilecek Paylaşımlar, Telif Hakkı İhlali ve İstenmeyen İçerik boyutlarında kız öğrencilerin erkek öğrencilere göre daha bilinçli oldukları belirlenmiştir. Ayrıca Şifre ve Kullanıcı Adı Kolaylığı boyutunda erkek öğrencilerin çok daha bilinçli olduğu ortaya çıkmıştır.

Bilişüstü Beceriler Ölçeğine İlişkin Değerlendirmeler

Araştırma kapsamında, kız ve erkek öğrencilerin bilişüstü becerileri arasında fark olup olmadığını belirlemek için yapılan t-testi analiz sonuçları Tablo 3'te verilmiştir.

Tablo 3. Cinsiyete Göre Bilişüstü Beceriler Puanlarının Karşılaştırılması

	Cinsiyet	N	X	Ss	sd	t	p
Bilişüstü Beceriler Ölçeği	Kız	111	2.9	.44	219	3.2	.00
	Erkek	110	2.7	.43			

Tablo 3'te görüldüğü gibi öğrencilerin bilişüstü becerileri arasında cinsiyete göre anlamlı bir farklılaşma gerçekleşmiştir. Kızların erkeklere göre bilişüstü beceri puanlarının daha yüksek olduğu belirlenmiştir.

Bilişüstü Beceriler ve Güvenli İnternet Kullanımı Arasındaki İlişkiye Ait Değerlendirmeler

Öğrencilerin bilişüstü becerileri ile güvenli internet kullanımları arasında ilişki olup olmadığı Pearson Korelâsyon Katsayısıyla bakılmış ve sonuçlar Tablo 4'te verilmiştir.

Tablo 4. Öğrencilerin Güvenli İnternet Kullanımlarının Bilişüstü Becerilere Göre İncelenmesi

		Bilişüstü Beceriler
Güvenli İnternet Kullanımı	Pearson Correlation	.322**
	Sig. (2-tailed)	.000
	N	221

**. Correlation is significant at the 0.01 level (2-tailed).

Tablo 4'te görüldüğü gibi bilişüstü beceriler ve güvenli internet kullanımı puanları arasında çok güçlü olmasa da pozitif bir ilişkinin olduğu belirlenmiştir. Burada gerçekleştirilen korelasyon çalışmaları istatistiksel olarak orta düzeyde güçlü değerler vermekte, ancak ilişkilerin varlığını ortaya koymaktadır.

SONUÇ

Bilgisayar ve haberleşme teknolojilerinde yaşanan baş döndürücü gelişmeler ve özellikle internetin katalizör etkisi ile insanların, çalışma, iletişim kurma ve her türlü günlük ihtiyaçlarını karşılama biçimi sürekli bir dönüşüm halindedir (Nagurney, Dong & Mokhtarian, 2002). Araştırmalara göre kız öğrencilerde daha yüksek tespit edilen internet bağımlılığı skoru, ayrıca ailenin gelir düzeyiyle beraber de artmaktadır. Kız öğrenciler, interneti iletişim ağırlıklı motivasyonla kullanırken, erkekler ise video oyunları, gazete ve dergi takibi önceliğinde kullanmaktadır. İnternet kullanım sebepleri arasında birinci sırada facebook, ikinci sırada ödev, üçüncü sırada gazete dergi takibi gelirken, liste, müzik, dosya indirme, e-mail, video indirme ve sanal video oyunları sıralamasıyla devam etmektedir (Ak, Koruklu & Yılmaz, 2013; Cömert & Ziyalar, 2012).

Araştırma sonucunda kız öğrencilerin erkek öğrencilere göre güvenli internet kullanımında daha bilinçli oldukları belirlenmiştir. Benzer bir sonuç Beder (2015) tarafından yapılan araştırma sonuçlarında da görülmüştür. Çalışmada kız öğrencilerin erkek öğrencilere göre güvenli internet kullanımında daha bilinçli ve problemsiz hareket ettikleri görülmüştür. Literatür incelendiğinde problemli internet kullanımı ile ilgili daha önce yapılmış olan çalışmalarda erkek öğrencilerin kızlara göre daha çok problemli internet kullandıkları ifade edilmiştir (DiNicola, 2004; Kubey, Lavin & Barrows, 2001; Johansson & Götestam, 2004; Yang & Tung, 2007). Araştırmada yapılan daha özel incelemelerde ise Siber Zorbalık, Sorun Olabilecek Paylaşımlar, Telif Hakkı İhlali ve İstenmeyen İçerik boyutlarında kız öğrencilerin erkek öğrencilere göre daha bilinçli oldukları belirlenmiştir. Şifre ve Kullanıcı Adı Kolaylığı boyutunda ise erkek öğrencilerin daha bilinçli olduğu ortaya çıkmıştır.

Araştırmada kız öğrencilerin erkek öğrencilere göre bilişüstü becerileri puanlarının daha yüksek olduğu belirlenmiştir. Bu sonuç yapılan çalışmaların sonuçlarına benzer bir bulgudur (Altındağ, 2008; İflazoğlu & Saban, 2008). Araştırmada bilişüstü beceriler ve güvenli internet kullanımı puanları arasında çok güçlü olmasa da pozitif bir ilişkinin olduğu belirlenmiştir. Literatür taramasında güvenli internet kullanımı ile bilişüstü becerileri beraber inceleyen çalışmalara rastlanmamıştır. Ancak Kılınç ve Doğan (2014) tarafından yapılan çalışmada biliş üstü farkındalık düzeyleri yüksek olan öğrencilerin, internet bağımlılıklarının düşük olduğu belirlenmiştir. Ayrıca bilişüstü beceri aktivitelerini arttırmada, bilgisayar tabanlı programların önemli etkilerinin olduğuna işaret eden çalışmalar da bilinmektedir (Küçük-Özcan, 2000). Ortaokullardaki tüm öğrencilerimizin bilinç seviyelerinin daha yüksek çıkması için, bu araştırmanın sonuçları doğrultusunda çocuklara güvenli internet kullanımı ile ilgili bilinçlendirmeye yönelik eğitsel çalışmalar planlanmalı ve yapılmalıdır. Bilişötesi ve güvenli internet kullanımı arasındaki ilişki eğitim literatürüne katkıda bulunmak amacıyla diğer değişkenler açısından da değerlendirilmelidir.

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APPLICATIONS OF DAILY LIFE BASED SCIENCE EDUCATION TECHNOLOGY SUPPORT

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ABSTRACT: The aim of this study is to examine the effects of activities designed according to computer assisted education under the name of daily life science on students ‘attitudes towards science, motivation for science course. According to the results gathered by the data’s, positive results in the favor of experimental group were taken in the total scores of attitudes and motivation scale for learning science. As a result, it was determined that the computer assisted daily life based science teaching affected the attitudes and motivations of the students towards science. When the answers are examined, it was found out that the answers are changed according to the stipulation and the concern of the students. The results of this research show that if the quality of education and the usage of the technology are increased, it is going to influence the student’s attitudes towards the computer assisted education.

Key words: computer assisted-instruction, science teaching, attitude, motivation.

GÜNLÜK YAŞAM TEMELLİ FEN ÖĞRETİMİNİN TEKNOLOJİ DESTEKLİ UYGULAMALARI

ÖZET: Bu çalışmanın amacı, günlük yaşam bilimleri adı altında bilgisayar destekli eğitim sistemine göre tasarlanmış faaliyetlerin öğrencilerin fen bilgisine yönelik tutum ve motivasyonlarına etkilerini incelemektir. Araştırma sonucunda; bilgisayar destekli günlük yaşam temelli fen öğretiminin öğrencilerin fen bilgisine dönük tutumlarını ve motivasyonlarını olumlu yönde etkilediği tespit edilmiştir. Tutum ölçeğindeki önermelere öğrencilerin verdikleri yanıtlar incelendiğinde bu tutumların da koşullara göre değiştiği görülmektedir. Bu araştırma sonuçları göstermektedir ki, eğitim kalitesinin artırılması, teknolojinin eğitim dünyasında daha fazla kullanılmaya başlanması, öğrencilerin derslere olan ilgisini etkileyerek, bilgisayar destekli eğitime yönelik tutumlarını belirleyecektir.

Anahtar sözcükler: bilgisayar destekli eğitim, fen bilgisi öğretimi, tutum, motivasyon.

GİRİŞ

Fen, nesnenin doğasını keşfetmeyi denemenin bir yoludur. Fen derslerinin asıl amacı öğrencilere fen kavramlarını ezberletmek değil, öğrenmeyi öğreterek düşünme becerilerinin geliştirilmesini sağlamak, araştırmacı ve sorgulayıcı bireyler yetiştirmektir (Lin, 2004). Ancak fen öğretiminde ağırlıklı olarak geleneksel yöntemlerle gerekli kavramlar belli bir sistematik içerisinde verilmekte, günlük yaşama yönelik problemlerin çözümünde kullanılacak bilgilere daha az yer verilmektedir. Bu nedenle bilgiler arasında boşluklar oluşmaktadır. Çünkü verilen bilgiler, öğrenme durumuna bağlı olarak kolayca uygulanabilir değildir (Wanjek, 2000). Binbaşıoğlu (2004)’na göre olay ya da olgulardan soyutlanmış bir eğitim ve öğretim ortamının eğitimsel değeri yeterli olamaz. Böyle bir yolla kazanılan bilgiler, yaşamla ilişkisi olmayan, kuru birtakım kavram ve kurallar olmaktan kendilerini kurtaramaz. Bu nedenle özellikle fen öğretiminde soyut bilgilerin somutlaştırılabildiği ve öğrencilerin daha aktif olabildiği günlük yaşam temelli yöntem ve teknikler uygulanmalıdır.

Fen dersleri, bilgisayarların yetenekleri kullanılarak hazırlanmış, ses, görüntü ve etkileşimler içeren ders yazılımları sayesinde daha etkili bir şekilde anlatılabildiğinden öğrencilerin derse daha aktif bir şekilde katılmaları sağlanabilir. Bilgisayar destekli öğretim sayesinde öğrenciler soyut bilgileri daha kolay kavrayabilirler (Yumuşak & Aycan, 2002). Bilgisayar destekli öğretim sayesinde, öğretimin kalitesi, etkinliği ve derslerin çekiciliği artırılabilir. Ayrıca içerik farklı biçimlerde sunulabildiğinden, esnek bir öğrenme ortamı sağlanarak öğrenci motivasyonu artırılabilir (Alessi & Trollip, 2001).
Teknoloji kullanımı, tüm eğitsel sorunların üstesinden gelebilecek bir çözüm olmamasına rağmen; günümüzde teknoloji ortamlarının, öğretim işlerinde kullanılması gereklilik göstermektedir (Kirschner & Selinger, 2003). Renshaw ve Taylor (2000)’ a göre bilgisayar destekli eğitimin başarıyı artırmasının yanı sıra öğrencilerde üst

düzey düşünme becerilerinin gelişmesini sağladığı, dolayısıyla öğrencilerin ezberden çok kavrayarak öğrendiği görülmüştür (Çevik, Önen & Koçak, 2009). Bu nedenle günlük yaşam temelli öğretim ortamı bilgisayar yazılımları ile gerçekleştirilebilir. Bu görüşten hareketle çalışmada günlük yaşam bilimleri adı altında bilgisayar destekli öğretim sistemine göre tasarlanmış faaliyetlerin öğrencilerin fen bilgisine yönelik tutum ve motivasyonlarına etkilerini incelemek amaçlanmıştır.

YÖNTEM

Bu çalışmanın amacı, günlük yaşam bilimleri adı altında bilgisayar destekli eğitim sistemine göre tasarlanmış faaliyetlerin öğrencilerin fen bilgisine yönelik tutum ve motivasyonlarına etkilerini incelemektir. Yöntem olarak ön test- son test kontrol gruplu yarı deneysel yöntem tercih edilmiştir. Araştırmanın çalışma grubunu 40 kontrol, 40 deney grubu olmak üzere 80 öğrenci oluşturmaktadır. Araştırmada geri dönüşüm ve yangın konuları deney grubuna 20 adet günlük yaşam temelli fen deneyi videoları ile anlatılırken, kontrol grubunda geleneksel yöntemle anlatılmıştır.

Veri Toplama Araçları

Araştırmada Yılmaz ve Çavaş-Huyugüzel (2007) tarafından düzenlenen "Fen Öğrenimine Yönelik Motivasyonları Ölçeği" ve Geban ve arkadaşları (1994) tarafından geliştirilen "Fen Bilgisi Tutum Ölçeği" kullanılmıştır. Veriler SPSS 21,0 programında değerlendirilmiştir. Verilerin değerlendirmesinde t testinden yararlanılmıştır.

BULGULAR

Deney grubu ile kontrol grubu deneklerinin fen bilgisi tutum ile motivasyon ön test puanları arasında anlamlı bir farkın olup olmadığını belirlemek amacıyla bağımsız örneklemli t-testi kullanılmıştır. Tablo 1'de deney grubu ve kontrol grubunun tutum ile motivasyon ön test puanlarıyla ilgili sonuçlar verilmiştir.

Tablo 1. Fen Bilgisi Tutum İle Motivasyon Ön Test Puanlarının Karşılaştırılması

	Grup	N	X	Ss	t	p
Fen Bilgisi Tutum	Deney Grubu	40	3.31	.36	1.69	0.95
	Kontrol Grubu	40	3.15	.45		
Fen Öğrenmeye Yönelik Motivasyon	Deney Grubu	40	3.75	.48	3.07	0.30
	Kontrol Grubu	40	3.42	.49		

Tablo 1'e göre araştırmada kullanılan fen bilgisi tutum ve motivasyon ölçeklerine ait ön test puanları arasındaki farka ilişkin yürütülen ilişkisiz t-testi sonucunda anlamlı farklılık bulunmamıştır. Elde edilen bu sonuçlar grupların başlangıçta denk olduğunu göstermektedir.

Deney ve kontrol grubunda bulunan öğrencilerin fen bilgisi tutum ile motivasyon son test puanları arasında anlamlı bir farkın olup olmadığını belirlemek amacıyla yapılan analiz sonucunda elde edilen veriler Tablo 2'de görülmektedir.

Tablo 2. Fen Bilgisi Tutum ile Motivasyon Son Test Puanlarına İlişkin İlişkisiz Gruplar t-Testi Değerleri

	Grup	N	X	Ss	t	p*
Fen Bilgisi Tutum	Deney Son Test	40	3.36	.37	5.6	0.00
	Kontrol Son Test	40	3.13	.51		
Fen Öğrenmeye Yönelik Motivasyon	Deney Son Test	40	4.03	.40	5.06	0.00
	Kontrol Son Test	40	3.45	.52		

Tablo 2'ye göre öğrencilerin deney ve kontrol grubu fen bilgisi tutum ve motivasyon son test puan ortalamalarının anlamlı bir farklılık gösterip göstermediğini belirlemek amacıyla yapılan ilişkisiz t-testi sonucunda grup ortalamaları arasındaki fark istatistiksel açıdan anlamlı bulunmuştur. Deney grubunun fen bilgisi tutum ve motivasyon ölçeklerine genel puanlarının, kontrol grubunun genel puanlarından yüksek olduğu görülmüştür.

Deney grubunda bulunan öğrencilerin fen bilgisi tutum ile motivasyon ön-son test puanları arasında anlamlı bir farkın olup olmadığını belirlemek amacıyla yapılan analiz sonucunda elde edilen bulgular Tablo 3'te özetlenmiştir.

Tablo 3. Deney Grubu Ön Test İle Son Test Puanları Arasındaki Farka İlişkin Değerler

	Grup	N	X	Ss	t	p*
Fen Bilgisi Tutum	Deney Ön Test	40	3.31	.36	-4.9	0.00
	Deney Son Test	40	3.64	.37		
Fen Öğrenmeye Yönelik Motivasyon	Deney Ön Test	40	3.75	.48	-3.05	0.00
	Deney Son Test	40	4.03	.40		

Tablo 3'e bakıldığında öğrencilerin deney grubu fen bilgisi tutum ve motivasyon genel puanları ortalamalarının anlamlı bir farklılık gösterip göstermediğini belirlemek amacıyla yapılan ilişkili gruplar t-testi sonucunda grup ortalamaları arasındaki fark istatistiksel açıdan anlamlı bulunmuştur. Benzer şekilde kontrol grubunda bulunan öğrencilerin fen bilgisi tutum ile motivasyon ön-son test puanları arasında anlamlı bir farkın olup olmadığını belirlemek amacıyla yapılan analiz sonucunda elde edilen bulgular Tablo 4'te özetlenmiştir.

Tablo 4. Kontrol Grubu Ön Test İle Son Test Puanları Arasındaki Farka İlişkin Değerler

	Grup	N	X	Ss	t	p
Fen Bilgisi Tutum	Kontrol Ön Test	40	3.15	.45	.44	0.66
	Kontrol Son Test	40	3.13	.51		
Fen Öğrenmeye Yönelik Motivasyon	Kontrol Ön Test	40	3.42	.49	-0.57	0.56
	Kontrol Son Test	40	3.45	.52		

Tablo 4'te görüldüğü gibi öğrencilerin kontrol grubu fen bilgisi tutum ve motivasyon ortalamaları arasındaki fark istatistiksel açıdan anlamlı bulunmamıştır.

SONUÇ

Gittikçe hızlanan bilimsel bilgi birikmesinin sonucu olarak, öğretim programı içerikle dolmaktadır. Zamanla öğretim programı, çoğu kez kendi bilimsel kökenlerinden ayrılan soyutlanmış bilgi yığınlarına dönüşmektedir. Dolayısıyla öğrenciler, tutarlı zihinsel şema oluşumu için uygun olmayan, soyutlanmış bilgi birikintilerini nasıl birleştireceklerini bilememektedirler. Öğrenciler, bildikleri yolların dışında, diğer durumlarda kavramları kullanarak problemleri çözmede başarısız olmaktadırlar (Koçak, 2011). Bu ve benzeri görüşlerden hareketle çalışmanın amacı, günlük yaşam bilimleri adı altında bilgisayar destekli eğitim sistemine göre tasarlanmış faaliyetlerin öğrencilerin fen bilgisine yönelik tutum ve motivasyonlarına etkilerini incelemektir.

Araştırmada geri dönüşüm ve yangın konuları deney grubuna 20 adet günlük yaşam temelli fen deneyi videoları sayesinde sanal bir laboratuvar ortamı sağlanmıştır. Araştırma sonucunda günlük yaşam temelli fen deneyi videoları sayesinde deney grubunun fen öğrenmeye yönelik motivasyonlarının ve fen bilgisine yönelik tutumlarının olumlu yönde değiştiği belirlenmiştir. Öğrencilerin, günlük yaşam temelli materyalleri kullandıklarında ve günlük yaşam temelli dersleri takip ettiklerinde, fen derslerine olan ilgilerinin ve fen derslerinden aldıkları hazzın arttığı yapılan çalışmalar sonucunda ortaya çıkmıştır (Bennett, 2003; Gilbert, 2006; Milner, Templin & Czerniak, 2010; Gilbert, Bulteb, & Pilot, 2011). Literatür incelendiğinde bilgisayar destekli öğretimin türlerinden olan sanal laboratuar uygulamalarının, laboratuar ortamında riskli, zaman alıcı, tehlikeli ya da uygulanması mümkün olmayan deneylerin yapılabilmesini sağlayan ve motive edici yönleri olan bir öğretim türü olduğu görülmektedir (Demirer, 2009; Kelly, Bradley & Gratch, 2008). Martínez, Pedrajas ve Polo, (2003) tarafından yapılan çalışmada fen eğitiminde çok önemli bir yeri olan bilgisayarların, deney hazırlamada ve problem çözmede de etkili bir şekilde kullanılabileceğini gösterilmiştir. Günlük yaşam temelli öğretim ile geleneksel öğretim programları kıyaslandığında günlük yaşam temelli öğretim programlarıyla yapılan öğretim sonucunda öğrencilerin ilgilerinin, motivasyonlarının ve başarılarının daha çok arttığı görülmektedir (Wu, 2003; Gilbert, 2006).Yapılan bu çalışmada da öğrencilerin izlediği videoların günlük yaşam olayları ile birleştirilmiş olması, konuya ilgiyi arttıran bir unsur oluşturmuştur. Bu çalışmada olduğu gibi, yapılan çalışmalarda da derse karşı tutumun anlamlı bir şekilde olumlu yönde değiştiği bulgularına rastlanmaktadır (Kulik, Kulik & Cohen, 1980; Kulik, Bangert & Williams; 1983).

Yaşamakta olduğumuz bilgi ve teknoloji çağı büyük oranda fen bilimlerindeki değişme ve gelişmelerin bir sonucu veya ürünüdür. Bilim, doğada oluşan tüm olayların sistematik olarak izlenmesi, akıl ve mantık çevresinde izah edilmesi yönündeki tüm faaliyetlerdir. Teknoloji ise, insanın doğayı egemenliği altına alması ve daha mutlu yaşam koşulları oluşturması için bilimsel verilerin yol göstericiliğinde çevresini değiştirme faaliyetleri biçiminde tanımlanmaktadır. Bir başka ifadeyle teknoloji, fen bilimlerinin uygulamaya yansımasıdır (Arslan, 2001). Aycan (2002)'a göre bilgisayar destekli öğretim, öğretim sürecini ve öğrenci motivasyonunu güçlendiren, öğrencinin kendi öğrenme hızına göre yararlanabileceği, kendi kendine öğrenme ilkelerinin bilgisayar teknolojisiyle birleşmesinden oluşan bir öğretim yöntemidir. Dolayısıyla bundan sonra yapılacak benzer çalışmalarda da bilgisayar destekli fen öğretimi ile günlük yaşam temelli fen öğretiminin birleştirilmesi başarılı sonuçlar vermeye devam edecektir.

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RANKING THE INTERNET USAGE PURPOSES OF INDIVIDUALS IN TURKEY WITH MULTIMOORA METHOD

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ABSTRACT: Today, increasing communication need with developing technology appears as a factor in promoting the use of internet. The internet which was used with under speed and high cost in the 1990s, has been available for many people in recent years with high speed and lower cost due to the diversification of firms operating in the market and the increasingly competitive environment. In this study, it was aimed to rank the purposes of using the internet for internet users in Turkey between the years of 2012 and 2015 with MULTIMOORA which is one of the Multi Criteria Decision Making Methods and analysis results were interpreted.

Key words: Multi Criteria Decision Making, MULTIMOORA.

MULTIMOORA YÖNTEMİYLE TÜRKİYE'DE BİREYLERİN İNTERNETİ KULLANMA AMAÇLARININ SIRALANMASI

ÖZET: Günümüzde, gelişen teknolojiyle birlikte artan iletişim ihtiyacı, internet kullanımını yaygınlaştıran bir etken olarak karşımıza çıkmaktadır. 1990'lı yıllarda düşük hızla ve yüksek bir maliyetle kullanılan internet, son yıllarda piyasada faaliyet gösteren firmaların çeşitlenmesi ve artan rekabet ortamıyla yüksek hız ve daha düşük maliyetle çok sayıda insanın kullanımına sunulmaktadır. Bu çalışmada Çok Kriterli Karar Verme (ÇKKV) yöntemlerinden MULTIMOORA ile 2012-2015 yılları arasında Türkiye'deki internet kullanıcılarının interneti kullanım amaçlarının sıralanması hedeflenmiş ve analiz sonuçları yorumlanmıştır.

Anahtar sözcükler: Çok Kriterli Karar Verme, MULTIMOORA.

GİRİŞ

Günümüzün en önemli iletişim araçlarından olan internet, dünyayı küçülterek ayağımıza getiren bir teknolojidir. İsteyen herkes istediği bilgiye bir tuşla ulaşabilmektedir. Önceleri düşük hızla ve yüksek bir maliyetle kullanılan internet, son yıllarda piyasada faaliyet gösteren firmaların çeşitlenmesi ve artan rekabet ortamıyla yüksek hız ve daha düşük maliyetle çok sayıda insanın kullanımına sunulmaktadır.

Günümüzde gelişen teknoloji ile birlikte artık internet erişimi sadece bilgisayarlardan değil, akıllı telefonlardan ve televizyonlardan da sağlanabilmektedir. Dolayısıyla, Türkiye genelinde internet erişim imkânına sahip hanelerin oranı gittikçe artmaktadır. TÜİK verilerine göre, 2015 yılında on hanenin yedisinde internet erişimi mevcuttur.

Dünya çapında yaygın olarak kullanılan bu iletişim ağı, diğer tüm teknolojik ürünlerde olduğu gibi amacına uygun kullanıldığında faydalı olmaktadır. Bu çalışmada ÇKKV yöntemlerinden MULTIMOORA ile Türkiye'deki internet kullanıcılarının son dört yıla göre interneti kullanım amaçlarının sıralanması hedeflenmiştir.

Literatürde MOORA yöntemi ile gerçekleştirilen çalışmalardan bazıları şöyledir: Brauers ve Zavadskas (2008, 2008a 2010, 2011); Brauers ve Ginevicius (2009, 2010); Chakraborty (2011); Kracka vd. (2010); Özçelik vd, (2014); Akkaya vd. (2015); Altuntas vd. (2015); Achebo ve Odinikuku (2015); Patel ve Maniya (2015).

YÖNTEM & BULGULAR

Çalışmada, Türkiye İstatistik Kurumu (TÜİK)' ndan elde edilen "Hanehalkı Bilişim Teknolojileri Kullanım Araştırması" verileri kullanılarak bireylerin interneti kişisel kullanma amaçlarını temsil eden sekiz alternatifin 2012-2015 yılları arasındaki değerlerine göre MULTIMOORA yöntemi ile sıralanması amaçlanmıştır. Kriterlere ve alternatiflere ilişkin detaylı bilgiler Tablo 1'de verilmektedir.

Tablo 1. Kriterler ve Alternatifler

		Kriterler			
		2012	**2013**	**2014**	**2015**
Alternatifler	**E-Posta gönderme / alma** (Sending / receiving e-mails)	66,8	62,5	53,9	49,5
	İnternet üzerinden telefonla görüşme/ video görüşmesi (webcam ile) (Telephoning over the Internet / video calls (via webcam) over the Internet)	42,5	55,1	37,1	38,1
	İnternet üzerindeki sosyal gruplara (Facebook, twitter vb) katılma (Participating in social networks)	41,6	73,2	78,8	80,9
	Online haber, gazete ya da dergi okuma (Reading online news / newspapers / news magazines)	72,5	75,6	74,2	70,2
	Mal ve hizmetler hakkında bilgi arama (Finding information about goods or services)	61,3	59,9	67,2	59,4
	Seyahat veya seyahat ile ilgili konaklama için online hizmetleri kullanma (Using services related to travel or travel related accommodation)	18,9	26,6	23,4	19,7
	Mal veya hizmet satışı (Selling of goods or services, e.g. via auctions (e.g. eBay))	7,2	9,3	16,5	20,8
	İnternet bankacılığı (Internet banking)	17,1	24,8	28,2	29,3

MOORA Yöntemleri

MOORA metodu; ilk olarak Willem Karel M. Brauers ve Edmundas Kazimieras Zavadskas tarafından bir bütün olarak 2006 yılında 'Control and Cybernetics' adlı çalışmaları ile tanıtılmıştır (Brauers ve Zavadskas, 2006). Literatürde çeşitli MOORA yöntemleri bulunmaktadır:

- MOORA-Oran Metodu
- MOORA-Referans Noktası Yaklaşımı
- MOORA-Tam Çarpım Formu
- MULTIMOORA

MOORA-Oran Metodu

Oran sisteminde, kriter temelindeki her bir alternatif, o kriterle ilgili bütün alternatifleri temsil eden bir payda (*bölen*) ile karşılaştırılır (Kracka vd., 2010). Payda, her kriterin, her bir alternatifte aldığı değerlerin kareler toplamının karekökünü içerir. X_{ij}: *i* kriteri için *j* alternatifinin değeri; *j* = 1, 2, …, *m*; m alternatiflerin sayısı; *i* = 1, 2, …, *n*; n kriterlerin sayısı; X^*_{ij}: *i* kriteri için *j* alternatifinin normalize değerini ifade eden boyutsuz (*ölçüleri olmayan*) sayını ifade etmektedir (Kracka vd., 2010).

Bu doğrultuda, öncelikle her bir alternatifin kriterler bazında aldığı değerlerin kareler toplamı ve kareler toplamının karekökleri bulunmuştur (Tablo 2), daha sonra kriterler bazında alternatiflerin aldığı değerler eşitlik 1'deki formülasyona göre normalize edilmiş ve Tablo 3'de gösterilmiştir.

$$x_{ij}^{*} = \frac{x_{ij}}{\sqrt{\sum_{j=1}^{m} x_{ij}^{2}}} \qquad (1)$$

MOORA metodunun oran sistemi yaklaşımına dayanan optimizasyonu için, normalize değerler eşitlik 2'deki formülasyonda belirtildiği gibi maksimizasyon durumunda eklenir minimizasyon durumunda ise çıkarılır (Stanujkic vd., 2012);

$$y_{j}^{*} = \sum_{i=1}^{g} x_{ij}^{*} - \sum_{i=g+1}^{i=n} x_{ij}^{*} \qquad (2)$$

i = 1, 2, ..., *g*, maksimize edilecek (*fayda*) kriterilerdir; *i* = g + 1, g + 2, ..., *n* ise minimize edilecek (*maliyet*) kriterleridir. *j* = 1, 2, ..., *m* alternatifleri temsil etmektedir ve y_j: *j* alternatifinin toplam sıralama indeksidir. y_j'nin büyüklük sıralaması nihai durumu verecektir, dolayısıyla en iyi alternatif en yüksek y_j^* değerine sahipken, en kötü alternatif en düşük y_j^* değerine sahiptir (Chakraborty, 2011). Bu doğrultuda Moora-Oran yöntemine ilişkin sonuçlar Tablo 4'te gösterilmiştir.

Tablo 2. Kareler Toplamı ve Karekökler

	Kriter 1	Kriter 2	Kriter 3	Kriter 4
Alternatif 1	66,8	62,5	53,9	49,5
Alternatif 2	42,5	55,1	37,1	38,1
Alternatif 3	41,6	73,2	78,8	80,9
Alternatif 4	72,5	75,6	74,2	70,2
Alternatif 5	61,3	59,9	67,2	59,4
Alternatif 6	18,9	26,6	23,4	19,7
Alternatif 7	7,2	9,3	16,5	20,8
Alternatif 8	17,1	24,8	28,2	29,3
Kareler Toplamı	**17714,45000**	**23012,96000**	**22127,59000**	**20582,29000**
Karekökler	**133,095642**	**151,700231**	**148,753454**	**143,465292**

Tablo3. Normalize Değerler

	Kriter 1	Kriter 2	Kriter 3	Kriter 4
Alternatif 1	0,501895	0,411997	0,362345	0,345031
Alternatif 2	0,319319	0,363216	0,249406	0,265569
Alternatif 3	0,312557	0,482531	0,529736	0,563899
Alternatif 4	0,544721	0,498351	0,498812	0,489317
Alternatif 5	0,460571	0,394858	0,451754	0,414037
Alternatif 6	0,142003	0,175346	0,157307	0,137315
Alternatif 7	0,054096	0,061305	0,110922	0,144983
Alternatif 8	0,128479	0,163480	0,189575	0,204231

Tablo 4. Oran Sistemi Metodu Sonuç Tablosu

	Kriter 1	Kriter 2	Kriter 3	Kriter 4	Skor	Sıralama
	Max	**Max**	**Max**	**Max**		
Alternatif 1	0,501895	0,411997	0,362345	0,345031	**1,621267**	**4**
Alternatif 2	0,319319	0,363216	0,249406	0,265569	**1,197511**	**5**
Alternatif 3	0,312557	0,482531	0,529736	0,563899	**1,888723**	**2**
Alternatif 4	0,544721	0,498351	0,498812	0,489317	**2,031201**	**1**
Alternatif 5	0,460571	0,394858	0,451754	0,414037	**1,721220**	**3**
Alternatif 6	0,142003	0,175346	0,157307	0,137315	**0,611972**	**7**
Alternatif 7	0,054096	0,061305	0,110922	0,144983	**0,371306**	**8**
Alternatif 8	0,128479	0,163480	0,189575	0,204231	**0,685765**	**6**

MOORA-Referans Noktası Yaklaşımı

Referans noktası yaklaşımında en iyi kriter değeri referans noktası olarak dikkate alınır (Brauers ve Zavadskas, 2009). Referans noktası yaklaşımı daha gerçekçi ve objektiftir, her bir kriter için aday alternatiflerin en iyi skorları belirlenerek (r_i) referans seri oluşturulur. Karar matrisinde verilen normalize değerlerin referans seriden sapmaları eşitlik 3'te verilen formülasyona göre hesaplanır. Bu yaklaşımda 4. eşitlikteki gibi hesaplanan (P_i), i. alternatifin tüm dikkate alınan fayda ve maliyet kriterleri için toplam sapmasını ölçmektedir (Karande ve Chakraborty, 2012). Referans noktaları ve sonuç değerleri Tablo 5 ve Tablo 6'da gösterilmektedir.

$$d_{ij} = \left| r_i - x_{ij}^* \right| \tag{3}$$

$$P_i = \min_{(i)} (\max \left| ri - x_{ij}^* \right|_{(j)}) \tag{4}$$

Tablo 5. Referans Noktaları

	Kriter 1	Kriter 2	Kriter 3	Kriter 4
Referans Noktaları	0,544721	0,498351	0,529736	0,563899

Tablo 6. Referans Noktası Yaklaşımı Sonuç Tablosu

	Kriter 1	Kriter 2	Kriter 3	Kriter 4	Skor	Sıralama
	Max	Max	Max	Max		
Alternatif 1	0,042826	0,086355	0,167391	**0,218868**	**0,218868**	**3**
Alternatif 2	0,225402	0,135135	0,280330	**0,298330**	**0,298330**	**5**
Alternatif 3	**0,232164**	0,015821	0,000000	0,000000	**0,232164**	**4**
Alternatif 4	0,000000	0,000000	0,030924	**0,074582**	**0,074582**	**1**
Alternatif 5	0,084150	0,103494	0,077981	**0,149862**	**0,149862**	**2**
Alternatif 6	0,402718	0,323005	0,372428	**0,426584**	**0,426584**	**7**
Alternatif 7	**0,490625**	0,437046	0,418814	0,418917	**0,490625**	**8**
Alternatif 8	**0,416242**	0,334871	0,340160	0,359669	**0,416242**	**6**

Tam Çarpım Formu

Brauers and Zavadskas, MOORA (MULTIMOORA) diğer karışık formlardan ayıran tam çarpım formu için aşağıdaki formulasyonu (eşitlik 5) geliştirmişlerdir (Karande ve Chakraborty, 2012; Brauers ve Zavadskas, 2010; Brauers ve Zavadskas, 2011).

$$U_i = \frac{A_i}{B_i} \tag{5}$$

Burada $A_i = \prod_{j=1}^{g} x_{ij}^*$, $B_i = \prod_{j=g+1}^{n} x_{ij}^*$ şeklinde ifade edilmiştir, U_i ise *i.* alternatifin kullanım derecesidir. 5. eşitlikte maksimize edilecek kriter (fayda kriteri) pay olarak, minimize edilecek kriter ise (maliyet kriteri) payda olacak şekilde dikkate alınmıştır (Balezentis vd., 2010). Tam çarpım metoduna göre yapılan analiz sonuçları Tablo 7'de gösterilmiştir.

Tablo 7. Tam Çarpım Formu

	Kriter 1	Kriter 2	Kriter 3	Kriter 4	TAM ÇARPIM	
	Max	Max	Max	Max	(K1*K2*K3*K4)	Sıralama
Alternatif 1	66,8	62,5	53,9	49,5	**11139108,75**	**4**
Alternatif 2	42,5	55,1	37,1	38,1	**3310087,04**	**5**
Alternatif 3	41,6	73,2	78,8	80,9	**19412396,39**	**2**
Alternatif 4	72,5	75,6	74,2	70,2	**28549652,04**	**1**
Alternatif 5	61,3	59,9	67,2	59,4	**14656930,04**	**3**
Alternatif 6	18,9	26,6	23,4	19,7	**231753,09**	**7**
Alternatif 7	7,2	9,3	16,5	20,8	**22980,67**	**8**
Alternatif 8	17,1	24,8	28,2	29,3	**350400,34**	**6**

MULTIMOORA

Multi-Moora ilk kez 2010 yılının başlarında Brauers ve Zavadskas tarafından ortaya atılmıştır. Multi-Moora, Moora yöntemlerinin ve çok amaçlı tam çarpan formlarının bir dizisi şeklindedir. Temelde amaç, baskın alternatifleri belirlemek ve bu doğrultuda karar vericiye yön vermektir.

Multi-Moora analizi sonuçları Tablo 8'de gösterilmiştir. Her bir alternatif için yukarıdaki üç yöntemin sonucuna göre baskınlık durumları dikkate alınarak sıralama yapılmıştır. Örneğin Alternatif 1, yapılan analizlerde oran metodu ve tam çarpım formuna göre 4. sırada, referans noktası yaklaşımına göre ise 3. sırada yer almıştır. Alternatif 1 çoğunlukla 4. Sırada yer aldığı için Multi-Moora analizine göre 1. alternatif, 4. sıradadır denilmektedir.

Tablo 8. Multi-Moora Analizi

	Oran	Referans	Tam Çarpım	**MULTIMOORA**
Alternatif 1	4	3	4	**4**
Alternatif 2	5	5	5	**5**
Alternatif 3	2	4	2	**2**
Alternatif 4	1	1	1	**1**
Alternatif 5	3	2	3	**3**
Alternatif 6	7	7	7	**7**
Alternatif 7	8	8	8	**8**
Alternatif 8	6	6	6	**6**

SONUÇ

Günümüzde gelişen teknoloji ile birlikte internet erişimi gittikçe artmaktadır. TÜİK verilerine göre, Türkiye genelinde internet erişim imkânına sahip hanelerin oranı 2015 yılında %69,5 olmuştur. Diğer tüm teknolojik ürünlerde olduğu gibi internet de amacına uygun kullanıldığında faydalı olmaktadır.

Bu çalışmada, ÇKKV yöntemlerinden MULTIMOORA ile Türkiye'deki internet kullanıcılarının 2012-2015 yılları arasında interneti kullanım amaçlarının sıralanması hedeflenmiştir. Tablo 9 incelendiğinde, son dört yıl baz alındığında bireylerin interneti kullanım amaçlarının başında online haber, gazete ya da dergi okumanın geldiği, bu alternatifi internet üzerindeki facebook, twitter vb sosyal gruplara katılmanın takip ettiği görülmektedir. Sekiz alternatif arasında internet üzerinden mal veya hizmet satışı, bireylerin interneti kullanma amaçlarında son sırada tercih edilmektedir.

Tablo 9. MULTIMOORA ile Alternatifler Arası Sıralama

Sıralama	**Alternatifler**
1	Online haber, gazete ya da dergi okuma
2	İnternet üzerindeki sosyal gruplara (Facebook, twitter vb) katılma
3	Mal ve hizmetler hakkında bilgi arama
4	E-Posta gönderme / alma
5	İnternet üzerinden telefonla görüşme/ video görüşmesi (webcam ile)
6	İnternet bankacılığı
7	Seyahat veya seyahat ile ilgili konaklama için online hizmetleri kullanma
8	Mal veya hizmet satışı

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RESEARCH OF THE EFFECTS OF SCIENCE EDUCATION BASED ON PREDICT - OBSERVE - EXPLAIN STRATEGY ON STUDENTS' SCIENCE PROCESS SKILLS AND SUCCESS

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ABSTRACT: In this study, it is aimed to research the effect of a lecturing of "Visit and Learn the Creatures World" based on POE technique on 5th grade middle school students' academic success and science process skills. Focus group of this research consists of 52 students studying in 5/A and 5/B classes of a state school located in Büyükçekmece district of Istanbul City during the 2014-2015 academic year. The study has two groups, control group and experiment group, consisting of 26 people each. Experimental design of the research, since the students forming the study groups are not randomly assigned to the experiment and control groups, it's pretest-posttest quasi-experimental design with control group. Experimental work of the research is 4 weeks long covering a 7-week-long period. In experiment group, activities on "Visit and Learn the Creatures World" topic of science lectures are done according to POE strategy while in control group, lecturing is done according to the teaching method of the lecture present in the program. Data collection tools used in this research are academic success test and science process skills test. Data analysis of the studies are done by using SPSS.18 statistics program while independent t-test is utilised for analysis of intergroup tests and dependent t-test is utilised for analysis of intragroup tests. By looking at the analysis results of the research, a significant difference on behalf of experiment group is seen for the effect of a lecturing of "Visit and Learn the Creatures World" based on POE technique on 5th grade middle school students' academic success and science process skills.

Key words: poe strategy, science education, science process skills

TAHMİN ET- GÖZLE-AÇIKLA STRATEJİSİNE DAYALI FEN ÖĞRETİMİNİN ÖĞRENCİLERİN BİLİMSEL SÜREÇ BECERİLERİNE VE BAŞARISINA ETKİSİNİN ARAŞTIRILMASI

ÖZET: Bu çalışmada Canlıların Dünyasını Gezelim Tanıyalım konusunun TGA tekniğine dayalı bir ders anlatımının ortaokul 5. sınıf öğrencilerinin akademik başarısına ve bilimsel süreç becerilerine etkisinin incelenmesi amaçlanmaktadır. Bu araştırmanın çalışma grubunu 2014-2015 Eğitim Öğretim yılında İstanbul ili Büyükçekmece ilçesinde bulunan bir devlet okulunda 5/A ve 5/B sınıflarında okuyan 52 öğrenci oluşturmaktadır. Çalışmada her biri 26 kişilik olup kontrol ve deney grubu olmak üzere iki küme bulunmaktadır. Araştırmanın deneysel deseni, çalışma grubunu oluşturan öğrenciler deney ve kontrol gruplarına rastgele dağıtılmadıklarından ön test-son test kontrol gruplu yarı deneysel desendir. Araştırmanın deneysel çalışması 4 hafta olup toplam 7 haftalık bir süreci kapsamaktadır. Deney grubunda fen bilimleri dersindeki canlıların dünyasını gezelim tanıyalım konusundaki etkinlikler TGA stratejisine göre yapılırken kontrol grubunda ise programdaki dersin öğretim yöntemine göre ders anlatımı yapılmıştır. Araştırmada veri toplama araçları olarak akademik başarı testi ve bilimsel süreç beceri testi kullanılmıştır. Veri analizinde SPSS.18 istatistik programından yararlanılmıştır. Araştırmanın sonucunda ortaokul 5. sınıf Canlıların Dünyasını Gezelim Tanıyalım konusunun TGA tekniğine dayalı etkinliklerle anlatıldığı deney grubu lehine öğrencilerinin akademik başarısına ve bilimsel süreç becerilerine etkisinde anlamlı bir fark görülmüştür.

Anahtar sözcükler: TGA stratejisi, fen Eğitimi, bilimsel süreç becerileri

GİRİŞ

Çağımız teknolojiden ayrı düşünülemez ve teknolojinin gelişmesi, küreselleşme gibi unsurların etkisi ile değişen ve gelişen koşullar, eğitim alanında da kendisini göstermektedir. Öğrenme, eğitiminin en temel taşlarından birisidir. Öğrenmenin sağlıklı gerçekleşebilmesi için pek çok yaklaşım ve teknik ortaya atılmıştır. Özelikle son yıllarda yapılan akademik çalışmalara ve verilen ürünlere bakıldığında karşımıza büyük bir yelpaze çıkmaktadır. Tüm bu yaklaşımlar öğrenme ile ilgili olarak kendi içerisinde önemli olgular barındırmaktadır. Dolayısı ile bu da öğrenmeden elde edilen beklentilerin günümüz koşullarında ilerlemesine ve değişmesine yol açmaktadır.

Öğrenmeden elde edilen beklenti çıtasının yükselmesi için; öğrencinin zihinsel yapılarının oluşması, ön bilgilerinin tamamlanması, varsa kavramsal anlama yanılgılarının giderilmesi, bilgi ve becerilerini, tutum ve inançlarını olumlu yönde değiştirmesi gereklidir. Gerekli olan değişim ve doğru ön bilgiler için ise pastanın en önemli payı ilköğretim yaşlarında saklıdır. Fakat bazı kavramlar, bazı konular öğrenci düzeyine uygun dahi olsa bireysel farklılıktan ötürü geleneksel yaklaşımla işlenen bir ders planlaması, eksiklerin giderilmesinde yeterli olmamaktadır. Bu da eğitimde yeni tekniklerin kullanılmasını, buna göre bir ders tasarlanmasını zorunluluk haline getirmiştir. Bu bağlamda ise 2004 yılında yaklaşımı değişen fen ve teknoloji dersinin kavram öğrenmeli bir tabanla öğretilmesi gerekliliğini, öğrencinin çevresini gözleyip bilgiye kendi ulaşması gerektiğini ve öğrenme düzeyinin ülkemizde yükselip nitelikli bireylerin yetiştirilmesi ihtiyacını gözler önüne sermektedir.

1.1 Problem Durumu

Fen, geçmişten günümüze insan ve çevresiyle bağlantılı bir disiplindir. İnsanın kendisini, çevresini ve yaşadığı hayatı tanıması bireyin farkındalığını arttırır. Fen dersi, İçinde gündelik hayatta kullanılan birçok kavram, olay, olgu barındırmaktadır. Ayrıca fen ve teknoloji dersi, bireyin akademik hayatındaki hayat bakışını, nitelikli sosyal insanı, ileriki sayısal çalışmalarında fizik, kimya, biyoloji disiplinlerine karşı ön tutum, ön bilgi tamamlama süreçlerini sağlıklı yürütmesi için verilen ilk adım disiplinidir. İlköğretim düzeyinde alınmış iyi bir fen eğitimi, bireyin ileriki sayısal akademik başarısında ve sözel olan hayat başarısında etkili olmaktadır.

Ortaokul 5. Sınıf düzeyindeki 'Canlılar Dünyasını Gezelim ve Tanıyalım' ünitesinde öğrencilere verilmesi gereken kazanımlar incelendiğinde bir öğretim süreci içinde, bireyin çevresini tanımasında, canlı kavramını algılayıp sınıflandırmasında, yaşamı ve yaşamın içindeki yerini algılayabilmesinde öğrencinin çevresini gözlemlemesi ve genel olarak kalıcı bilgiler içinse kendi doğrusuna kendinin oluşturması gerekli olduğu anlaşılmaktadır.

Öğrencilerin, öğrenme seviyelerine ve bireysel algılamalarına göre kavram öğretimi stratejilerinin geliştirilmesi için, öğrencilerin kavramlar hakkındaki bilgi birikimlerinin ve kavramı kavramsallaştırdıkları farklı yolların bilinmesi gerekmektedir (Çalık, 2003; Ebenezer & Fraser, 2001,Aktr.Bilen &Köse, 2012).Bu bağlamda geleneksel bir ders anlatımı, günümüzde aranan nitelikli insan tanımına uymamaktadır. Günümüzde öğretim teknikleri yelpazesine baktığımız zaman özellikle fen dersi için birçok alternatif görülmektedir. Kavram öğretiminde uygulanan Tahmin Et – Gözle – Açıkla (TGA, Prediction-Observation-Explanation, POE) yöntemi son zamanlarda göze çarpmaktadır.

Bu araştırmanın temel problemi, 'Canlıların Dünyasını Gezelim Tanıyalım konusunun Tahmin Et – Gözle – Açıkla(TGA) tekniğine dayalı bir ders anlatımının ortaokul 5. sınıf öğrencilerinin akademik başarısına ve bilimsel süreç becerilerine etkisi var mıdır?' sorusuna çözümler bulmaktır.

1.2 Araştırmanın Önemi ve Amacı

İlköğretim öğrencilerinin en zorlandığı derslerin başında matematik ve fen derslerinin geldiği, uluslararası karşılaştırma sınavlarından biri olan TIMSS'den elde edilen bulgular, Türkiye ve başarı sıralamasında ilk beş içinde bulunan ülkelerin Fen Bilimleri ve Matematik derslerine yönelik başarıları arasında bir paralellik olduğunu göstermektedir (Uzun, Bütüner ve Yiğit, 2010).Ülkemizde kullanılan Yapılandırmacı anlayış, Ausubel'in 'öğrenmeyi etkileyen en önemli faktör öğrencinin bilgi birikimidir' şeklinde ifade edilen düşüncesine dayanmakla birlikte temelde öğrencilerin mevcut bilgilerini kullanarak yeni bilgi edinmelerini, öğrenmeyi ve kendine özgü bilgi oluşturmayı açıklayan bir öğrenme kuramı olarak kabul edilmektedir (Hand ve Treagust, 1991; Turgut ve ark., 1997; Appleton, 1997; Akt. Özmen, 2004).Ön öğrenmelerin eksik veya hatalı olduğu durumlarda yeni bilgi anlaşılması zorlaşır ya da doğru bir şekilde kazandırılamaz. Bu durumlarda ortaya kavram yanılgıları çıkar. İlköğretim fen dersinde oluşturulan kavram yanılgıları ise bireyin ileriki kazanımlarını önemli boyutta etkilemektedir. Bu bakımdan fen öğretiminde yararlı stratejiler kullanmak, ders deseninin değiştirmek, bir konu üzerinde etkili olan bir yaklaşım benimsemek, ortaokul öğretmenleri için kaçınılmaz olmuştur. Çünkü fen öğretimi ön bilgileri toparlayarak, öğrencinin bilgiye kendisinin ulaşmasını sağlatmak ve dolayısıyla bilginin kalıcı olmasını hedef almaktadır. Bu nedenle fen öğretiminde öğretim yöntemleri ve teknikleri açısından birçok çalışma yapılıp çeşitlilik sağlanmıştır ve öğrencilerin temel fen kavramlarını doğru bir şekilde öğrenmeleri için değişik yaklaşımlar geliştirilmiştir.

İlköğretim ilk kademenin son basamağı olan 5. Sınıfı değişen 4+4+4 eğitim sistemimize göre ilköğretim 2. Kademesinin ilk basamağı olmuştur. Bu nedenle beşinci sınıf fen konuları, programlarında değişiklikler yer almış hatta öğretmenlerden günlük ders planlamaları hazırlamaları zorunluluk haline getirilmiştir. Ara bir sınıf oluşturulduğundan dolayı başkalaşım haline gelen beşinci sınıf, öğrencilerin gözünde anlaşılması güç konuları olan bir basamak olarak görülmektedir. Fen dersine ilişkin 5. Sınıf 'Canlıların Dünyasını Gezelim Ve Tanıyalım' ünitesinde yer alan canlı sınıflandırılması, insan ve çevre ilişkisi temaları, öğrencilerin edinilmesi gereken kazanımları ilk öğrenme boyutundan ortaokul düzeyine harmanlanmıştır ve bu bakımdan hem öğretmeyle hem de ilgili kazanımların öğrencilere benimsetilmesi zorlaşmıştır. Çünkü MEB(2012)'e göre ilkokul kazanımları üst programlarının bütününe yönelik olarak fazla sayıda seçeneği barındırmaktadır. Buradan anlaşılacağı gibi öğretimde geniş bir öğretim tekniği kullanılmalıdır. Fakat kullanılacak tüm ihtiyaç olan ders gereksinimlerini bir yaklaşım altında toparlamak zordur. Bu bağlamda öğrencilerin öğretim öncesi bilgilerini, kendi yaşam deneyimlerini, ön bilgilerini, inançlarını öğretim süreci ile birlikte harmanlayarak yeniden yapılandırması gerekmektedir. Bir başka deyişle öğrencilerin öğretim öncesi bilgilerini, öğretim süreci sonunda arzu edilen noktaya taşımak için kavramsal değişim stratejilerinden yararlanılması gerekmektedir. Bunun için Tahmin Et – Gözle – Açıkla(TGA) yöntemi de uygun bir stratejidir. Çünkü Tahmin Et – Gözle – Açıkla(TGA) yönteminde öğrenci kendi ön bilgileriyle olası problem karşısında tahminlerde bulunur, gözlemlerine dayanarak ve tahminlerini harmanlayarak ta kendi oluşturduğu kavram bilgisini açıklar.

YÖNTEM

2.1.Araştırmanın Modeli

Bu çalışmada, canlıların sınıflandırılması, toplum, insan ve çevre kavramlarına ilişkin öğrencide kavram yanılgılarını engellemek ve bu zihinde oluşturulacak bilginin günlük yaşamda kullanılabilirliğini arttırmak amaçlanmıştır. Dolayısı ile öğrenci fikirlerini belirleme, kavram gruplandırılmalarını doğru bir şekilde örgütleme ve tek yöntem kullanılmayı amaçlama adına TGA yöntemi ile ders anlatımı seçilmiştir. Çalışmada kıyas ve uygulama çalışması olduğundan deneysel yöntem uygulanması belirlenmiştir. Bu araştırmada, uygulanan deneysel yöntemde, deney grubu üzerinde etkisi incelenen bağımsız değişken "TGA Yöntemine Dayalı Canlıların Dünyasını Gezelim Tanıyalım Ünitesinin ders anlatımı" kontrol altına alınmıştır. Kontrol grubunda ise, "MEB in uygun gördüğü ders Yaklaşım planına göre klasik ders anlatımı" kullanılmıştır.

Araştırmanın deneysel deseni, ön test-son test kontrol gruplu yarı deneysel desendir. Çünkü çalışma grubunu oluşturan öğrenciler, deney ve kontrol gruplarına rastgele dağıtılmadıklarından yarı deneyseldir (Campbell & Stanley, 1966). Bu yöntemde, deney ve kontrol gruplarının birbiri ile tamamen aynı özelliklere sahip olması mümkün değildir. Bu nedenle deney ve kontrol gruplarının tespitinde mümkün olduğu kadar benzer özellikler taşıyan grupların seçilmesi gerekmektedir. Deney grubuna müdahale yapılırken kontrol grubuna herhangi bir müdahale yapılmamaktadır (Cohen & Manion, 1994). Araştırmada kontrol gruplu ön test-son test deseni kullanılmıştır. Bu desen işlemin bağımlı değişken üzerindeki etkisinin test edilmesiyle ilgili olarak araştırmacıya yüksek bir istatistiksel güç sağlayan, elde edilen bulguların neden-sonuç bağlamında yorumlanmasına olanak veren ve davranış bilimlerinde sıklıkla kullanılan güçlü bir desendir (Büyüköztürk, 2010).

Araştırmada uygulama yapılan deney ve kontrol grubu öğrencilerine deneysel işlem öncesi ve sonrası uygulanan testler Tablo 1'de gösterilmiştir.

Tablo 1.Deney ve Kontrol Grubuna Uygulanan Ölçme Araçları

GRUP	ÖN TEST	DENEYSEL İŞLEM	SON TEST
Deney Grubu	CDGTT, BSBT	TGA yöntemine dayalı ders anlatımı	CDGTT, BSBT
Kontrol Grubu	CDGTT, BSBT	MEB Planına göre ders anlatımı	CDGTT, BSBT

•**CDGTT** Canlıların Dünyasını Gezelim Tanıyalım Başarı Testi •**BSBT** Bilimsel Süreç Becerileri Testi

2.2 Araştırmanın Çalışma Grubu

Bu araştırmanın çalışma grubunu 2014-2015 Eğitim Öğretim yılında İstanbul ili Büyükçekmece ilçesinde bulunan bir devlet okulunda 5/A ve 5/B sınıflarında okuyan 52 öğrenci oluşturmaktadır. Oluşturulan öğrenme ortamında başarı testleri her öğrenciye uygulanmıştır. Kontrol ve deney grupları rastgele belirlenememesine rağmen, uygulamadan önce öğrencilere uygulanan dönemsel ortak birinci ve ikinci yazılı sınavları arasında aritmetik ortalama sonucu anlamlı bir fark bulunamamıştır.

2.3. Araştırmanın Uygulama Aşaması

Bu araştırma oluşturulmuş olan başarı testinin ön uygulaması, Uygulama zamanı olarak okulun ve öğrencilerin mağdur olmaması için fen bilimleri dersinin yıllık planı doğrultusunda 'Canlıların Dünyasını Gezelim Tanıyalım' ünitesinin denk geldiği süreç kabul edilmiştir.

Araştırmanın deneysel çalışması 4 hafta olup toplam 7 haftalık bir süreç belirlenmiştir. Çalışmalar, deney grubu ve kontrol grubu olmak üzere 26 kişilik kümelerden oluşmaktadır. Deney grubunda fen bilimleri dersindeki canlıların dünyasını gezelim tanıyalım konusundaki etkinlikler TGA stratejisine göre yapılırken kontrol grubunda ise programdaki dersin öğretim yöntemine göre ders anlatımı yapılmıştır. Etkinlikler yapılmadan önce iki gruba da CDGTT ve BSBT ön test uygulanmıştır. Ön testler uygulandıktan sonra sınıf yoklama listesi baz alınarak okul numaralarına göre öğrenci çalışma grupları belirlenmiş ve çalışmalar en az 2 en fazla 4er kişilik gruplar halinde yapılmıştır.

Çalışmada; Deney grubuna TGA ile uygulanan 7 tane etkinlik kâğıdı hazırlanmıştır. Bu etkinliklerin uygulanma süreci eğitim öğretimin aksamaması için ilgili yıllık planın doğrultusunda yapılmıştır. Her etkinlikte bir tahmin et kâğıdı, bir de gözle ve açıkla kâğıdı yer almaktadır. Tahmin et aşamasında öğrencilere o günkü etkinlik ile ilgili tahminde bulunmaları istenmiş ve öğrencilere dağıtılan etkinlik kâğıdına görüşlerini yazmaları belirtilmiştir. Cevaplar yazıldıktan sonra öğrencilerden kâğıtlar toplanmıştır. Buradaki amaç diğer aşamalarda öğrencilerin önceden verdiği cevapları düzeltme durumuna girmelerini engellemektir. Tahmin aşamasında ayrıca öğrencilerin kavram yanılgıları varsa tespit edilmesi de amaçlanmıştır. Bu aşamanın en önemli tarafı da öğrencilerin verdikleri cevaptan sonra kâğıtların neden toplandığını, cevapların doğruluğunu merak etmeleri dersi onlar için daha keyifli hale gelmesini sağlamaktır. Bu aşamadan sonra gözlem ve açıklama soruları olan kâğıt öğrencilere dağıtılıp araştırmacı ve bir gözleyici öğretmen eşliğinde etkinlikler öğrenci grupları tarafından yapılmıştır. Etkinlikler yapılırken öğrencilerin gözlemlerini kâğıda yazmaları istenmiştir. Son aşamada ise çalışma grupları gözlemlerini başlangıçta yaptıkları tahmin sonuçlarına göre karşılaştırıp fikirlerinin doğru ya da neden yanlış olduklarını analiz etmiş ve bunu açıklamışlardır. Kontrol grubunda ise aynı ünite ve kazanımlarını içeren M.E.B kitabı rehber edinilmiştir.

Çalışmanın uygulama süreci bittikten sonra her iki gruba da uygulama başında yapılan başarı testi ve bilimsel süreç beceri testleri son test olarak tekrar uygulanarak veriler toplanılmıştır.

2.4 Araştırmada Kullanılacak Veri Toplama Araçları

Araştırmada Canlıların Dünyasını Gezelim ve Tanıyalım Ünitesine yönelik olarak öğrencilerin başarılarını, kavram yanılgılarını ve bilimsel süreç becerilerine yönelik değişimlerini ortaya koymak adına araştırmacı tarafından derlenen bir akademik başarı testi, bilimsel süreç beceri testi kullanılmıştır.

2.4.1 CDGT Akademik Başarı Testi

Bu çalışmada kullanılacak akademik başarı testi program kazanımları dikkate alınarak çeşitli kaynaklardan ve milli eğitim müfredatından yararlanılarak kavram yanılgılarını ortaya koymak ve öğrencilerin ön bilgilerini yoklamak amacıyla araştırmacı tarafından uzman görüşü alınarak hazırlanan, çoktan seçmeli sorular içeren ve bu soruların açıklamalarını sorgulayan açık uçlu sorulardan da oluşan iki aşamalı bir testtir.

İki aşamalı testler, adından da anlaşılacağı üzere iki kısımdan oluşan testlerdir. İki aşamalı testleri çoktan seçmeli testlerden farklı kılan onun ikinci kısmıdır. Bu bölümde, öğrencinin ilk aşamada işaretlediği seçeneği, işaretleme gerekçesini belirtmesi istenmektedir (Karataş vd. 2003). Böylelikle ikinci kısımda öğrencinin işaretlediği birinci kısım seçenekte olası kavram yanılgısı, bilgi eksikliği kolaylıkla araştırmacıya somutlaştırılır. Ayrıca bu ikinci bölüm, öğrencilerin muhakeme yeteneğini daha iyi ölçebilmek ve daha önce belirlenen yanılgılardan farklı alternatif kavramların olup olmadığını tespit edebilmek amacıyla açık uçlu bir yapıda da düzenlenebilmektedir (Mann & Treagust, 1998; Voska & Heikkinen, 2000). Akademik başarı testinin geliştirilmesi için 4 fen ve teknoloji öğretmeninden, bir konu uzmanı akademisyenden görüş alınmıştır. Hazırlanan başarı testi güvenirlik açısından pilot çalışması 2014-2015 eğitim öğretim yılında İstanbul ili, Büyükçekmece ilçesinde bulunan 3 ilköğretim okulunda 286 adet 6. Sınıf öğrencileri üzerinde uygulanmıştır. Pilot uygulama sonucunda 26 soruluk başarı testinin güvenirlik kat sayısını 0,725 alfa bulunmuştur. Fakat madde ayırt ediciliği düşük olan (0.20nin altında) 1.5.7. ve 16. Sorular çıkarıldığı zaman güvenirlik kat sayısı 0,7512'e yükselmiştir. Uygulanmış olan başarı testi 22 soruya indirilmiştir.

2.4.2 BSB Testi

Araştırmada kullanılacak Bilimsel süreç becerileri testinin orijinali Okey, Wise ve Burns (1985) tarafından geliştirilmiştir. Testin Türkçeye çevirisi ve uyarlaması ise Özkan, Aşkar ve Geban tarafından yapılmıştır (Doğruöz, 1998). Testin orijinalinde KR-20 güvenirlik katsayısı 0.86 olarak hesaplanmıştır (Burns vd. 1985:169). Bu test, bilişsel gelişim düzeyi bakımından İlköğretim 8. sınıf öğrencilerine uygun olduğu saptanmıştır (Tobin ve Capie, 1982:133). Ancak, araştırma örneklemi 5. sınıf öğrencilerinde oluştuğu için test incelenmiş ve teste bulunan maddeler 5. sınıf Fen ve Teknoloji Programına ve öğrencilerin bilişsel gelişim düzeylerine göre yeniden düzenlenerek 5. sınıf Fen ve Teknoloji programında yer alan 24 bilimsel süreç becerileri kazanımlarını temsil edecek şekilde oluşturulmuştur(Çakar, 2008). Bilimsel Süreç Becerileri Testinin geçerliği konusunda 1 uzman görüşü ve 5 fen öğretmeninin görüşleri alınmıştır (Çakar, 2008). Uzmanların ve öğretmenlerin belirttikleri görüşlere göre maddeler üzerinde düzeltmeler yapılarak uygulama yapılmıştır.

Kullanılacak bilimsel süreç beceri testinde dört seçenekli 24 soru yer almaktadır. Bu testte yer alan maddelerin, madde ayırt edicilik gücü indeksleri 0.31 ile 0.73 arasında ve madde güçlük indeksleri 0.36 ile 0.79 arasında değişmektedir(Çakar, 2008) Bilimsel Süreç Becerileri Testinin KR-20 güvenirlik katsayısı ise 0.86 olarak hesaplanmıştır. KR-20 güvenirlik katsayısının 0.70 ve daha yüksek olması test puanlarının güvenirliği için yeterlidir (Büyüköztürk,2010).

BULGULAR

Araştırmada analiz yolunu belirlemek için öncelikle çalışma gruplarının normal dağılım gösterip göstermeyeceğine bakılmıştır. Bu amaçla başarı sınavı ile bilimsel süreç becerileri testinden elde edilen veriler ile SPSS 18.00 paket programından yararlanılarak Shapiro-Wilks testine aktarılmıştır. Veri sayısı 29'dan az olduğunda Shapiro-Wilks testi kullanılır (Kalaycı, 2010). Araştırmada deney ve kontrol grubundaki öğrenci sayısı eşit (26 kişi) tir. Tablo 2 de de görüldüğü gibi Shapiro-Wilks testi sonucunda verilerin normal dağılım göstermesi sonucu çalışmada parametrik testler olan ilişkili t testi ve ilişkisiz t testi kullanılmıştır.

Tablo2: Çalışmada uygulanan ölçme araçlarının normal dağılım açısından karşılaştırılması

	CDGT ön test		**CDGT son test**		**BSBT ön test**		**BSBT son test**	
	5/A	**5/B**	**5/A**	**5/B**	**5/A**	**5/B**	**5/A**	**5/B**
N	26	26	26	26	26	26	26	26
X	11,27	11,12	13,35	19,58	13.5	13.5	14,1	16,5
Standart Sapma	3,69	2,55	2,622	3,42	3.56	3.80	3.78	3.40
Shapiro Wilks	0,977	0.946	0,948	0.958	0.971	0.952	0.973	0.965
Anlamlılık	0.801	0.189	0.205	0.358	0.655	0.255	0.695	0.491

3.1.CDGT Başarı Testine ilişkin Bulgular

Tablo3: Deney ve Kontrol Grubu CDGT başarı ön testi puanlarının karşılaştırılması

GRUP	**N**	**X**	**S.S**	**t Testi**		
				Sd	**t**	**p**
Kontrol	26	11,26	3,68	50	,175	0,862
Deney	26	11,11	2,55			

Tablo 3 incelendiğinde kontrol gruplarının aritmetik ortalaması11,26 iken deney gruplarının aritmetik ortalaması11,11 olarak bulunmuştur. Kontrol grubu ön test puanları arasında 3,68 standart sapma var iken deney grubu ön test puanları arasında 2,55 standart sapma görülmüştür. Spss 18 paket programında yapılan ilişkisiz t-testi sonucunda; deney ve kontrol grupları CDGT başarı ön test puanları arasında anlamlı bir fark yoktur ($t=,175$, $p>0.05$).

Tablo4: Deney ve Kontrol Grubu CDGT başarı son testi puanlarının karşılaştırılması

GRUP	**N**	**X**	**S.S**	**t Testi**		
				Sd	**t**	**p**
Kontrol	26	13,35	2,62	50	-7,37	0,00
Deney	26	19,57	3,42			

Tablo 4 incelendiğinde kontrol gruplarının son test puanı aritmetik ortalaması13,35 iken deney gruplarının aritmetik ortalaması 19,57 olarak bulunmuştur. Kontrol grubu son test puanları arasında 2,62 standart sapma var iken deney grubu son test puanları arasında 3,42 standart sapma görülmüştür. Spss 18 paket programında yapılan ilişkisiz t-testi sonucunda; deney ve kontrol grupları CDGT başarı son test puanları arasında anlamlı bir fark vardır ($t=-7,37$, $p<0.05$).

Tablo5: Deney Grubunun CDGT başarı testi ön ve son test puanlarının karşılaştırılması

TEST	N	X	S.S	t Testi		
				Sd	t	p
Başarı Ön Test	26	13,19	2,82	25	-12,928	0,00
Başarı Son Test	26	19,57	3,42			

Tablo 5 incelendiğinde deney grubu öğrencilerinin akademik başarı ön test ortalamalarının 13,19, standart sapmasının 2.82; son test ortalamalarının 19,57, standart sapmasının 3,42 olduğu görülmektedir. Deney grubunun Canlılar Dünyasını Gezelim Tanıyalım akademik başarı ön test puanları ile son test puanları arasında istatistiksel olarak anlamlı bir fark oluşmuştur (t=-12,928, p<0.05).

Tablo6: Kontrol Grubunun CDGT başarı testi ön ve son test puanlarının karşılaştırılması

TEST	N	X	S.S	t Testi		
				Sd	t	p
Başarı Ön Test	26	11,26	3,68	25	-5,35	0,00
Başarı Son Test	26	13,34	2,62			

Tablo6 incelendiğinde kontrol grubu öğrencilerinin akademik başarı ön test ortalamalarının 11,26, standart sapmasının 3,68; son test ortalamalarının 13,34, standart sapmasının 2,62 olduğu görülmektedir. Kontrol grubunun Canlılar Dünyasını Gezelim Tanıyalım akademik başarı ön test puanları ile son test puanları arasında istatistiksel olarak anlamlı bir fark oluşmuştur (t=-5,35, p<0.05).

3.2. BSB Testine ilişkin Bulgular

Tablo7: Deney ve Kontrol Grubu BSB ön testi puanlarının karşılaştırılması

GRUP	N	X	S.S	t Testi		
				Sd	t	p
Kontrol	26	13,50	3,55	50	0	1
Deney	26	13,50	3,79			

Tablo 7 incelendiğinde kontrol ve deney gruplarının aritmetik ortalaması 13,50 olarak bulunmuştur. Kontrol grubu BSB ön test puanları arasında 3,55 standart sapma var iken deney grubu BSB ön test puanları arasında 3,79 standart sapma görülmüştür. SPSS 18 paket programında yapılan ilişkisiz t testi sonucunda; deney ve kontrol grupları BSB ön test puanları arasında anlamlı bir fark yoktur (t=0, p>0.05).

Tablo8: Deney ve Kontrol Grubu BSB son testi puanlarının karşılaştırılması

GRUP	N	X	S.S	t Testi		
				Sd	t	p
Kontrol	26	14,15	3,78	50	-2,39	0,02
Deney	26	16,53	3,40			

Tablo 8 incelendiğinde kontrol gruplarının BSB son test puanı aritmetik ortalaması14,15 iken deney gruplarının aritmetik ortalaması 16,53 olarak bulunmuştur. Kontrol grubu BSB son test puanları arasında 3,78 standart sapma var iken deney grubu son test puanları arasında 3,40 standart sapma görülmüştür. SPSS 18 paket programında yapılan ilişkisiz t testi sonucunda; deney ve kontrol grupları BSB son test puanları arasında anlamlı bir fark vardır (t=-2,39, p<0.05).

Tablo 9: Deney Grubunun BSB testi ön ve son test puanlarının karşılaştırılması

TEST	N	X	S.S	t Testi		
				Sd	t	p
BSB Ön Test	26	13,50	3,79	25	-6,986	0,00
BSB Son Test	26	16,53	3,40			

Tablo 9 incelendiğinde deney grubu öğrencilerinin bilimsel süreç becerileri ön test ortalamalarının 13,50, standart sapmasının 3,79; son test ortalamalarının 16,53, standart sapmasının 3,40 olduğu görülmektedir. Deney grubunun bilimsel süreç becerileri ön test puanları ile son test puanları arasında istatistiksel olarak anlamlı bir fark oluşmuştur (t=-6,986, p<0.05).

Tablo10: Kontrol Grubunun BSB testi ön ve son test puanlarının karşılaştırılması

TEST	N	X	S.S	t Testi		
				Sd	t	p
BSB Ön Test	26	13,50	3,55	25	-4,183	0,00
BSB Son Test	26	14,15	3,78			

Tablo 10 incelendiğinde kontrol grubu öğrencilerinin BSB ön test ortalamalarının 13,50, standart sapmasının 3,55; BSB son test ortalamalarının 14,15, standart sapmasının 3,78 olduğu görülmektedir. Kontrol grubunun bilimsel süreç becerileri ön test puanları ile son test puanları arasında istatistiksel olarak anlamlı bir fark oluşmuştur ($t=-4,183$, $p<0.05$).

SONUÇ

Bu çalışmada Tahmin et- Gözle-Açıkla tekniğine dayalı fen öğretiminin ortaokul 5. sınıf öğrencilerinin akademik başarısına ve bilimsel süreç becerilerine etkisinin olup olmadığı incelenmiştir. Araştırmada elde edilen bulgulara dayanarak; (1) Deney grubunun ön test puanları ile son test puanları arasında son test puanları lehine anlamlı bir farklılığın çıkması deney grubunda uygulanan TGA yöntemine dayalı dersin öğrencilerin akademik başarısına olumlu etkisinin olduğu sonucunu ortaya çıkarmıştır. Elde edilen bu sonuç literatürde yapılan TGA ilgili çalışmalara bakıldığında aynı doğrultuda olduğu saptanmıştır (Acar,2010; Özdemir,2011;Sünkür,2013; Bilen, 2014). (2) Kontrol grubunun ön test ve son test puanları arasında da son test puanları lehine anlamlı bir fark ortaya çıkmıştır. Fakat Deney grubunun son test puan ortalamaları kontrol grubundan daha yüksek olduğu görülmektedir. Bu da ders tekniğinin olumlu katkı sağladığını göstermektedir.

Çalışmanın öneminde değinildiği gibi 5. sınıf fen bilimleri dersi müfredatı ve kazanımları ilkokul ve ortaokul düzeylerinde harmanlanması hem öğretmeyle hem de ilgili kazanımların öğrencilere benimsetilmesi zihinsel şekil olarak zorlaşmıştır. Sorun giderilmesi için bilişsel düzeyde teknik ve yöntemler bir arada kullanılmalı alternatif materyaller ile öğretim zenginleştirilmelidir. Fakat kullanılacak tüm ihtiyaç olan ders gereksinimlerini bir yaklaşım altında toparlamak zordur. Bu bağlamda öğrencilerin öğretim öncesi bilgilerini, kendi yaşam deneyimlerini, ön bilgilerini, inançlarını öğretim süreci ile birlikte harmanlayarak yeniden yapılandırması gerekmektedir. Bir başka deyişle öğrencilerin öğretim öncesi bilgilerini, öğretim süreci sonunda arzu edilen noktaya taşımak için kavramsal değişim stratejilerinden yararlanılması gerekmektedir. Burada çalışmanın da bulgularına dayanarak TGA yönteminin bunu gerçekleştirdiği söylenebilir.

ÖNERİLER

TGA ders tekniği ile ilgili yapılan çalışmalara bakıldığı zaman ortaokul düzeyinde pek fazla çalışmaya rastlanmamıştır. Olan çalışmaların çoğu lise düzeyi öğrencileri ve yahut öğretmen adayları üzerinde yapılan incelemelerdir.
Bu çalışmada ortaokul 5. sınıf fen bilimleri dersinde canlıların dünyasını gezelim tanıyalım adlı ünitede TGA tekniğinin olumlu katkı sağladığı görülmektedir. Diğer araştırmalarda başka ünitelere katkısı da incelenebilir.
Yapılan çalışma göz önüne alınarak teknolojik imkânlar kullanılarak ders materyalleri görsel, videolar ile de ders ortamları çeşitlendirilebilir.

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PERCEPTUAL INTERFACES FROM THE PERSPECTIVE OF HUMAN-COMPUTER INTERACTION AND ITS USE IN EDUCATION

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The human-computer interaction is a hot topic because of the considerable increase in the production and use of information and communication technologies. In this interaction context, new generation interaction styles have emerged by the constant advancements in the technology. One of these interaction styles is perceptual interfaces that contain different kinds of high level natural interaction. This interaction is based on natural human-human interaction style like gestures, touching and speaking.

The purpose of this research is that to examine perceptual interfaces in the perspective of human-computer interaction and infer some results about how to use them in education and offer suggestions about it. In this study, interaction design of the perceptual interfaces was discussed according to the reviewed literature. Also motion-based technologies, used in these interfaces, were presented and use of these technologies in the field of educational technologies was examined. It is considered that the results of the study can provide guidance to researchers and practitioners.

There are many types of perceptual user interface interaction. Today, the most popular application area of the motion-based technology is Kinect technology. This technology includes a variety of perceptual interaction such as; image viewing, skeletal detection and monitoring system. Kinect technology is one of the most popular devices in the field of image processing technology that can detect movements and send these to computers.

Kinect technology was developed by Microsoft to play digital games with Xbox console and it has been used in other areas as time goes by. Although this technology originally developed for digital games, it has often begun to be used in scientific researches by the capability of catching depth of an image. By considering that perceptual interfaces can provide natural interaction to individuals like in their social life, users can exhibit their skills without extreme cognitive load and they can learn easier via perceptual interfaces. In this context, it is envisaged that perceptual interfaces can support learning by providing ease of use and control.

Key Words: Natural User Interfaces, Perceptual Interfaces, Motion Based Technologies, Kinect Technologies, Educational Technologies

İNSAN-BİLGİSAYAR ETKİLEŞİMİ PERSPEKTİFİNDE ALGISAL ARAYÜZLER VE EĞİTİMDE KULLANIMI

ÖZET: Bilgi ve iletişim teknolojilerinin üretiminin ve kullanımının hızla artması ile birlikte insan-bilgisayar etkileşimi konusu sıkça gündeme gelmektedir. Bu etkileşim kapsamında sürekli yenilenen teknolojilerle birlikte birçok yeni nesil etkileşim stili de ortaya çıkmıştır. Bu etkileşim stillerinden birisi; araştırmanın odak noktasını da oluşturan, yüksek oranda etkileşim ve çeşitlilik arz eden, insanla insan arasındaki doğal olan etkileşimler (örn; görme, işitme, dokunma, konuşma vb.) temel alınarak modellenen algısal kullanıcı arayüzleridir.
Bu araştırmanın amacı, insan-bilgisayar etkileşimi perspektifinde algısal arayüzleri incelemek ve bu arayüzlerin eğitimde kullanımına ilişkin sonuçlar çıkararak bu konuda öneriler sunmaktır. Çalışmada literatür taraması yapılarak algısal arayüzlerin etkileşim tasarımı boyutuna ilişkin analizlere yer verilmiştir. Ayrıca ilgili literatürden yola çıkarak, bu arayüzlerde kullanılan hareket tabanlı teknolojilere örnekler verilmiş ve bu teknolojilerin eğitim teknolojileri alanındaki kullanımları irdelenmiştir. Yapılan analiz ve sentezlerin sonucunda çıkarılan anlamların araştırmacılara ve uygulayıcılara yol gösterici olacağı düşünülmektedir.
Birçok algısal arayüz etkileşim çeşidi bulunmaktadır. Günümüzde en popüler uygulama alanı ise hareket tabanlı teknolojilerden Kinect teknolojisidir. Bu teknoloji; görüntü izleme, iskelet algılama ve izleme sistemi gibi algısal etkileşim çeşitlerini içermektedir. Kinect Teknolojisi; insan hareketlerini algılayıp bu hareketleri bilgisayarlara gönderebilen, görüntü teknolojisi alanındaki en popüler cihazlardandır.

Kinect teknolojisi Microsoft tarafından Xbox oyun konsolu ile oyun oynamak için geliştirilmiş ve zamanla diğer alanlarda da kullanılmaya başlanmıştır. Algısal bir etkileşim çeşidi içeren bu teknoloji başlangıçta oyun amacıyla üretilmiş olsa da derinlik görüntüsü alınabildiği için bilimsel çalışmalarda da sıklıkla kullanılmaya başlanmıştır.

Algısal arayüzlerin bireylere sosyal hayatlarındaki gibi doğal etkileşim sunduğu düşünüldüğünde, algısal arayüzler sayesinde kullanıcıların becerilerini aşırı bilişsel yüke maruz kalmadan sergileyecekleri ve daha kolay öğrenebilecekleri düşünülmektedir. Bu bağlamda, algısal arayüz kullanımının bireylere kullanım ve kontrol kolaylığı sağlayıp öğrenmeyi destekleyeceği ön görülmektedir.

Anahtar Kelimeler: Doğal Kullanıcı Arayüzleri, Algısal Arayüzler, Hareket Tabanlı Teknolojiler, Kinect Teknolojisi, Eğitimde Teknoloji Kullanımı.

GİRİŞ

Günlük hayatta, farklı birçok ürünü çeşitli amaçlar için kullanmaktayız. Bu ürünlerle birlikte var olan her şey birbiri ile bir etkileşim içerisindedir (Dix, Finlay, Abowd ve Beale, 2004). Bu sebeple, bir ürünün tasarımının kullanılabilir olması isteniyorsa o ürünün insanlarla olan etkileşimi mutlaka hesaba katılmalıdır (Olson ve Olson, 2003). Etkileşim; bir durumdan etkilenme ya da karşılıklı olarak birbirini etkileme olarak tanımlanmaktadır (Dix, Finlay, Abowd ve Beale, 2004). Bilgi ve iletişim teknolojilerinin üretimindeki ve kullanımındaki hızlı artışın sonucu olarak insanlarla teknolojik ürünler arasındaki etkileşim sayısı ve çeşidi de artmaktadır. Ortaya çıkan bu yeni durumda, insan-bilgisayar etkileşimi kavramı daha çok bilimsel araştırmaya konu olmaya başlamıştır. Çağıltay (2005), insan-bilgisayar etkileşimini etkileşimli teknolojilerin tasarımı, değerlendirmesi ve uygulaması ile ilgilenen disiplinler arası bir çalışma alanı olarak tanımlamaktadır. Bu tanım çerçevesinde etkileşimli teknolojilerin kullanıldığı alanlardan birisi eğitimdir. Stephanidis, Kouroumalis ve Antona (2012), etkileşimin "yeni medya" ve "eğitim teknolojilerinin" ilişkisi bağlamında ele alınması gerektiğini savunmaktadır. Eğitim teknolojilerinde yeni medya kullanımının öğrenme ortamlarına katkı yapması için; bu teknolojilerin, kullanıcıların (öğrenenlerin) ihtiyaçlarını en kolay şekilde karşılayabilecekleri şekilde tasarlanması (Norman ve Draper, 1986) gerekmektedir.

Eğitim teknolojilerinde kullanılacak yeni medyanın tasarlanmasında insan-bilgisayar etkileşimi alanında gelişen teknolojilerle birlikte ortaya çıkan yeni nesil etkileşim stilleri önemli rol oynamaktadır. Bu araştırmanın odak noktasını ise yeni nesil etkileşim stillerinden biri olan algısal arayüzlerin eğitim teknolojileri alanında kullanılması oluşturmaktadır.

Algısal Arayüzler

Algısal arayüzler kullanıcı ile birden fazla kanal yolu ile etkileşim kurulmasına olanak tanıyan yapılardır. Geleneksel arayüzlerde kullanıcı sadece yazarak ya da fare yardımı ile etkileşime geçerken algısal arayüzlerde bunlara ek olarak konuşma, dokunma, mimik gibi etkileşimler de devreye girmektedir. Yüksek oranda etkileşimli ve çeşitlilik arz eden algısal kullanıcı arayüzleri insanla insan arasındaki doğal olan etkileşimler (örn; görme, işitme, dokunma, konuşma vb.) baz alınarak modellenmiştir (Turk, 2000).

Algısal Arayüzlerin Kullanım Alanları

Algısal arayüzlerin kullanım alanları ile ilgili literatür incelendiğinde, bu etkileşim stilinin pek çok alanda kullanıldığı görülmektedir. Geng vd. (2003) gerçekleştirdiği araştırmada algısal arayüzlerin insanlara fiziksel olarak bulunamadıkları bir alışveriş merkezinden sanal olarak alışveriş yapabilme imkanı sunduğunu göstermektedir. Bu çalışmada, insanların 3 boyutlu navigasyonlar ve vücut hareketleri ile kontrol edebilecekleri koşu bandı benzeri bir aygıt kullanarak nasıl sanal alışveriş yapabilecekleri incelenmiştir.

Öğrenci motivasyonu öğrenme sürecinin en önemli etkenlerindendir. Geleneksel yöntemlerde öğrenci motivasyonu yapılan anketlerle ölçülmektedir, ancak oyun temelli öğrenmede oyun oynayan kişinin konsantrasyonu olumsuz etkilendiği için bu tarz ölçümler pek uygun değildir. Ghergulescu ve Muntean (2014) tarafından yapılan çalışma, oyuncuyu rahatsız etmeden EEG yardımıyla algılayıcı temelli bir ölçüm yöntemi ile öğrencinin motivasyonunu ölçmeyi hedeflemektedir. Yaşları 18-55 arasında değişen 48 kişi ile yürütülen bu çalışma birebir uygulanmış ve 45 dakika sürmüştür. Sonuç olarak, kullanıcıların motivasyonunu ölçmede anket uygulamasının yetersiz olduğu bunun yerine algılayıcı temelli bir ölçüm yönteminin motivasyonu daha iyi ölçümlediği ortaya çıkmıştır (Ghergulescu ve Muntean, 2014).

Okuma, karışık bilişsel süreçleri içerdiği için öğrencilerin gelişimlerini gözlemleyerek tespit etmek zordur. E-kitaplar öğrencilerin okuma zorluklarını ve zayıflıklarını anlamak için bir yol olarak gösterilmektedir. Dokunmatik arayüzler ve e-kitaplar yardımı ile öğrencilerin okuma davranışlarının gözlemlenmesi hedeflenmektedir. Bunun için yapılan bir araştırmada 3 aşama takip edilmiştir: 1) Gerçek sınıf koşullarının analiz edilmesi, 2) Sistemin tasarlanması ve uygulanması, 3) Sistemin kullanılabilirliğinin ve fonksiyonelliğinin değerlendirilmesi. 15 kişi ile gerçekleştirilen bu çalışmada dokunmatik ekran ve web kamerası yardımı ile bir algoritmaya dayalı olarak öğrencinin okuma süreci kayıt altına alınmıştır. Sonuç olarak, bu kayıt yardımı ile gözlemlenerek tespit edilmesi zor olan okuma süreci daha kolay tespit edilmiştir (Huang, Hsu, Su ve Liu, 2014).

Yüz mimiklerinden bilişsel yük ölçmeyi hedefleyen bir başka çalışmada ise 20 kişinin zihinsel matematiksel işlemleri gerçekleştirirkenki durumları bilgisayarın başına yerleştirilen bir kamera ve katılımcılara takılan bazı aygıtlar sayesinde (ECG, SC, BIOPAC MP1502ve RESP) ölçülmüştür. Sonuçlar, bilişsel yük ölçülürken yüz modellemeden faydalanmanın bilişsel yüke sebebiyet veren unsurları tespit etmekte oldukça başarılı olduğunu göstermektedir (Hussain, Calvo ve Chen, 2014).

İlgili araştırmalarda da bahsedildiği gibi birçok algısal arayüz etkileşim çeşidi bulunmaktadır. Günümüzde en popüler uygulama alanı ise Kinect teknolojisidir. Bu teknoloji görüntü izleme, iskelet algılama ve izleme sistemi gibi algısal etkileşim çeşitlerini içermektedir.

Kinect Teknolojisi

İnsan hareketlerini algılayıp bu hareketleri bilgisayarlara gönderebilen ve görüntü teknolojisi alanındaki en popüler cihazlardan olan Kinect, Microsoft tarafından Xbox oyun konsolu ile oyun oynamak için geliştirilmiş ve kullanımı zamanla diğer alanlarda yaygınlaşmıştır. Algısal bir etkileşim çeşidi içeren bu teknoloji başlangıçta oyun amacıyla üretilmiş olsa da derinlik görüntüsü alınabildiği için bilimsel çalışmalarda da sıklıkla kullanılmaya başlanmıştır.

Üzerinde mikrofon, hareket sağlayıcı bir motor mekanizması ve 3 göz bulunan Kinect'in soldaki gözü lazer projeksiyonu yaparken, sağdaki kızılötesi sensör bu ışınların gidiş – geliş süresini hesaplayarak her bir noktanın mesafesini bildirmektedir. Bu veriler ışığında Kinect'in içerisinde yer alan yazılım, iskelet yapısını hesaplayıp veriyi XBox'a ya da bilgisayara göndermektedir (Colvin, Babcock, Forrest, Stuart, Tonnemacher ve Wang, 2011). Kinect'in ortasında bulunan göz ise 640 x 480 çözünürlüğünde 30 FPS (Frame Per Second) bir VGA (Video Graphics Array) kameradır. Yakalanan görüntü, saniyede 30 kez resim olarak uygulamaya iletilmektedir (Stowers ve Hayes, 2011). Ayrıca, Kinect, sensörlerini kullanarak topladığı verileri ses, görüntü ve derinlik olarak doğal kullanıcı ara yüzü kütüphanesine iletip burada yorumlayarak uygulamalara iletmektedir (Çolak, Yüksel, Sunguray ve Gümüş, 2013).

Kinect teknolojisinin diğer bir özelliği ise iskelet algılama ve izleme sistemidir. Kinect'e hareket algılama komutu verilmesi ile beraber kızılötesi kamera, ortama kızılötesi ışın yaymakta ve bu sayede insan vücudunda bulunan 20 farklı hareket noktası algılanıp izlenebilmektedir (Sidik, Sunar, İsmail ve Mokhtar, 2011; Ikemura, Fujiyoshi, 2011). Gerçekleştirilen hareket, Kinect'in ROM'unda kayıtlı olan bir hareket ise sistem tarafından bilgisayara uyarı kodu gönderilmektedir. Eğer gerçekleştirilen hareket tanımlı hareketler arasında yok ise Kinect, sistemi beklemeye almaktadır (Tong, Zhou, Pan, ve Yan, 2012).

Kinect Teknolojisinin Kullanım Alanları

Microsoft'un el ve kol hareketleriyle kontrol imkanı sunan konsolu Kinect teknolojisi ve farenin kullanılabilirliğini ölçmek için gerçekleştirilen bir çalışmada; bilginin görselleştirildiği bir yazılım olan MetricSPlat'dan faydalanılarak 10 kişiye fare, 10 kişiye hareket tabanlı etkileşim imkanı sunan Kinect teknolojisi kullandırtılmıştır. Kullanılabilirlik testi ile yapılan ölçümlerde Kinect teknolojisinin daha etkili olduğu (doğal etkileşim sağladığı) sonucuna varılmıştır (Libardi, Traina ve Rodrigues, 2014).

Chang, Chen ve Huang (2011), Kinect teknolojisi kullanılarak oluşturulan öğrenme ortamlarının öğrencilere günlük yaşam becerilerini kazanma ve gerçek yaşama transfer etme konusunda yardımcı olduğunu belirtmişlerdir. Tenekeci ve Gümüşçü (2016), Türkçe'de kullanılan latin harflerinin ilk okuma yazma eğitiminde kullanımına yönelik geliştirilen uygulama ile iki aşamalı bir çalışma gerçekleştirmiştir. Uygulamanın ilk aşamasında, harfleri tanıtmak için bir ekran hazırlanmıştır. Uygulamayı kullanan kişiye ait iskelet bilgileri programla yorumlanarak istediği harfin üzerine gelip yeteri kadar beklerse o harfin adının kullanıcıya sesli olarak aktarılması sağlanmaktadır. Çocuk hangi harfin ismini tekrar dinlemek istiyorsa, o harfin üzerine gelip belirtilen ikonda belirli bir süre beklemesi gerekmektedir. İkinci aşamada ise, harfleri öğrenen çocuğun kendini test edebileceği bir ekran geliştirilmiştir. Bu ekranda, kullanıcıya harflerin isimleri rastgele dinletilmekte ve öğrenciden dinlediği harfin ikonu üzerine gelerek belirli süre durması istenmektedir. Öğrenci doğru cevap vermiş ise tebrik ederek yeni harf sorulmakta, yanlış harf seçmişse yanlış olduğu belirtilerek tekrar denemesi istenmektedir. Sonraki aşamada Kinect'ten elde edilen iskelet verisi yorumlanarak ellerden birisinin herhangi bir harf üzerinde belirli bir süre bekleyip beklememe işlemine bağlı uygulama kodlanmaktadır.

Microsoft Visual Studio platformunda geliştirilen eğitim uygulaması ve Kinect teknolojisi kullanılarak, kullanıcının tüm uygulamaları temassız bir şekilde yürütüp kullanabileceği; hesap makinesi, müzik orkestrası yerleşimi, insan vücudundaki organların yerleştirilmesi ve Powerpoint sunumunun yönetilmesi gibi uygulamalar geliştirilmiştir. Sunum işlemlerinde sununun açılması için ses özellikleri de eklenerek bir sununun ses ile otomatik bir şekilde çalışması ve yönetilmesi sağlanırken aynı işlemlerin yine temassız bir şekilde kontrolü de sağlanmıştır. Bu eğitim uygulamasında kullanıcıların daha çok yaparak öğrenmesi hedeflendiğinden kullanımı oldukça basit tutulmaya çalışılan Kinect Yazılım Geliştirme Kitinden (SDK) faydalanılmıştır (Çolak, Yüksel, Sunguray ve Gümüş, 2013).

SONUÇ VE TARTIŞMA

Algısal arayüzlerin bireylere sosyal hayatlarındaki gibi doğal etkileşim sunduğu göz önüne alındığında, algısal arayüzler sayesinde kullanıcıların becerilerini aşırı bilişsel yüke maruz kalmadan sergileyecekleri ve daha kolay öğrenebilecekleri düşünülmektedir (Turk ve Robertson, 2000). Bu bağlamda, algısal arayüz kullanımının bireylere kullanım ve kontrol kolaylığı sağlayıp öğrenmeyi destekleyeceği ön görülmektedir. Algısal arayüzlerin kullanımının ve kontrolünün kolaylığını sağlamak için de insanların ürünle olan etkileşimi mutlaka hesaba katılmalıdır (Olson ve Olson, 2003) ve algısal deneyimlerinin nasıl çalıştığına, makinelerin insan algısını nasıl değiştirebileceğine ve iyileştirebileceğine dikkat edilmelidir (Reeves ve Nass, 2000).

İlgili araştırmaların sonuçlarına bakıldığında, kullanıcının sistemle birebir etkileşim kurmasını sağlayan teknolojilerin öğrenme üzerinde daha etkili olduğu söylenebilir (Preece, Rogers ve Sharp, 2002). Kullanıcı ile etkileşimi ne kadar arttırırsak teknolojinin o ölçüde kullanıcıya fayda sağlayacağı da çıkarılabilecek diğer sonuçlardandır (Preece, Rogers ve Sharp, 2002). Öte yandan tasarlanan bir sistemin kullanılabilirliği ölçülürken çoktan seçmeli anketlerin her zaman yeterli olamayacağı, özellikle etkileşim ölçülmek istendiğinde kullanıcının etkileşim sürecini bölmeden yapılacak algısal ölçümlerin daha faydalı olduğu belirtilmektedir (Ghergulescu ve Muntean, 2014).

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PRE-SERVICE SCIENCE TEACHERS' VIEWS TOWARDS SOCIOSCIENTIFIC ISSUES

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ABSTRACT: The aim of this study is to uncover pre-service science teachers' views about socioscientific issues. The sample of the study consisted of 152 pre-service science teachers. An open ended questionnaire and interviews are used to gather data. Open ended questionnaire applied to 152 pre-service teachers while interviews are conducted with 7 pre-service science teachers on a voluntary basis. Open ended questionnaire consist of 3 questions. Interviews were recorded with recording devices. Interviews done with each of the pre-service science teachers took about 8-12 minutes. Data obtained from questionnaire and interviews were analyzed descriptively. In the analysis of survey data tables have been created within the framework of the common perceptions of pre-service science teachers. Frequency and percentiles are utilized in the creation of the tables. At the end of the study it has seen that most of the pre-service science teachers expressed socioscientific issues as nuclear energy, global warming and cloning.

Key words: socioscientific issues, pre-service science teachers.

FEN BİLGİSİ ÖĞRETMEN ADAYLARININ SOSYOBİLİMSEL KONULARA YÖNELİK GÖRÜŞLERİ

ÖZET: Bu çalışmanın amacı fen bilgisi öğretmen adaylarının sosyobilimsel konular hakkındaki düşüncelerini ortaya çıkarmaktır. Çalışmanın örneklemini 152 fen bilgisi öğretmen adayı oluşturmaktadır. Çalışmada veri toplama aracı olarak açık uçlu anket ve mülakatlardan yararlanılmıştır. Açık uçlu anket 152 öğretmen adayına uygulanırken, mülakatlar gönüllülük esasına göre seçilen 7 öğretmen adayı ile yürütülmüştür. Açık uçlu anket 3 sorudan oluşmaktadır. Mülakatlar ses kayıt cihazı ile kayıt edilmiştir. Her bir öğretmen adayıyla yapılan mülakatlar yaklaşık 8-12 dakika sürmüştür. Anket ve mülakatlardan elde edilen nitel bulgular betimsel analize tabi tutulmuştur. Anket verilerinin analizinde öğretmen adaylarının ortak görüşleri çerçevesinde tablolar oluşturulmuştur. Bu tabloların oluşturulmasında frekans ve yüzdelik dilimlerden yararlanılmıştır. Çalışma sonucunda öğretmen adaylarının sosyobilimsel konu olarak çoğunlukla nükleer enerji, küresel ısınma ve klonlamayı ifade ettikleri sonucuna varılmıştır.

Anahtar sözcükler: sosyobilimsel konu, fen bilgisi öğretmen adayları.

GİRİŞ

Bilim ve teknolojideki gelişmelere paralel olarak bilim, teknoloji ve toplum etkileşimi ile ortaya çıkan sosyal sorunlar tartışılmaya başlanmıştır. Bu konulardan klonlama (Sadler & Zeidler, 2004; Sürmeli & Şahin, 2010), genetiği değiştirilmiş organizmalar (Walker & Zeidler, 2007), küresel ısınma (Kılınç, Boyes & Stanisstreet, 2011), nükleer enerji (Kılınç, Boyes & Stanisstreet,2012; Topçu, Yılmaz-Tüzün & Sadler, 2011; Topçu, Sadler & Yılmaz- Tüzün, 2010) gibi konular ülkelerin ortak konuştukları sosyal ve tartışmalı konular haline gelmiştir (Kolsto, 2001). Bu konular hem sosyal hem de bilimsel faktörlerde merkezi role sahip oldukları için sosyobilimsel konu olarak adlandırılmıştır. Sosyobilimsel konular öğrencilerin bilimsel konular ile ilgili diyalog, tartışma ve düşünmelerini gerektirmektedir. Bu konular doğada tartışmalı ama ahlaki bir rolü gerektiren, karar verme sürecinde etik değerlerin de rol oynadığı durumlardan oluşmaktadır (Zeidler & Nichols, 2009).

1980'lerden beri fen- teknoloji ve toplum arasındaki bağ konusunda öğrencilere eğitim verilmektedir. Nitekim ülkemizde de 2004 yılında kabul edilen fen ve teknoloji öğretim programında da bu üç unsura ek olarak çevre alanı eklenmiş ve fen-teknoloji-toplum-çevre (FTTÇ) olarak bir öğrenme alanı oluşturulmuştur (Yetişir & Kaptan, 2008). Bu programda FTTÇ yaklaşımı bir bütün olarak yer bulurken 2013 yılında uygulanmaya başlayan fen bilimleri öğretim programında ise 6 alt alana ayrılmış ve sosyobilimsel konular da doğrudan programda bir alt alan olarak yer almıştır. Zeidler vd. (2005)'in çalışmasında sosyobilimsel konuların eğitimde kullanılmasının bilimin doğasına argümantasyon, değerler, ahlaki yargıları entegre etmede fen-teknoloji-toplum hareketinden daha iyi bir yol olduğunu göstermiştir (Simonneaux, 2010). Eğitimi, toplumu, ahlaki ve etik değerleri bir araya getiren ve bu değerler arasında bağ kurmayı sağlayan sosyobilimsel konular ile ilgili yurt içinde ve yurt dışında birçok çalışma yürütülmüştür (Choi, Cho & Kim, 2000; Zengin, Keçeci, Kırılmazkaya & Şener, 2011; Topçu, Muğaloğlu & Güven, 2014).

Fen eğitiminde Türkiye'de sosyobilimsel konular ile ilgili yapılan araştırmalar incelendiğinde genellikle fen öğretmen adaylarının sosyobilimsel konu örnekleri ve bu örnekler ile ilgili bilgi düzeylerinin, öğretim öz yeterliklerinin ve informal muhakeme yeteneklerinin incelendiği çalışmaların yürütüldüğü görülmüştür (Topçu, Muğaloğlu & Güven, 2014). Cebesoy & Dönmez Şahin (2013) yaptıkları çalışmada fen bilgisi öğretmen adaylarının sosyobilimsel konulara yönelik tutumlarının, cinsiyet ve sınıf düzeyi değişkenleri açısından incelemiş ve cinsiyet ve sınıf düzeyinin öğretmen adaylarının sosyobilimsel konulara yönelik tutumlarını etkilemediğini belirlemişlerdir. Zengin, Keçeci, Kırılmazkaya & Şener (2011) ilköğretim 7. sınıf öğrencilerinin bir sosyobilimsel konu olan nükleer enerji kullanımı, nükleer santrallerin riskleri ve faydaları hakkındaki farkındalıklarını ölçmek, arttırmak ve çevreye duyarlılıklarını geliştirmek amacıyla yürüttükleri çalışmanın sonucunda fen ve teknoloji derslerinde öğrencilerin bilinçlendirilmesi için sosyobilimsel konulara daha fazla yer verilmesi gerektiğini belirtikleri görülmektedir. Öğrencilerin sosyobilimsel konulara dikkatini çekmenin onların fene yönelik tutum ve fen ve teknoloji ile ilişkili kişisel ve sosyal problemlerle başa çıkma kabiliyetlerini de artırdığını göstermektedir (Choi, Cho & Kim, 2000).

Gençlerin alternatif çözümlerin riskleri ve kazanımları, elde edilen kanıtları sorgulama ve bu sorgulamalardan sonra sonuçlara ulaşarak doğru düşünceye ulaşma becerisini kazanmaları gerekmektedir (Dawson & Venville, 2010). Bu durumda onları en iyi şekilde yönlendirecek ve doğru bilgiyi sağlayacak kişiler eğitim kurumlarındaki öğretmenler olmaktadır. Öğretmenlerin de sınıflarında sosyobilimsel konular ile ilgili tartışma yürütebilmeleri ve öğrencileri yönlendirebilmeleri için konu ile ilgili güçlü bir altyapıya sahip olmaları gerekmektedir (Knippels, Severiens & Klop, 2008). Bu noktada öğretmen adaylarının eğitim fakültelerinde sosyobilimsel konularla ilgili bilgilendirilmeleri ve bu konular ile ilgili eksiklerinin giderilmesi gerekmektedir. Bu çalışmanın amacı öğretmen adaylarının sosyobilimsel konular ile ilgili düşüncelerini belirlemektir.

YÖNTEM

Yapılan çalışma nitel bir araştırma olup mevcut durumu betimlemek amacı ile yürütülmüştür. Bu çalışmada veri toplamak amacıyla açık uçlu anket ve yarı yapılandırılmış mülakatlardan yararlanılmıştır. Araştırmanın örneklemini fen bilgisi öğretmenliği programında öğrenim gören 152 (45 erkek, 107 kız) öğretmen adayı oluşturmaktadır. Çalışmaya katılan öğretmen adayları araştırma etiği çerçevesinde Ö1, Ö2, Ö3, Ö4, Ö5,……., Ö152 şeklinde kodlanmıştır.

Açık Uçlu Anket

Üç sorudan oluşan açık uçlu anket, 152 öğretmen adayına uygulanmıştır. Açık uçlu anketin geçerliliğini sağlamak amacıyla iki alan eğitimi (fen eğitimi ve biyoloji eğitimi) uzmanın görüşüne başvurulmuştur. Açık uçlu anket fen bilgisi öğretmenliğinde öğrenim gören 8 öğretmen adayına uygulanarak anketin anlaşılabilirliği belirlenmeye çalışılmıştır. Açık uçlu ankette öğretmen adaylarına aşağıda belirtilen 3 soru yöneltilmiştir.
1. Sosyobilimsel konu kavramını nasıl tanımlarsınız? Açıklayınız.
2. Sizce hangi konular sosyobilimsel konu kapsamına girer? Belirtiniz.
3. Sizce sosyobilimsel konuların özellikleri nelerdir? Açıklayınız.

Mülakat

Çalışma kapsamında yarı yapılandırılmış mülakatlardan yararlanılmıştır. Mülakatlar 7 öğretmen adayı (Ö9, Ö28, Ö45, Ö68, Ö71, Ö133, Ö141) ile yürütülmüştür. Yarı yapılandırılmış mülakatlarla açık uçlu anket sorularının desteklenmesi amaçlanmıştır. Öğretmen adayları ile yürütülen mülakatlarda gönüllülük esas alınmıştır. Mülakatlar bireysel mülakatlar şeklinde gerçekleştirilmiştir. Araştırma sürecinde veri kaybını önlemek açısından mülakatlar ses kayıt cihazı ile kaydedilmiş olup, her bir mülakat yaklaşık 8–12 dakika sürmüştür. Mülakat sorularının anlaşılabilirliğini belirlemek için 2 öğretmen adayı ile mülakatlar yürütülmüştür. Geçerlik çalışmaları kapsamında mülakat sorularının ilk hali fen eğitimi uzmanına inceletilmiştir.

Veri Analizi

Anket ve mülakatlardan elde edilen nitel bulgular betimsel analize tabi tutulmuştur. Anket verilerinin analizinde öğretmen adaylarının ortak görüşleri çerçevesinde tablolar oluşturulmuştur. Bu tabloların oluşturulmasında frekans ve yüzdelik dilimlerden yararlanılmıştır. Mülakat verilerinin analizi ise öğretmen adaylarının görüşleri önemlilik ve anlamlılık düzeyi dikkate alınarak analiz edilmiş ve bazı ifadeler tırnak işareti içinde aynen verilerek düzenlenmiştir.

BULGULAR

Elde edilen bulguların analizinde öncelikle anket sorusu yazılıp ardından öğretmen adaylarının ortak görüşlerinden yararlanılarak tablolar oluşturulmuştur.
"Sosyobilimsel konu kavramını nasıl tanımlarsınız? Açıklayınız." sorusuna öğretmen adaylarının verdikleri cevaplar analiz edilerek Tablo 1 oluşturulmuştur.

Tablo 1. Öğretmen Adaylarının Sosyobilimsel Konu Kavramına İlişkin Düşünceleri

Sosyobilimsel konu;	f	%
Toplumu ilgilendiren konulardır.	94	61.8
Bilimsel konulardır.	47	30.9
Fen konuları ile ilgilidir.	24	15.7
Evrenseldir.	23	15.1
Tartışmaya açık konulardır.	23	15.1
Belli bir grup insanı ilgilendiren konulardır.	4	2.6
İlgisiz cevap/ cevapsız	21	13.8

Tablo 1 incelendiğinde öğretmen adaylarının % 61,8' inin sosyobilimsel konu kavramını "Toplumu ilgilendiren konu" şeklinde tanımladıkları görülmektedir.

Sosyobilimsel konu kavramıyla ilgili yapılan mülakatlardan elde edilen bulgular aşağıda sunulmuştur. Mülakat yapılan öğretmen adaylarından 4'ünün sosyobilimsel konu kavramını toplumu ilgilendiren, 2'si toplumu ilgilendiren bilimsel konular ve 1'si ise toplumu ilgilendiren tartışmaya açık konular şeklinde açıkladıkları görülmüştür. Öğretmen adayı ifadelerine örnekler aşağıda sunulmuştur.

> "*Sosyobilimsel konu toplumun genelini ilgilendiren, toplumun geneli tarafından önemsenen ya da dikkat edilen konulardır.* " (Ö71)
> "*Sosyobilimsel konular bilimsel konulardır. Tüm toplumu ilgilendirirler. Sadece birkaç kişi ile ilgili değildirler. Bu tür konuların bilimsel bir alt yapısının olması gerekir. Kısacası tüm toplumu ilgilendiren, bilimsel konuları biz sosyobilimsel konu olarak tanımlayabiliriz.*" (Ö45)
> "*Bir konu sosyobilimsel olabilmesi için tartışmaya açık olması gerekir. Sosyobilimsel konu hakkında doğru veya yanlış demek olmaz. Çünkü bu konular tartışmalı konulardır. Tüm toplumla alakalıdırlar.*" (Ö141)

"Sizce hangi konular sosyobilimsel konu kapsamına girer? Belirtiniz." sorusuna öğretmen adaylarının verdikleri cevaplar analiz edilerek Tablo 2 oluşturulmuştur.

Tablo 2. Öğretmen Adaylarına Göre Sosyobilimsel Konular

Konular	f	%
Nükleer enerji	59	38.8
Küresel ısınma	24	15.7
Klonlama	21	13.8
Genetiği Değiştirilmiş Organizma (GDO)	16	10.5
İklim değişikliği	12	7.8
Genetik	10	6.5
Hidroelektrik santral (HES)	16	10.5
Kök hücre	17	11.1
Kürtaj	10	6.5
Aşı	8	5.2
İlgisiz cevap/ cevapsız	32	21.0

Tablo 2 incelendiğinde öğretmen adaylarının % 38,8'i sosyobilimsel konu olarak "nükleer enerji" ve % 15,7'si "küresel ısınma" konularını ifade etmişlerdir.

Hangi konuların sosyobilimsel konu kapsamına gireceğine yönelik yürütülen mülakat sorusundan elde edilen bulgular aşağıda sunulmuştur. Mülakat yapılan öğretmen adaylarından 3'ü nükleer enerjinin, 3'ü nükleer enerji ve küresel ısınmanın, 1'i ise hidroelektrik santral ve klonlamanın sosyobilimsel konu kapsamına girdiğini ifade etmiştir.

> "*Sosyobilimsel konu kapsamına tartışmalı konular girer. Bu nedenle nükleer enerjinin sosyobilimsel konu kapsamına girdiğini düşünüyorum. Birçok insan bu konuda tartışıyor. Kimine göre bu santraller kurulmalı, kimine göre ise kurulmamalıdır*. " (Ö9)
> "*Sosyobilimsel konular tüm toplumu ilgilendiren konular olduğuna göre nükleer enerji ve küresel ısınma sosyobilimsel konudur bence. Çünkü küresel ısınma tüm dünyanın sorunudur. Aynı şekilde nükleer enerji. Bu iki konuda tüm toplumla alakalıdır.* " (Ö45)
> "*Sosyobilimsel konu olarak hidroelektrik santral ve klonlamadan bahsedebilirim. Bu konular sosyobilimsel konulardır. Bu konuların bilimsel yönleri var. Tüm insanlığa açık ve evrensel boyutları da var.* " (Ö133)

"Sizce sosyobilimsel konuların özellikleri nelerdir? Açıklayınız." sorusuna öğretmen adaylarının verdikleri cevaplar analiz edilerek Tablo 3 oluşturulmuştur.

Tablo 3. Öğretmen Adaylarına Göre Sosyobilimsel Konuların Özellikleri

Sosyobilimsel konu özellikleri;	f	%
Toplumla ilgili	98	64.4
Nesnel	53	34.8
Tartışmaya açık	31	20.3
Güncel	30	19.7
Bilimsel	28	18.4
Evrensel	15	9.8
Disiplinler arası	10	6.5
Öznel	6	3.9
İlgisiz cevap/ cevapsız	30	19.7

Tablo 3 incelendiğinde öğretmen adayları sosyobilimsel konuların özelliklerini "toplumla ilgili" (% 64.4), "nesnel" (% 34,8) ve "tartışmaya açık" (%20,3) şeklinde ifade ettikleri görülmektedir.

Sosyobilimsel konuların özelliklerinin neler olacağına yönelik yürütülen mülakat sorusundan elde edilen bulgular aşağıda sunulmuştur. Mülakat yapılan öğretmen adaylarından 2'si sosyobilimsel konuların özelliklerini toplumla ilgili, 2'si toplumla ilgili, tartışmaya açık, 2'si toplumla ilgili, nesnel ve 1'i ise güncel konular olarak ifade etmişlerdir.

> "*Sosyobilimsel konular toplumla alakalıdır. Toplumlar içerisinde üretilirler.* " (Ö133)
> "*Bir konunun sosyobilimsel olabilmesi için tartışılması gerekir. Tartışılabilmek sosyobilimsel konu özelliğidir. Aynı şeklide tartışılabilmenin yanında toplumla ilgili de olmalıdır. Sosyobilimsel konu toplumla ilgili ve toplumca tartışılabilmelidir* " (Ö68)
> "*Sosyobilimsel konu bana toplumu ve nesnelliği ifade ediyor. Sosyobilimsel konuların en önemli özelliklerinden biri nesnel olmasıdır. Aynı zamanla toplumla ilgili olduğunu da ifade edebilirim.* " (Ö71)
> "*Sosyobilimsel konuların güncel olması gerekir. Güncel konular sosyobilimsel konular olabilir.*" (Ö28)

SONUÇ

Açık uçlu anketin 1. sorusuna verilen cevaplar incelendiğinde (Tablo1) öğretmen adaylarının sosyobilimsel konu kavramını tanımlarken en çok "Toplumu ilgilendiren konu" ve "Bilimsel konu" ifadelerini kullandıkları görülmektedir. Öğretmen adaylarının bu şekilde tanımlamalarda bulunmaları sosyobilimsel kavramından yola çıktıklarının bir göstergesi olabilir. Öğretmen adayları sosyobilimsel kavramının anlamını bilmeden sadece kelimeden yola çıkarak tanımlama yapmış olabilirler. Fen Bilimleri Dersi Öğretim Programında "sosyobilimsel konular" "*bilim ve teknoloji ile ilgili sosyo-bilimsel problemlerin çözümüne yönelik bilimsel ve ahlaki muhakeme becerilerini kapsamaktadır*" şeklinde ifade edilmektedir (MEB, 2013). Öğretmen adaylarının yaptıkları tanımlamalar ve mülakatlar incelendiğinde sosyobilimsel konu kavramına yönelik yeterli bilgiye sahip olmadıkları sonucuna varılabilir. Bu çalışmanın sonucuna paralel olarak, Sadler (2004) çalışmasında bireylerin sosyobilimsel konularla ilgili bilgi eksikliklerinin bulunduğunu belirtmektedir. Aynı şekilde, Kortland (1996) da öğrencilerin basit bir argüman oluşturma becerilerini incelediği çalışması sonucunda öğrencilerin sosyobilimsel konularla ilgili bilgi eksikliklerinin olduğunu tespit etmiştir.

Açık uçlu anketin 2. sorusu ile öğretmen adaylarına göre sosyobilimsel konu kapsamının belirlenmesi amaçlanmıştır. Öğretmen adaylarının bu soruya verdikleri cevaplar incelendiğinde (Tablo 2) öğretmen adaylarının nükleer enerji, küresel ısınma ve klonlama konularına daha çok vurgu yaptıkları görülmüştür.

Öğretmen adaylarının bu üç kavrama vurgu yapmalarına eğitim fakültelerinde aldıkları “Bilimin Doğası ve Öğretilmesi” ve “Genetik ve Biyoteknoloji” gibi derslerin içeriğinde çoğunlukla nükleer enerji, küresel ısınma, klonlama konularının tartışılmasının sebep olarak gösterilebileceği düşünülmektedir. Öğretmen adaylarının aldıkları dersler ile birlikte bu konulardaki bilgi seviyeleri ve farkındalıkları da artmaktadır (Cebesoy & Dönmez Şahin, 2013).

Anketin 3. sorusu ile öğretmen adaylarının sosyobilimsel konuların özellikleri ile ilgili görüşlerinin belirlenmesi amaçlanmıştır. Öğretmen adaylarının bu soruya verdikleri cevaplar ve mülakat verileri incelendiğinde sosyobilimsel konuların özelliklerini "toplumla ilgili", "tartışmaya açık" ve "nesnel" şeklinde ifade ettikleri görülmektedir. Sosyobilimsel konuların toplumu ilgilendiren, tartışmaya açık ve kişilerin kendi görüşlerini belirttikleri konular olması sebebiyle öğrencilerin sosyobilimsel konuların özelliklerini de bu şekilde gruplandırdıkları görülmüştür. Yapılan çalışmalarda da öğretmen adaylarının sosyobilimsel konuların eğitimde tartışma için ortam yaratacağını ve bu durumun konuların daha iyi anlaşılmasına yardımcı olacağını düşündükleri belirlenmiştir (Lee, Abd-EI-Khalick & Choi, 2006). Ayrıca sosyobilimsel konuların kişisel veya sosyal anlamda değerler, ahlaki ve etik öğeler, fayda- zarar dengesi gibi konularda karar vermeyi gerektirmesi toplum ve bilim dünyası arasında anlaşmazlığa sebep verebildiği için toplumla ilgili ve tartışmaya açık bir konu olarak nitelendirilmektedir (Sönmez & Kılınç, 2012).

ÖNERİLER

Son zamanlarda sıklıkla gündeme gelen sosyobilimsel konular ile ilgili öğretmen adaylarının gerek derslerde gerekse sosyal hayatlarında bilgi sahibi olmaları ve bilinçlendirilmeleri gerekmektedir.

Fen bilimleri öğretim programında yer alan FTTÇ öğrenme alanının bir alt boyutu olan sosyobilimsel konuların tanımı ve içeriği öğretim programında daha detaylı olarak anlatılmalıdır.

Öğretmen adaylarının sosyobilimsel konular ile ilgili okutulan derslerde edindikleri bilgileri öğretmen olduklarında hangi yöntem ve teknikleri kullanarak öğrencilerine kazandıracakları konusunda da bilgilendirilmeleri gerekmektedir.

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CYBER SECURITY EDUCATION IN TURKEY

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ABSTRACT: Widespread use of technology have made information security and more specifically the security of critical infrastructure indispensable for countries. Thus, it is important to have well-trained cyber security experts and national software and systems that provide security for computer technologies. The importance of cyber security education becomes evident considering global and more recently local cyber attacks. Developed countries value the importance of cyber security and use different methods in educating their own security experts. With a newly developed consciousness for cyber security in Turkey, it is predicted that 20.000 experts are needed to work in this field. In Turkey, education of cyber security is generally provided by private sector. The most appropriate institutions for training qualified staff and enough experts to meet the country's needs are the universities. Although some universities in Turkey began education on cyber security in the last years, it is not sufficient. This paper examines the importance of cyber security education, Turkey's condition in cyber security education and developed countries' policies and methods for cyber security education.

Key words: cyber security, information security, education

TÜRKİYE' DE SİBER GÜVENLİK EĞİTİMİNİN DURUMU

ÖZET: Teknolojinin yaygın kullanımı, ülkeler açısından bilgi güvenliğini ve daha özelde kritik altyapı güvenliğini vazgeçilemez unsurlar haline getirmiştir. Bu bakımdan iyi yetişmiş siber güvenlik uzmanlarına sahip olmak, bilgisayar teknolojilerinin güvenliğini sağlayan yazılım ve sistemlerin milli olması önem arz etmektedir. Dünyadaki siber saldırılar ve son yıllarda ülkemizde yaşanan siber saldırılar göz önüne alındığında, siber güvenlik eğitiminin önemi ortaya çıkmaktadır. Gelişmiş ülkeler siber güvenlik konusuna gereken önemi göstermekte ve güvenlik uzmanlarının eğitiminde farklı metotlar kullanmaktadır. Ülkemizde siber güvenlik bilinci yeni oluşmaya başlamış olmakla birlikte bu alanda çalışacak 20.000 uzmana ihtiyaç duyulduğu öngörülmektedir. Türkiye'de siber güvenlik alanındaki eğitimler genelde özel firmalar tarafından verilmektedir. Nitelikli eleman ve ülke ihtiyacını karşılayacak sayıda uzman yetiştirilmesi işini yapabilecek en uygun kurum üniversitelerdir. Ülkemizde son yıllarda, bazı üniversiteler siber güvenlik konusunda eğitim vermeye başlamış olmakla birlikte, ihtiyaçları karşılama hususunda yeterli düzeye ulaşılamamıştır. Bu çalışmada siber güvenlik eğitiminin önemi, Türkiye'nin siber güvenlik eğitimindeki durumu ve gelişmiş ülkelerin siber güvenlik eğitiminde izledikleri politikalar ve yöntemler incelenmiştir.

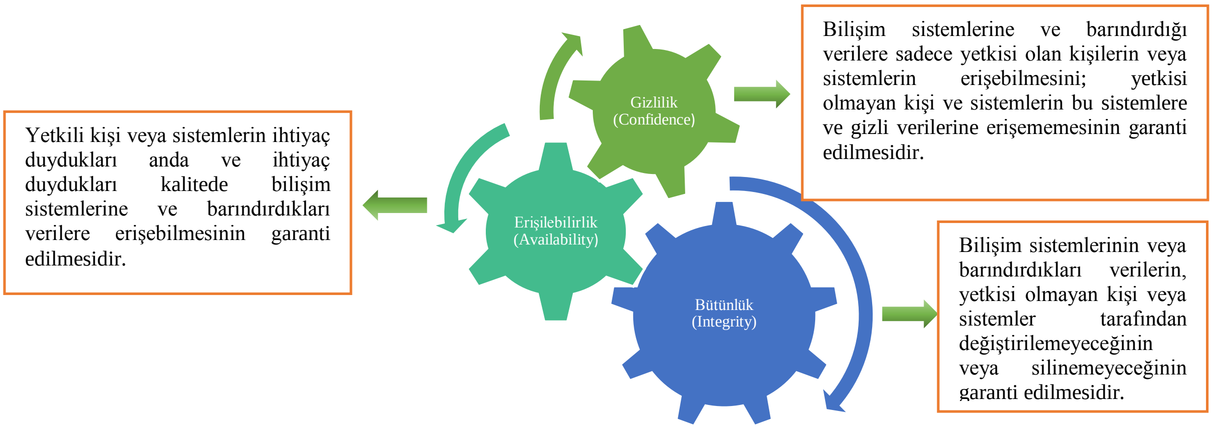
Anahtar sözcükler: siber güvenlik, bilgi güvenliği, eğitim

GİRİŞ

Teknolojinin hızlı gelişimi, dijital ortamda bilgi ve haber iletiminin dünyanın en ücra köşelerine dek yayılmasını sağlamıştır. Teknolojideki bu hızlı gelişme, sorunlarını da beraberinde getirmiştir. Teknolojinin yoğun kullanımından kaynaklanan sosyal, psikolojik vb. sorunlar bir yana, teknik olarak en önemli sorunu bilgi ve iletişim güvenliği sorunu oluşturmaktadır (Sevgi, 2001). Haberleşme ve bilişimde temel sorunlardan birisi siber güvenliktir. İnternet gibi dünyanın hemen her noktasına açık erişimin sağlandığı bir ortamda siber güvenliğin sağlanması kritik bir öneme sahiptir. Teknoloji geliştikçe bilgi çoğalmakta, bilgiye erişim, paylaşma, koruma, eleme, vb. konular önem kazanmaktadır. Bilgi teknolojilerine giderek artan bağımlılık, yönetimleri değişik güvenlik önlemleri almaya yöneltmektedir. İnternet üzerinden banka fon transferleri, bireysel bankacılık işlemleri, uçak rezervasyonları, sanal ortamda alışveriş gibi ekonomik ve toplumsal yaşamın her alanında olduğu kadar, ulusal savunma ve ulusal güvenlik konularında da güvenlik bir numaralı sorun haline gelmiştir (Bektaş, 2006).

Siber güvenlik, siber ortamda, kurum, kuruluş ve kullanıcıların varlıklarını dışardan veya içeriden gelebilecek saldırılara karşı korumak amacıyla kullanılan cihazlar, yazılımlar, araçlar, güvenlik stratejileri, güvenlik politikaları, güvenlik kavramları, kılavuzlar, risk yönetimi, eğitimler ve güvenlik için kullanılan teknolojiler bütünü olarak tanımlanmaktadır. Kurum, kuruluş ve kullanıcıların varlıkları, bilgi işlem ekipmanları, kurum veya kuruluş personelini, altyapıları, uygulamaları, hizmetleri, elektronik haberleşme sistemlerini ve siber ortamda iletilen ve/veya depolanan bilgilerin tümünü kapsamaktadır. Siber güvenlik, kurum, kuruluş ve kullanıcıların varlıklarına karşı siber ortamda bulunan güvenlik risklerine karşı koyabilecek güvenlik özelliklerinin bulundurulması, devam ettirilmesi ve yeni saldırı türlerine karşı güncellenebilmesini amaçlamaktadır (ITU, 2008; Ünver & Canbay, 2010).

Şekil 1'de görüleceği üzere siber güvenliğin; gizlilik, bütünlük ve erişilebilirlik olmak üzere temelde üç saç ayağı bulunmaktadır. Bu bakımdan siber güvenlik; siber ortamı oluşturan bilişim sistemlerinin saldırılardan korunmasını, bu ortamda işlenen bilginin gizlilik, bütünlük ve erişilebilirliğinin güvence altına alınmasını, saldırıların ve siber güvenlik olaylarının tespit edilmesini, bu tespitlere karşı tepki mekanizmalarının devreye alınmasını ve sonrasında ise sistemlerin yaşanan siber güvenlik olayı öncesi durumlarına geri döndürülmesini ifade etmektedir.



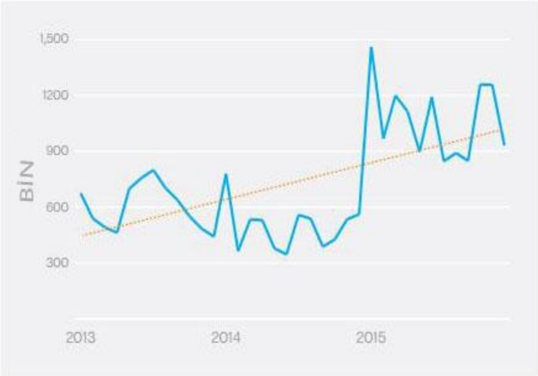
Şekil 1. Siber Güvenliğin Temel Unsurları

Siber alanın bir sınırı bulunmadığı için devletler açısından önemli bir problem teşkil etmekte olup, devletlerin zaman ve mekân sınırlaması bulunmayan, ne zaman başlayıp, ne zaman biteceği belli olmayan siber saldırılara karşı etkili önlemler ve çözümler getirmeleri gerekmektedir. Devletler açısından bakıldığında, siber güvenlik ile alakalı gelecek tehditler ve bunlara karşı alınacak tedbirlerle ilgili değişik algılama seviyeleri ve yöntemler ortaya çıkmaktadır. Siber ortamda gerçekleştirilecek bir saldırıyı askeri savaş sebebi sayacağını ve bu saldırılara konvansiyonel silahlar ile karşılık vereceğini deklare eden devletlerin (Pentagon, ABD) yanı sıra, siber ortamdan gelen saldırılara yine siber ortamda karşılık verilmesinin gerektiğini savunan yaklaşımlarda bulunmaktadır. Farklı bakış açıları beraberinde saldırıların kaynağının neresi olduğu, amacının ne olduğu, neyi hedeflediği ve bu saldırılara karşı nasıl karşılık verilmesi gerektiği gibi tartışmalarını da beraberinde getirmektedir (ESSARP, 2013; Öğün & Adem, 2013).

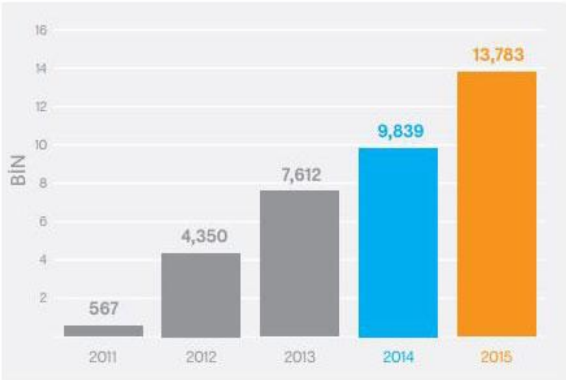
SİBER GÜVENLİK EĞİTİMİNİN ÖNEMİ

Her şeyin teknolojiye bağımlı hale geldiği günümüzde, çok fazla emek harcamadan ve maliyetsiz şekilde yüksek maddi kazanımların elde edildiği bilgisayar korsanlığı yetenekli kişiler için cazip hale gelmiştir. Son zamanlarda sık yaşanan fidye zararlı yazılımı incelendiğinde bu durum net şekilde görülmektedir. ZDnet araştırmacıları tarafından fidye zararlı yazılımın bir türevi olan Cryptolocker ile fidye talep edilen 4 tane Bitcoin hesabı takip edilmiş olup, 15 Ekim ile 18 Aralık 2013 tarihleri arasında bu hesaplara toplam 41928 bitcoin, yani o günkü değeri ile yaklaşık 27 milyon USD (Amerikan Doları) gönderildiği tespit edilmiştir (Blue, 2013). Sadece 3 ayda bu kadar para toplanması diğer bilgisayar korsanlarının iştahını kabartmakta ve buna benzer zararlı yazılım türevleri her geçen gün artmaya devam etmektedir. Siber ortamda gerçekleşen saldırılar her geçen gün daha da karmaşıklaşarak artmakta ve daha hedef odaklı hale gelmektedir.

Symantec firmasının 2016 internet güvenliği tehdit raporuna (Symantec, 2016) göre Android tabanlı mobil zararlı yazılım çeşidindeki artış önceki yıl %29 iken 2015 yılında toplam %40 artış olmuştur. Şekil 2'de 2011 yılından itibaren ortaya çıkan yeni Android tabanlı mobil zararlı yazılım çeşidi gösterilmektedir. Aynı rapora göre 2015 yılında günlük engellenen web saldırısı sayısı ortalama 1 milyon olup, 2014'e göre %117 (iki katıdan fazla) artış olduğu tespit edilmiştir. Şekil 3'de 2013 yılından itibaren günlük engellenen web saldırılarının grafiği gösterilmektedir.



Şekil 2. Android Tabanlı Zararlı Yazılım Çeşitleri



Şekil 3. Günlük Engellenen Web Saldırı Sayısı

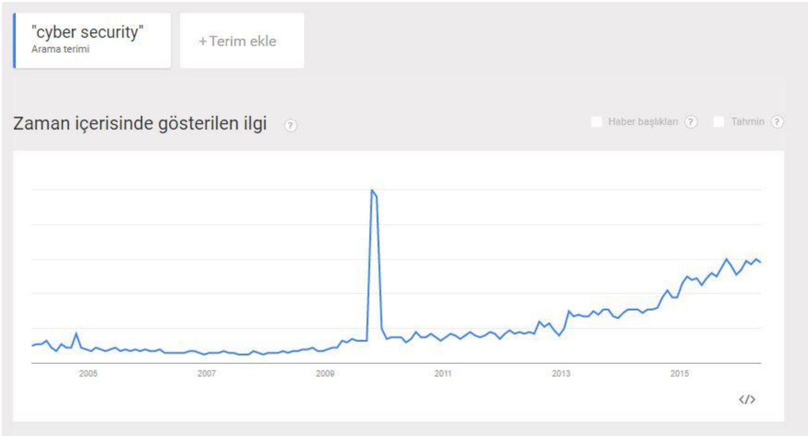
Ülkeler açısından bakılacak olursa, Sun Tzu' nun meşhur Savaş Sanatı (Tzu, 2011) kitabında geçen "En iyi zafer savaşmadan kazanılan zaferdir" sözü ekseninde, gelişmiş ülkeler arasındaki konvansiyonel savaşlar günümüzde yerini bilgi ve istihbarat savaşlarına bırakmıştır. Devletlerarasında gerçekleşen bilgi savaşlarının en önemli aracını teknoloji ve siber ortam oluşturmaktadır. Devlet arasında gerçekleşen siber saldırılara çok çarpıcı örnekler bulunmaktadır. Bu saldırılardan ilk akla geleni, Rusya tarafından gerçekleştirildiği tahmin edilen ve 27 Nisan 2007 yılında Estonya'ya gerçekleştirilen ve bankacılık, devlet kurumları, radyo ve televizyon istasyonları gibi kritik yerleri hedef alan, Estonya'nın siber alandaki altyapısını çökerten siber saldırıdır. Bu saldırı sonrasında NATO tarafından Estonya merkezli Siber Savunma Mükemmeliyet Merkezi kurulmuştur. Ayrıca bu saldırının ardından NATO siber güvenlik alanındaki çalışmalara hız vererek 2011 yılında siber güvenlik doktrinini açıklamıştır. Bu doktrine göre, NATO önemli tesisleri, altyapıları ve insan hayatını tehlikeye sokan herhangi bir siber saldırıyı silahlı bir saldırıyla eş tutacağını ve gerekirse bu türdeki siber saldırılara silahla karşılık vermekten kaçınmayacağını açıklamıştır. 2011 yılında gerçekleşen ve devlet desteği olmadan gerçekleştirilmesinin imkânsız olduğu düşünülen, İran devletinin nükleer faaliyetlerini hedef alan, Stuxnet saldırısı, siber saldırıların gücünü ve etkisini tüm ülkelere göstermiştir.

Ülkeler arasında bu tür saldırıların yanı sıra istihbarat amaçlı siber saldırılarda yoğun olarak yaşanmaktadır. Teknolojide yaşanan gelişmeler askeri harekât ortamına farklı bir mekân boyutu eklemiş ve harplerin icra edildiği kara, deniz ve hava gibi fiziksel mekânlara ek olarak bütün bu alanlarda icra edilen harekâtları doğrudan etkileyen yeni bir boyut olan siber ortamı kazandırmıştır (Bayraktar, 2014; Özteke, 2013). Siber istihbarat alanında tasarlanmış en gelişmiş dinleme ağı; Avustralya, Kanada, Yeni Zelanda, Birleşik Krallık ve Amerika Birleşik Devletleri arasında imzalanan UKASA sözleşmesi çerçevesinde hayata geçirilen ECHELON (Sloan, 2001) ve Amerika Birleşik Devletleri tarafından geliştirilen istihbarat toplama yazılımı olan PROMIS (Prosecutor's Management Information System) programıdır.

DÜNYA'DA SİBER GÜVENLİK EĞİTİMİ

Siber güvenliğin öneminden dolayı birçok ülkede farklı yöntemlerle siber güvenlik uzmanı yetiştirilmektedir. Siber güvenlik konusunda eğitim ve araştırmaya yönelik olarak üniversitelerde lisans, yüksek lisans, doktora düzeylerinde programlar açılmakta, üniversitelerin ve devlet kurumlarının bünyesinde araştırma enstitüleri ve birimler kurulmaktadır. Bu eğitimlerin yanı sıra ülkeler siber saldırı anında güvenliklerini sağlamak ve gerektiğinde karşı saldırı yapmak için siber ordular kurmaya başlamışlarıdır. 2011 yılı Haziran ayında Çin tarafından 30 kişilik ekiple kendi siber ordusunu kurduğunu resmen açıklamış olup, günümüzde ekip sayısının 9000'e çıktığı tahmin edilmektedir. ABD'nin de direk ABD Genelkurmay Başkanlığına bağlı ve askerler tarafından yönetilen, 12 bin kişinin görev yaptığı tahmin edilen siber ordusu uzun süredir mevcut olup, askeri operasyonlarda istihbarat ve saldırı amaçlı görev yaptıkları bilinmektedir. Bunun yanı sıra Rusya, İran, İsrail, Kuzey Kore, Suriye ve bazı Avrupa ülkelerinin kendi siber ordusuna sahip olduğu bilinmektedir.

Dünya'daki siber güvenliğe olan ilginin 2004 ile 2016 yılları arasındaki değişimi Google Trend 'den sağlanan eğilim grafiği ile Şekil 4' de gösterilmiştir. Şekil 4'dende anlaşılacağı üzere insanların siber güvenliğe olan ilgisi her geçen yıl artış göstermektedir. 2009 yılı ekim ayında görülen tepe noktasının oluşma nedeni ABD başkanı Barack Obama tarafından o ayın Ulusal Siber Güvenlik Bilinçlendirme Ayı ilan edilmesi dolayısıyla insanların arama eğilimlerinde meydana gelen artıştan kaynaklanmaktadır.



Şekil 4. Dünya'da Siber Güvenliğe Olan İlginin Değişimi

Dünyada siber güvenlik eğitimi veren kurumlar incelendiğinde eğitimler genellikle lisans düzeyinde yoğunlaşmakla birlikte yüksek lisans, doktora ve ön lisans düzeyinde eğitim veren veya sertifikalı kurs düzenleyen üniversiteler ve eğitim kurumları bulunmaktadır. Dünyada siber güvelik eğitimi verilen programların ülkelere göre dağılımı Tablo 1' de verilmiştir (Orakcı, Kök, & Çakır, 2016). Buna göre siber güvenlik alanında en çok eğitim programını barındıran ülke ABD olup toplam 85 tane üniversite programı ve 25 tane sertifika programı bulunmaktadır. ABD'yi İngiltere 38 program ile takip ederken, diğer ülkelerin program sayıları bu ülkelerin çok gerisinde kalmaktadır. Kanada'nın siber güvenlik uzmanı ihtiyacını üniversite programlarından ziyade daha çok sertifika programları ile gidermeye çalıştığı görülmektedir.

Tablo 13. Siber Güvenlik Eğitimi Programlarının Ülkelere Göre Dağılımı

Ülkeler	Ön Lisans	Lisans	Y. Lisans	Doktora	Sertifika
Kanada	-	3	1	-	13
USA	13	46	23	3	25
İngiltere	-	23	14	1	-
Almanya	-	-	1	-	-
Galler	-	4	2	-	-
İrlanda	-	5	4	-	-
Hollanda	-	1	1	-	-
İskoçya	-	3	1	-	-
İsveç	-	1	-	-	-
İtalya	-	3	-	-	-
Birleşik Arap Emirlikleri	-	1	2	-	-
Hindistan	-	1	4	-	-
Avusturalya	-	5	6	1	-
Yeni Zelanda	-	1	1	-	-
Güney Afrika	-	-	1	-	-
Toplam	**13**	**97**	**61**	**4**	**38**

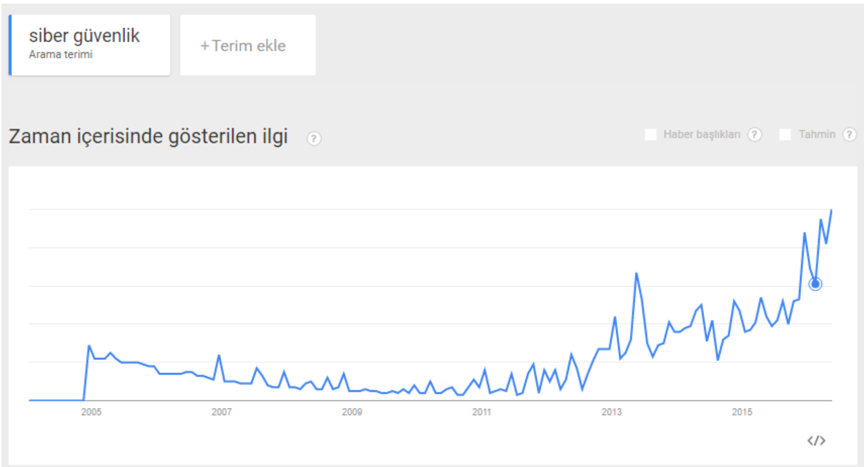
Siber güvenlik eğitim programlarının kıtalara göre dağılımı Tablo 2' de gösterilmiştir (Orakcı, Kök & Çakır, 2016). Buna göre siber güvenlik eğitiminin en yaygın olduğu kıta ABD' yi barındırması nedeniyle Amerika kıtası olup toplam 128 program bulundururken, Avrupa kıtasında toplam 64 eğitim programı bulunup diğer kıtaların toplam program sayısının neredeyse 3 katı program bulundurmaktadır.

Tablo 2. Siber Güvenlik Eğitimi Programlarının Kıtalara Göre Dağılımı

Kıtalar	Ön Lisans	Lisans	Y. Lisans	Doktora	Sertifika	Toplam
Amerika	13	49	24	4	38	128
Avrupa	-	40	23	1	-	64
Asya	-	2	6	-	-	8
Okyanusya	-	6	7	1	-	14
Afrika	-	-	1	-	-	1

TÜRKİYE' DE SİBER GÜVENLİK EĞİTİMİNİN DURUMU

Türkiye'de 20 Kasım 2012 yılında resmi gazetede yayınlanarak yürürlüğe giren bakanlar kurulu kararı ile Siber Güvenlik Kurulu kurulmuş olup, bu kurul tarafından Ulusal Siber Güvenlik Stratejisi ve Eylem Planı hazırlanması kararlaştırılmıştır. Bu karar, ülke olarak siber güvenlik alanında atılmış en etkili ilk adım olup, ilgili strateji belgesi ile kritik altyapılar belirlenmiş olup, kurumların siber güvenlik alanında yapması gerekenler açıklanmıştır. İlgili belge siber güvenliğin sürdürülebilirliği açısından üniversitelerin siber güvenlik alanında uzman yetiştirmelerini tavsiye etmektedir. Türkiye' de Türk Silahlı Kuvvetleri bünyesinde TSK Siber Savunma Merkezi Başkanlığı oluşturulmuştur. Bunun yanında siber güvenlik konusunda Ulaştırma Denizcilik ve Haberleşme Bakanlığı, Bilgi Teknolojileri ve İletişim Kurumu, Siber Güvenlik Kurulu, Ulusal Siber Olaylara Müdahale Merkezi (USOM) ve TÜBİTAK gibi kurumlar da çalışmalar ve düzenlemeler yapmaktadır. Şekil 5'de Google Trend aracılıyla 2004 yılından günümüze kadar Türkiye' den gerçekleşen "siber güvenlik" aramalarının eğilim grafiği gösterilmektedir. Şekil 5'den görüleceği üzere Türkiye'de siber güvenliğe olan ilgi Dünyadaki ilgiye paralellik göstermekte ve her geçen gün artmaktadır.



Şekil 5. Türkiye'de Siber Güvenlik Terimi Aramalarının Eğilimi

Cisco firması tarafından 2014 yılında yayınlanan bir tavsiye raporuna (Cisco, 2014) göre 5 yıl içinde dünya genelinde 1 milyon siber güvenlik uzmanına ihtiyaç duyulacaktır. Aynı rapora göre Türkiye için 20 bin siber güvenlik uzmanına ihtiyaç bulunmaktadır. Türkiye'de siber güvenlik konusunda en önemli problemi yetişmiş siber güvenlik uzmanı ihtiyacı oluşturmaktadır. Ülkemizin diğer sektörlerden farklı olarak Siber Güvenlikle ilgili eleman yetişme potansiyeli yaklaşık % 1 dir. Son iki yılda Üniversitelerin ilgili bölümlerinden mezun olup Siber Güvenlik sektöründe yer alanların oranı % 0,7 dir (Derneği, 2016). Bu da ulusal siber güvenlik vizyonunun tamamlanmasının önünde en büyük engel olarak gözükmektedir.

Türkiye'de siber güvenlik alanında uzman yetiştirmeye yönelik kamu ve özel üniversitelerde yüksek lisans ve doktora programları açılmıştır. Ülkemizde bulunan siber güvenlik eğitimine ilişkin programlar Tablo 3' de gösterilmekte olup, Adli Bilişim gibi siber güvenlik alanına yakın programlara tabloda yer verilmemiştir. Buna göre Türkiye'de 13 yüksek lisans ve bir doktora programı bulunmakta olup, lisans veya ön lisans seviyesinde hiç programa rastlanmamıştır. Diğer ülkeler ile karşılaştırıldığında Türkiye'nin ortalamanın üstünde bulunduğu görülmekte olup, halen kendi ihtiyacını karşılayacak uzman yetiştirmek için yeterli program sayısına ulaşılamamıştır. Bunun yanı sıra özel eğitim kurumları ile birlikte TSE (Türk Standartları Enstitüsü) bünyesinde "Beyaz Şapkalı Hacker" eğitimi ile birlikte çeşitli sertifika programları düzenlenmektedir (TSE, 2015). Bu sertifika programları aracılıyla Ulusal Siber Güvenlik Stratejisi ve Eylem Planı çerçevesinde kurumlarda kurulması zorunlu hale getirilen SOME'lere (Siber Olaylara Müdahale Ekibi) uzman eleman yetiştirilmesi planlanmaktadır.

Tablo 3. Türkiye'de Bulunan Siber Güvenlik Programları

Üniversite	Enstitü	Program	YL/DR
Yaşar Ünv.	Fen Bilimleri Enstitüsü	Siber Güvenlik	YL
İstanbul Ticaret Ünv.	Fen Bilimleri Enstitüsü	Siber Güvenlik	YL
ODTÜ	Enformatik Enstitüsü	Siber Güvenlik	YL
GYTÜ	Fen Bilimleri Enstitüsü	Siber Güvenlik	YL
Bahçeşehir Ünv.	Fen Bilimleri Enstitüsü	Siber Güvenlik	YL
Sakarya Ünv.	Fen Bilimleri Enstitüsü	Siber Güvenlik	YL
Kadir Has Ünv.	Fen Bilimleri Enstitüsü	Enformasyon Teknolojileri	YL
Deniz Harp Okulu	Deniz Bilimleri Enstitüsü	Siber Güvenlik	YL
Medipol Ünv.	Fen Bilimleri Enstitüsü	Elektrik, Elektronik Ve Siber Sistemler	YL
Gazi Ünv.	Fen Bilimleri Enstitüsü	Bilgi Güvenliği Müh.	YL/DR
Hacettepe Ünv.	Bilişim Enstitüsü	Bilgi Güvenliği	YL
TOBB ETÜ	Fen Bilimleri Enstitüsü	Bilgi Güvenliği	YL
İstanbul Ünv.	Fen Bilimleri Enstitüsü	Bilgi Güvenliği Müh.	YL

SONUÇ

Siber güvenliğinin ülkeler ve kurumlar açısından göz ardı edilemeyecek bir unsur haline geldiği günümüzde bu alanda yaşanan en büyük sorun yetişmiş uzman sorunudur. Bu çalışmada siber güvenlik eğitiminin dünyadaki durumu ve ülkemizdeki durumu ortaya koyulmuştur. Dünyada üniversitelerde çeşitli program seviyelerinde eğitim verilmekte olup, en çok programın bulunduğu ülke ABD'dir. Türkiye'de siber güvenlik ve bilgi güvenliği alanında yüksek lisans ve doktora programı düzeyinde programlar açılmış ve uzman yetiştirilmeye başlanmıştır. Bununla birlikte sektörün önemi ve gün geçtikçe hızlı şekilde artan ihtiyaç göz önünde bulundurulduğunda çok daha fazla uzmana ihtiyaç duyulduğu görülmektedir. Sektörün ihtiyacını karşılayacak kalifiye eleman yetiştirme konusunda en büyük sorumluluk üniversitelere düşmektedir. En kalifiye elemanların lisans programlarından yetiştirileceği göz önüne alındığında, üniversitelerin iş sıkıntısı yaşanmayacak olan siber güvelik alanına yönelik lisans hatta ön lisans programları açmaları gerekmektedir.

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THE PLACE OF THE HISTORY OF MATHEMATICS IN THE SIXTH GRADE TEXTBOOKS

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ABSTRACT: Despite of great improvements in ICT (information and communications technology) the textbooks continue to be one of the most important learning materials (Aslan, 2010). It is stated that the presence of the historical development of math concepts in renewed middle school mathematics curriculum develops positive attitudes towards math among students (MEB, 2013). In other words, it can be said that the presence of the activities about the history of mathematics in the math textbooks is important for the development of positive attitudes towards mathematics among students. In this regard, the aim of this study is to thematically examine the activities about the history of mathematics in the math textbooks. In this study, the case study method, one of the qualitative research designs was used. In this study, in order to identify how to take place the history of mathematics in the 6th grade textbooks, the textbooks from two publishers were examined. The existence of the activities about the anecdotes, the old methods and the historical development of concepts of scientists is observed in the end of the study. It is observed that the activities take place mostly in the introduction of lesson of the math textbooks so as to get students' attention and to increase their interest and motivation. Moreover, the history of mathematics was also found in the sample questions and project works. However, it is stated that there aren't enough problem solving techniques in the history of mathematics in the textbooks. Additionally, it can be said that the activities concentrate more on teaching numbers and geometry. In the result of the study, it seems that there aren't enough activities about the history of mathematics in the 6th grade textbooks.

Key words: History of mathematics, lesson book, learning activities

ALTINCI SINIF MATEMATİK DERS KİTAPLARINDA MATEMATİK TARİHİNİN YERİ

ÖZET: Bilgi ve iletişim teknolojilerinde meydana gelen büyük gelişmelere rağmen ders kitapları en önemli öğrenme materyallerinden biri olmaya devam etmektedir (Aslan, 2010). Yenilenen Ortaokul Matematik Dersi Öğretim Programı'nda ise matematik derslerinde kavramların tarihsel gelişimlerine yer vermenin öğrencilerin matematiğe karşı tutumlarını olumlu yönde geliştireceği ifade edilmiştir [MEB, 2013]. Yani matematik ders kitaplarında matematik tarihi etkinliklerinin yer almasının öğrencilerin matematiğe olan bakış açılarının olumlu yönde gelişmesi açısından önemli olduğu söylenebilir. Bu bağlamda bu çalışmanın amacı altıncı sınıf matematik ders kitaplarında yer alan matematik tarihi etkinliklerinin tematik açıdan incelenmesidir. Bu çalışmada nitel araştırma desenlerinden durum çalışması yöntemi kullanılmıştır. Bu çalışmada altıncı sınıf ders kitaplarında matematik tarihine nasıl yer verildiğini belirlemek amacıyla iki yayınevinin öğrenci ders kitapları incelenmiştir. Çalışma sonunda ders kitaplarında bilim adamlarının hayatlarını, eski yöntemleri ve kavramlarının tarihsel gelişimlerini ele alan etkinliklerin yer aldığı görülmüştür. Matematik ders kitaplarında etkinliklere, daha çok öğrencilerin derse karşı dikkatlerini çekme, ilgilerini ve motivasyonlarını artırma amacıyla dersin giriş bölümünde yer verildiği görülmüştür. Ayrıca matematik tarihine soru örnekleri içerisinde ve proje ödevlerinde de rastlanmıştır. Fakat ders kitaplarında matematik tarihinde yer alan problem çözme tekniklerine yeterince yer verilmediği de belirlenmiştir. Bunlara ek olarak etkinliklerin daha çok sayılar ve geometri öğrenme alanlarında yoğunlaştığı söylenebilir. Çalışma sonucunda altıncı sınıf matematik öğrenci ders kitaplarında matematik tarihi etnikliklerine yeterince yer verilmediği görülmektedir.

Anahtar sözcükler: Matematik tarihi, ders kitabı, etkinlik

GİRİŞ

Matematik anlaşılması ve öğrenilmesi zor bir ders olduğundan, onu öğrencilere sevdirecek yaklaşımlara ihtiyaç vardır (Alkan, 2011). Bu nedenle, sadece sayılara ve sembollere bağlı olarak matematiğin ele alınması, öğrencilerin matematiği daha fazla sevmesini sağlamayacaktır (Yevdokimov, 2007; Gazit, 2013). Milli Eğitim Bakanlığı tarafından hazırlanan son müfredatta da öğrencilerin bilgiyi işlemesi, sorgulaması, derinlemesine öğrenmesi ve araştırma yapması gibi benzer bakış açıları üzerinde durulmuştur (Pesen, 2008). Dolayısı ile matematik derslerinde klasik matematik öğretimi bakış açısı dışında bazı yaklaşımlara da yer vermek, matematiğin derinlemesine öğrenilmesi açısından önem arz etmektedir. Kuşkusuz bu yaklaşımlardan biri de matematik tarihidir (Marshall, 2010; Swetz, 1994; Bidwell, 1993; Fauvel, 1991).

Matematik tarihi, matematiğin gelişim süreçlerini, matematiğe katkı yapmış kişilerin hayatlarını ve çalışmalarını, matematiğin sosyal ve kültürel boyutunu ele alan bir bilim dalıdır (Bidwel, 1993). NCTM (2000) matematik tarihinin matematik öğretiminde kullanılmasın avantajlarını;

a) öğrencilerin derse olan motivasyonlarını arttırması.
b) geçmiş dönemlerde matematiğin gelişim aşamalarına bağlı olarak bazı zorlukları fark edilmesi ve buradan hareketle günümüzle ilişki kurabilme.
c) matematiksel bilginin ortaya çıkış aşamalarına tanıklık ederek matematiğin bir insan ürünü olduğunu görebilme.
d) tarihsel problemler çerçevesinde matematiksel düşünmeyi geliştirme alt başlıkları kapsamında yer verilmiştir.

Yenilenen Ortaokul Matematik Dersi Öğretim Programı'nda ise matematik derslerinde kavramların tarihsel gelişimlerine yer vermenin öğrencilerin matematiğe karşı tutumlarını olumlu yönde geliştireceği ifade edilmiştir [MEB, 2013]. Yani, matematik tarihi derslerde konuların başında motivasyonu arttırmak için derse hazırlık aşamasında, tarihsel problem çözümüyle derslerde derinlemesine bir bakış açısı geliştirme için kullanılabilir (Swets, 1994; Tzanakis ve Arcavi, 2002).

Bilgi ve iletişim teknolojilerinde meydana gelen büyük gelişmelere rağmen ders kitapları en önemli öğrenme materyallerinden biri olmaya devam etmektedir (Aslan, 2010). Matematik tarihi ders kitaplarında konuya göre farklı bölümlerde kullanılmaktadır. Ders kitaplarında matematik tarihine yer vermek, öğretmenlerinde bu kapsamda derslerinde matematik tarihini kullanmalarını sağlayacaktır. Böylece bu kitaplar matematik tarihi kullanma noktasında yetersiz olan öğretmenlere (Avital, 1995; Fried, 2001) bir rehber olacaktır. Ülkemizde de son dönemde yapılan bazı revizyonlarla matematik tarihi ders kitaplarında yer bulmaya başlamıştır (Baki ve Bütüner, 2013). Yani ders kitaplarında matematik tarihi etkinliklerine yer verilmesinin hem öğrencilerin kavramları daha iyi öğrenmesine hem de matematiğe karşı olan tutumlarının gelişmesine katkı sağlayacağı söylenebilir. Bu bağlamda bu çalışmanın amacı altıncı sınıf matematik ders kitaplarında yer alan matematik tarihi etkinliklerinin tematik açıdan incelenmesidir.

YÖNTEM

Çalışmanın bu bölümünde, araştırmanın yöntemi, veri toplama ve analiz tekniklerine yer verilmiştir.

Araştırmanın Deseni

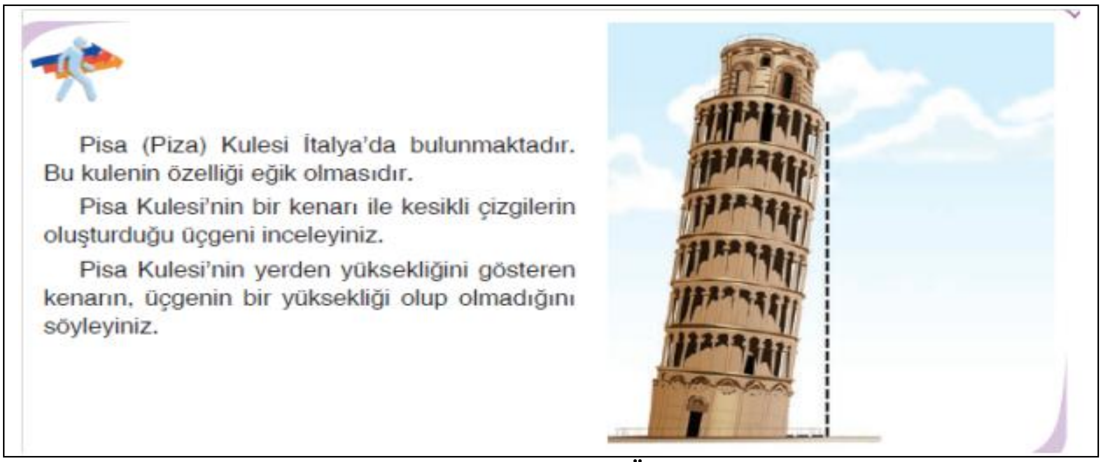
Bu araştırmada nitel araştırma yaklaşımına dayalı durum çalışması yöntemi kullanılmıştır. Nitel araştırma yaklaşımı, sosyal yaşamı ve insanla ilgili problemleri kendine özgü metotlarla sorgulayan ve anlamlandıran süreçtir (Creswell, 1998). Araştırmada nitel yaklaşımın benimsenmesinin sebebi; nitel araştırmalarda, belirli bir içeriğin derinlemesine olarak irdelenmesi (Yıldırım & Şimşek, 2011) ve zengin veri elde etmeye imkân veren yaklaşım olması gösterilebilir.

Veri Toplama

Bu çalışmada nitel veri toplama tekniklerinde doküman incelemesi yöntemi kullanılmıştır. Doküman incelemesi araştırılması hedeflenen olgu ve olaylar hakkında bilgi edinilmesini sağlayan yazılı, sözlü ve görsel materyallerin incelenmesidir (Yıldırım&Şimşek, 2011).Bu bağlamda bu çalışmada veri toplama sürecinde iki yayın evine ait ders kitaplarından yararlanılmıştır. Bulgular kısmında yayın evlerinin isimleri verilmemiştir. Bunun yerine ders kitapları için A yayın evine ve B yayın evine ait ders kitapları ifadesi kullanılmıştır.

Veri Analizi

Çalışmadan elde edilen veriler betimsel ve içerik analizi tekniklerinin bir arada kullanılması ile gerçekleştirilmiştir. Matematiksel beceri, öğrenme alanı ve bilişsel beceri değişkenlerine ait verilerin analizinde betimsel analiz tekniği kullanılırken diğer değişkenlere ait verilerin analizinde ise içerik analizi tekniği kullanılmıştır. Ayrıca birden fazla araştırmacının veri analizinde birlikte çalıştığı durumlarda kodlama güvenirliğinin kontrol edilmesi gerekmektedir. Bu durumda araştırmacılar aynı veri setini kodlar ve ortaya çıkan kodlama benzerliklerini ve farklılıklarını sayısal olarak karşılaştırarak bir kodlama yüzdesine ulaşırlar. Bu tür çalışmalarda en az %70 düzeyinde bir güvenirlik yüzdesine ulaşmak gerekir (Yıldırım & Şimşek, 2011). Bu amaçla çalışmadan elde edilen veriler iki araştırmacı tarafından kodlanmıştır. Ve kodlama güvenirlik yüzdesi %98 olarak bulunmuştur. Aşağıda yer alan Şekil 1' de ve Tablo 1'de veri analiz çerçevesinin daha iyi anlaşılması için bir etkinliğin nasıl analiz edildiğine yer verilmiştir.



Şekil 1. Bir Etkinlik Örneği

Tablo 1. Örnek Veri Analiz Çerçevesi

Etkinliğin Ders Esnasında Verilmesi Sırası	Dersin Başı
Öğrenme Alanı	Geometri ve Ölçme
Kavram	Yükseklik
Etkinliğin İçeriği	Tarihi Yapıtlar
Etkinliğin Amacı	Derse karşı Güdüleme
Matematiksel Beceri	İlişkilendirme
Bilişsel Beceri	Kavrama
Öğretim yöntemi	Tartışma

3. BULGULAR

Çalışmanın bu bölümünde incelenen ders kitaplarında matematik tarihinin yeri; etkinliklerin dersin hangi aşamasında ele alındıkları, amaçları, öğrencilerin rolü, öğrenme alanı, ele aldıkları kavramlar, dayandığı öğretim yöntemi, matematiksel beceri ve bilişsel beceri değişkenleri bağlamında tablolar halinde sunulmuştur.

Etkinliklerin Dersin Hangi Aşamasında Ele Alındığına Ait Bulgular

Aşağıda yer alan Tablo 2' de incelenen ders kitaplarında matematik tarihi etkinliklerin dersin hangi aşamasında yer aldığına ait bulgulara yer verilmiştir.

Tablo 2. Etkinlerin Ders Esnasında Verilme Aşamasına Ait Bulgular

	A Yayınevi		**B Yayın Evi**		**Toplam**	
	f	**%**	**f**	**%**	**f**	**%**
Ders Öncesi	-	-	1	25	1	8.33
Dersin Girişinde	5	62.5	1	25	6	50
Ders Esnasında	-	-	1	25	1	8.33
Dersin Sonunda	3	37.5	1	25	4	33,33
Toplam	8	100	4	100	12	100

Yukarıda yer alan Tablo 2'den görüldüğü üzere, B yayınevine ait ders kitabında etkinlikler dersin tüm aşamalarına eşit bir şekilde yayılırken A yayınevine ait kitapta ise etkinliklerin dersin giriş bölümünde yoğunlaştığı görülmektedir. Ayrıca A yayınevine ait kitapta ders öncesi ve ders esnasına yönelik matematik tarihi etkinliklerine ise yer verilmemiştir.

Etkinliklerin Yer Aldığı Öğrenme Alanlarına Ait Bulgular

Aşağıda yer alan Tablo 3' de incelenen ders kitaplarında matematik tarihi etkinliklerin hangi öğrenme alanlarında yer aldığına ait bulgulara yer verilmiştir.

Tablo 3. Etkinlerin Yer Aldığı Öğrenme Alanlarına Ait Bulgular

	A Yayınevi		B Yayın Evi		Toplam	
	f	%	f	%	f	%
Öğrenme Alanlarından Bağımsız	1	12.5	-	-	1	8.33
Sayılar ve İşlemler	3	37.5	2	50	5	33.33
Veri İşleme	1	12.5	-	-	1	8.33
Cebir	1	12.5	-	-	1	8.33
Geometri ve Ölçme	2	25	2	50	4	41.66
Toplam	8	100	4	100	12	100

Yukarıda yer alan Tablo 3'den görüldüğü üzere, A yayınevine ait ders kitabında tüm öğrenme alanlarına ait etkinlikler yer almaktadır. B yayınevine ait ders kitabında ise sadece "*Sayılar ve İşlemler*" ile "*Geometri ve Ölçme*" öğrenme alanlarına ait etkinlikler yer almaktadır. Tüm etkinliklerin genel bir şekilde incelersek, etkinliklerin "*Sayılar ve İşlemler*" ile "*Geometri ve Ölçme*" öğrenme alanlarında yoğunlaştığı görülmektedir.

Etkinliklerin Ele Aldıkları Kavramlara Ait Bulgular

Aşağıda yer alan Tablo 4' de incelenen ders kitaplarında matematik tarihi etkinliklerin hangi matematiksel kavramı ele aldığına ait bulgulara yer verilmiştir.

Tablo 4. Etkinlerin Ele Aldığı Kavramlara Ait Bulgular

	A Yayınevi		B Yayın Evi		Toplam	
	f	%	f	%	f	%
Kavramların Ele alınmadığı Etkinlikler	2	25	-	-	2	16.66
Doğal sayılarda işlemler	1	12.5	-	-	1	8.33
Kesirlerde İşlemler	-	-	1	25	1	8.33
Asal Sayı	1	12.5	1	25	2	16.66
Açı	1	12.5	-	-	1	8.33
Kesir	1	12.5	-	-	1	8.33
Örüntü	1	12.5	-	-	1	8.33
Pi Sayısı	1	12.5	-	-	1	8.33
Yükseklik	-	-	1	25	1	8.33
Sıvı Ölçme Birimleri	-	-	1	25	1	8.33
Toplam	8	100	4	100	12	100

Yukarıda yer alan Tablo 4'den görüldüğü üzere, her iki ders kitabında da asal sayı kavramına ait etkinliklere yer verilmiştir. Ayrıca A yayınevine ait ders kitabında yer alan iki etkinlikte herhangi bir kavrama yer verilmemiştir.

Etkinliklerin İçeriklerine Ait Bulgular

Aşağıda yer alan Tablo 5' de incelenen ders kitaplarında yer alan matematik tarihi etkinliklerin içeriklerine ait bulgulara yer verilmiştir.

Tablo 5. Etkinlerin İçeriklerine Ait Bulgular

	A Yayınevi		B Yayın Evi		Toplam	
	f	%	f	%	f	%
Bilim Adamlarının Hayatı	3	37.5	-	-	3	25
Eski Matematiksel Yöntemler	2	25	2	50	4	33.33
Kavramların Tarihsel Gelişim Süreci	1	12.5	1	25	2	16.66

Tarihi Yapıtlar	1	12.5	1	25	2	16.66
Eski Aletler	1	12.5	-	-	1	8.33
Toplam	8	100	4	100	12	100

Yukarıda yer alan Tablo 5'den görüldüğü üzere, ders kitaplarına yer alan etkinliklerin özellikle daha önce kullanılan matematiksel yöntemlerle (Eski Mısır Sayı Sistemi) ve bilim adamlarının hayatlarıyla ilgili olduğu söylenebilir. Ayrıca ders kitaplarında kavramların tarihsel gelişim süreçlerine, tarihi yapıtlara ve eski aletlere de yer verildiği görülmektedir.

Etkinliklerin Amaçlarına Ait Bulgular

Aşağıda yer alan Tablo 6' da incelenen ders kitaplarında yer alan matematik tarihi etkinliklerin amaçlarına ait bulgulara yer verilmiştir.

Tablo 6. Etkinlerin Amaçlarına Ait Bulgular

	A Yayınevi		**B Yayın Evi**		**Toplam**	
	f	**%**	**f**	**%**	**f**	**%**
Derse Karşı Güdüleme	4	50	1	25	5	41.66
Bilgilendirme	2	25	-	-	2	16.66
Pekiştirme (Alıştırma)	1	12.5	1	25	2	16.66
Proje-Araştırma Ödevi	1	12.5	2	50	3	25
Toplam	8	100	4	100	12	100

Yukarıda yer alan Tablo 6'dan görüldüğü üzere, A yayın evine ait ders kitabında yer alan matematik tarihi etkinliklerin daha çok dersin giriş bölümünde öğrencileri derse karşı güdülemek amacıyla kullanıldığı görülmektedir. B yayınevine ait kitapta ise etkinliklerin daha çok araştırma amaçlı olduğu görülmektedir.

Etkinliklerin Kazandırdığı Matematiksel Becerilere Ait Bulgular

Aşağıda yer alan Tablo 7' de incelenen ders kitaplarında yer alan matematik tarihi etkinliklerin kazandırdığı matematiksel becerilere ait bulgulara yer verilmiştir.

Tablo 7. Etkinlerin Kazandırdığı Matematiksel Becerilere Ait Bulgular

	A Yayınevi		**B Yayın Evi**		**Toplam**	
	f	**%**	**f**	**%**	**f**	**%**
İletişim	2	25	-	-	2	16.66
Akıl Yürütme	2	25	-	-	2	16.66
Problem Çözme	-	-	2	50	2	16.66
İlişkilendirme	4	50	2	50	6	50
Toplam	8	100	4	100	12	100

Yukarıda yer alan Tablo 7'den görüldüğü üzere, ders kitaplarında yer alan etkinliklerin matematiksel temel becerilerinden *"ilişkilendirme"* becerisi üzerine yoğunlaştığı görülmektedir. Ayrıca A yayınevine ait ders kitabında "problem çözme" becerisine ait etkinliklere yer verilmezken B yayınevine ait ders kitabında ise "iletişim" ve "akıl yürütme" becerilerine dönük etkinliklere yer verilmemiştir.

Etkinliklerin Gerektirdiği Bilişsel Becerilere Ait Bulgular

Aşağıda yer alan Tablo 8' de incelenen ders kitaplarında yer alan matematik tarihi etkinliklerin gerektirdiği bilişsel becerilere ait bulgulara yer verilmiştir.

Tablo 8. Etkinlerin Gerektirdiği Bilişsel Becerilere Ait Bulgular

	A Yayınevi		**B Yayın Evi**		**Toplam**	
	f	**%**	**f**	**%**	**f**	**%**
Bilgi	4	50	-	-	4	33.33
Kavrama	3	37.5	2	50	5	41.66
Uygulama	1	12.5	2	50	3	25
Analiz	-	-	-	-	-	-
Sentez	-	-	-	-	-	-

Değerlendirme	-	-	-	-	-	-
Toplam	8	100	4	100	12	100

Yukarıda yer alan Tablo 8'den görüldüğü üzere, ders kitaplarında yer alan matematik tarihi etkinliklerin Bloom taksonomisinde yer alan bilgi, kavrama ve uygulama basamaklarına dönük olduğu görülmektedir. Buna rağmen üst düzey bilişsel becerilerden olan analiz, sentez ve değerlendirme basamaklarına dönük etkinliklere ise yer verilmemiştir.

Etkinliklerin Gerektirdiği Öğretim Yöntemlerine Ait Bulgular

Aşağıda yer alan Tablo 9' da incelenen ders kitaplarında yer alan matematik tarihi etkinliklerin gerektirdiği öğretim yöntemlerine ait bulgulara yer verilmiştir.

Tablo 9. Etkinlerin Gerektirdiği Öğretim Yöntemlerine Ait Bulgular

	A Yayınevi		**B Yayın Evi**		**Toplam**	
	f	**%**	**f**	**%**	**f**	**%**
Düz Anlatım	3	37.5	-	-	3	25
Buluş Yolu	2	25	-	-	2	16.66
Araştırma	1	12.5	2	50	3	25
Tartışma	2	25	2	50	4	33.33
Toplam	8	100	4	100	12	100

Yukarıda yer alan Tablo 9'dan görüldüğü üzere, A yayınevine ait ders kitabında daha çok düz anlatıma yönelik etkinlikler yer almakta iken B yayınevine ait ders kitabında araştırma ve tartışmaya yönelik etkinlikler yer almaktadır.

SONUÇLAR

Ortaokul altıncı sınıf ders kitaplarında yer alan matematik tarihi etkinliklerin tematik açıdan incelenmesi amacıyla yapılan bu çalışma sonunda, iki yayınevine ait altıncı sınıf matematik öğrenci ders kitapları incelenmiştir. Çalışma sonucunda ders kitaplarında matematik tarihine yeterince yer verilmediği görülmüştür. Siu (2007) bu sonucu matematik tarihinin derslerde kullanımına engel durumlardan biri olarak ifade etmiştir. Bu konuyla ilgili benzer çalışmalar incelendiğinde (Fasanelli, 2000; Lakoma, 2000) Çin, Norveç ve Polonya gibi ülkelerde program ve ders kitabı bazında matematik tarihinin etkin bir kullanım alanı olduğu görülmektedir. Ortaokul Matematik Dersi Öğretim Programı'nda kavramların öğretilmesinde ve öğrencilerin matematiğe karşı olumlu tutum geliştirmesinde matematik tarihi etkinliklerinin kullanılması gerçeği [MEB, 2013] göze alındığında, ders kitaplarının matematik tarihi açısından yetersiz olduğu söylenebilir. Ayrıca 18000 üyesi olan The Mathematical Association of America (MAA) ders kitaplarında ve öğretim programlarında matematik tarihine yer verilmesi gerektiğini vurgulamıştır.

Çalışma sonucunda ders kitaplarında yer alan matematik tarihi etkinliklerinin daha çok dersin giriş bölümünde yer aldığı görülmektedir. Etkinliklerin daha çok öğrencilerin derse karşı olan ilgilerini çekmek ve derse karşı güdülemek amacıyla verildiği söylenebilir. Bu çalışmaya paralel olarak Baki ve Bütüner (2013) yaptıkları çalışmada matematik ders kitaplarında, matematik tarihinin kullanımının aydınlatma yaklaşımına dayalı olarak, tarihsel ufak parçaların ilgili konunun hemen başında verilmesiyle gerçekleştirildiği sonucuna ulaşılmışlardır.

Bu çalışmada altıncı sınıf matematik ders kitaplarında yer alan etkinliklerin araştırma ödevi, alıştırma ve bilgilendirme amacıyla da kullanıldığı görülmüştür. Bunlara ek olarak matematik tarihi etkinliklerinin daha çok *"Sayılar ve İşlemler*" ile *"Geometri ve Ölçme"* öğrenme alanlarına yoğunlaştığı sonucuna da ulaşılmıştır. Buna rağmen öğrencilerin yoğun bir şekilde öğrenme zorlukları yaşadığı (Şahin&Soylu, 2011) cebir öğrenme alanına yönelik ise yeterince etkinliğe yer verilmediği görülmüştür. Matematik ders kitaplarında yer alan etkinliklerde bilim adamlarının hayatlarına, eski yöntemlere (Eski Mısır sayı sistemi), tarihi yapıtlara, kavramların tarihsel gelişim süreçlerine ve çeşitli aletlerin geçmişteki kullanım şekillerine yer verildiği görülmüştür. Ayrıca ders kitaplarında daha çok eski yöntemlere yönelik etkinliklerin yer aldığı sonucuna ulaşılmıştır. Matematik ders kitaplarında yer alan etkinliklerin bilgi, kavrama ve uygulama bilişsel becerilerine dönük olduğu buna karşın analiz, sentez ve değerlendirme basamaklarına yönelik etkinliklerin yer almadığı görülmüştür. Ayrıca matematik tarihi etkinliklerinin daha çok *"ilişkilendirme"* becerinse hizmet ettiği sonucuna da ulaşılmıştır Bunlara ek olarak ders kitaplarına yer alan matematik tarihi etkinliklerin genel olarak öğretim yöntemlerinden "tartışma" yöntemini esas aldığı da görülmüştür.

ÖNERİLER

- Matematik ders kitaplarında matematik tarihi etkinliklerine daha fazla yer verilmelidir.
- Matematik ders kitaplarında yer alan matematik tarihi etkinlikleri sadece bilim adamlarının hayatları üzerine odaklanmamalıdır. Bunun yerine eski matematiksel yöntemlere ve kavramların tarihsel gelişimlerine dönük etkinliklere ağırlık verilmelidir.
- Matematik ders kitaplarında yer alan matematik tarihi etkinlikleri sadece öğrencilerin derse karşı ilgilerini çekme ve güdülemede değil aynı zamanda kavramların öğretim sürecinde de kullanılmalıdır.
- Cebir ve veri işleme öğrenme alanlarına dönük daha fazla matematik tarihi etkinliklerine yer verilmelidir
- Matematik tarihi etkinliklerinde sözel anlatımlardan ziyade matematik tarihine ait dokümanlara yönelik görsel öğelere ağırlık verilmelidir.

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LIFELONG LEARNING TENDENCIES OF ACADEMICIANS

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ABSTRACT: The aim of this study is to determine the lifelong learning tendencies of academicians in terms of some variables. The sample group for the research comprised a total of 408 academicians that works in various faculties of the Trakya University during the spring term of the 2014-2015 academic year. The "Lifelong Learning Tendency" scale and the "IT Literacy" scale were used for the research. Descriptive statistics, Mann Whitney U and Kruskal-Wallis H tests were used to analyze the data. Spearman Brown rank correlation coefficient was used to examine the relationships between scales. It was emerged that the lifelong learning tendencies and information technology literacies of academicians were high and their tendencies vary according to years of service and academic title. The findings of the research revealed a positive and moderate relationship between the lifelong learning tendencies of academicians and their information technology literacies.

Key words: lifelong learning tendency, IT literacy, academician.

AKADEMİSYENLERİN YAŞAM BOYU ÖĞRENME EĞİLİMLERİ

ÖZET: Bu çalışmada, akademisyenlerin yaşam boyu öğrenme eğilimlerinin çeşitli değişkenlere göre incelenmesi amaçlanmıştır. Çalışmanın örneklemini, 2014-2015 öğretim yılında Trakya Üniversitesi'nin çeşitli fakültelerinde görev yapan 408 akademisyen oluşturmaktadır. Çalışmada veri toplama araçları olarak "Yaşam Boyu Öğrenme Yeterlik Algısı Ölçeği" ve "Bilgi Teknolojileri Okuryazarlığı Ölçeği" kullanılmıştır. Verilerin analizinde betimsel istatistikler, Mann Whitney U testi ve Kruskal Wallis H testlerinden yararlanılmıştır. Ölçekler arasındaki ilişkiyi belirlemek amacıyla Spearman Brown sıra farkları korelasyon katsayısı kullanılmıştır. Araştırmada Akademisyenlerin yaşam boyu öğrenme eğilimlerinin ve bilgi teknolojileri okuryazarlıklarının yüksek olduğu, eğilimlerin hizmet yılı ve akademik unvana göre farklılaştığı ortaya çıkmıştır. Araştırma bulguları, akademisyenlerin yaşam boyu öğrenme eğilimleri ve bilgi teknolojileri okuryazarlıkları arasında pozitif yönde ve orta düzeyde bir ilişki olduğunu ortaya koymuştur.

Anahtar sözcükler: yaşam boyu öğrenme eğilimi, bilgi teknolojileri okuryazarlığı, akademisyen.

GİRİŞ

1970'li yıllardan beri UNESCO (United Nations Educational, Scientific and Cultural Organization), OECD (Organization for Economic Cooperation and Development) ve Avrupa Birliği gibi uluslararası kuruluşların en önemli gündem konularından biri olan ve hala önemini koruyan yaşam boyu öğrenme, insan yaşamının her alanında devam eden bilgi, beceri ve potansiyelini geliştirildiği süreç olarak tanımlanmaktadır (Borat, 2010; Ersoy ve Yılmaz, 2009; European Commission, 2002). Güleç, Çelik ve Demirhan (2012)'a göre ise yaşam boyu öğrenme, mevcut sistemi yeniden yapılandırarak, formal eğitim sisteminin dışında da eğitimle ilgili her türlü gelişmeyi sağlayan, örgün ve yaygın her türlü eğitim faaliyetini kapsayan geniş bir alan olarak tanımlanmaktadır. Öte yandan, Kılıç ve Tuncel (2015) ise yaşam boyu öğrenme kavramını, gelişmiş ülkeler başta olmak üzere hemen hemen her ülkenin eğitim politikalarında yer alan ve kazandırılmak istenilen temel beceriler olarak tanımlanmaktadır.

Okuryazarlık kavramları alanyazında genel olarak, belirli bir alana özgü bilgiyi edinebilmek amacıyla, gerekli olan önkoşulların yerine getirilmesi olarak tanımlanmaktadır. Bu tanımdan hareketle, bilgi teknolojileri okuryazarlığı ise; bilgi toplumu yolunda, bilginin edinimi, yönetimi ve entegrasyonu, değerlendirilmesi ve yeni bilgilerin üretimi ile ilgili gerekli olan etik ve yasal kullanım becerisinin edinilmesi olarak tanımlanmaktadır (iSkills, 2007).

Yaşam boyu öğrenmeye yönelik gerçekleştirilen pek çok alanyazın çalışmasında (Dinevski ve Dinevski, 2004; Göksan, Uzundurukan ve Keskin, 2009), bilgi toplumunun ihtiyaç duyduğu niteliklere sahip olan başka bir değişle yaşam boyu öğrenebilen bireylerin yetiştirilmesinde yükseköğretim kurumlarının rolü vurgulanmıştır (Coşkun Diker, 2009; Dağ, 2016; Konakman ve Yelken, 2014; Soran, Akkoyunlu ve Kavak, 2006). Üniversitelerin yaşam boyu öğrenme bağlamında üzerlerine düşen sorumluluğu yerine getirebilmeleri için öncelikle bu süreçte en temel unsur olan akademisyen ve eğitmenlerin yaşam boyu öğrenme becerilerine sahip olmaları ve bu becerileri öğrencilerine aktarabilmek için de öğretim sürecini ve ortamını uygun şekilde tasarlamaları beklenmektedir (Demirel, Sadi ve Dağyar, 2016; Konakman ve Yelken, 2014; Selvi 2011). Buna karşın, gerçekleştirilen alanyazın çalışmaları, yaşam boyu öğrenme bağlamında üniversite öğrencilerinin kendilerini geliştirmeye yönelik çalışmalara katılma konusunda isteksiz olduklarını ve yaşam boyu öğrenen bağlamında yetersiz bireyler olarak fakültelerden mezun olduklarını belirtmektedir (Diker Çoşkun ve Demirel 2012; Selvi 2011). Bu nedenle bilgi çağının gerekleri doğrultusunda analiz-sentez yapabilen, problem çözme becerisi gelişmiş, yaratıcı ve yenilikçi ve aktif öğrenen bireylerin yetiştirilmesinde akademisyenlere çok önemli görevler düşmektedir. Bu bağlamda, yaşam boyu öğrenen bireyleri yetiştirecek olan öğretim elemanlarının yaşam boyu öğrenme eğilimlerinin belirlenmesi ve bu eğilim üzerinde etkili olan değişkenlerin ortaya çıkarılması gerekmektedir. Araştırmada akademisyenlerin yaşam boyu öğrenme eğilimlerinin belirlenmesi amaçlanmış olup aşağıda belirtilen alt sorulara yanıt aranmıştır.

- Akademisyenlerin yaşam boyu öğrenme eğilimleri hangi düzeydedir?
- Akademisyenlerin yaşam boyu öğrenme eğilimleri çeşitli değişkenlere (cinsiyet, akademik unvan, yaş ve hizmet yılı) göre anlamlı bir farklılık göstermekte midir?
- Akademisyenlerin yaşam boyu öğrenme eğilimleri ile bilgi teknolojileri okuryazarlık düzeyleri arasında ilişki var mıdır?

YÖNTEM

Araştırma Modeli

Bu araştırma, betimsel bir araştırma olup ilişkisel tarama modeli kullanılarak gerçekleştirilmiştir. Karasar (2005, s.81)'a göre ilişkisel tarama modelinde; iki veya daha çok sayıdaki değişken arasında var olan değişim ve/veya bu değişimin derecesini belirlemek amaçlanır. Tarama yolu ile bulunan ilişkiler bir neden sonuç ilişkisinden ziyade bir değişkendeki durumun bilinmesi halinde diğerinin kestirilmesini sağlaması bağlamında yorumlanır. Bu doğrultuda gerçekleştirilen bu araştırmada, akademisyenlerin yaşam boyu öğrenme eğilimleri ile bilgi teknolojileri okuryazarlık düzeyleri arasındaki ilişki, korelasyon türü ilişkisel tarama modeli kullanılarak çözümlenmeye çalışılmıştır. Cinsiyet, akademik unvan, hizmet yılı, yaş değişkenleri ile yaşam boyu öğrenme eğilimleri arasında farklılaşma olup olmadığını belirlemek amacıyla ise karşılaştırma türü ilişkisel tarama modeli kullanılmıştır.

Evren ve Örneklem

Araştırmanın örneklemini 2014-2015 öğretim yılı Bahar döneminde, Trakya Üniversitesi'nin çeşitli fakültelerinde görev yapan 408 akademisyen oluşturmaktadır. Araştırma örneklemini oluşturan akademisyenlere ilişkin demografik bilgiler Tablo 1'de sunulmuştur.

Tablo 1. Akademisyenlere İlişkin Demografik Bilgiler

Cinsiyet	N	(%)	Akademik Unvan	N	(%)
Erkek	233	51.1	Prof. Dr.	24	5.9
Kadın	175	42.9	Doç. Dr.	70	17.2
			Yrd. Doç. Dr.	136	33.3
Yaş	**N**	**(%)**	Öğr. Gör. Dr.	13	3.2
30 ve altı	60	18.6	Arş. Gör. Dr.	40	9.8
31-40 arası	175	15.4	Öğr. Gör.	65	15.9
41-50 arası	117	30.9	Arş. Gör.	50	12.3
51 ve üzeri	56	18.1	Okutman	10	2.5
Hizmet Yılı	**N**	**(%)**	**Hizmet Yılı**	**N**	**(%)**
1-5 yıl	76	18.6	16-20 yıl	74	18.1
6-10 yıl	63	15.4	21 ve üstü yıl	69	16.9
11-15 yıl	126	30.9			

Veri Toplama Araçları

Araştırma verileri, Yaşam Boyu Öğrenme Eğilimleri Ölçeği ve Bilgi Teknolojileri Okuryazarlığı Ölçeği aracılığı ile toplanmıştır. Araştırmada ayrıca çalışma grubuna ilişkin demografik bilgilerin edinilmesi amacıyla kişisel bilgiler formu kullanılmıştır.

Yaşam Boyu Öğrenme Eğilimleri Ölçeği: Araştırmada Coşkun Diker (2009) tarafından geliştirilen "Yaşam Boyu Öğrenme Eğilimleri Ölçeği" kullanılmıştır. 6'lı Likert tipindeki ölçek Motivasyon (6 madde), Sebat (6 madde), Öğrenmeyi Düzenlemede Yoksunluk (6 madde) ve Merak Yoksunluğu (9 madde) olmak üzere dört alt boyuttan oluşmaktadır. Ölçekte toplam 27 madde bulunmaktadır. Ölçeğin genel ortalamasında ölçekten alınabilecek minimum puan (27x1) 27 ve maksimum puan (27x6) 162 olarak belirlenmiştir. Cronbach Alpha güvenirlik katsayısı α=.89 olarak belirlenen ölçeğin güvenirlik katsayısı eldeki araştırmada α=.91 olarak saptanmıştır.

Bilgi Teknolojileri Okuryazarlığı Ölçeği: Ölçek, Varış (2008) tarafından geliştirilmiş 38 maddelik 6'lı Likert tipinde ve altı alt boyuttan oluşan bir ölçektir. Her bir madde için alınabilecek minimum puan 0, maksimum puan ise 5'tir. Her bir alt boyut için alınabilecek minimum ve maksimum puanlar ise o boyuttaki madde sayısı ile çarpılarak elde edilmiştir. Bu şekilde elde edilen maksimum ve minimum değer arasındaki fark 3'e bölünerek, 3 farklı düzey için puanlar elde edilmiştir. Bu düzeyler ise düşük, orta ve yüksek olarak adlandırılmıştır. Ölçeğin Cronbach Alfa katsayıları; Problem Çözme Becerileri alt boyutu (6 madde) için .94, İletişim ve Metabilişsel Beceriler alt boyutu (4 madde) için .90, Temel Bilgi Teknolojileri Becerileri alt boyutu (6 madde) için .92, Analiz ve Üretim Becerileri (7 madde) ve Bilgi ve İnternet İle İlgili Beceriler alt boyutu (12 madde) için .95, Sürdürebilme ve Transfer Etme Becerileri alt boyutu (3 madde) için .94 ve toplam için de .98'dir. Mevcut çalışmada ölçeğin geneline ilişkin güvenilirlik değeri α=.92 olarak saptanmıştır.

Kişisel Bilgiler Formu: Araştırmacılar tarafından hazırlanan kişisel bilgi formunda cinsiyet, akademik unvan, hizmet yılı ve yaş gibi bazı demografik bilgilerin belirlenmeye çalışıldığı bir grup soru yer almaktadır.

Verilerin Toplanması ve Analizi

Araştırma yüz yüze gerçekleştirilmiş olup, araştırma öncesinde akademisyenlere öncelikle araştırma konusu ve veri toplama araçları hakkında bilgi verilmiş, ardından araştırmaya katılımın gönüllülük esasına dayalı olduğu hatırlatılarak ölçeklerin yanıtlanması sağlanmıştır. Ölçekler yaklaşık 20 dakikalık sürede yanıtlanmıştır. Verilerin analizinden önce veri girişinin doğruluğu ve değişkenlerin dağılımının normalliğe uygunluğu test edilmiştir. Veri toplama araçlarını uygun bir şekilde doldurmayan 5 akademisyenin verileri analiz dışında bırakılarak araştırma örneklemi 408 akademisyenden oluşmuştur. Normal dağılım göstermediği tespit edilen verilerin değerlendirilmesi amacıyla betimsel istatistikler, Mann Whitney U testi ve Kruskal Wallis H testlerinden yararlanılmıştır. Alt gruplar arasındaki farklılığın tespiti için ise grupların ikili kombinasyonları üzerinden Mann Whitney U testi kullanılarak farkın kaynağı incelenmiştir. Ölçekler arasındaki ilişkiyi belirlemek amacıyla Spearman Brown Sıra Farkları korelasyon katsayısı kullanılmıştır.

BULGULAR

Akademisyenlerin Yaşam Boyu Öğrenme Eğilimleri ve Bilgi Teknolojileri Okuryazarlık Düzeylerine İlişkin Bulgular

Akademisyenlerin yaşam boyu öğrenme eğilimleri ve bilgi teknolojileri okuryazarlık düzeylerine ilişkin betimsel istatistikler Tablo 2'de sunulmuştur. Akademisyenlerin yaşam boyu öğrenme eğilim puanları incelendiğinde ($\bar{X}$=133.49) yaşam boyu öğrenme eğilimlerinin "yüksek" düzeyde olduğu söylenebilir. Akademisyenlerin yaşam boyu öğrenme eğilimi ölçeğinden elde ettikleri en yüksek ortalama puanın "Motivasyon" alt boyutunda ($\bar{X}/m$=5.22) olduğu, en düşük ortalama puanın ise "Merak Yoksunluğu" alt boyutunda ($\bar{X}/m$=4.67) olduğu görülmektedir. Akademisyenlerin bilgi teknolojileri okuryazarlık düzeylerine ilişkin ortalamalar incelendiğinde ise ($\bar{X}$=137.53) bilgi teknolojileri okuryazarlığı konusunda kendilerini "yüksek" düzeyde yeterliğe sahip bireyler olarak algıladıkları söylenebilir. Alt boyutlar bazında yapılan incelemede ise ölçek bazında elde edilen en yüksek ortalama puanın "Problem Çözme Becerileri" alt boyutunda ($\bar{X}/m$=3.97) olduğu, en düşük ortalama puanın ise "Sürdürebilme ve Transfer Etme Becerileri" alt boyutunda ($\bar{X}/m$=3.22) olduğu görülmektedir.

Tablo 2. Akademisyenlerin Yaşam Boyu Öğrenme Eğilimleri ve Bilgi Teknolojileri Okuryazarlık Düzeylerine İlişkin Ortalamaları

Değişken	*N*	*m*	$\bar{X}$	$\bar{X}/m$	*S*
Yaşam Boyu Öğrenme Eğilimi	408	27	133.49	4.94	9.33
Motivasyon	408	6	31.29	5.22	2.40
Sebat	408	6	30.13	5.02	3.00
Öğrenmeyi Düzenlemede Yoksunluk	408	6	30.01	5.00	3.24
Merak Yoksunluğu	408	9	42.07	4.67	4.38
Bilgi Teknolojileri Okuryazarlığı	408	38	137.53	3.62	9.24
Problem Çözme Becerileri	408	6	23.81	3.97	3.92
İletişim ve Metabilişsel Beceriler	408	4	15.78	3.95	2.58
Temel Bilgi Teknolojileri Becerileri	408	6	21.10	3.52	4.62
Analiz ve Üretim Becerileri	408	7	24.74	3.53	5.00
Bilgi ve İnternet İle İlgili Beceriler	408	12	42.43	3.54	8.20
Sürdürebilme ve Transfer Etme Becerileri	408	3	9.67	3.22	2.82

Not: m=madde sayısı

Akademisyenlerin Yaşam Boyu Öğrenme Eğilimlerinin Demografik Değişkenlerle Karşılaştırılmasına İlişkin Bulgular

Akademisyenlerin yaşam boyu öğrenme eğilimlerinin cinsiyet değişkenine göre farklılaşıp farklılaşmadığının belirlenmesi için araştırmada ilişkisiz ölçümler için Mann Whitney U testinden yararlanılmıştır. Gerçekleştirilen analiz sonucunda elde edilen bulgular Tablo 3'te sunulmuştur.

Tablo 3. Cinsiyet Değişkenin Akademisyenlerin Yaşam Boyu Öğrenme Eğilimlerine Göre U-Testi Sonucu

Değişken	*Grup*	*N*	*Sıra Ortalaması*	*Sıra Toplamı*	*U*	*p<*
Yaşam Boyu Öğrenme Eğilimi	Erkek	233	202.83	47260.50	19999.50	.742
	Kadın	175	206.72	36175.50		
Motivasyon	Erkek	233	203.08	47317.50	20056.50	.777
	Kadın	175	206.39	36118.50		
Sebat	Erkek	233	212.65	49548.00	18488.00	.105
	Kadın	175	193.65	33888.00		
Öğrenmeyi Düzenlemede Yoksunluk	Erkek	233	199.43	46466.50	19205.50	.314
	Kadın	175	211.25	36969.50		
Merak Yoksunluğu	Erkek	233	201.70	46996.00	19735.00	.579
	Kadın	175	208.23	36440.00		

Tablo 3'te yer alan bulgulara göre akademisyenlerin yaşam boyu öğrenme eğilimlerinin ($U=19999.50$, $p>.05$) cinsiyet değişkenine göre anlamlı bir farklılık göstermediği ortaya çıkmıştır. Ölçeğin alt boyutları bazında yapılan incelemede ise, erkek akademisyenler ile kadın akademisyenler arasındaki en büyük fark, ölçeğin Sebat alt boyutunda ortaya çıkmıştır.

Araştırmada akademisyenlerin yaşam boyu öğrenme eğilimlerinin akademik unvan değişkenine göre farklılaşıp farklılaşmadığın incelenmiş ve gerçekleştirilen Kruskal Wallis H testi sonucunda elde edilen bulgular Tablo 4'te sunulmuştur.

Tablo 4. Akademisyenlerin Yaşam Boyu Öğrenme Eğilimlerinin Akademik Unvana Göre Kruskal Wallis H Testi Sonucu

Değişken	*N*	*Sıra ortalaması*	*sd*	χ^2	*p*	*Anlamlı fark*
Prof. Dr. (A)	24	235.04	7	17.29	.016	A-D, A-E, B-D, B-E, C-D, C-E
Doç. Dr. (B)	70	227.91				
Yrd. Doç. Dr. (C)	136	218.41				
Öğr. Gör. Dr. (D)	13	144.65				
Arş. Gör. Dr. (E)	40	160.73				
Öğr. Gör. (F)	65	196.32				
Arş. Gör. (G)	50	186.66				
Okutman (H)	10	173.45				

Tablo 4'te yer alan analiz sonuçları, akademisyenlerin akademik unvan değişkeni ile yaşam boyu öğrenme eğilimleri arasında anlamlı bir fark olduğunu göstermektedir (χ^2(sd=7 n=408)=17.29, p<.05). Gruplar arasında gözlenen farkın kaynağını belirlemek amacıyla, grupların ikili kombinasyonları üzerinden Mann Whitney U testileri uygulanmıştır. Gerçekleştirilen testler sonucunda, profesör, doçent ve yardımcı doçent kadrosuna sahip öğretim üyelerinin yaşam boyu öğrenme eğilimine ilişkin sıra ortalamalarının, doktorası olan, öğretim görevlisi ve araştırma görevlisi kadrolarında görevlerini sürdüren akademisyenlerin yaşam boyu öğrenme eğilimine ilişkin sıra ortalamadan daha yüksek olduğu ortaya çıkmıştır.

Araştırmada akademisyenlerin yaşam boyu öğrenme eğilimlerinin yaş değişkenine göre farklılaşıp farklılaşmadığı incelenmiş ve gerçekleştirilen Kruskal Wallis H testi sonucunda elde edilen bulgular Tablo 5'te sunulmuştur.

Tablo 5. Akademisyenlerin Yaşam Boyu Öğrenme Eğilimlerinin Yaşa Göre Kruskal Wallis H Testi Sonucu

Değişken	***N***	***Sıra ortalaması***	***sd***	χ^2	***p***
30 ve altı	60	185.71	3	2.89	.409
31-40 arası	175	210.30			
41-50 arası	117	211.13			
51 ve üzeri	56	192.64			

Tablo 5'te sunulan bulgular, akademisyenlerin yaş değişkeni ile yaşam boyu öğrenme eğilimleri arasında anlamlı bir fark olmadığını göstermektedir (χ^2(sd=3 n=408)=2.89, p>.05).

Araştırmada akademisyenlerin yaşam boyu öğrenme eğilimlerinin hizmet yılı değişkenine göre farklılaşıp farklılaşmadığın incelenmiş ve gerçekleştirilen Kruskal Wallis H testi sonucunda elde edilen bulgular Tablo 6'da sunulmuştur.

Tablo 6. Akademisyenlerin Yaşam Boyu Öğrenme Eğilimlerinin Hizmet Yılına Göre Kruskal Wallis H Testi Sonucu

Değişken	***N***	***Sıra ortalaması***	***sd***	χ^2	***p***	***Anlamlı fark***
1-5 yıl (A)	76	205.89	4	9.66	.047	A-E, B-E, C-E, D-E
6-10 yıl (B)	63	212.17				
11-15 yıl (C)	126	215.92				
16-20 yıl (D)	74	213.87				
21 yıl ve üstü (E)	69	165.05				

Tablo 6'da sunulan bulgular, akademisyenlerin hizmet yılı değişkeni ile yaşam boyu öğrenme eğilimleri arasında anlamlı bir fark olduğunu göstermektedir (χ^2(sd=4 n=408)=9.66, p<.05). Gruplar arasında gözlenen farkın kaynağını belirlemek amacıyla, grupların ikili kombinasyonları üzerinden Mann Whitney U testileri uygulanmıştır. Gerçekleştirilen testler sonucunda, akademisyenlik görevini 20 ve daha az yıldır sürdüren katılımcıların yaşam boyu öğrenme eğilimlerine ilişkin sıra ortalamalarının, hizmet yılı 21 ve üstü olanlara kıyasla daha yüksek olduğu ortaya çıkmıştır.

Akademisyenlerin Yaşam Boyu Öğrenme Eğilimleri ve Bilgi Teknolojileri Okuryazarlık Düzeyi Arasındaki İlişkiye Yönelik Bulgular

Gerçekleştirilen korelasyon analizinden elde edilen bulgulara göre yaşam boyu öğrenme eğilimi ile bilgi teknolojileri okuryazarlık düzeyi arasında orta düzeyde (r=.367; p<.01), pozitif ve anlamlı bir ilişki olduğu Tablo 7'de görülmektedir.

Tablo 7. Öğretmen Adaylarının Yaşam Boyu Öğrenme Eğilimi ve Bilgi Teknolojileri Okuryazarlık Düzeyi Arasındaki İlişki

	1	2	3	4	5	6	7	8	9	10	11	12
1- Motivasyon		.496**	.293**	.243**	.198*	.111	.225**	.257**	.120	.146	.416**	.218**
2-Sebat	.496**		.196*	.402**	.457**	.309**	.307**	.454**	.338**	.373**	.621**	.481**
3- Öğrenmeyi Düzenlemede Yoksunluk	.293**	.196*		.346**	.204*	.111	.140	.206*	.194*	.145	.534**	.229**
4- Merak Yoksunluğu	.243**	.402**	.346**		.506**	.288**	.108	.173*	.149	.298**	.585**	.333**
5- Problem Çözme Becerileri	.198*	.457**	.204*	.506**		.384**	.274**	.337**	.230**	.468**	.356**	.542**
6- İletişim ve Metabilişsel Beceriler	.111	.309**	.111	.288**	.384**		.290**	.270**	.297**	.334**	.320**	.482**
7- Temel Bilgi Teknolojileri Becerileri	.225**	.307**	.140	.108	.274**	.290**		.590**	.474**	.467**	.153	.667**
8- Analiz ve Üretim Becerileri	.257**	.454**	.206*	.173*	.337**	.270**	.590**		.538**	.455**	.307**	.681**
9- Bilgi ve İnternet İle İlgili Beceriler	.120	.338**	.194*	.149	.230**	.297**	.474**	.538**		.662**	.247**	.698**
10- Sürdürebilme ve Transfer Etme Becerileri	.146	.373**	.145	.298**	.468**	.334**	.467**	.455**	.662**		.257**	.722**
11- Yaşam Boyu Öğrenme	.416**	.621**	.534**	.585**	.356**	.320**	.153	.307**	.247**	.257**		.367**
12- Bilgi Teknolojileri Okur Yazarlığı	.218**	.481**	.229**	.333**	.542**	.482**	.667**	.681**	.698**	.722**	.367**	

* Korelasyon .05 düzeyinde anlamlıdır. ** Korelasyon .01 düzeyinde anlamlıdır.

SONUÇ

Akademisyenlerin yaşam boyu öğrenme eğilimleri ve bilgi teknolojileri okuryazarlık düzeylerinin incelendiği bu araştırmada, katılımcıların hem yaşam boyu öğrenme eğilimlerinin hem de bilgi teknolojileri okuryazarlıklarının yüksek düzeyde olduğu ortaya çıkmıştır. Öte yandan bu bulgular, araştırmanın bir diğer bulgusu olan yaşam boyu öğrenme eğilimlerinin yaşa göre değişmediği bulgusu ile de tutarlıdır. Bu bulgular alanyazın çalışmaları ile de benzerlik göstermektedir (Köğce, Özpinar, Mandaci Şahin ve Aydoğan Yenmez, 2014). Görev tanımı gereği akademisyenler, yükseköğretim kurumlarında öğretim faaliyetlerine katılan, özgün ve alanına katkı yapan araştırmalar gerçekleştiren ve alanındaki gelişmeleri takip ederek bu gelişmeleri derslerine taşımak durumunda kalan kişilerdir. Bu bağlamda, araştırmada elde edilen bu bulguların ortaya çıkmasında, mesleği gereği kendini sürekli geliştirme çabası içinde olan akademisyenin bu süreçte çeşitli bilgi ve iletişim teknolojilerinden de yararlanmasının hem yaşam boyu öğrenme hem de teknoloji okuryazarlığı konusunda kendilerini yüksek düzeyde yeterli görmelerine yol açtığı şeklinde yorumlanabilir.

Araştırmanın bir diğer bulgusu, akademisyenlerin yaşam boyu öğrenme eğilimlerinin cinsiyet değişkenine göre farklılaşmadığıdır. Bu bulgu, Uysal (2013) tarafında gerçekleştirilen ve cinsiyetin akademisyenlerin öze-yeterlikleri üzerinde etkili bir değişken olmadığı sonucu ile benzerlik göstermektedir. Bu bulgunun ortaya çıkmasında, cinsiyetin, mesleğin ihtiyaçlarını yerine getirmede bir engel teşkil etmemiş olmasının etkisi olduğu düşünülmektedir. Başka bir değişle mesleğin gereği olan araştırma ve kendini geliştirme sürecinde bilgi teknolojilerinin kullanımı ve yaşam boyu öğrenme anlamında hem erkek hem de kadın akademisyenlerin kendilerini eşit düzeyde yeterli gördükleri söylenebilir. Öte yandan elde edilen bu bulgu, Konakman ve Yelken (2014) tarafından gerçekleştirilen ve cinsiyetin yaşam boyu öğrenme üzerinde etkili bir değişken olduğunu belirten çalışmanın sonuçları ile örtüşmemektedir. Alanyazın araştırmaları arasında ortaya çıkan bu farkın katılımcıların özelliklerinden kaynaklandığı düşünülmektedir.

Hizmet yılındaki artış ile birlikte akademisyenlerin yaşam boyu öğrenme eğilimlerinin azaldığı bulgusu araştırmanın bir diğer bulgusudur. Elde edile bulgu, 21 yıl ve daha uzun mesleki hizmeti bulunan akademisyenlerin yaşam boyu öğrenme eğilimlerinin meslektaşlarına kıyasla daha düşük düzeyde olduğu ortaya çıkarmıştır. Alanyazın çalışmalarında Sağlam (2011) ile İraz ve Ganiyusufoğlu (2011), mesleki tükenmişliğin bir alt boyutu olan kişisel başarı bağlamında bu araştırmanın bulguları ile örtüşen sonuçları ortaya koymuştur. Bu bulgunun ortaya çıkmasında, kişinin fiziksel gücündeki azalma ya da kariyerindeki olası başarısızlıklar sebebiyle bireyin kendini geliştirme yönündeki motivasyonu, sabrı ve merakındaki azalmanın etkisinin olduğu düşünülmektedir.

Unvan değişkeninin akademisyenlerin yaşam boyu öğrenme eğilimleri üzerinde etkili bir değişken olduğu bulgusu araştırmanın bir diğer önemli bulgusudur. Nitekim araştırmada, yaşam boyu öğrenme eğilimi en düşük düzeyde olan katılımcıların doktorasını tamamlamış fakat ilgili kadrosunu alamamış akademisyenler olduğu ortaya çıkmıştır. Bu bulgu, Sağlam (2011)'ın mesleki tükenmişliğin en az profesör ve doçent unvanlarına sahip akademisyenlerde olduğu en fazla ise doktorasını tamamlamış araştırma görevlilerinde olduğunu belirten araştırmanın sonuçları ile örtüşmektedir. Öte yandan elde edilen bu bulgu Konakman ve Yelken (2014) tarafından gerçekleştirilen ve akademik unvanın yaşam boyu öğrenme üzerinde etkili bir değişken olmadığını belirten çalışmanın sonuçları ile örtüşmemektedir. Alan yazın çalışmaları arasındaki farklılığın ortaya çıkmasında, kariyer gelişimi bağlamında engellendiğini düşünen akademisyenin duygusal tepkilerinin etkili olduğu düşünülmektedir.

Araştırmada ayrıca, bilgi teknolojileri okuryazarlık düzeyi ile yaşam boyu öğrenme eğilimi arasında orta düzeyde ve pozitif yönde bir ilişkinin olduğu ortaya çıkmıştır. İlgili alanyazında Tan ve Morris (2006) ile Günüç, **Odabaşı ve Kuzu** (2012) bilgi ve iletişim teknolojileri ile yaşam boyu öğrenme arasında yüksek düzeyde bir ilişki olduğunu belirtmektedir. Benzer şekilde Mouzakitis ve Tuncay (2011) ile Nordin, Embi ve Yunus (2010) da bilgi ve iletişim teknolojileri sayesinde yaşam boyu öğrenmenin en temel bileşenlerinden biri olan esnekliğin sağlandığını belirtmiş ve iki kavram arasındaki ilişkiye vurgu yapmıştır.

Sonuç olarak, gerçekleştirilen bu araştırmada akademisyenlerin yaşam boyu öğrenme yeterliklerinin ve bilgi teknolojileri okuryazarlıklarının yüksek düzeyde olduğu ve akademik unvan ile hizmet yılının yaşam boyu öğrenme üzerinde etkili değişkenler olduğu ortaya çıkmıştır. Yükseköğretimin kalitesini belirleyen en önemli unsurun, akademisyenlerin gösterdiği performans olduğu göz önüne alındığında, özellikle hizmet yılı artan ve kadrosunu alamayan akademisyenlerin yaşam boyu öğrenen bireyler olma yolunda motivasyonlarının artmasına yardımcı olabilecek çalışmalara ihtiyaç vardır. Ayrıca akademisyenlerin yaşam boyu öğrenme eğilimleri üzerinde etkisi olabilecek diğer değişkenlerin değerlendirildiği nitel ve nicel çalışmaların yapılması önerilebilir.

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WHAT DO PRE-SERVICE ELEMANTARY SCHOOL TEACHERS THINK ABOUT KEEPING JOURNALS?

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ABSTRACT: Language is an essential element of learning. Therefore, educators should use different kind of language activities suc as reading, writing, talking, listening, enacting and visualizing in teaching. Writing is one of these activities. It is aimed to determine pre-service elementary teachers' opinions related to keeping learning journals in Science-Technology-Society-Environment (STSE) lesson. Senior pre-service elementary teachers (N=33) participated in this study. Pre-service elementary teachers kept learning journals at the end of each STSE lesson through one term once a week. At the end of the term, pre-service elementary teachers were asked to answer an online survey which consists of ten open-ended questions to determine pre-service teachers' opinions regarding the implementation. The answers given by pre-service teachers show that pre-service teachers think that learning journals have positive effect on their learning, language and thinking abilities. Some of the pre-service teachers thought that the time for given keeping learning journals was not enough. To overcome this problem giving the learning journals as homework is recomended.

Keywords: Learning journal, elementary pre-service teachers, writing

INTRODUCTION

Language is an important factor in learning. Therefore, educators should use language activities in their professional courses. This can be via reading, writing, talking, listening, enacting and/or visualizing (Norton-Meier, Hand, Hockenberry ve Wise, 2008).

The aim of this study is to use writing activities in classroom environment. The writing has a positive effect on students' learning. Through writing, students can see how they can use their prior knowledge and new knowledge and they think about what they know (Günel, Kabataş Memiş ve Büyükkasap, 2009). Brian Cambourne (1987) listed the essential elements of writing as follows (cited in Norton-Meier et all. 2008):

1. *Immersion.* Students should be faced with different kind of language activities. To enable using language activities in classroom environment, teachers should provide texts, audiences and materials.
2. *Demonstration.* It is not important for students do everything right while they are engaging in writing activities. Teachers should focus on students' learning about using language appropriately.
3. *Expectation.* Teachers should trust all the students that can be successful at language activities.
4. *Responsibility.* Students should be given responsibility for using language in classroom environment.
5. *Use.* It should be known that if students are expected to sit quietly in classroom, they will never attemt to use the language.
6. *Approximation.* Students can learn more from their mistakes rather than their achievements. In this sense, students should be given enough time to confront their misconceptions.
7. *Response.* Feedback should be given to students by their teachers and peers, because feedback is the essential element for the development of the writer.

There are different kinds of writing activities for different purposes including personal writing, two column writing, dialogue writing, whole class writing, particular subject area writing and learning journals (Ünver, 2003).

In learning journals, students write about their learning process, their opinions which change during the learning process and the knowledge they gained. Learning journals do not only consist of gained knowledge but they also consist of students' reflections and analysis about their learning and learning process (Wilson ve Jan, 1993). Learning occurs via journal writing because it provides favorable conditions for learning. Writing journal enables focusing and ordering thoughts and makes sense out of a situation or information. Furthermore journal writing encourages reflection which is associated with the deep approaches to learning. In addition to this, writing forces learner to clarify his/her thoughts and it enables learner to understand if s/he does or does not understand the subject (Moon, 2010). According to Boud (2001, p.9) "Journal writing can be used to enhance what we do and how we do it. As a vehicle for lerning, it can be used in formal courses."

In this study, to enable elementary pre-service teachers to successfully negotiate meaning in the STSE course, they were asked to record their initial understanding by using learning journals (Norton-Meier et all., 2008). The aim of this study was to determine elementary pre-service teachers' opinions about keeping learning journals on STSE lesson.

METHOD

This study was based on qualitative research approach. Qualitative approach allows studying the subject in depth and detail. But if it is compaired with quantitative methods it can be seen that qualitative approach allows studying with participant and case. Studying with fewer participants enables to understand the cases deeply but it limits its generalizability. In this study, phenomenographic metod which is one of the qualitative approaches was used. Phenomenographic metod focuses on people's descriptions on what they have experienced (Patton, 2002).

Participants

This study was conducted with 33 senior pre-service elementary teachers (20 female and 13 male) in an education faculty which is located in Blacksea Region of Turkey. Seven of these pre-service teachers have never kept journal before this research, ten pre-service teachers have tried journal keeping but could not continue to keep after one or two times. The remaining 16 pre-service teachers have an experience on keeping journals regularly.

Implementation Process

This study was conducted in 2013-2014 term with senior pre-service elementary teachers in STSE course. One of the researchers was the lecturer of the course. STSE course was held once a week for two hours. The pre-service teachers were informed about what learning journal is and how to prepare it at the beginning of the semester. They were asked to prepare learning journal every week after STSE course. In journals they were asked to write what did they learn in each session and they also encouraged adding their reflections on their learning. These journals picked up by the research assisstant of the course (one of the researchers of the study). The journals that were prepared by the pre-service teachers were graded by using a likert scale which is developed by one of the researchers (see Table 1).

Table 1. Likert scale for assessment of the learning journals

Score	Description
4 points	Demonstrates complete understanding of the content of the course
3 points	Demonstrates considerable understanding of the content of the course
2 points	Demonstrates partial understanding of the content of the course
1 point	Demonstrates little understanding of the content of the course
0 point	Demonstrates no understanding of the content of the course

Pre-service teachers were also given written feedback to their journals. The journals were given back to pre-service teachers, in the next STSE class. At the beginning of the class pre-service teachers read one of their friends' journals. The study lasted one term. At the end of the term pre-service teachers were asked to answer an online survey which was developed by one of the researchers to determine pre-service teachers' opinions related to the implementation process. The implementation process is summarized in Figure 1.

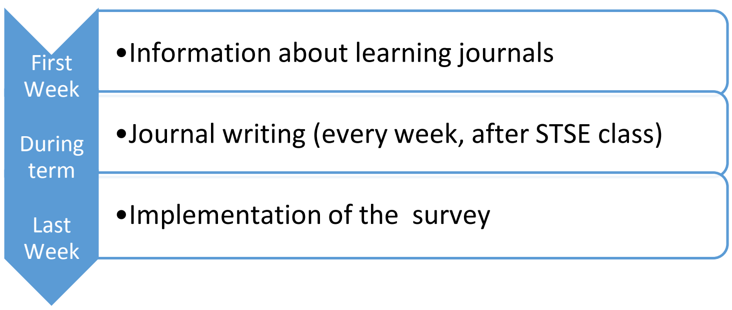

Figure 1. Summary of Implementation Process

Data Collection Tools

In this study an online survey, which was developed by the researchers of the study, was used. Questions were examined by an expert in scinece education and revised. In the survey there were ten open ended questions. Some of these questions are as following

- Considering your experiences in this lesson, are you going to use learning journals in your professional life? Please explain the reasons of your answer.
- What do you think about using learning journals as an assessment tool? Please explain in detail.
- What do you think about the defective points of keeping learning journals? Please explain in detail.

Data Analysis

The data was analysed through content analysis. By reading pre-service teacher's online entries started the analyse process. Codes were determined by classifying the entries according to their similarities and differences and the frequency of the codes were calculated. Then themes were determined according to the similar features (Johnson ve Christensen, 2014). These themes were then examined by the other researchers as an external observer, and the researchers finalized the themes through discussion.

FINDINGS

In this section, findings gathered from pre-service teachers' responses to the online survey are presented. 33 pre-service teachers responded to the online survey. Analysis of these entries was carried out according to nine themes, found out from data analysis,including first impressions, learning, evaluation, professional life, reflecting ideas, language skills, thinking skills, inconveniences, and suggestions. In Table 2, each theme, the codes gathered under each theme, the frequency of the codes in the entries and illustrative quotes from the entries are presented.

First impressions

The first impressions theme involves pre-service teachers' opinions about their first impressions according to journal writing. There were three main repeated codes under the first impression theme: difficult, useless, and refrain from the reader. The frequencies of these codes are outlined in Table 2. Each code gathered under this theme is explained.

Difficult: The pre-service teachers mentioned that at the beginning of the term they found journaling difficult but later they gained experience and learned how to write (f=7).
Useless: The pre-service teachers mentioned that they find writing journal as a useless activity at the beginning of the implementation but later their opinions changed in positive way when they saw the benefits of journaling in the process (f=3).
Refrain from the reader: The pre-service teachers expressed that at the beginning of the implementation they hesitated to share their writing with the researcher (f=2).

Table 2. Pre-service teachers' opinions related to keeping journals

Theme	Code	f	Quotes from the online survey
First impressions	Difficult	7	At first, I did not know how to start (my journal), how to express (what I know). In time I learned what I need to write and how can I tell it. (P2)
	Useless	3	At first I tought that keeping journal is worthless and meaningless. (P14)
	Refrain from the reader	2	There is no problem about how to keep it (journal) but knowing that it is going to read by someone else challenged me. (P10)
Learning	Understanding and reinforcement	27	It is effective in developing understanding because it impulses you to listen the course both for learning and finding something to write (in journal). (P3)
	Permanent learning	18	I think that it has provided more permanent learning. (P11)
	Self-evaluation	7	…in every lesson writing what I have learned about the lesson has showed me what I have learned and have not learned. (P23)
	Ineffective	2	I don't think that keeping journal is effective on understanding and reinforcing the subject of the lesson. (P16)

Evaluation	Should not be used	11	Being evaluated by using journals may be not reliable. It may be not trustable to use the journals for students' understanding. (P31)
	Should be used	9	…the journals can be used for evaluating learning. Because some people has board phobia or some can not talk in front of the community… (P29)
	Should not be used alone	4	Journaling is a very good application as a part of evaluating learning but using merely journals for evaluation can not be enough. (P1)
Professional life	Will be use	24	I think (I will use journals) but it will be better to ask to write journals home rather than in class. (P8)
	Will not be use	3	No I do not think (to use journals). It takes a lot of time. (P7)
	Indecisive	2	I am indecisive in this subject because it might be beneficial for some courses and it might not be beneficial for some other courses. (P2)
Reflecting ideas	Effective	24	I can better evaluate and express myself. (P12)
	Ineffective	5	Obviously I do not think (that journaling is effective for reflecting ideas better). That's may be about my negative precudice to writing. (P11)
Language skills	Effective	27	…Yes I think (that it impoves language skills)… When I read what I wrote my journal last week, I saw some meaningless sentences there and I think that my writing will improve through writing. (P5)
	Ineffective	1	I think that journals do not any addition to the development of language abilities. I use the same vocabulary which I used before journal keeping. (P16)
Thinking skills	Effective	15	It is an effective method because it was a review of the course and it helped us to express ourselves. (P19)
	Ineffective	3	I do not think that it is effective for developing critical thinking or reflection. ..I think this make our learning permanent. (P11)
Inconveniences	Sometimes boring	12	Sometimes people do not want to speak with themselves at these times keeping journal is becomes a boring activity. (P4)
	Insufficient time	11	…the most problematic thing is (insufficient) time and the abstract words related to the content of the lesson. (P33)
	Insufficient feedback	5	…the feedback given the journals should be better and explanatory. (P19)
Suggesions	Reducing the course time	6	It is tiring to write journals after the lesson which takes one and a half hour. Writing the journals at the last 20 minutes of the course should be more effective. (P27)
	Different content	4	Instead of writing about the content of the course it would be better to answer a question about the subject by writing. (P14)
	Training for journaling	3	students should be informed more about journaling and the importance of reflective thinking should be emphasized. (P4)
	Journal as an homework	3	Instead of writing journals at the end of the course, it would be more benefical if it is given as homework. (P13)
	Verbal feedback	2	…I think that students need to get verbal feedback about their writing. (P30)
	Voluntary	2	I think it would be better if it is not compulsory. (P10)

Learning

Pre-service teachers mentioned the effects of journaling on learning. These ideas are presented under learning theme. There are four main tendencies under this theme: understanding and reinforcement, permanent learning, self-evaluation, and ineffective.

Understanding and reinforcement: The pre-service teachers frequently mentioned that preparing learning journals enabled them to better understand the lesson and it helped them to reinforce their learning (f=27).
Permanent learning: As seen in Table 2, 18 pre-sevice teachers stated that journaling makes learning permanent.
Self-evaluation: Occassionaly pre-service teachers wrote that journaling enabled them to evaluate their own learning (f=7).
Ineffective: As can be seen in Table 2. Two pre-service teachers did not find journaling effective on learning process.

Evaluation

As can be seen in Table 2, the evaluation theme is about views of using journals as assessment tools. The participants' views were coded in three actions.

Should not be used: Pre-service teachers (f=11) mentioned that journals are not good assessment tools because assessing by journals may be not reliable.
Should be used: Pre-service teachers (f=9) mentioned that journals are useful assessment tools.
Should not be used alone: Some pre-service teachers (f=4) mentioned that journals are useful assessment tool when they are used with other assessment tool(s).

Professional life

The Professonal life theme is consists of pre-service teachers views about using learning journals in their classroom in the future.
Will use: Pre-service teachers mentioned that they will use learning journals in their professional life (f=24).
Will not use: Pre-service teachers mentioned that they will not use learning journals in their professional life (f=3).
Indecisive: Two pre-service teachers stated that they are indecisive about using learning journals in their classrooms in the future (f=2).

Reflecting ideas

The Reflecting ideas theme is consists of pre-service teahers' opinions about the effect of journaling on reflecting ideas.
Effective: Most of the pre-service teachers indicated that journaling is effective in development of reflecting ideas. Pre- service teachers mentioned that writing made them start to think. Some of the pre-service teachers emphasized the benefits of journaling for pre-service teachers who are refrain from saying what he/she thinks (f=11).
Ineffective: Five pre-service teachers stated that they did not find journals effective in the development of reflecting ideas. Four pre-service teachers said that that's why they wrote their journals reluctantly. The other pre-service teacher indicated that it was difficult to reflect for him because the subject was difficult and he couldn't understand it very well.

Language skills

The Language skills theme is consists of pre-service teachers' opinions about the effect of journaling on language skills.
Effective: Pre-service teachers found journaling effective on language skills' development. They thought that by writing, they learn some new vocabulary and they improve their writing. Also they thought that reading old journals give them opportunity to see their grammer mistakes and meaningless sentences.
Ineffective: One pre-service teacher did not find journaling effective on the development of language skills.

Thinking skills

The Thinking skills theme consists of the pre-service teachers' opinions about the journals effect on thinking skills. As seen in Table 2, there are two repeating codes under the Thinking skills theme: Effective (f=15) and Not effective (f=3).
Effective: Pre-service teachers stated that by writing, they ask themselves what they learned and how they learned so this improved their thinking skills. Also they discussed course subject in each journal and this also improved their thinking skills.
Ineffective: Pre-service teachers who didn't find journaling beneficial for the development of thinking skills found journaling just as a summarizing process.

Inconveniences

Although in general pre-service teachers have positive opinions about keeping journals, some of them have some negative opinions. In Inconveniences theme pre-service teachers mentioned the failing points of the implementation process.
Sometimes boring: Pre-service teachers indicated that writing journals was sometimes boring (f=12).
Insufficient time: Pre-service teachers mentined that the time given for writing journals in class was not enough (f=11).
Insufficient feedback: Some pre-service teachers indicated that feedbacks were not interpretive enough (f=5).

Suggesions

Pre-service teachers made some suggesions for making journaling more effective method in STSE lesson. These are classified in Suggesions theme.
Reducing the course time: Some pre-service teachers suggested reducing the course time and increasing the time for journal writing (f=6).
Different content: A few of the participants suggested the instructor should prepare questions for journals (f=4).
Training for journaling: Three participants noted that it would be better to train pre-service teachers longer at the beginning of the implementation.
Journal as homework: Few participants mentioned that it would be better to write journals at home rather than in class (f=3).
Verbal feedback: Only two participants indicated that it would be better to provide verbal feedback in addition to written feedback.
Voluntary: Another two pre-service teachers suggested that journaling shoud be voluntary.

DISCUSSION AND CONCLUSIONS

When the data from the survey is examined it can be seen that pre-service teachers have generally positive views about keeping learning journals in STSE lesson. Most of the pre-service teachers felt that writing learning journals had a positive effect on their learning (see Table 1). Pre-service teachers mentioned that they learned from writing of learning journals when they first do the writing and when they re-read what they have written (URL-1). Pre-service teachers focused on different features of writing journals as an indicator of learning. As they stated, writing journals gave them opportunity to compare their prior knowledge and new knowledge, think about what they know, fix up their thoughts and so they can make sense of knowledge by writing (Günel ve ark., 2009; Moon, 2007). Also some pre-service teachers indicated that by showing the weak points of the learner, the journals impulse them for studying (Wilson and Jan, 1993). Based on the findings, we can conclude that writing journal in the STSE class had a positive effect on the pre-service teachers' learning skills.

Further more, most of the pre-service teachers indicated that journal writing helped them to develop higher order thinking skills. They mentioned that they found the answers of questions such as 'what did I learn' and 'how did I learn' while writing journals. As Gleaves, Walker and Grey (2008) mentioned that journal writing is a reflexive meta-cognitive strategy by enabling students to critically review processes of their own learning and to understand their ability to transform their own learning strategies. So it can be said that learning journals improved pre-service teachers' metacognitive thinking skills. In literature similar results were reported by Amedeo, (1996) and Lew and Schmidt (2011).

Most of the pre-service teachers think that writing journal improves their language skills. Pre-service teachers mentioned that journaling also improves their writing skill which is one of four language systems (speaking, listening, reading, and writing). Pre-service teachers did not recognized any effect of journaling on their speaking, listening and reading but it is known that four language systems, speaking, listening, reading and writing develop in overlapping and parallel waves (Berlinger, 2000). Similar results were found by Kozan (2007). We can conclude that pre-service teacher' language skills -especially writing skill- were improved by journaling.

Pre-service teachers' frequently mentioned that they get bored while journaing and they find the time given for keeping journals insufficient. In this study each week STSE lesson was lasted one and a half hour and at the end of this session pre-service teachers are asked to keep journals in 30 minutes. Pre-service teachers indicated that they get tired after one and a half hour session and find keeping journal tiring. Cengiz and Karataş (2015) determined that pre-service teachers sometimes get bored when keeping journals, in their study which they were conducted with pre-service science teachers in General Chemistry Class.

Some of the pre-service teachers stated that they had negative attitude toward keeping journals at the beginning of the implementation but in time they saw the benefits of keeping journals and their opinions were changed. The reason might be related to half of the pre-service teachers who did not keep journals regularly before this implementation. So, at the begining they had difficulty about what to write and others whoread their journal made them worried. As Boud (2001) stated that "The expectation of writing for an external audience profoundly shapes what we write and even what we allow ourselves to consider (p.15)."

Pre-service teachers were divided into nearly equal two groups according to their views about using journals as an assessment tool. One half of the pre-service teachers did not find journals as an appropriate assessment tool.

Cengiz and Karataş's (2013) study showed that when journals are not scored by the instructors, students do not pay enough attention to preparing them. As Boud (2001) stated that "The conventions of assessment demand that students display their best work for it to be judged (p.16)."

SUGGESIONS

Whether the benefits of learning journals, pre-service teachers' found some inconveniences about the implementation process. Based on these findings and our discussions we have some suggestions for improving journaling implementation STSE lesson;

- Journals can be given as homework in further studies to give more time for student to prepare them.
- More extensive training for journaling can make the journaling process more beneficial.
- First weeks of the implementation, the journals may not be scored. So pre-service teachers' may have better attitudes towards journaling.
- It is worth examining effects of verbal feedbacks in addition to written ones about their journals as few of the participants suggested.

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A GENERAL VIEW OF COMPUTER FORENSICS EDUCATION IN TURKEY: EXIGENCE OF COMPUTER FORENSICS AND ITS EDUCATION

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ABSTRACT: Nowadays, information technologies as a part of the social life cause to many negative situations, along with their benefits on people lives. They have spread in the whole branches of the society fast and now they become essential for it. Moreover, security gaps in information systems are abused by some people and people have started perpetration via information systems. Crimes that are committed via information technologies are called as cyber crimes. As time passes by, cyber crimes' danger and number increase as a new crime type and also more complicated structure of cyber crimes becloudes their detection. This difficulty reveals needs of computer forensics expert who capable to struggle with these types of crimes. Computer forensics is an interdisiplinary science and to be capable in this branche possible with having knowledge of law, information systems and criminology. Therefore, education of computer forensics becomes a necessity to train qualified individuals in this branche that needs existence of experts. In this study, the processes of computer forensics are analysed by explaining "computer forensics" term, at first. Thereafter, current situation is evaluated by discussing exigence and importance of the computer forensics education in Turkey.

Key words: computer forensic, computer forensics education, cyber crime

TÜRKİYE'DE ADLİ BİLİŞİM EĞİTİMİNE GENEL BİR BAKIŞ: ADLİ BİLİŞİMİN VE ADLİ BİLİŞİM EĞİTİMİNİN GEREKLİLİĞİ

ÖZET: Günümüzde sosyal yaşamın bir parçası haline gelen bilişim teknolojileri, insan hayatına fayda sağlamasının yanı sıra birçok olumsuzluğu da beraberinde getirmiştir. Toplumun her kurumuna hızlı bir şekilde yayılan bilişim teknolojileri, toplum için vazgeçilmez bir hal almıştır. Öte yandan, bilişim sistemlerinde oluşan güvenlik zaafiyetleri kötü niyetli insanların dikkatini çekmiş ve artık bilişim sistemleri üzerinden suç işlenmeye başlanmıştır. Bilişim teknolojileri kullanılarak işlenen suçlar, diğer adıyla siber suçlar, yeni bir suç türü olarak tehlikeli bir hal almış ve sayı olarak günden güne artmıştır. Siber suçların zamanla karmaşık bir hal alması durumu ise, bu suçların tespitini zorlaştırmıştır. Bu durum; siber suçlarla mücadele edebilecek yeterliliğe ve beceriye sahip, adli bilişim uzmanı ihtiyacını doğurmuştur. Adli bilişim, birden fazla alanı kapsadığı için disiplinler arası bir bilim olma özelliği taşımaktadır. Bu alanda yetkin sayılabilmek; hukuk, bilişim sistemleri ve kriminoloji(suç bilimi) alanlarında ileri düzeyde bilgi sahibi olmayı gerektirmektedir. Bu sebeple, adli bilişim eğitimi, bilirkişi ihtiyacı olan bu alanda nitelikli birey yetiştirmek için bir gereklilik halini almıştır. Yapılan çalışmada öncelikle adli bilişim kavramı açıklanarak, adli bilişim süreçleri incelenmiştir. Daha sonra ise, Türkiye'de adli bilişim eğitiminin gerekliliği ve önemi tartışılarak mevcut durum değerlendirmesi yapılmıştır.

Anahtar sözcükler: adli bilişim, adli bilişim eğitimi, siber suçlar

GİRİŞ

Son dönemlerde bilişim teknolojilerinde yaşanan hızlı gelişme, suç işlemeye eğilimli kişilerin ilgisini çekmekte ve normal yollarla işlenmesi daha güç olan suçlar bilişim teknolojileri sayesinde daha kolay işlenebilir hale gelmektedir. Geleneksel suçların aydınlatılmasında fiziksel delillerden faydalanılırken, bilişim teknolojileri üzerinde işlenen suçların çözüme kavuşturulması için elektronik delillere ihtiyaç duyulmaktadır. Elektronik deliller ise bir elektronik aygıt üzerinde saklanıp bu aygıtlar vasıtasıyla iletilen ve soruşturma kapsamında değeri olan veriler (Keser Berber, 2004) olarak tanımlanabilmektedir. Klasik delillerin, elle tutulup gözle görülüyor olmaları dolayısıyla tespitleri, el koyma ve muhafaza altına alma işlemleri kolaydır. Ancak dijital delillerde bu durum farklılık göstermektedir. Dijital delillerin ortaya çıkartılabilmesi için birkaç katmandan oluşan inceleme sürecinin gerçekleştirilmesi gerekmektedir. Dijital delillerin adli bir vakada delil olarak kullanılabilmeleri için, fiziksel delillerin sahip olması gereken özelliklere de sahip olmaları gerekmektedir. Bu özellikler:

1. Kabul edilebilir: Hukuki kurallara uygun şekilde elde edilmelidir.
2. Gerçeklik: Adli vaka ile ilgili ve diğer belgelerle ilişkilendirilebilir nitelikte olmalıdır.
3. Bütünlük: Elde edilmiş olan veriler tarafsız ve adli vakayı yansıtır şekilde olmalıdır.

4. Güvenilir: Elde edilmesi sırasında herhangi bir kuşkuya yer verilmeyecek şekilde hareket edilmelidir.
5. İnanılır: Adli merciler tarafından inandırıcı ve anlaşılabilir nitelikte olmalıdır (Brezinski & Killalea, 2002).

Dijital deliller elektronik bir yapı içerisinde saklandıklarından, ortam koşullarından ve geçen zamandan olumsuz etkilenmekte ve kolaylıkla zarar görebilmektedirler. Bu sebeple adli bilişim olarak adlandırılan ve bilgisayar sistemlerinden delillerin elde edilerek, yargıya intikal ettirilme süreci olarak tanımlanan adli bilişim süreci titiz bir çalışma gerekmektedir. Mahkemeye sunulacak delillerin suçun aydınlığa kavuşturulmasındaki önemi ve bu delillerin ortaya çıkarılma sürecinin hassasiyeti göz önüne alındığında bu sürecin ancak adli bilişim uzmanlarınca yürütülmesi gerektiği unutulmamalıdır. Gerçekleştirilen adli bilişim süreci; olay yerine ilk müdahale ile başlayarak, olay yerinde delil olma niteliğini gösterebilecek elektronik aygıtlara el konulması, bu medyaların laboratuvar ortamında veya olay yerinde incelenmesi, sonuçların analiz edilmesi ve bu işlemler sonucunda elde edilen delillerin mahkemeye sunulması için rapor haline getirilmesi olarak özetlenebilmektedir.

Adli bir vakada bilgisayar sistemlerinin olayla ilgisi iki şekilde olabilmektedir. Bunlar;

6. Bilgisayar veya diğer elektronik cihazların suçun işlenmesinde kullanılması
7. Bilgisayar veya diğer elektronik cihazların geleneksel suçlarda yardımcı unsur olarak kullanılması sonucu, delil niteliğinde bilgileri bulundurması (Aydoğan, 2009)

ADLİ BİLİŞİM

Adli bilişim; bilişim sistemlerinin, herhangi bir suçu işlemede veya yasaklanmış bir faaliyette kullanılıp kullanılmadığının tespiti üzerine çalışmaların yürütülmesini içermektedir (Henkoğlu, 2014). Temel amacı dijital veriler ile vaka arasındaki bağlantıyı bulmak, bu doğrultuda vakanın çözümüne ışık tutabilmektir. Terim olarak İngilizce "Computer Forensic" deyiminden Türkçeye kazandırılmıştır. Adli bilişimin genel bir tanımını yapmak gerekirse adli bilişim; vakada delil olarak kullanılabilecek bulguların elde edilmesi amacıyla, bilgisayar inceleme ve analiz teknikleri kullanılarak yapılan bir uygulamadır (Keser Berber, 2004). Adli bilişim bilgisayardaki verilerden delillerin elde edilmesini, dökümantasyonunu ve yorumlanmasını içermesinin yanında; hukuki kuralları dikkate alarak, elde edilen deliller hakkında rapor yazılmasını da kapsamaktadır.

Adli Bilişim Aşamaları:

Adli bilişim süreçlerini tanımlamaya yönelik farklı yaklaşımlar geliştirilmiştir. Bu yaklaşımlar temelde birbirine benzemektedir. Ancak izlenecek teknik ve yöntemler farklı aşamalarda ele alınmıştır. Bazı kaynaklar bu süreçleri üç aşamada (Henkoğlu, 2014) değerlendirirken, bazı kaynaklar dört aşamada (Brown, 2006) ele alabilmektedir. Bu çalışmada adli bilişim aşamaları Elde Etme(Acquisition), Tanımlama(Identification), Değerlendirme (Evaluation) ve Sunum (Presentation) olmak üzere dört aşamada değerlendirilecektir.

Elde Etme(Acquisition)

Adli bilişimde elde etme aşaması, olay yeri çalışmaları ile başlamaktadır. Olay yerindeki dijital delil içerebilecek bilişim malzemelerine belirli kurallara göre müdehale edilmekte ve yine belirli kurallara göre delillerin bozulmaması, değiştirilmemesi için özel bir taşıma prosedürü uygulanmaktadır. İnceleme yapmak üzere adli bilişim laboratuvarlarına getirilen bilişim malzemelerinin mühürleri açılmakta ve olayın çözüme kavuşturulmasında ihtiyaç duyulan dijital delillerin ortaya çıkartılması için analizlere başlanmaktadır. Yapılan analizler, sistemin veri depolama birimlerinin birebir alınmış kopyaları üzerinde gerçekleştirilmelidir. Bu kopyalara adli bilişimde "imaj (Forensic Image)" adı verilmektedir. Birebir alınmış kopya üzerinde orijinal medyada bulunmayan en küçük bir bilgi olmamalıdır. Doğru bir imaj alma işlemi, orijinal medya üzerinde en ufak bir değişiklik yaratmamalıdır (Altheide & Carvey, 2011).

Tanımlama (Identification)

Elde etme aşaması sonucunda elde edilen ham veriler tanımlama aşamasında anlamlı verilere dönüştürülmektedir. Bu safhada yapılan analizler yalnızca kayıtlı veriler üzerinde değil de silinmiş veya disk üzerinde artık olarak kalmış veriler üzerinde de çalışılmaktadır. Yapılan inceleme ve analizler özel adli bilişim yazılım ve donanımları ile yapılmaktadır. İnceleme ve analizde kullanılan yazılım ve donanımların sınırları iyi bilinmeli ve sadece tek bir yazılım veya donanıma bağlı kalınmamalıdır. Her yazılım kendi içinde farklı becerilere sahiptir. Bu yüzden farklı yazılımlar kullanarak farklı sonuçlara ulaşılabilir. Bu doğrultuda; adli bilişim uzmanları için hangi durumda hangi yazılımı kullanacağı bilgisi önem arz etmektedir (Jones, Bejtlich, & Rose, 2006).

Değerlendirme (Evaluation)

Bu aşamada, elde edilen dijital delillerden hangilerinin delil olarak adli mercilere sunulacağına karar verilmektedir. Karar aşamasında önemli olan, adli mercilere sunulan delillerin olayın çözümüne ışık tutabilecek nitelikte olmasıdır. Bu doğrultuda; suç ile ilişkili olabilecek dosya içeriği, dosya erişim bilgileri, internet geçmişi bilgileri, mesaj bilgileri gibi veriler analiz edilerek, delil olarak hangilerinin kullanılacağına karar verilmektedir (Aydoğan, 2009).

Sunum (Presentation)

Sunum safhasına gelindiğinde artık, olayla bağlantısı bulunan dijital deliller tespit edilmiştir. Bu aşamadan sonra yapılacak olan elde edilen bulguların adli mercilere rapor halinde sunulmasıdır. Burada dikkat edilmesi gereken nokta, sunulacak olan raporun belli standartlara göre oluşturulması ve adli makamların anlayabileceği şekilde yazılmasıdır. Adli bilişim sürecinde amaç; suç vakasından sorumlu kişi ya da kişilerin kesin olarak bulunmasına yönelik, bilişim sistemleri üzerindeki delillerin dökümante edilmesi amacıyla yapılan sistematik bir araştırmadır (Jadhav & Patil, 2012). Bu doğrultuda sunum aşaması; adli mercilere sunulmak üzere, suçun aydınlatılmasını sağlayacak olan delillerin bilimsel olarak ortaya konmasıdır.

NEDEN ADLİ BİLİŞİM?

İşlenen suçların çözüme kavuşturulması için ihtiyaç duyulan elektronik delillerle karşılaşma sıklığı, teknolojinin gelişimi ile doğru orantılı olarak artmaktadır. Bu durum; Bilişim sistemleri üzerinde bulunan dijital verilerin toplanması, delilleştirilmesi ve raporlandırılması aşamalarını kapsayan adli bilişim biliminin öneminin giderek artmasına sebep olmuştur. Adli bilişimin konusu olabilecek her türlü elektronik medyanın günlük hayatın her noktasında kullanılıyor olması, önemli boyutlarda maddi ve manevi kayıplara sebep olabilecek bilişim suçlarının işlenme oranı da artmaktadır. Ancak bu noktada adli bilişim açısından sadece bilişim suçlarını değerlendirmek doğru olmayacaktır. Bilişim sistemleri sadece bilişim suçlarını işlemede değil diğer birçok suç türünün de işlenmesinde yardımcı unsur olarak kullanılabilmektedir. Bu doğrultuda bu suçların çözüme kavuşturulmasında adli bilişim tekniklerinden her geçen gün daha fazla faydalanıldığını söylemek mümkün olacaktır.

Adli bilişim süreçlerinde uygulanan yöntemler de gelişen teknolojiyle birlikte değişime uğramaktadır. Bu sebeple yeni yöntem ve tekniklerin sürece entegre edilmesi önemli bir konudur. Aksi durumda elde edilmesi beklenen elektronik delilleri elde etme konusunda sıkıntılar yaşanabilmektedir. Bu doğrultuda gelişimini henüz tamamlamamış olan adli bilişim, teknik gelişmelere bağlı olarak kendini yenileyebilmek ve değişen ihtiyaçlar doğrultusunda ilerleme kaydedebilmek için ancak kendini bu alanda yetiştirmiş olan ve adli bilişim uzmanı olarak adlandırabileceğimiz bireyler sayesinde ilerleme kaydedecektir.

Adli bilişim uzmanlığı, adli bilişim aşamalarında yalnızca teknik açıdan değil hukuk alanında bilgi ve beceriye sahip olma zorunluluğunu da içeren bir uzmanlık alanıdır. Bu sebeple adli bilişim uzmanlarından faydalanılması, adli mercilere katkı sunmakla kalmayıp; bilişim hukuku, bilişim suçları ile mücadele ve adli bilişim uygulama alanlarında daha güçlü ve bilinçli kadrolardan oluşan hukuku sisteminin oluşmasına katkı sağlayacaktır (Henkoğlu, 2014). Adli bilişim uzmanlarınca gerçekleştirilen, adli bilişim sürecinde yapılan tüm işlemler genel kabul edilen yöntemler kullanılarak yapılmalıdır. Ayrıca dijital delillerin kolaylıkla değiştirilebilmesinin ve yok edilebilmesinin mümkün olması, adli bilişim süreçlerinin belli prosedürler içinde yapılmasını gerekli kılmaktadır. Bu sebeple adli bilişim alanında sadece adli bilişim eğitimi almış kişilerin görev alması, adli bilişim süreçlerinin doğru işlemesine, delillerin güvenirliğinin artmasına ve bu konuda bilinçliliğin artmasına katkı sağlayacaktır.

TÜRKİYE'DE ADLİ BİLİŞİM EĞİTİMİ

Bilişim sistemleri vasıtası ile işlenen suçlar yalnızca sayı bakımından değil, çeşitlilik bakımından da artış göstermektedir. Bu alandaki suç türleri çoğaldıkça, bu suçlar karşısında gerekli tedbirleri zamanında ve etkin biçimde almak da zorlaşmaktadır. Bilişim sistemleri vasıtası ile işlenen suçlar karşısında yeterli eğitimi hem deneysel hem de uygulamalı olarak uzmanlaşmış eleman bulmak her geçen gün daha da güçleşmektedir. Bu doğrultuda siber suçlarla mücadele edebilecek beceri ve eğitimi bu alanda çalışanlara kazandırmak gerekmektedir. Bu amaçla adli bilişim alanında çeşitli düzeylerde eğitim ve öğretim verilmesi kaçınılmazdır (Varol, Cooper, & Varol, 2013).

Teknolojinin sürekli gelişimi, bilgisayar sistemleri yolu ile işlenen suçların dünyada olduğu gibi ülkemizde de yaygın olarak görülmesine sebep olmuş ve adli bilişimin ülkemizde önemli bir bilim dalı haline gelmesine zemin hazırlamıştır. Bu doğrultuda ülkemizde son yıllarda adli bilişim eğitimi alanında yapılan çalışmalar artmış, adli bilişim veya adli bilişime yakın olan siber güvenlik, bilgi güvenliği ve bilişim hukuku alanlarında lisans, yüksek lisans ve doktora programları oluşturulmaya başlanmıştır (Çakır, Orakcı, & Kök, 2016).

Ülkemizde adli bilişim eğitimini veren lisans ve yüksek lisans düzeyinde sınırlı sayıda üniversite bulunmaktadır. Doktora düzeyinde program ise yalnızca Gazi Üniversitesi bünyesinde bulunan Bilişim Enstitüsünde bulunmaktadır. Ülkenin adli bilişim uzmanına duyduğu ihtiyaç düşünüldüğünde, hali hazırda bulunan eğitim programlarının yetersizliği göze çarpmaktadır. Bu alanda duyulan ihtiyacın giderilmesi için adli bilişim alanında her düzeyde yeni programların oluşturulması gerekmektedir. Mevcut durumda adli bilişim alanında eğitim öğretim veren üniversiteler aşağıdaki tabloda gösterilmiştir.

Tablo 14. Adli Bilişim Eğitimi veren Üniversiteler

Üniversite	Fakülte/Yüksekokul	Program	L / YL/ DR
Fırat Üniversitesi	Fen Bilimleri Enstitüsü	Adli Bilişim Müh.	L
Mustafa Kemal Üniversitesi	Bilişim Teknolojisi Yüksekokulu	Adli Bilişim	L
Gazi Üniversitesi	Bilişim Enstitüsü	Adli Bilişim	YL
Turgut Özal Üniversitesi	Fen Bilimleri Enstitüsü	Adli Bilişim Müh.	YL
Atatürk Üniversitesi	Sosyal Bilimler Enstitüsü	Güvenlik ve Adli Bilimler	YL
Ankara Üniversitesi	Adli Bilimler Enstitüsü	Adli Bilişim	YL
Gazi Üniversitesi	Bilişim Enstitüsü	Adli Bilişim	DR

SONUÇ

Bilişim teknolojileri kullanılarak işlenen suçların her geçen gün artması, bu suçlarla mücadele edebilecek beceri ve birikime sahip insan gücü ihtiyacını da her geçen gün arttırmaktadır. Adli bilişim uzmanı olarak adlandırabileceğimiz bu insan gücü sayesinde işlenen suçların çözüme kavuşturulması sağlanabilecektir. Bu bağlamda gelişen teknolojiye uyum gösterebilecek adli bilişim uzmanlarının yetiştirilmesi için Türkiye'de lisans ve lisansüstü düzeylerde programlar oluşturulmaya başlanmıştır. Ancak bu programların sayılarına bakıldığında ülkemizdeki adli bilişim uzmanı ihtiyacını karşılayacak yeterlilikte olmadığı görülmektedir. Ülkemizde adli bilişim eğitiminin daha yaygın ve daha köklü olarak verilmesi, alana uzman yetiştirilmesi açısından ülke gereksinimlerini karşılayacak seviyeye ulaştıracaktır.

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LITERATURE REVIEW ABOUT THE CONCEPT OF GRAVITY IN SCIENCE EDUCATION

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ABSTRACT: The concept of gravity is a subject which has a vital importance for science educators. Because of its nature,students have got understanding and learning difficulty. As the gravity is a concept that we are in a relationship in our daily lives, it is important for science teaching. For this reason, the studies about gravity will be viewed. In this work in the database of Web of Science,Eric and EBSCO untill the 2000 will be analyzed. It is estimated that the results of studies will be shed light on later researches.

Key words: gravity, science education, teaching of concept.

FEN EĞİTİMİNDE YERÇEKİMİ KAVRAMI ÜZERİNE BİR LİTERATÜR TARAMASI

ÖZET: Yerçekimi kavramı fen eğitimcileri için hayati önemi olan bir konudur. Doğası gereği yerçekimi konusunda öğrenciler çok sayıda öğrenme ve anlama güçlüklerine sahiptir. Günlük yaşamımızda sürekli iç içe olduğumuz bir kavram olması nedeniyle fen eğitimi açısından oldukça önemli bir kavramdır. Bu nedenle bu çalışmada fen eğitiminde yerçekimi kavramı ile ilgili yapılan çalışmalar gözden geçirilecektir. Çalışma da 2000 yılından günümüze kadar Web of Science, ERIC ve EBSCO veritabanlarında yer alan çalışmaların analizi yapılacaktır. Çalışma sonuçlarının yerçekimi kavramı ile ilgili bundan sonra yapılacak çalışmalar ışık tutması beklenmektedir.

Anahtar sözcükler: yerçekimi, fen eğitimi, kavram öğretimi.

GİRİŞ

Yerçekimi evrenin başlangıcından günümüze kadar var olmuş olan bir kavramdır. Hayatımızın her döneminde doğumumuzdan ölümümüze kadar aralıksız olarak bu kavramı tecrübe ederiz. Bu şekilde elde ettiğimiz deneyimler sayesinde bu kavram hakkında devamlı olarak kaçınılmaz bir deneysel öğrenme yaşarız. Bu öğrenmelerimiz kişiseldir ve her zaman bilimsel açıdan doğruyu ifade etmemektedir. Doğruyu ifade etmeyen fikirlerimiz eğitim öğretim yaşantılarımız için birer engel oluşturmaktadır. Bu nedenle yerçekimi kavramı ve hakkında edinilen yanlış fikirler üzerine çalışmaların yapılması oldukça doğal bir durumdur. Bu doğrultuda antik yunan filozoflarından günümüze kadar yerçekimi kavramının kendisi ve öğretimiyle ilgili birçok çalışma yapılmıştır.

Bu çalışmada incelenen araştırmalar ilgilenilen konu, çalışmanın gerçekleştirildiği örneklem ve metot olarak yerçekimi kavramı çerçevesinde gerçekleştirilmiş birbirinden farklı araştırmalardır. Yapılan araştırmalara bakıldığında hayatın içerisinde kolayca rastlanabilecek düşen cisimlerden (Cahyadi ve Butler, 2004) ileri düzey öğretim programlarında rastlanabilecek karanlık madde, görelilik, uzay-zaman (Baldy, 2007; Ford, Stang ve Anderson, 2015; Gao, 2013; Pitts, Venville, Blair ve Zadnik, 2013; Williamson, Willoughby ve Prather, 2013) gibi konulara uzanan geniş bir çalışma yelpazesi görülmektedir. Bazı çalışmalar yerçekimi kavramı, yerçekimi kavramının öğretilmesi, yerçekimi kavramı anlamaları ve yanlış kavramaları, problem durumlarındaki kullanımları, tarihsel gelişimi (Apostolides ve Valanides, 2008; Asghar ve Libarkin, 2010; Aydın, Bakırcı, Artun ve Çepni, 2013; Blown ve Bryce, Feeley, 2007; 2012; Kocakülah ve Açıl, 2011; Küçük, 2005; Lelliot, 2014; Öztürk ve Doğanay, 2011; Palmer, 2001; Sharma, Millar, Smith ve Sefton, 2004; Zhou, Zhang ve Xiao, 2015) gibi yerçekimi kavramını doğrudan merkeze alan araştırmalar yapmıştır. Bazıları ise kütle ve ağırlık merkezi, manyetik ve yerçekimsel alan, kuvvet kavramı, fizikte bilgi yapıları, ağırlık tanımı, cismin hareketi ve fen eğitim merkezi kavramları (Blair, De Laeter, Deshon, Meagher, Nicolson ve Cody, 2006; Bradamante ve Viennot, 2007; Galili, 2001; Kırtak ve Kocakülah, 2013; Kikas, 2003; Özdemir, 2007; Özdemir ve Clark, 2009; Mildenhall ve Williams, 2001) gibi içerisinde doğrudan olmasa da yerçekimi kavramıyla ilgili konular incelenmiştir. Bu çalışmada ayrıca yanlış kavramalar, ön öğrenmeler, kavramsal değişim ve öğrenci algıları

(Gönen, 2007; Pocovi, 2007; Varelas, Becker, Luster ve Wenzel, 2002) üzerine yapılmış çalışmalar da incelenmiştir.

Geçen on yıl içinde yapılan araştırmalar öğrencilerin Newton'un üçüncü kanunu hakkında birçok yanlış kavramaya sahip olduğunu göstermektedir. Zhou, Zhang ve Xiao (2015)'in çalışmasındaki bu bulgu tüm sınıflardaki öğrencilerin sayısal olarak yerçekimi etkileşimi hakkında kötü olduklarını göstermektedir. Baldy (2007)'ye göre öğrenciler Einstein'ın uzay-zaman bozulma teorisi ile düşen cisimlerin nedenini, yerçekimi olgusunu ve g.'nin anlamını kavramayı başarabilir. Bu teori ile öğrenciler çekim ile ilgili problemlere daha yetenekli hale gelebilir ve evrenin çalışma prensibi hakkında fikir sahibi olur. Kelimeler her alanda aynı anlama gelmese de kullanılmaya devam eder. Bu sözel bir problemdir. Einstein teorisinin olumlu yanları Newton teorilerinin okulda yer almayacağı anlamına gelmez. Newton fiziği eğitimin belirli düzeylerinde Einstein fiziğinden daha işlevsel olmaktadır. Newton ve Einstein fizikleri birbiri ile uyumsuz görünse de birbirlerini bütünleyici bir role sahiptir.

Einstein fiziği ile ilgili kavramlar genellikle öğrenciler üniversiteye gelene kadar öğretilmez, uzay zaman yerçekimi anlamasının bu güçlü yoluna erişimden genç çocuklar mahrum bırakılmaktadır. Ancak, önemli araştırmalar gösterdi ki karmaşık ve soyut bilim fikirleri ölçülebilir öğrenme ile sonuçlanan yaşa uygun yöntemlerde sunulabilir. Araştırmalar öğrencilerin çoğunun üniversite öncesi için Einstein fiziğiyle ilgili kavramları öğrenmekte kendilerini çok genç hissetmediklerini ve bu konuyu öğrenebildiklerini rapor etmektedir (Pitts, Venville, Blair ve Zadnik, 2013).

Lelliott (2014) yaptığı çalışmada yerçekimi kavramı ile ilgili bazı kavram yanılgıları tespit etmiştir. Bunlar şu şekildedir. A) Uzayda yerçekimi yoktur B) Ay veya diğer gökcisimlerinde yerçekimi yoktur. C) Yerçekimi atmosfer veya cisimlerin özelliklerinden dolayı oluşur. Kırtlak ve Kocakülah (2013) ise çalışmalarında kütle merkezi, ağırlık merkezi ve yerçekimi ile ilgili yanılgılara dikkat çekmişlerdir. Bu çalışmada bulunan yanılgılar şu şekildedir. A) Ağırlık merkezi yerçekimi etkisiyle cismin odak noktasındadır. B) Ağırlık merkezi cisimlerin ağırlıklarının yerçekimi kuvvetine bağlı olarak oluşturdukları yerdir. C) Kütle merkezine yerçekiminin etkisi yoktur. D) Ağırlık merkezi maddenin her yerinde yerçekimi etkisiyle oluşan kuvvetlerin bileşkesinin olduğu yerdir. E) Ağırlık merkezi hesaplamalarında yerçekimi ivmesi kullanılır. E) Yerçekimi ivmesine bağlı olarak kütle merkezi değişmezken ağırlık merkezi değişebilir.

Gao (2013)'e göre yerçekimi kökeni halen tartışılan bir konudur. Farklı kültürlerde bilimsel dünya görüşüne sahip öğretmenlerle yapılan çalışmalar, yerçekiminin dünyanın şekli ve hareketi kavramları ile ilgili ön öğrenme ve deneyimlere dayanan sezgisel yerçekimi düşüncelerine sahip olduklarını göstermektedir. Bu durumda yerçekimi hakkındaki sezgilerimizle yaptığımız çıkarımlardan kaynaklanan kavram yanılgılarının her yaş düzeyinde var olduğunu göstermektedir. Blown ve Bryce (2012) yaptıkları çalışmaya göre ğrencilerin yeryüzü ve yerçekimi kavramları hakkındaki düşünceleri parça parça değil bütünleşik şekildedir. Öğrencilerin yeryüzü şekli, hareketi ve yerçekimi kavramları hakkındaki düşünceleri astronomi ve yerçekimi kavramlarının tarihsel gelişimi ile paralellik göstermektedir. Geçmiş dönemlerde inanılmış ama günümüzde geçerliğini kaybetmiş bilgiler hala öğrencilerin zihninde varlığını sürdürmektedir.

Fizik dersi almayan lise öğrencilerinin yerçekimi kavramları kendilerinden küçük yaşlardaki çocukların yerçekimi hakkındaki fikirleriyle benzerlik göstermektedir. Yeryüzü ve uzay bilimi gibi alanlarda alternatif kavramaların mantık üzerine etkisi küçümsenemez. Yeryüzü merkezli yerçekimi modeli taşıyan öğrenciler yerçekiminin yalnızca yeryüzünde gerçekleştiğini düşünürler veya Mars'ta manyetik alan olmadığından yerçekiminin de olmayacağı görüşüne sahip olabilirler (Asghar ve Libarkin, 2010). Bu nedenle gerçek dünyada her gün iç içe olduğumuz yerçekimi kavramının okullarda herkes tarafından öğrenilmesi önem arz etmektedir.

Yerçekimi kavramı öğretilirken verilecek eğitimin öğrencilerde var olan fikirlerle bu konudaki bilimsel bilgiler arasındaki boşluğu dolduracak nitelikte olması önemlidir (Apostolides ve Valanides, 2008). Öğrenciler yerçekimi kavramını yerçekimi kuvveti, ağırlık ve serbest düşme ile ilişkilendirmede tutarlı görünseler de kendi deneyimsel bakış açılarına dayanan yerçekimi algısına sahiptirler. Bununla birlikte öğrencilerin bu yanılgılarının nasıl ölçüldüğü önemlidir. Öğrenciler yerçekimi hakkında yanlış kavramalara sahip olsalar bile çoktan seçmeli sorularda doğru sonuçlara ulaşabilirler (Feeley, 2007).

Bradamante ve Viennot (2007)'ye göre öğrenciler mıknatıs ve yeryüzünde meydana gelen yerçekimi gibi olaylardan haberdardır fakat bu iki olayı karıştırma veya bu olayların yalnızca belirli uzay bölümlerinde gerçekleştiğini düşünme eğilimleri vardır. Öğrenciler çevrelerinde gerçekleşen yerçekimi olaylarını öngörebilmektedir fakat bunu gezegen ölçeğinde ifade edemezler. Çünkü burada asıl güçlük durumun yeryüzünde değil yeryüzünden belirli bir mesafedeki uzaklıkta çizilen durumdur. Öğrencilere yerçekimi ile ilgili kavramlar küresel ölçekte kafalarında canlandırılarak verilebilir

Sharma, Millar, Smith ve Sefton (2004)'e göre öğrenciler yörüngedeki bir uzay aracı içerisinde yerçekiminin sıfır olduğunu düşünür. Öğrenciler farklı öğretim süreçlerinden geçmiş olsalar da uzay aracında sıfır yerçekimi yaklaşımında benzer anlamalara sahip olabilirler. Öğrencilerin yörüngedeki uzay aracı içerisinde yerçekimi kavramı için anlamaları astronotların ağırlıksız olacağı kadar küçük fakat aracı yörüngede tutacak kadar büyük cümlesi ile özetlenebilir.

Cahyadi ve Butler (2004)' e göre öğrenciler idealleştirilmiş ortamda ağır cisimlerin yere ilk olarak ulaşacağını çünkü ağır cisimlerin daha hızlı hareket edeceğini düşünürler. Eğer ortam idealleştirilmemişse yani gerçek dünya ortamıysa cisimlerin boyutları ve kütleleri de işin içine girmektedir. Gerçek dünya ortamındaki sorularda öğrenciler yerçekimi kuvveti ile sürtünme kuvvetini aynı anda düşünüp kullanmada başarısızlık göstermektedirler. Öğrenciler farklı boyutlu aynı kütleli cisimlere uygulanan hava direncini farklı kütleli aynı boyuttaki cisimlere uygulanan hava direncinden daha kolay anlamaktaydı. Bunun sebebi farklı boyuttaki cisimlerle gündelik hayatta daha fazla örnek üzerinde karşılaşmak olabilir. Öğrenciler ağırlıktan dolayı ağır cisimlerin düşmek için daha az zamana ihtiyaç duyduğuna inanırlar. Ayrıca farklı boyutlu cisimlerin üzerine etki eden hava direnci öğrencilerce görmezden gelinir. Öğrenciler boşluktaki cisimlerin yerçekimi etkisinde olmadığı fikrine sahiptir.

Yerçekimi kavramı antik çağlardan günümüze dek araştırılmaya değer bulunmuş hayati öneme sahip gözlemlenebilir bir astronomi ve fizik kavramıdır (Galili, 2001). Yerçekimi düşen cisimlerde aşağı doğru etki eder. Yerçekiminin düşey doğrultuda yukarı doğru hareket eden cisimlere etkisi yoktur. Yerçekimi hareketsiz cisimlerde aşağı doğru etki eder. Yerçekimi hareketsiz cisimlere etki etmez. Yerçekimi yukarı yönde hareket eden cisimlere yukarı yönde etki eder. Yerçekimi yukarı doğru hareket eden cisimlere aşağı doğru etki eder. Yerçekimi düşen cisimlere etki etmez. Yerçekimi toprakta gömülü olan cisimlere etkimez. Bunun sebebi yerçekimi yeryüzündeki cisimleri yerin altına doğru çeker fakat yerin altındakilere etki etmez. Ayrıca yerçekimi atmosfere ihtiyaç duyduğundan ve yer altında hava olmadığından yerçekimi de yoktur. Öğrencilerin yukarı yönde hareket eden cisimlere yerçekiminin yukarı yönde etki ettiğini düşündüğü kavrama durumunda yerçekimi bir hareket kuvveti anlamını taşır (Palmer, 2001).

SONUÇ VE ÖNERİLER

Yapılan araştırmalar yerçekimi hakkında öğrencilerin çok sayıda kavram yanılgısına ve öğrenme güçlüklerine sahip olduklarını göstermektedir. Bu kavram yanılgıları ilköğretim öğrencilerinden öğretmenlere kadar her yaş kuşağında bulunabilmektedir. Bireylerin gerçek dünyayı anlamlandırabilmesi için yerçekimi kavramının okullarda öğretilmesi önemlidir. Okullarda bu eğitimi almayan yetişkinler yerçekimi hakkında dünyayı yeni keşfeden çocuklar ile aynı seviyede yanılgılara sahip olabilmektedir. Yerçekimi konusu benimsenen kurama göre farklı anlamlar içeren bir konudur. Aristoteles'in algıladığı evren, Newton'un algıladığı evren ve Einstein'ın algıladığı evrene göre yerçekimi kavramı farklı anlamlar içermektedir. Einstein fiziğine göre yerçekimi kavramının öğretimi genellikle ileri yaşlara bırakılmaktadır. Bazı ülkelerde üniversite düzeyine kadar bu konu öğretilmemektedir. Oysa öğrenciler lise seviyesinde Einstein fiziğini kavrayabilmektedir.

Yerçekimi kavramı hakkındaki anlamalar literatür de genellikle dünyada yerçekimi ve uzayda yerçekimi algısı üzerine yoğunlaşmaktadır. Öğrencilerin dünyamızın dışındaki alanda yerçekimi kavramının varlığını anlamada daha fazla zorlandıkları görülmektedir. Bu durumda öğrencilere yerçekimi kavramı öğretilirken dünyamızın dışındaki etkilerine de dikkat çekilerek öğretilmesinin önemine işaret etmektedir.

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DISCOVERING RELATION BETWEEN PYTHAGORAS RELATIONSHIP AND THE GRANDI'S ROSES WITH A DYNAMIC GEOMETRY SOFTWARE

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ABSTRACT: In the second half of the 20th century new technologies were emerged rapidly. Mathematics education was also affected by this change like other education areas. When it comes to technologies used in mathematics education, one of the most conceivable ones is Dynamic Geometry Softwares such as Cabri, Cinderella, Geogebra. Dynamic Geometry Softwares has the important potential to teach and learn geometry subjects. One of the subjects is locus. It is taught that Dynamic Geometry Softwares are highly effective in the process of solving locus problems. The dynamic geometry softwares's "Trace", "Animation" and "Locus" features offer new possibilities for solving locus problems. In traditional learning processes including use of paper, pencil, ruler, solving locus problems is very hard. Contrary to application process used paper, pencil, ruler in the process of the software solution, students get opportunity to discover mathematical associations by recognizing invariant features in addition to variant features by the help of the software's drag and feedback features. Snapshot impressions can be easily done with these softwares. In this study, it is presented a locus activity using Dynamic Geometry Software. In activity, Dynamic Geometry Softwareoffer the opportunity to create curves called as Grandi's roses using the Pythagorean relationship and open the way for the generalization.

Key words: pythagorean relationship, rose curves, locus, Dynamic Geometry Software

PİSAGOR BAĞINTISI VE GRANDİ'NİN GÜLLERİ ARASINDAKİ İLİŞKİNİN BİR DİNAMİK GEOMETRİ YAZILIMI İLE KEŞFEDİLMESİ

ÖZET: 20. yüzyılın ikinci yarısında yeni teknolojiler hızla ortaya çıkmıştır. Diğer eğitim alanları gibi matematik eğitimi de bu değişimden etkilenmiştir. Matematik eğitiminde kullanılan teknolojilere gelindiğinde ilk akla gelenlerden biri Cabri, Cindirella ve Geogebra gibi Dinamik Geometri Yazılımlarıdır. Dinamik Geometri yazılımları geometri konularını öğrenmek ve öğretmek için önemli potansiyele sahiptir. Bu konulardan biri geometrik yerdir. Dinamik Geometri yazılımlarının geometrik yer problemlerinin çözümünde oldukça etkili olduğu düşünülmektedir. Dinamik Geometri Yazılımlarının "İz", "Animasyon" ve "Geometrik Yer" özellikleri geometrik yer problemlerinin çözümünde yeni olanaklar sunmaktadır. Kâğıt, kalem, cetvelin kullanıldığı geleneksel öğrenme süreçlerinde geometrik yer problemlerinin çözümü oldukça zordur. Kalem, kâğıt, cetvel kullanılan uygulama sürecinin aksine, yazılımla çözüm sürecinde, öğrenciler yazılımın çizim ve geri bildirim özelliklerinin yardımıyla değişen özelliklere ek olarak değişmeyen özelliklerin farkına vararak matematiksel ilişkileri keşfetme fırsatı bulur. Bu yazılımlarla anlık gösterimler kolaylıkla yapılabilir. Bu çalışmada dinamik geometri yazılı kullanılarak bir geometrik yer etkinliği sunulmuştur. Bu etkinlikte Dinamik Geometri Yazılımı Pisagor bağıntısı kullanılarak literatürde Grandi'nin gülleri olarak adlandırılan eğrileri oluşturma imkânı sunmuş ve genellemelerin yolunu açmıştır.

Anahtar sözcükler: pisagor bağıntısı, gül eğrileri, geometrik yer, Dinamik Geometri Yazılımı

GİRİŞ

Teknolojinin hızlı gelişimi diğer eğitim alanlarını olduğu gibi matematik eğitimini de etkilemiştir (Habre ve Grundmeier, 2007). Matematik eğitiminde kullanılan teknolojilere gelindiğinde ilk akla gelenlerden biri Cabri, Cindirella ve Geogebra gibi Dinamik Geometri Yazılımlarıdır (Hohenwarter ve Fuchs, 2004; Karataş, 2011; Kokol- Voljc, 2007; Laborde, 2003). Dinamik Geometri yazılımları geometri konularını öğrenmek ve öğretmek için önemli potansiyele sahiptir (Leung, 2008; Lee, Wong ve Tang, 2004; Mariotti, 2000; Mariotti, 2001; Straesser, 2001). Bu konulardan biri geometrik yer konusudur. Geometrik yer kavramı, 100 yıl kadar önce

Alman müfredatı başta olmak üzere gelişmiş birçok ülkenin müfredatında fonksiyonel düşünme biçiminden doğmuştur (Pekdemir, 2004). Böyle bir düşünme biçiminde bağımsız değişkenlerin farklı konumları için bağımlı değişkenin yeni konumunun tahmin edilmesi gerekmektedir (Güven ve Karataş, 2009). Bu düşünme biçimi ve tamamen soyutlamayı gerektiren yapısı geometrik yer konusunun müfredatlarda sembolik olarak yer almaya başlamasına (Pekdemir, 2004) ve eğitim-öğretim ortamlarında önem verilmeyen, çoğu zaman üzerinden geçilen bir konu haline gelmesine neden olmuştur (Güven ve Karataş, 2009).

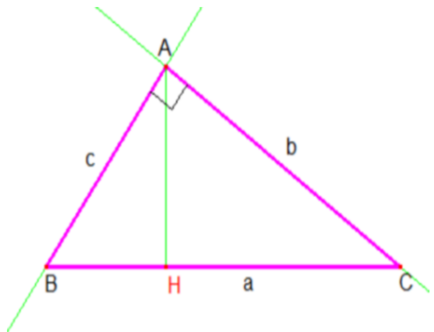
Geleneksel ortamlarda geometrik yer problemlerinin çözümüyle ilgili genel bir yöntem olmamakla birlikte (Cha ve Noss, 2001; Gorghiu, Puana ve Gorghiu, 2009) problemler büyük bir dikkatle analiz edilerek aranan geometrik yerin keşfedilmesini gerektirmektedir (Gorghiu, Puana ve Gorghiu, 2009). Bazı geometrik yer problemlerinin çözümü açıktır. Örneğin Düzlemde sabit bir noktadan eşit uzaklıktaki noktaların geometrik yeri bir çember, bir doğru parçasının uç noktalarına eşit uzaklıktaki noktaların geometrik ise bu doğru parçasının orta dikme doğrusudur. Geleneksel ortamlarda sonucu açıkça görülmeyen problemlerin çözümünde kağıt-kalem, pergel-cetvel kullanılabilir. Gülkılık (2008), geometrik yer problemlerinin çözümünde, istenilen şarta uygun en az üç tane olmak üzere özel noktalar bulunması ve daha sonra bu noktaları birleştirerek oluşturulan yörüngenin sezgisel olarak tahmin edilmesi gerektiğini belirterek aşağıdaki adımların izlenmesi gerektiğini söylemiştir.

1. Verilen koşulları yansıtacak şekil çizilmelidir.
2. Bu şekilden de yararlanarak tahmin yapılmalıdır.
3. Yapılan tahmini doğrulamak için matematiksel açıklamalar yapılmalıdır.

Bahsedilen çözüm yönteminde neredeyse her bir soru için farklı bir şekil tasarlamak gerekmektedir. Ancak kağıt-kalem, pergel cetvel gibi araçların kullanıldığı geleneksel ortamlarda bu mümkün olmamaktadır (Güven ve Karataş, 2009). Bu gibi nedenlerden dolayı birçok öğrenci bu konuyla ilgili problemleri çözmekte zorluklar yaşamaktadır (Açıkgül ve Aslaner, 2012; Gorghiu, Puana ve Gorghiu, 2009; Gülkılık, 2008; Güven ve Karataş, 2009). Birçok araştırmacı bu problemlerin giderilmesinde DGY lerin önemli bir potansiyele sahip olduğunu belirtmektedir (Güven, 2002; Güven ve Karataş, 2009; Jahn, 2002; Real and Leung, 2006). Bu programların sahip oldukları *İz Bırakma* ve *Geometrik Yer* gibi özellikler geometrik yer problemlerinin çalışılması için yeni imkânlar sağlamaktadır. Bu araç çubukları kullanılarak mevcut müfredat tarafından reddedilen fonksiyonel ilişki kavramı keşfedilebilmektedir (Cha ve Noss, 2001). Geometrik yer problemlerinin çözümünde gerekli olan ve geleneksel ortamlarda gerçekleştirilmesi pek de mümkün olmayan anlık gösterimler bu programlar sayesinde yapılabilmektedir. Böylece öğrenciler çeşitli varsayımlarda bulunabilmekte ve bu durum onların hayal gücünü geliştirmektedir (Güven ve Karataş, 2009). Bu çalışmada Pisagor Bağıntısı ile gül veya çiçek yaprağına benzeyen eğriler arasındaki ilişkinin bir geometrik yer problemi olarak ele alınması ve bir DGY ile matematiksel ilişkileri araştırma ve keşfetme süreçlerinin betimlenmesi amaçlanmıştır.

ETKİNLİK

Verilen şartları sağlayan noktaların kümesi (bu şartlar cebirsel veya geometrik olabilir) olarak tanımlanan geometrik yer geometrinin en önemli konularından biridir. Bir yörünge üzerinde hareket eden bir A noktasına bağımlı olan ve verilen şartları sağlayan bir P noktası (veya birden fazla P_1,P_2, … noktaları) bulunarak, A noktası kendi yörüngesinde hareket ederken P noktasının nasıl bir küme oluşturduğu tahmin edilmeye çalışılır. Bu tahmin bazen kolaylıkla yapılabilirken bazen de oldukça zordur. Ancak gerekli ortamlar hazırlandıktan sonra (DGY)'nın sahip olduğu *iz bırakma, animasyon* ve *geometrik yer* özelliklerinden faydalanarak bu geometrik yer kolayca tahmin edilebilir. Hatta "*P noktasının A noktasına geometrik nedir?* " sorusu sorularak geometrik yer tam olarak görülebilir.



Şekil 1. ABC Dik Üçgeni

Pisagor bağıntısı bir dik üçgende $a^2=b^2+c^2$ olduğunu ifade eder. A noktasının hipotenüs üzerindeki dik iz düşüm noktası olan H noktası bu üçgen için özel noktalardan birisidir. Özellikleri;

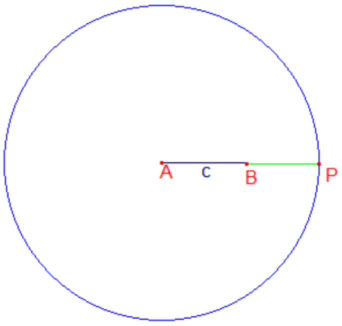
1) [AH] doğru parçası verilen üçgeni kendine ve bir birine benzeyen iki üçgene ayırır. Yani *ABC≈HBC≈HCA* dir. Bu önerme üçgenlerde Açı-Açı benzerlik Teoremi ile gösterilebilir.

2) $|AH|^2=|BH|.|HC|$ dir. Bu eşitliğe dik üçgende *Öklid'in yükseklik bağıntısı* adı verilir.

3) $|AB|^2=|BH|.|BC|$ ve $|AC|^2=|CH|.|CB|$dir. Bu eşitliklere de *dik üçgende kenar bağıntıları* adı verilir ve *"Benzer üçgenlerin karşılıklı kenar uzunlukları orantılıdır."* önermesinden görülmektedir (Aslaner 2015).

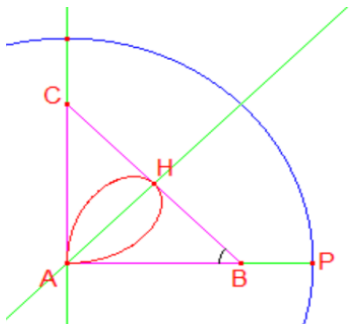
B (ya da C) noktası doğru üzerinde hareket ettirildiğinde *H* noktasının da değiştiği görülmektedir. *Burada H noktası B* (veya C) noktası bağımlıdır. Bu durum acaba *"H noktasının B noktasına göre geometrik yeri nedir?"* sorusunu aklımıza getirmektedir. Bu durum acaba *"H noktasının B noktasına göre geometrik yeri nedir?"* sorusunu aklımıza getirmektedir.

Bunun için Cabri programında bir [AP] doğru parçası ve üzerinde bir B noktası alalım. Eğer P noktasını, *çember* seçeneğini kullanarak *A* merkezli *a* yarıçaplı bir çember çizip bu çember üzerinde seçersek elde ettiğimiz şeklin hem büyüklüğünü değiştirme hem de A noktası etrafında döndürme imkânımız olur.



Şekil 2. A Merkezli Çemberde [AP] Doğru Parçası Üzerinde Alınan B Noktası

|AB|=c diyelim. Burada daima c<a ve b=√(a2-c2) tanımlı olup bu değeri A noktasında [AP] ye dik olan ışın üzerine aktararak varılan noktaya C dersek elde edilen ABC üçgeni bir dik üçgen olup [BC] bu üçgenin hipotenüsüdür.
Burada B noktası [AP] üzerinde hareket ederken H noktası da bir eğri çizer. Cabri programına "H noktasının B noktasına göre geometrik yeri nedir?" diye sorduğumuzda elde edilen eğrinin yandaki gül yaprağına benzeyen bir eğri olduğu görülür.

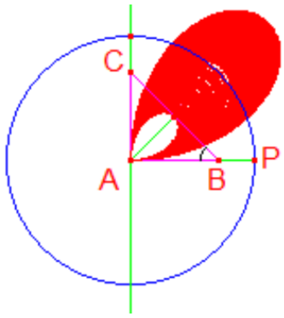


Şekil 3. H Noktasının B Noktasına Göre Geometrik Yeri Sonucu Elde Edilen Gül Yaprağına Benzeyen Eğri

BULGULAR VE YORUMLAR

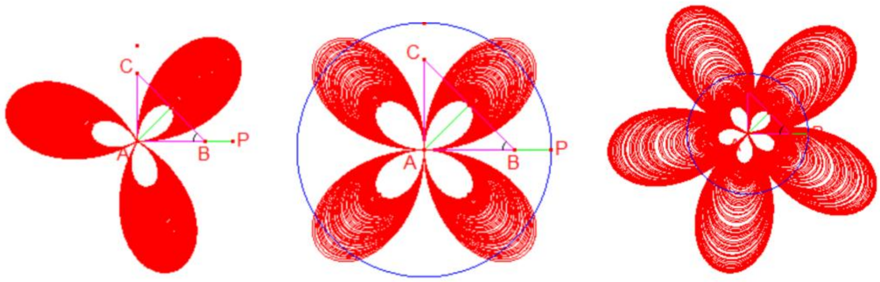
1) ABC üçgeninde |AB|=|AC| olması, yani üçgenin bir ikizkenar dik üçgen olması durumunda AH doğrusu elde edilen eğrinin simetri eksenidir.

2) Elde edilen geometrik yere iz vererek çemberin yarıçap uzunluğu olan a değerini değiştirip elde edilen eğrinin içini doldurarak gerçek bir yaprak resmi elde edilir.



Şekil 4. a Değerine Bağlı Olarak Elde Edilen Yaprak Resmi

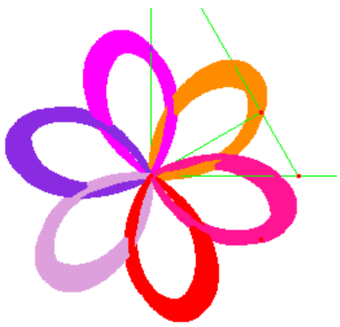
3) *n>2* bir doğal sayı *ve* $\alpha = 360/n$ olmak üzere *H* noktası A noktası etrafında *(n-1)* defa α açısı kadar döndürüp elde edilen H_n noktalarının B noktasına göre geometrik yerleri bulunarak n yapraklı gül resimleri elde edilir.



n=3 n=4 n=5

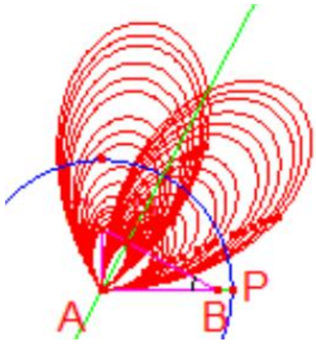
Şekil 5. n Yapraklı Gül Resimleri

Gül ve çiçeklere benzeyen eğriler üzerine uzun yıllar çalışmalar yapan İtalyan matematikçi, fizikçi ve papaz **Guido Grandi** (1671-1742) anısına bu tür eğriler *"Grandi`nin gülleri"* olarak bilinir. Bu eğrilere *iz verip* çemberin yarıçap uzanluğu olan *a* değeri sürüklenerek eğrilerin büyüklüğü değiştirilip iç bölgeleri doldurulup istenilen renkte gerçek bir gül resmi elde edilebilir.



Şekil 6. a Değeri Değiştirilerek Elde Edilen Gül Resmi

4) ABC üçgeninde |AB|>|AC| olması durumunda AH doğrusu simetri ekseni değildir. Geometrik yerin AH doğrusuna göre simetriği alınırsa kalp eğrisine benzer bir eğri elde edilir.



Şekil 7. |AB|>|AC| Olması Durumunda Elde Edilen Kalp Eğrisine Benzer Eğri

SONUÇ VE ÖNERİLER

Yapılan etkinlikte de görüldüğü gibi DGY'ler öğrencilerin pergel cetvel gibi geleneksel araçlarla çözmekte zorlandıkları GY problemlerinin çözümünde soyut matematiksel ilişkileri somutlaştırarak öğrencilerin anlamalarına katkıda bulunabilir. Teknoloji, sunduğu olanaklarla sezgilere dayalı olarak yeni matematiksel ilişkilerin bulunmasına ortam sağlayabilir. Geometrik yer problemlerinde geleneksel ortamlarda yaşanan sıkıntılar göz önünde bulundurularak farklı geometrik yer probleminin çözümü için DGY etkinlikleri hazırlanabilir. DGY'lerin geometrik yer konusundaki potansiyelleri dikkate alınarak öğretmen ve öğretmen adaylarına bu programları nasıl kullanılması gerektiği örnek etkinliklerle uygulamalı olarak yaptırılabilir. Bu sayede hem yaşanan güçlükler giderilebilir hem de etkinlikleri derslerine kolaylıkla taşımaları sağlanabilir.

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EVALUATING THE LOYALTY OF CUSTOMERS WHO USE THE GSM OPERATORS WITH DATA MINING ACCORDING TO EDUCATIONAL STATUS

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ABSTRACT: Customer loyalty has become an all important factor under today's economic conditions. At first, consumer was consuming what manufacturer produced but today, manufacturer produces what consumer wants. Because, there are many equivalent of products which customers buy. In this study, customer loyalty survey related to GSM operators was applied to 454 people who use three biggest GSM operators of Turkey. The analysis was performed by using decision trees which are one of the Data Mining method. It was aimed to measure the customer loyalty according to educational status with C 5.0 algorithm and the results were interpreted.

Key words: GSM Operators, Customer Loyalty, Data Mining.

GSM OPERATÖRLERİNİ KULLANAN MÜŞTERİLERİN SADAKATLERİNİN EĞİTİM DURUMUNA GÖRE VERİ MADENCİLİĞİ İLE DEĞERLENDİRİLMESİ

ÖZET: Müşteri sadakati günümüz piyasa koşullarında oldukça önem arz eden bir unsur haline gelmiştir. Önceleri üretici ne üretirse tüketici onu tüketirdi, fakat günümüzde tüketici ne isterse üretici onu üretmek durumundadır. Çünkü günümüzde bir müşteri için alacağı ürün ya da hizmetin birçok muadili bulunmaktadır. Bu çalışmada Türkiye'nin en büyük üç GSM operatörünü kullanan 454 kişiye, kullandıkları operatörlerle alakalı müşteri sadakat anketi uygulanmıştır. Elde edilen veriler Veri Madenciliği (VM) yöntemlerinden karar ağaçları ile analiz edilmiştir. Uygulamada C 5.0 algoritması kullanılarak, eğitim durumuna göre müşteri sadakatinin ölçülmesi amaçlanmış ve sonuçlar yorumlanmıştır.

Anahtar sözcükler: GSM Operatörleri, Müşteri Sadakati, Veri Madenciliği.

GİRİŞ

Günümüzde firmalar rakipleriyle rekabet edebilmek için marka oluşturma stratejilerine önem vermektedirler. Fakat gelişen teknoloji ile birlikte işletmelerin ürettikleri stratejiler ve ürünler kolaylıkla kopyalanabilmektedir. Bu sayede pazarlarda birbirlerine çok benzeyen benzer kalitede ve fiyatta birçok ürün bulunabilmektedir. Böylece tüketicilerin alternatifleri artmakta ve sıklıkla marka değiştirebilmeleri kolaylaşmaktadır. Bu da şirketlerin müşterilerinde marka sadakati yaratmaları gerekliliğini doğurmaktadır. Müşteri sadakati, müşterilerin satın alacağı servis veya ürünün benzer özellikte, fiyatta ve kalitede başka markalar bulunmasına rağmen, uzun süreli olarak belirli bir markayı tercih etmeleri olarak tanımlanmaktadır (Gülmez ve Dörtyol, 2009).

Türkiye'de en hızlı gelişen sektörlerin başında GSM operatörlüğü gelmektedir. Ülkemizde GSM sektörünün doygunluk aşamasına gelmesi ve GSM operatörlerinin hali hazırdaki müşterilerinin diğer operatörlerin potansiyel müşterisi olması sektörde rekabetin kızışmasına yol açmıştır. Bu nedenle müşteri sadakati GSM operatörleri için önemini artırmıştır. Numara değişmeden operatör değiştirme imkânı, operatör değiştirme maliyetlerinin firmalarca karşılanması, numarasını taşıyan müşterilere çok daha cazip imkânlar sunulması gibi etmenler tüketicilerin operatör değiştirmelerini kolaylaştırmıştır. Bu etmenler firmaların müşterilerini ellerinde tutma ve onları sadık müşteriler haline getirmek için yoğun pazarlama faaliyetleri yapmalarını gerektirmektedir (Türker ve Türker, 2013). 2005 yılında ABD'de yayınlanan Tüketici raporlarına göre, 2004 yılında cep telefonu kullanıcılarının %35'i operatörünü değiştirmeyi düşünmüştür (Kim ve diğ., 2006:208).

Bu çalışmada GSM operatörleri için önem arz eden müşteri sadakatini etkileyen faktörler incelenmiştir. Ankara'da yaşayan 454 kullanıcıya GSM operatörlerine yönelik müşteri sadakati anketi uygulanmıştır. Elde edilen veriler VM yöntemlerinden çalışmamız için en yüksek doğruluk oranına sahip olan C 5.0 algoritması ile analiz edilmiştir. Araştırma sonuçları GSM operatörlerinin müşteri sadakati stratejileri geliştirmelerine ışık tutacak niteliktedir.

YÖNTEM

Türkiye'de faaliyet gösteren en büyük 3 GSM operatörü müşterilerinin sadakatlerini etkileyen faktörleri belirlemek amacıyla, Ankara ilinde toplam 454 kişi ile hem yüz yüz hem de elektronik posta aracılığıyla, anket yöntemiyle veri toplanmıştır. Ankette gönüllülük esası kullanılmış, gönüllü olan katılımcılara anket uygulanmıştır. Elde edilen veriler C 5.0 algoritması ile analiz edilmiştir.

Müşteri Sadakati

Müşteri sadakati, bir müşteri için alternatiflerinin de olduğu bir ortamda belirli bir ürüne, hizmete, satıcıya veya işletmeye yönelik duyduğu, hissettiği, içten bağlılık ve tesadüfi olmayan alışveriş eğilimi, arzusu ve eylemi olarak tanımlanmaktadır. Müşteri sadakati kavramı bir ürüne veya hizmete yönelik olabileceği gibi bir şirkete yönelik de olabilmektedir (Bayuk ve Küçük, 2007).

Bu çalışmada öncelikle cevaplayıcılara eğitim durumları, kullandıkları GSM operatörleri ve kaç yıldır bu operatörlerle çalıştıkları sorulmuştur. İkinci kısımda müşterilerin algıladıkları hizmet kalitesi neticesinde kendilerinde oluşan sadakate ilişkin 7 soru sorulmuştur. Bu ölçek Parasuraman ve diğerlerinin hizmet kalitesini ölçmek için geliştirdikleri SERVQUAL modelinin GSM hizmetlerine uyarlanması sonucu 5'li likert ölçeğine göre hazırlanmıştır. Araştırmada kullanılan anket Çiğdem Erk(2009:135) 'in yüksek lisans tez çalışmasında kullandığı anketin birinci ve üçüncü kısmından oluşmaktadır.

Veri Madenciliği

Veri madenciliği, tek başına ham verinin sunamadığı bilgiyi ortaya çıkaran veri analizi sürecidir (Jacobs,1999). Farklı bir ifadeyle veri madenciliği, büyük miktardaki veriden, anlamlı örüntüler ve kurallar keşfetme sürecidir (Linoff ve Berry, 2011).

Veri madenciliği, karar destek, pazar stratejisi, finansal tahminler gibi birçok alanda uygulanabilir olması nedeniyle son zamanlarda veritabanı kullanıcıları ve araştırmacıların önemli ölçüde dikkatini çekmektedir. Veri madenciliği, makine öğrenme, istatistik ve veri tabanları alanlarındaki teknikleri birleştirerek, büyük veri tabanlarından faydalı ve değerli bilgiyi çıkarmamıza imkân tanımaktadır (Ching ve Pong, 2002).

Karar Ağaçları

Karar ağaçları, sınıflandırma ve tahmin için sıkça kullanılan bir veri madenciliği yaklaşımıdır. Sinir ağları gibi diğer metodolojilerin de sınıflandırma için kullanılabilmesine rağmen karar ağaçları, kolay yorumu ve anlaşılabilirliği açısından karar vericiler için avantaj sağlamaktadır (Chien ve Chen, 2008).

Karar ağaçları; düşük maliyetli olması, anlaşılmasının, yorumlanmasının ve veri tabanları ile entegrasyonun kolaylığı, güvenilirliklerinin iyi olması gibi nedenlerden ötürü en yaygın kullanılan sınıflandırma tekniklerinden biridir.

C 5.0 Algoritması

En yaygın kullanılan karar ağacı algoritması Quinlan'ın ID3 algoritmasının geliştirilmiş hali olan C4.5 (Quinlan, 1993) algoritmasıdır. C5.0 algoritması ise C4.5'in geliştirilmiş hali olup, özellikle büyük veri setleri için kullanılmaktadır. C5.0 algoritması doğruluğu arttırmak için boosting algoritmasını kullandığından boosting ağaçları olarak da bilinir. C5.0 algoritması C4.5'e göre çok daha hızlı olup, hafızayı daha verimli kullanmaktadır. Her iki algoritmanın sonuçları aynı olsa da C5.0 biçim olarak daha düzgün karar ağaçları elde etmemizi sağlamaktadır.

BULGULAR

C 5.0 Algoritması Doğruluk Oranı

Eğitim durumu değişkeni için algoritmanın doğruluk oranı Şekil 1'de verildiği gibi %93,39 olarak hesaplanmış olup, algoritma yüksek doğruluk oranına sahip olduğundan bu aşamadan sonra C 5.0 algoritması ile karar ağacı oluşturulmuştur.

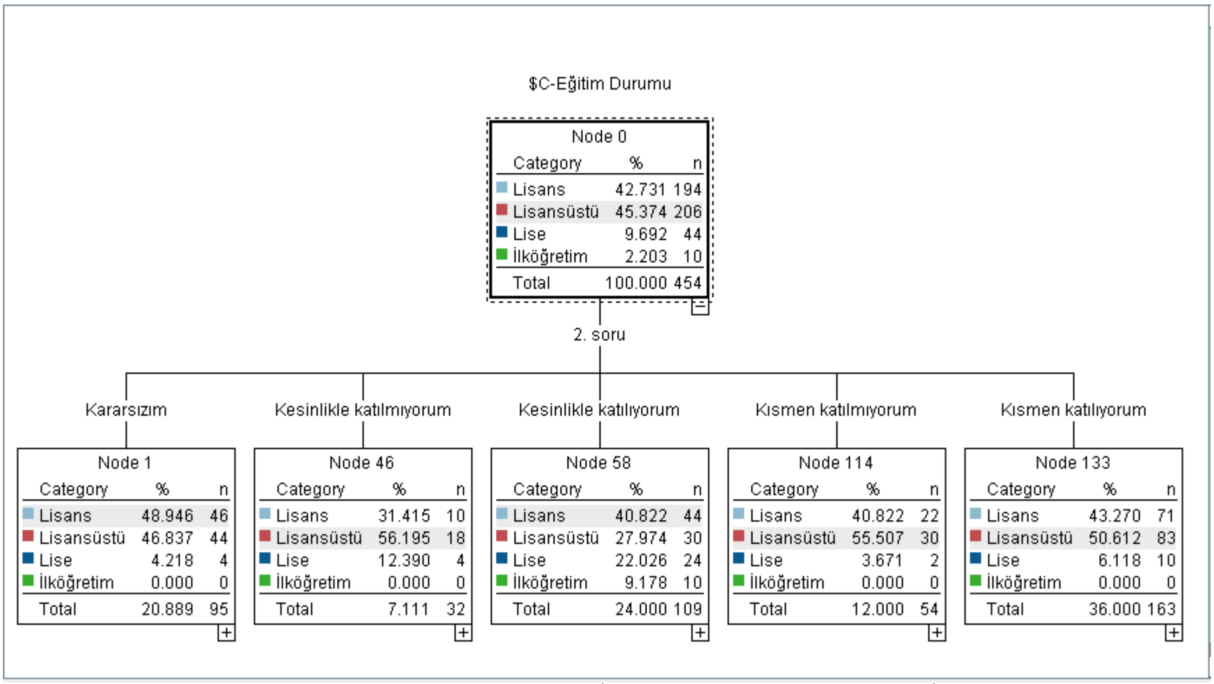
Results for output field Eğitim Durumu
Comparing $C-Eğitim Durumu with Eğitim Durumu

Correct	424	93,39%
Wrong	30	6,61%
Total	454	

Şekil 1. C 5.0 Algoritması Doğruluk Oranı

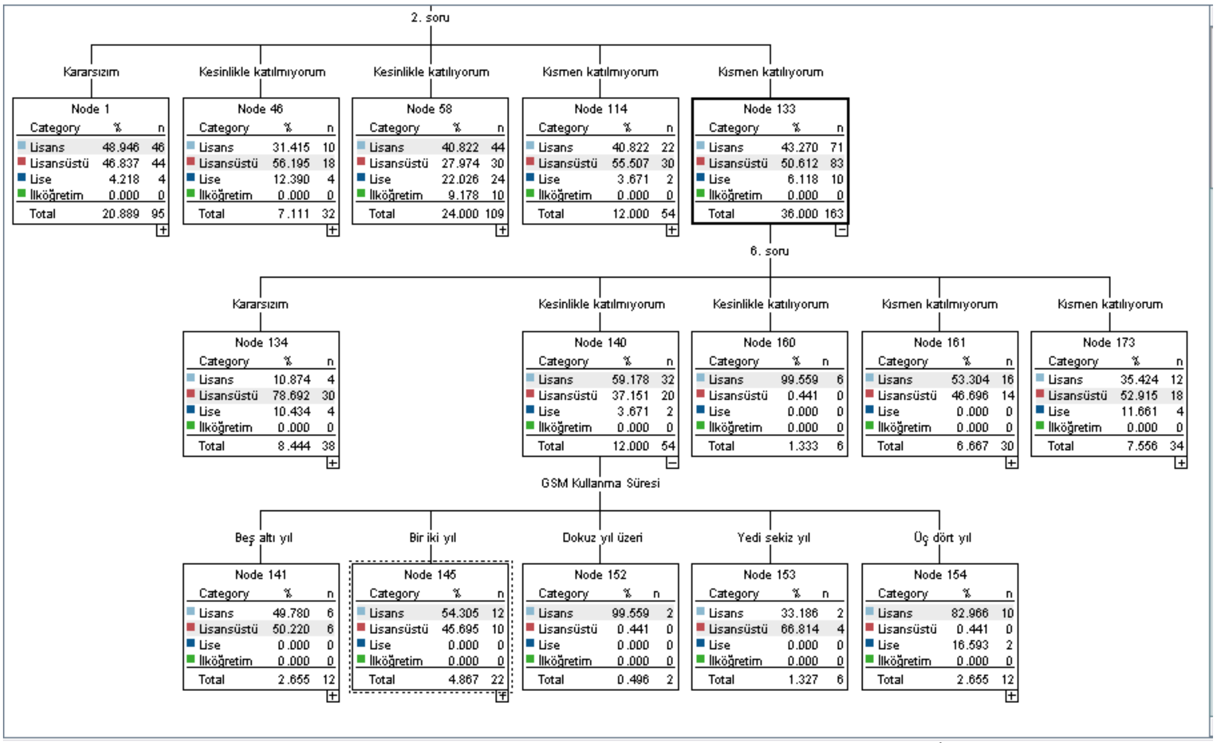
C 5.0 Algoritması ile Elde Edilen Karar Ağacı

Şekil 2 incelendiğinde, eğitim durumu değişkeni için C5.0 Algoritması ile oluşan karar ağacının ilk olarak 2. sorudan dallandığı görülmektedir. Yani eğitim durumu değişkeni için ağacın dallanmasındaki en etkili sorunun "İletişim hizmetlerinden yararlandığım GSM işletmesini soranlara tavsiye ederim" olduğu görülmektedir. Anketi uygulayan 454 kişiden çoğunlukta olan 163'ü bu soruya "Kısmen Katılıyorum" cevabını verirken, azınlıkta olan 32'si ise "Kesinlikle katılmıyorum" cevabını vermiştir.

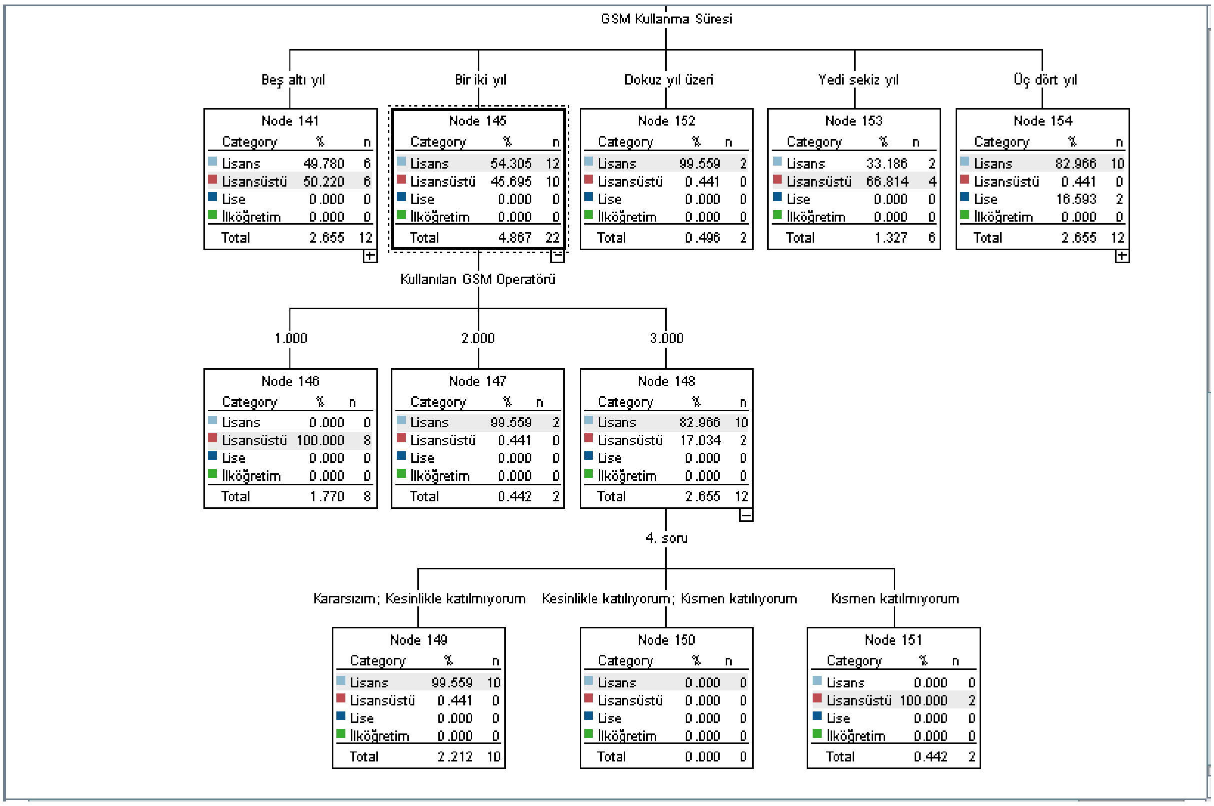


Şekil 2. Eğitim Durumu Değişkeni İçin Karar Ağacında Oluşan İlk Dal

2. soruya "Kısmen Katılıyorum" cevabını verenlerin eğitim durumlarının çoğunlukla lisansüstü düzeyinde olduğu görülmektedir. Bu gruptaki kişiler için karar ağacı dallanmaya 6. soru olan "İletişim hizmetlerinden yararlandığım GSM işletmesi, konuşma ve mesaj ücretlerini arttırsa da onu kullanmaya devam ederim" ile devam etmektedir. Şekil 3 incelendiğinde bu soruya çoğunluğun "Kesinlikle Katılmıyorum" cevabını verdiğini söylemek mümkündür. Bu gruptakilerin büyük bir kısmının GSM kullanma süreleri bir iki yıl arasındadır. Bu kişilerin çoğunlukla 3 numaralı GSM operatörünü kullandıkları ve iletişim hizmetlerinden yararlandıkları bu operatörün her zaman ilk tercihleri olmadığı ifadesi Şekil 4'ten elde edilebilmektedir.

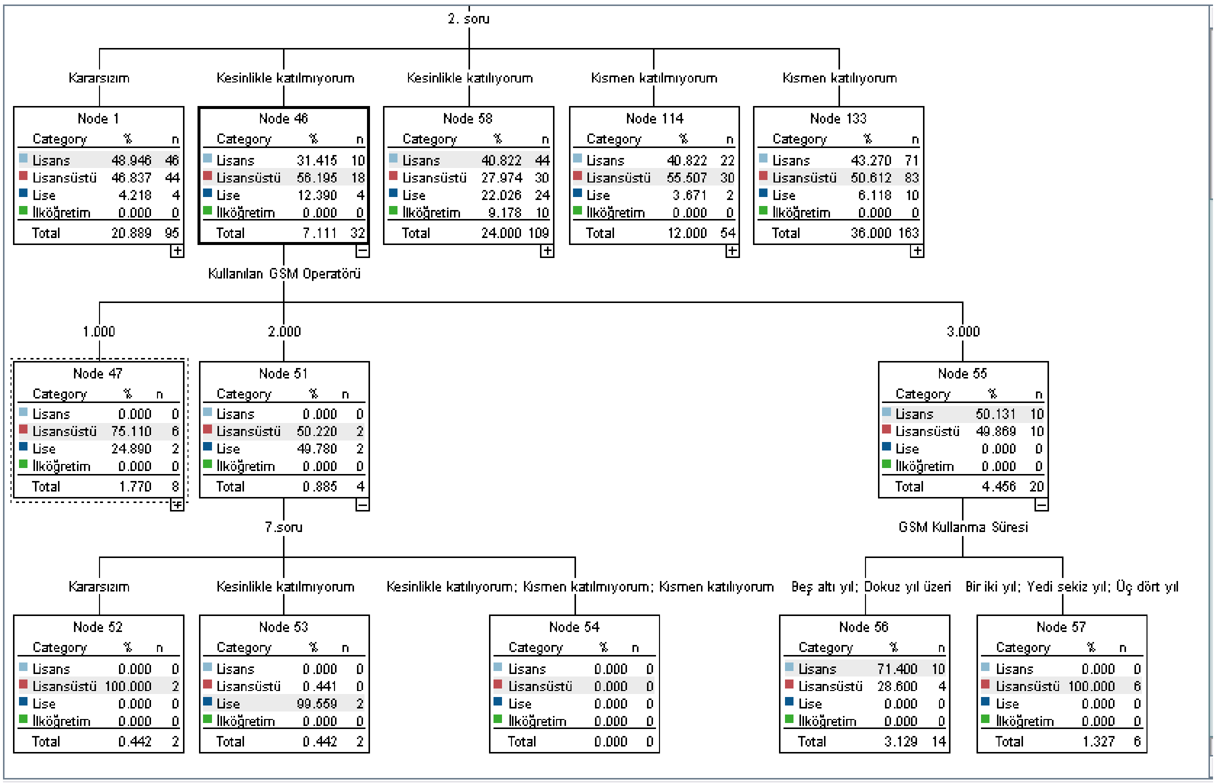


Şekil 3. Eğitim Durumu Değişkenine Göre 2. Soruya "Kısmen Katılanlar" İçin Karar Ağacı



Şekil 4. Eğitim Durumuna Göre GSM Kullanma Süresi 1-2 Yıl Arasında Olanlar için Karar Ağacı

Şekil 5 incelendiğinde 2. soruya kesinlikle katılmayanlar, yani iletişim hizmetlerinden yararlanılan GSM operatörünü soranlara kesinlikle tavsiye etmeyenlerin çoğunlukla 3 numaralı GSM operatörünü kullanan kişilerden oluştuğu görülmektedir. 3 numaralı GSM operatörünü kullanan kişiler için de karar ağacı dallanmayı "GSM Kullanma Süresi" ile bitirmektedir.



Şekil 5. Eğitim Durumu Değişkenine Göre 2. Soruya "Kesinlikle Katılmayanlar" İçin Karar Ağacı

SONUÇ

Müşteri sadakati, müşterinin algıladığı hizmet kalitesinden ortaya çıkan duygusal bağın müşteriler ile ilerletilmesidir (Kandampully, 1998). Bugüne kadar yapılan birçok çalışma müşteri sadakatinin sağlanması için müşteri memnuniyetinin çok ciddi bir öneme sahip olduğunu ortaya koymuştur (Örn. Hackl ve diğ., 2000, Cassel ve Eklöf, 2001). Yeni müşteri kazanma maliyetini, mevcut müşterileri elde tutma maliyetinden daha fazla olduğunun farkına varılmasıyla birlikte, müşteri sadakati şirketler için daha fazla önem kazanmıştır (Too, Souchon, Thirkell, 2000).

Bu çalışmada, Türkiye'de faaliyet gösteren 3 büyük GSM operatörü müşterilerinin sadakatlerinin oluşmasındaki en önemli faktörlerin VM tekniğiyle analiz edilmesi amaçlanmıştır. Çalışmada C5.0 algoritması kullanılarak eğitim durumu bağımlı değişken; müşteri sadakatini analiz etmeye yönelik oluşturulan anket soruları ise bağımsız değişkenler olarak ele alınmıştır. Eğitim durumuna göre karar ağacının 2. sorudan dallanmaya başladığı görülmüştür. Katılımcıların çoğunun bu soruya ''Kısmen katılıyorum'' cevabını verdikleri ve bu kişilerin eğitim durumlarının çoğunlukla lisansüstü düzeyinde olduğu belirlenmiştir. Kısmen katılıyorum cevabını verenler için ağaç dallanmaya 6. soru ile devam etmiştir. Bu soruya çoğu katılımcının "Kesinlikle katılmıyorum" cevabını verdiği tespit edilmiştir. Bu doğrultuda, bu gruptaki kişilerin öncelikle kullandıkları operatörleri yakınlarına tavsiye etmek istedikleri, fakat yine de ücretlendirme kriterini göz önünde bulundurdukları görülmüştür. Buradan yola çıkarak, genellikle GSM operatörlerinin müşteri sadakatini oluşturmak için müşterilerine rakiplerinden daha uygun ücret sunmaları gerektiğini söylemek mümkündür. Fakat ülkemizdeki GSM operatörlerinin bunun tam aksi bir strateji izlediği görülmektedir. Ocak 2016 itibariyle ülkemizdeki GSM operatörleri incelendiğinde, hali hazırdaki kampanyaların diğer operatörlerden geçiş yapan veya yeni hat alan abonelere, mevcut müşterilerden daha uygun fiyatla hazırlanmış olduğu gözlemlenmekte ve bu durumun müşteri sadakatini olumsuz etkileyen bir strateji olduğu düşünülmektedir.

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EKLER

EK:1 GSM OPERATÖRLERİNİ KULLANAN MÜŞTERİLERİN SADAKATİNİ ÖLÇME ANKETİ

MÜŞTERİ SADAKATİ

Bu bölümde müşteri sadakatine ilişkin görüşlerinizi öğrenmek amacıyla çeşitli sorular verilmiştir. Lütfen bu soruları kendi düşünceleriniz doğrultusunda;
1-Kesinlikle Katılmıyorum, 2-Katılmıyorum, 3-Fikrim Yok, 4-Katılıyorum, 5-Kesinlikle Katılıyorum, seçeneklerinden birini tik **(X)** koyarak cevaplandırınız.

SORU NO	SORULAR	Kesinlikle Katılmıyorum	Katılmıyorum	Fikrim Yok	Katılıyorum	Kesinlikle Katılıyorum
1.	İletişim hizmetlerinden yararlandığım GSM işletmesi hakkında eş, dost ve yakınlarıma olumlu şeyler söylerim					
2.	İletişim hizmetlerinden yararlandığım GSM işletmesini soranlara tavsiye ederim					
3.	Arkadaşlarımı ve yakınlarımı, iletişim hizmetlerinden yararlandığım GSM işletmesiyle çalışmaları konusunda ikna etmeye çalışırım					
4.	İletişim hizmetlerinden yararlandığım GSM işletmesi, iletişim konusunda her zaman ilk tercihimdir					
5.	İletişim hizmetlerinden yararlandığım GSM işletmesiyle gelecekte daha çok iş yapmayı düşünürüm					
6.	İletişim hizmetlerinden yararlandığım GSM işletmesi, konuşma ve mesaj ücretlerini arttırsa da onu kullanmaya devam ederim					
7.	Rakipleri fiyat avantajı sağlasa bile GSM hizmetlerinden yararlandığım işletmeyle çalışmaya devam ederim					

USABILITY AND PERFORMANCE ANALYSIS OF MEB WEBSITE

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ABSTRACT: According to Internet usage statistics; Turkey's estimated number of Internet users is 46.2 millions, which is 59.6% of the country's population, by November 2015. When people need information on a subject, the first source they refer to is the related institution's website. Design and usability of websites are important for users to rapidly and easily access to the information they demand. Ministry of National Education (MEB) website serves many users including millions of students and their guardians. In this study, MEB website's task based performance analysis and usability analysis according to Xerox heuristic scala are performed. The usability and human interaction level of this website, which belongs to a very important government organisation and is visited by multitudinous users, are determined. Website's inadequate parts are reported.

Key words: usability, human-computer ınteraction, meb, website

MEB WEB SİTESİ KULLANILABİLİRLİK VE PERFORMANS ANALİZİ

ÖZET: İnternet kullanım istatistiklerine göre ülkemizde internet kullanıcı sayısının 2015 Kasım ayı itibariyle 46.2 milyon yani ülke nüfusunun %59.6 sı olduğu tahmin edilmektedir. Kullanıcılar bir konu hakkında bilgiye ihtiyaç duyduklarında ilk başvurdukları ilgili kurum veya kuruluşun web sitesi olmaktadır. Kullanıcıların talep ettikleri bilgiye daha hızlı ve kolay ulaşabilmeleri için web sitelerinin tasarım ve kullanılabilirliği önem arz etmektedir. Milli Eğitim Bakanlığı (MEB) web sitesi, başta milyonlarca öğrenci ve velisi olmak üzere çok sayıda kullanıcıya hizmet vermektedir. Bu çalışmada MEB web sitesinin görev bazında performans ve Xerox sezgisel ölçeğine göre kullanılabilirlik analizi gerçekleştirilmiştir. Önemli bir kamu kurumuna ait olan ve çok sayıda kullanıcı tarafından ziyaret edilen bu web sitesinin kullanılabilirliği ve kullanıcı etkileşim düzeyi tespit edilmiştir. Sitenin eksik görülen yönleri belirlenmiştir.

Anahtar sözcükler: kullanılabilirlik, insan-bilgisayar etkileşimi, meb, web sitesi

GİRİŞ

Günümüzde bilgiye ulaşmak ve bunu hızla gerçekleştirmek insanların günlük yaşamlarının bir parçası haline gelmiştir. Bu sebeple insanlar bilgiye ulaşmak için ilk tercih ettikleri mecra internet ve web siteleri olmaktadır. Her geçen gün web sitelerinin sayısı, bilgi derinliği artmakta bunun sonucunda ise bu ortamda yer alan bilginin kontrolü ve takibi zorlaşmaktadır. Bu sebeple bilgiye hızla erişmek isteyen kullanıcılar için, web sitelerinin tasarımlarının ve kullanıcılara bilginin sunulma şeklinin nasıl olacağı ile ilgili soruların ortaya çıkmasına neden olmaktadır. Kullanıcıların etkin ve verimli bir kullanım edinebilmeleri açısından web sitelerinin kullanılabilirliklerinin yüksek olması önem arz etmektedir (Ateş & Karacan, 2009; Fang & Holsapple, 2007). Çok sayıda kullanıcının hizmet aldığı kamu kurumlarının internet sitelerinin kullanılabilirliğinden kaynaklanan sorunlar, kullanıcılar açısından verimlilik kayıplarına neden olmakta ve alınan hizmetin kalitesini düşürmektedir (İnal, Çınar, & Çağıltay, 2016). Literatür incelendiğinde kamu veya özel kurumlara ilişkin, anket tabanlı, göz takibi ile(eyes trakcing), performans bazlı, ölçek tabanlı vb. yöntemler ile birçok çalışmada yapıldığı görülmektedir (Ateş & Karacan, 2009; Bayram & Yaylı, 2009; Çakmak, Güneş, & Tahsin, 2011; İnal et al., 2016; Karacan & Demirtel, 2009; Kurulgan & Bayram, 2006; Özçelik, Kurşun, & Çağıltay, 2006; Tarhan, 2007; Uçak & Çakmak, 2009; Yeniad, Mazman, Tüzün, & Akbal, 2011).

Bu çalışmanın amacı T.C Milli Eğitim Bakanlığı web sitesi "www.meb.gov.tr"yi görev bazında performans analizine ve Xerox Sezgisel Ölçeğine göre incelenmesi ve sonuçların raporlanmasıdır. Önemli bir kamu kurumu olan ve milyonlarca öğrenci, veli, öğretmen ve vatandaş tarafından kullanılan bu web sitesinin kullanılabilirliği ve kullanıcı etkileşim düzeyi tespit edilmeye çalışılmış, sitenin eksik görülen yönleri ve kısımları açıklanmıştır.

Kullanıcılara daha iyi hizmet verilebilmesi ve zaman kaybının önlenebilmesi için çalışmada belirtilen eksiklik ve iyileştirmelerin yapılması önem arz etmektedir.

YÖNTEM

Web sayfasının kullanılabilirlik analizinde farklı kriterler göz önünde bulundurulmaktadır. Web sayfasının değerlendirilmesinde kullanılacak yöntemin doğru seçilmesi önem arz etmektedir. Yöntemin seçiminde zaman, bütçe, kullanıcı sayısı, kaynaklar ve amaç gibi kıstaslar göz önünde bulundurulmalı ve bu kıstaslar doğrultusunda en uygun yöntem belirlenmelidir. Her yöntemin bir diğerine göre avantajı ve dezavantajı olup, seçilen yönteme göre analiz sonuçları farklılık gösterebilmektedir. Web sayfası kullanılabilirlik analizi, tasarım sürecinin hangi aşamasında yapılacağı da seçilecek yöntemin belirlenmesinde etkin rol oynamaktadır (BAŞ, 2013).

Ara yüz tasarımı ve testinde izlenen yaklaşım türlerinden birisi ara yüzün uzmanlarca değerlendirilmesidir. Değişik uzman değerlendirmeleri arasında en yaygını, iyi bir ara yüz tasarımının sahip olması gereken özellikleri veren sezgisel yöntemlerin kullanılmasıdır.

Sezgisel yöntemler genelde platform (hem donanım hem de yazılım olarak) bağımsız ve kullanılabilirliği arttırmaya yöneliktir. Günümüzde kullanıcı ara yüz tasarımı için kullanılan en popüler rehberlerden biri, Jakob Nielsen (Nielsen, 1994) tarafından önerilen Sezgisel (Heuristic) değerlendirmedir. Sezgisel (Heuristic), bir tasarım kararına rehberlik edecek genel ilke, prensip ya da alınan bir kararı eleştirmek için kullanılır. Sezgisel (Heuristic) değerlendirme, bir sistem ya da kullanıcı ara yüzünün kullanışlılık açısından sistemli bir şekilde incelenmesidir (Tüzün & Çıralı, 2011). Bu değerlendirme yönteminde değerlendiriciler birbirinden bağımsız bir şekilde sistemin olası kullanılabilirlik problemlerini ileri sürerek sistemi eleştirirler.

Nielsen'e (Nielsen, 1994) göre üç ya da beş değerlendirici yeterlidir. Ortalama 5 kişinin yaptığı değerlendirmeyle, kullanışlılıkla ilgili problemlerin %75'i ortaya çıkmaktadır. Esnek, nispeten ucuz bir yaklaşımdır. Amaç, sistem ya da ara yüzün, belirlenen kullanışlılık kriterleriyle uyumlu olup olmadığını anlamak, büyük, küçük bütün problemleri tespit etmektir. Nielsen (Nielsen, 1994) kullanılabilirlik değerlendirme yöntemlerini, sezgisel değerlendirme (heurestic evaluation), performans ölçümleri (performance measurements), sesli düşünme (think aloud), gözlem, anket, görüşme, odak grup, gerçek kullanımın kaydedilmesi (logging actual use) ve kullanıcı dönütleri şeklinde sıralamaktadır.

Nielsenin 10 kullanılabilirlik sezgiseli adı verilen bu rehbere göre, kullanıcı ara yüzleri tasarımında dikkat edilmesi gereken noktalar ve kullanılabilirliğin bu çerçevede sorgulanması aşağıdaki gibidir (Tüzün & Çıralı, 2011).

1. Sistem durumunun görünürlüğü
2. Sistem ile gerçek dünyanın eşleşmesi
3. Kullanıcı kontrolü ve özgürlüğü
4. Tutarlılık ve standartlar
5. Hata engelleme
6. Hatırlama yerine tanımlama
7. Kullanımın esneklik ve verimliliği
8. Estetik ve sade tasarımlar
9. Hataları tanıma, tanımlama ve geri almada kullanıcılara yardım
10. Yardım ve belgelendirme

Şekil 1. Nielsen'nin 10 Kullanılabilirlik Değerlendirme Yöntemleri

Nielsen'nin (Nielsen, 1999) 10 Kullanılabilirlik Değerlendirme Yöntemlerine göre bir ara yüzde olması gereken 10 özellik ve açıklamaları şu şekildedir (www.userspots.com, 2009) :

Sistem durumunun görünürlüğü:

Sistem kullanıcıyı makul bir zaman içerisinde geri beslemeler ile sistemde neler olduğu konusunda haberdar etmelidir. Örneğin; "Sayfa yükleniyor…" veya "Sistemimizde hata oluştu Daha sonra tekrar deneyiniz" gibi mesajlar verilip kullanıcı bilgilendirmelidir.

Gerçek dünyaya yakınlık:

Sistem, kullanıcıların anlamayacağı terimler yerine kullanıcılara yakın gelen kelime ve ifadeleri kullanarak kullanıcıların dilinden konuşmalıdır.

Kullanıcı kontrolü ve özgürlük:

Kullanıcılar genellikle sistem fonksiyonlarını yanlışlıkla seçtikleri için sistem onlara bu durumdan uzunca bir diyaloga girmeden kurtulacakları bir acil çıkış kapısı sunmalıdır. Bu yüzden Geri Al ve Yinele fonksiyonları sistemde bulunmalıdır.

Tutarlılık ve standartlar:

Kullanıcılar farklı kelime, durum ve aksiyonların aynı anlama gelip gelmediğini merak etmek durumunda kalmamalıdır.

Hata Önleme:

Çok iyi hata mesajları yerine kullanıcıların hata yapmasını önleyen dikkatli tasarımlar oluşturmak daha önem kazanmaktadır. Kullanıcıların hata yapma olasılıklarını artıran durumlar elimine edilmeli veya kullanıcılardan bir aksiyon öncesi yapmak isteyip istemediğinin onayı alınmalıdır.

Hatırlanma yerine bilinme:

Kullanıcının hafıza yükünü minimuma indirecek şekilde aksiyonlar, objeler ve opsiyonlar görünür olmalıdır. Kullanıcı bir diyalogdan diğerine geçtiğinde bazı bilgileri hatırlamak zorunda kalmamalıdır. Sitenin nasıl kullanılacağına dair bilgiler görünür veya gerektiğinde kolayca bulunabilir olmalıdır.

Esneklik ve kullanım etkinliği:

Kullanıcı ihtiyaçlarını tahmin edip gerekli adımların sayısı düşürülmeli ve sistem özelleştirmeye imkân sağlamalıdır.

Estetik ve mininmalist tasarım:

Diyaloglar ihtiyaç duyulmayan veya alakasız bilgiler içermemelidir. Diyalog içinde bulunan fazladan her birim asıl ilgili olan bilgi ile rekabete gireceğinden onun görünürlülüğünü düşürmektedir.

Hataları tanıma, tanımlama ve geri almada kullanıcılara yardım:

Hata mesajları kod içermeyen açık bir dille ifade edilip, problem tam olarak anlatılmalı ve olumlu bir şekilde kullanıcıya çözüm önerilmelidir.

Yardım ve dokümantasyon:

Bir sistemin dokümantasyon olmadan kullanılabilmesi daha iyi olsa bile kullanıcılara yardım ve dokümantasyon sunmak gerekli olabilmektedir. Bu bilgiler kolayca aranabilmeli, kullanıcı görevlerine odaklanmalı, çözüme dönük somut adımlar içermeli ve çok uzun olmamalıdır.

Bu çalışmada www.meb.gov.tr sitesinin, seçilen 4 görevin performans analizi ve yukarıda verilen sezgisel değerlendirme mantığı çerçevesinde Xerox firmasına ait sezgisel ölçeğe göre değerlendirilmesi işlemlerinden oluşmaktadır.

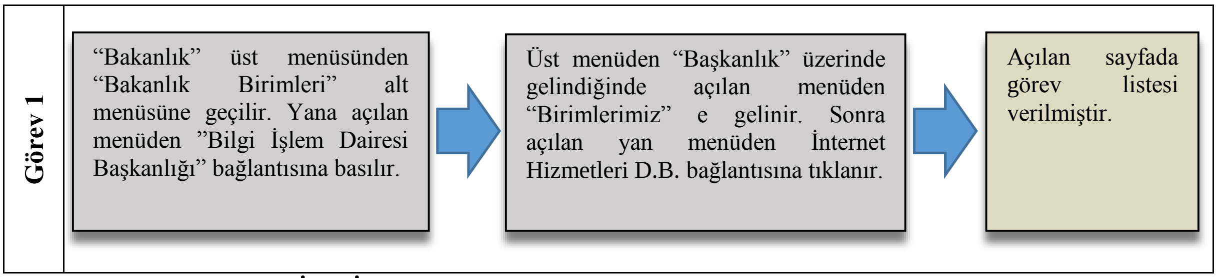
GÖREV BAZINDA PERFORMANS ANALİZİ

Görev bazında performans analizi için 2 kişiden oluşan uzmanlar ekibine aşağıdaki 4 görev verilmiştir. Bu uzmanlar ileri seviye bilgisayar kullanıcısı olup, görevler öncesinde ilgili siteyi ziyaret etmiş ve siteye aşina kullanıcılardan oluşmaktadır. Verilen sonuçların bu çerçevede değerlendirilmesi gerekmektedir. Görev bazından performans analizi sonuçları iki uzmanın ortalamaları alınarak hesaplanmıştır.

1. BİDB İnternet Hizmetleri şubesinin görevlerini bulunuz.
2. 2016 aday öğretmen sınav sonuç duyurusunu bulunuz.
3. 1990 yılında görev yapmış bakanlık müsteşarlarının adlarını bulunuz.
4. Ankara Çankaya İlçe Milli Eğitim Müdürlüğü'nün telefon numarasını bulunuz.

Görev 1: BİDB İnternet Hizmetleri Daire Başkanlığı görevlerini bulunuz.

Site üzerinde deneyimli bir kullanıcının, BİDB Ağ Yönetimi şubesinin görevlerini bulma işlemi 17 saniye içerisinde 3 ana adım ile tamamlanmıştır. Göreve ait adım listesi Şekil 2'de sunulmuştur.



Şekil 2. BİDB İnternet Hizmetleri Şubesinin Görevlerini Bulma Adımları

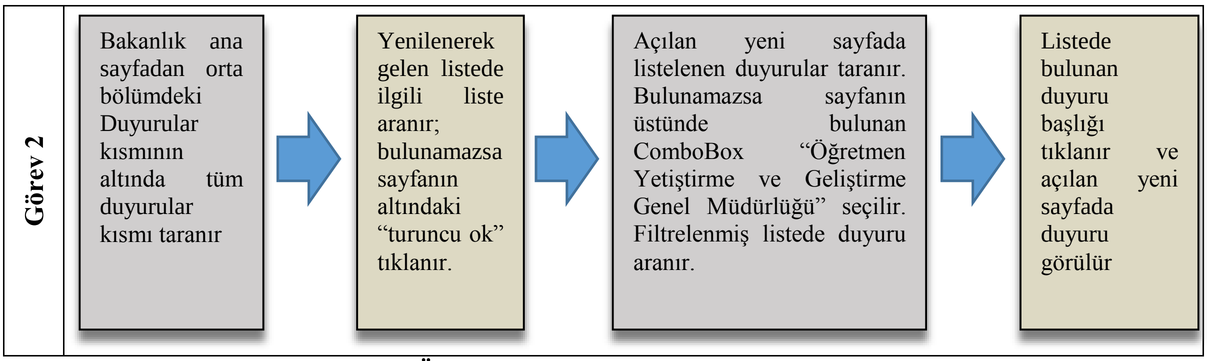
Yana açılan Bakanlık Birimleri menüsünde 23 adet alt menü bulunmaktadır. Bu kadar fazla sayıdaki alt menünün kullanıcının ekranına sığmadığı gözlemlenmiştir. Bu sebeple ekranın boyutu, çözünürlük değeri ve web tarayıcısının yakınlaşma düzeyi değerleri dikkate alınarak alt menünün çok sayıda olması çoğu deneyimsiz kullanıcıda sorun teşkil edebilecektir.

23 adet alt menüden "Bilgi İşlem Dairesi Başkanlığı" bağlantısına basıldığında açılan yeni sayfada ana sayfanın yatay üst menünün hiçbir değişikliğe uğramadığı, alt sayfalara ait menün sol düşeyde tasarlandığı gözlemlenmiştir. Bu durum kullanıcıda ilgili menüyü arayıp bulma sıkıntısı yaratmaktadır.

"Bilgi İşlem Dairesi Başkanlığı" sayfasında üst yatayda bulunan menülerden "Başkanlık" üzerinde gelindiğinde alta açılan menüden "Birimlerimiz" e gelinir. Sonra açılan 2. yan menüden İnternet Hizmetleri Daire Başkanlığı bağlantısına tıklanır. Açılan yeni sayfanın altında birimin görevleri eklenmiştir.

Görev 2: 2016 Aday öğretmen sınav sonuç duyurusunu bulunuz.

Site üzerinde deneyimli bir kullanıcının, "2016 Aday öğretmen sınav sonuç duyurusunu" nu bulma işlemi 32 saniye içerisinde 4 ana adım ile tamamlanmıştır. Göreve ait adım listesi Şekil 3'te sunulmuştur.

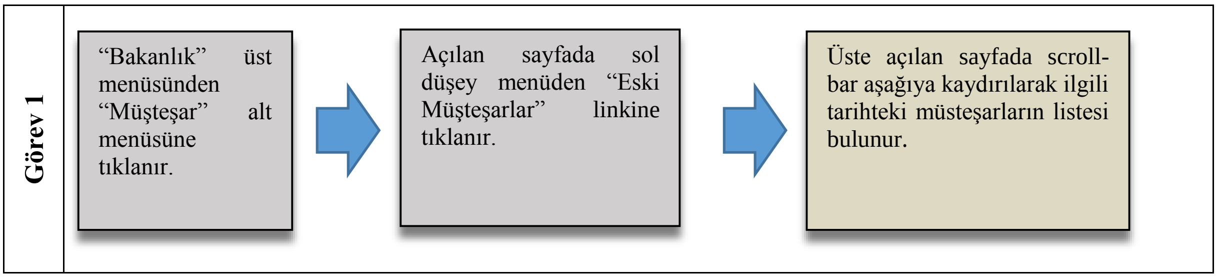


Şekil 3. 2016 Aday Öğretmen Sınav Sonuç Duyurusunu Bulma Adımları

Bakanlığın alt birimlerinin çok olması sebebiyle ana sayfadaki duyuru bölümünde birim duyurularının sayısı çok olmaktadır. Bu durum duyuruların fark edilmesini zorlaştırmaktadır. Alt birim sayfalarında duyuru bölümü olmasına rağmen fark edilmeyecek endişesiyle az kullanılmaktadır. Alt birim sayfalarının duyuru bölümünün kullanılmasını özendirmek gerekmekte ve duyuruların önem derecesine göre üst sıralara gelebilmesini sağlayacak bir mekanizma kullanılmalıdır.

Görev 3: 1990 yılında görev yapmış bakanlık müsteşarlarının adlarını bulunuz.

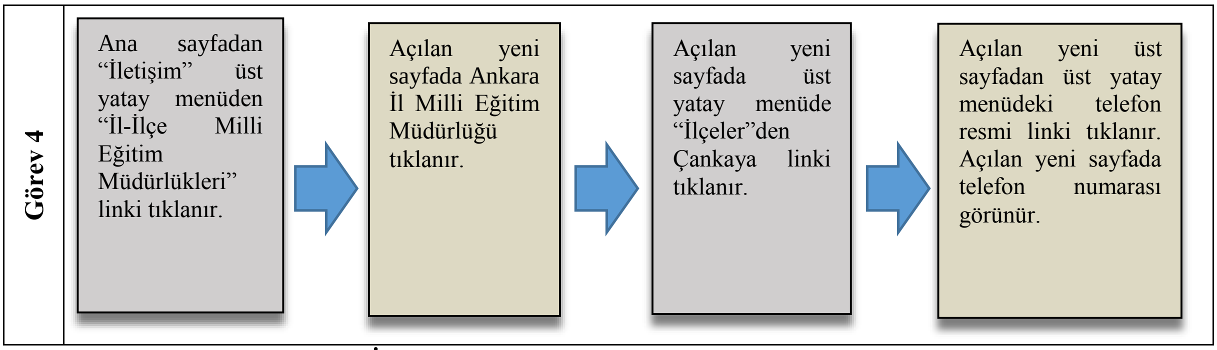
Site üzerinde deneyimli bir kullanıcının, "1990 yılında görev yapmış bakanlık müsteşarlarının adlarını" bulma işlemi 24 saniye içerisinde 3 ana adım ile tamamlanmıştır. Göreve ait adım listesi Şekil 4'de sunulmuştur.



Şekil 4. "1990 yılında görev yapmış bakanlık müsteşarlarının adları" Bulma Adımları

Görev 4: Ankara Çankaya İlçe Milli Eğitim Müdürlüğü'nün telefon numarasını bulunuz.

Site üzerinde deneyimli bir kullanıcının, "Ankara Çankaya İlçe Milli Eğitim Müdürlüğü'nün telefon numarası" bulma işlemi 28 saniye içerisinde 4 ana adım ile tamamlanmıştır. Göreve ait adım listesi Şekil 5'de sunulmuştur.



Şekil 5. "Ankara Çankaya İlçe Milli Eğitim Müdürlüğü'nün telefon numarası" Bulma Adımları

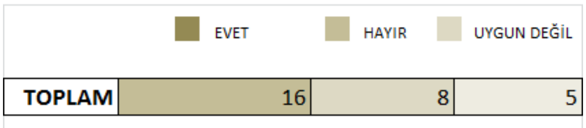
XEROX SEZGİSELLERİ BAZINDA DEĞERLENDİRME

Web sayfası iki uzman tarafından ayrı ayrı incelenmiş olup, kullanılabilirlik değerlendirme özelliğine göre yaptıkları analiz sonucunda, web sayfasının sağladığı kriterlere "Evet", sağlamadığı kriterlere "Hayır", web sayfası açısından değerlendirilmesi uygun olmayan kriterlere "Uygun Değil" cevabı verilmiştir. İki uzmanın verdiği farklı cevaplar daha sonra tekrar değerlendirilerek nihai değerlendirme yapılmıştır.

MEB web sitesinin Nielsen'nin Kullanılabilirlik Değerlendirme Yöntemine göre yapılan kullanılabilirlik analizine ilişkin sonuçlar aşağıda başlıklar halinde verilmiştir.

Sistem Durumunun Görünürlüğü

Şekil 6' da "Sistem Durumunun Görünürlüğü" özelliğine ilişkin analiz sonucu verilmiştir.

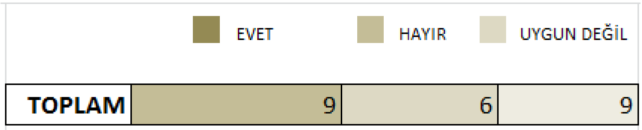


Şekil 6. "Sistem Durumunun Görünürlüğü" Başlığı İçin Sonuç Dağılımı

Web sayfasında her menüdeki bilgilendirmeler, hatırlatmalar ve hata mesajları sistem içerisinde aynı yerde görünmemektedir. Sistem içerisinde, veri girişi ekranları birden fazla sayfaya dağılmış ve bu sayfaların birbirleri ile ilişkisini gösteren adlandırmalar/etiketler mevcut değildir. Kullanıcı hareketleri ile ilgili herhangi bir geribildirim sistemi mevcut değildir. Sitenin hiçbir yerinde kullanıcıya ses ile geri bildirim yapılmamış, ayrıca onaylama veya tıklama işlemlerinde kullanıcıya görsel bir geri bildirimde verilmemektedir (Örneğin "İşleminiz onaylandı" gibi). Sistemin geri cevap vermesinde uzun süreli bekleme gerektiren durumlarda (15 saniyeden fazla), kullanıcı sistemin çalışır durumda olduğuna dair bilgilendirilmemektedir. Örneğin; Okul haritalarının açılması gerektiğinde harita geç açılmakta, ancak kullanıcıya işlemin devam ettiğine ilişkin bilgilendirme mesajı yapılmamaktadır.

Sistem ve Gerçek Dünyanın Uyumu

Şekil 7' de "Sistem ve Gerçek Dünyanın Uyumu" özelliğine ilişkin analiz sonucu verilmiştir.

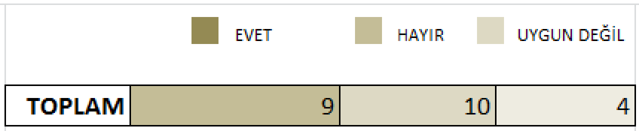


Şekil 7. "Sistem ve Gerçek Dünyanın Uyumu" Başlığı İçin Sonuç Dağılımı

Web sayfasının menü diziliminde bazı yerlerde alfabetik sıralamayı takip ettiği, bazı kısımlarda ise, doğal sıralamayı takip etmediği görülmüştür. Sayfalar geneli kırmızı olarak tasarlandığı görülmekte olup, bazı sayfalarda uyumsuz resimler ve renkler kullanılmaktadır.

Kullanıcı Kontrol ve Özgürlüğü

Şekil 8' de "Kullanıcı Kontrol ve Özgürlüğü" özelliğine ilişkin analiz sonucu verilmiştir.

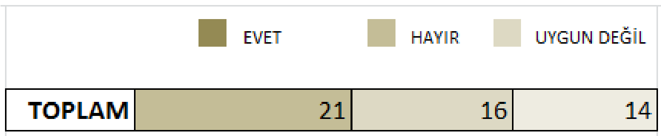


Şekil 8. "Kullanıcı Kontrol ve Özgürlüğü" Başlığı İçin Sonuç Dağılımı

Web sayfası, açılan pencereyi kapatmadan yeni pencere açılımına izin vermemektedir. Sadece web tarayıcısı yeni pencere açmakta olup, bu açılan pencereler arasında işlem yapılmaktadır. Web sayfasında uzun formların doldurulması sırasında, kullanıcının yaptığı işlemler kontrol edebilmesi açısından onay mekanizması kullanılmamaktadır. Herhangi bir işlem hareketi veya veri girişi işlemlerinde "geri al" fonksiyonu bulunmamaktadır. Web sayfası, zaman tasarrufu sağlamak adına, kullanıcının var olan verisini kopyalayarak ya da değiştirerek veri girişi yapmasına izin vermemektedir. Sayfalar üzerinde veri girişinin yapılmasında zaman tasarrufu gerektirecek bir yapı kurulmamıştır.

Tutarlılık ve Standartlar

Şekil 9'da "Tutarlılık ve Standartlar" özelliğine ilişkin analiz sonucu verilmiştir.

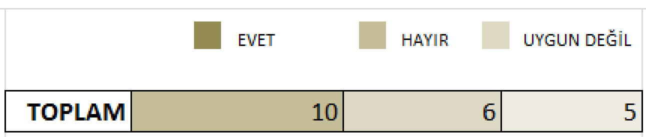


Şekil 9. "Tutarlılık ve Standartlar" Başlığı İçin Sonuç Dağılımı

Web sayfasındaki bütün ekranlarda, kuruma ait biçimlendirme standartları tutarlı bir şekilde kullanılmamaktadır. Web sayfasında kullanılan ikon tipleri kullanılabilirlik analizine uygun olan 12 ile 20 punto aralığını sağlamamaktadır. Web sayfası yazı büyüklüğü, yazı tipi, yazı rengi açısından kullanılabilir kriterlerine uymaktadır.

Hata Tanıma ve Önleme

Şekil 10'da "Hata Tanıma ve Önleme" özelliğine ilişkin analiz sonucu verilmiştir.

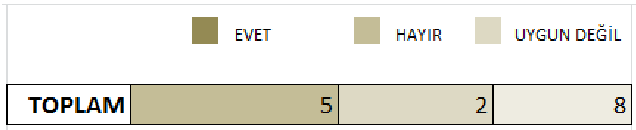


Şekil 10. "Hata Tanıma ve Önleme" Başlığı İçin Sonuç Dağılımı

Web sayfası herhangi bir hatayı bildirmek için sesli uyarıda bulunmamaktadır. Hata mesajlarında ünlem işareti kullanılmaktadır. Örneğin öneri kısmında kullanıcının eksik veya yanlış girdiği bilgiler ünlem ile uyarılmaktadır. Veri giriş alanında bir hata fark edilirse, sistem tarafından imleç hatanın olduğu alana yerleştirilmemekte veya hatayı vurgulamaya yönelik bir işlem yapılmamaktadır. Hata mesajları ile birlikte imlecin kullanıcıyı hatanın olduğu alana yönlendirmesi daha kullanışlı olacaktır. Web sayfasındaki hata mesajları sorunun nedeni hakkında herhangi bir öneride bulunmamaktadır. Sadece hatanın olduğunu belirtmektedir. Kullanıcıların hatalı veri girişleri hakkında, ilgili hata ile alakalı daha detaylı bilgilendirilmesi uygun olacaktır.

Hatadan Korunma

Bu başlık altında sistemin, hatadan korunması ve hata yapılmasının engellemesi ile ilgili olarak 15 kriter bazında değerlendirme yapılmaktadır. Değerlendirme sonuçlarının dağılımı şekil 11'de verilmiştir.

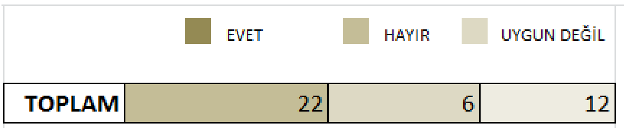


Şekil 11. "Hatadan Korunma" Başlığı İçin Sonuç Dağılımı

Web sayfası kullanıcıların mümkün olabildiğince az hata yapmasını sağlayacak bir yapıda tasarlanmamıştır. Örneğin "Öneri Formu" kısmında e-posta ve telefon numarası kontrolü yapılırken, "Bilgi Edinme" kısmında herhangi bir veri giriş kontrolü yapılmamaktadır.

Hatırlama Yerine Tanıma

Bu başlık altında sistemin kullanıcıya sistemi kullanırken hatırlatılması gereken yerleri belirtmesi ve bulunduğu yerle alakalı olarak bilgilendirmesi ile ilgili olarak 40 kriter bazında değerlendirme yapılmaktadır. Değerlendirme sonuçlarının dağılımı Şekil 12'de verilmiştir.

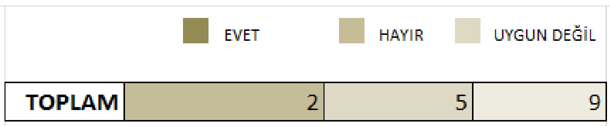


Şekil 12. "Hatırlama Yerine Tanıma " Başlığı İçin Sonuç Dağılımı

İsteğe bağlı veya zorunlu olan veri giriş alanları açıkça belirtilmiştir. Kullanıcıların girmesi mecburi olan yerler kırmızı * işareti ve altta bulunan açıklaması ile belirtilmesi gerekmektedir. Menü seçimlerinin varsayılan değerleri ayarlanmamıştır. Kullanıcıların sık seçtikleri seçenekler belirlenerek menü seçimlerinde bu seçenekler varsayılan olarak seçili yapılması gerekmektedir.

Esneklik ve Minimalist Tasarım

Bu başlık altında sistemin esneklik ve minimalist bir tasarıma sahip olduğu ile ilgili olarak 16 kriter bazında değerlendirme yapılmaktadır. Değerlendirme sonuçlarının dağılımı Şekil 13'de verilmiştir.



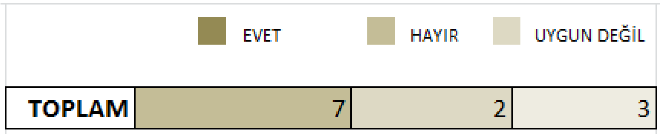
Şekil 13. "Esneklik ve Minimalist Tasarım" Başlığı İçin Sonuç Dağılımı

Kullanıcılar, birçok alandan oluşan ve tamamlanmamış olan veri giriş ekranlarında tanımlanmış olan bilgileri kaydedilerek daha sonra devam edebilmesine ve değişiklik yapabilmesine imkân sağlanmamıştır. Bu çerçevede ajax gibi teknolojiler kullanılarak, kullanıcıların girdikleri hali hazırdaki veriler saklanıp, aynı browser ile veri girişine kaldığı yerden devam etmesinin sağlanması gerekmektedir.

Sistem veri tabanı taramalarında “sonrakini bul” ve “öncekini bul” seçeneklerini sunmamaktadır. Okul listesinin alındığı alanlar gibi çok sayıda sonuç döndüren alanlarda veri tabanı sorguları önceki ve sonraki şeklinde gruplar halinde listelenmesi gerekmektedir.

Estetiklik ve Minimalist Tasarı

Bu başlık altında sistemin esneklik ve minimalist bir tasarıya sahip olduğu ile ilgili olarak 12 kriter bazında değerlendirme yapılmaktadır. Değerlendirme sonuçlarının dağılımı Şekil 14’ de verilmiştir.

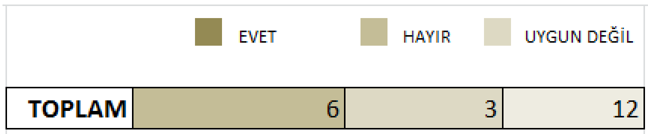


Şekil 14. “Estetiklik ve Minimalist Tasarı ” Başlığı İçin Sonuç Dağılımı

Menü başlıkları kısaltmak için yapılana kısaltmalar, kullanıcıların anlayabileceği şekilde olması gerekirken, sınavlar kısmında bulunan yan menüdeki kısaltmalar anlaşılır bulunmamıştır. Yapılan kısaltmalarda kullanıcılar tarafından sık kullanılmayan ve bilinmeyen kısaltmalardan kaçınmak gerekmektedir.

Yetenekler

Bu başlık altında sistemin yetenekleri ile ilgili olarak 21 kriter bazında değerlendirme yapılmaktadır. Değerlendirme sonuçlarının dağılımı aşağıdaki Şekil 15’ de verilmiştir.



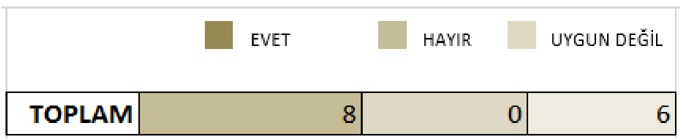
Şekil 15. “Yetenekler” Başlığı İçin Sonuç Dağılımı

Web sayfası tarafından kullanıcılar için herhangi bir veri transferi yapılmamaktadır. Örneğin öneri kısmında veya online bilgi edinme kısmında kullanıcının yaptığı başvurular ile alakalı bilgiler zaman belirterek kullanıcıya raporlanmalıdır, bu sayede kullanıcı ile daha iyi bir etkileşim sağlanmış olurken, kullanıcı da girdiği bilgilere sonradan göz atma olanağına sahip olacaktır.

Alan değerleri, mümkün olduğunca, alfabetik ve sayısal karakterlerin birbirine karıştırılmasından kaçınması gerekirken, sistemde bu durum göz önüne alınmamıştır. Örneğin, “Dilek ve Öneriler” kısmında isim soy isim gibi alfabetik olması gereken alanlara sayısal ve sembol türünden karakterler ile veri girişi yapılabilmektedir.

Kullanıcı ile Zevkli ve Saygılı İletişim

Bu başlık altında sistemin kullanıcı ile zevkli ve saygılı bir iletişim gerçekleştirmesi ile ilgili olarak 14 kriter bazında değerlendirme yapılmaktadır. Değerlendirme sonuçlarının dağılımı Şekil 16’ da verilmiştir.

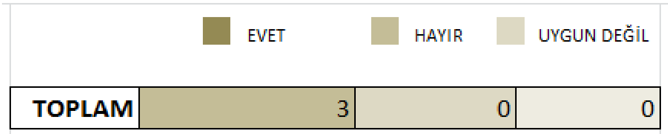


Şekil 16. “Kullanıcı ile Zevkli ve Saygılı İletişim” Başlığı İçin Sonuç Dağılımı

Renk kullanımı sırasında özenli ve dikkatli bir kullanım göz çarpmaktadır. Renklerin bulundukları alan itibariyle uyumlu bir ilişki bulunmaktadır.

Gizlilik

Bu başlık altında sistemin gizlilik ile ilgili olarak 3 kriter bazında değerlendirme yapılmaktadır. Değerlendirme sonuçlarının dağılımı Şekil 17’ de verilmiştir.



Şekil 17. "Gizlilik" Başlığı İçin Sonuç Dağılımı

Bu başlık altında bulunan 3 kriterden 3'ü de uygulama kriterini sağlamaktadır. Bu sistemin gizlilik ile ilgili bir kusuruna rastlanmamıştır.

SONUÇ

Bu çalışmada Türkiye'nin en büyük kamu kurumlarından biri olan, milyonlarca öğrenci ve veliye hizmet veren MEB.'e ait web sayfası kullanılabilirlik açısından değerlendirilmiştir. Değerlendirme işlemi Xerox sezgisel ölçeği ve görev bazında performans analiziyle yapılmıştır. Uzman değerlendirmesi, 2 uzman tarafından Nielsen'in 10 adet sezgisel ilkesi kullanılarak gerçekleştirilmiştir. Görev bazında performans analizi için uzmanlara web sayfasını kullanarak gerçekleştirmeleri için 4 adet görev verilmiştir. Verilen görevlerin en kısası 3 adım ve 17 saniye, en uzunu ise 4 adım 32 saniyede tamamlanmış olup ortalama görev süresi 25 saniye olarak ölçülmüştür. Xerox sezgisel ölçeğine göre, web sayfasının 10 özellik açısından 2 uzman tarafından değerlendirilmesi sonucunda, "Kullanıcı Kontrol ve Özgürlüğü" ve "Esneklik ve Minimalist Tasarım" özellikleri açısından kötü, "Sistem ve Gerçek Dünyanın Uyumu" özelliği açısından orta, diğer 7 özellik açısından ise iyi bulunmuştur.

Bakanlık ana sayfası genel olarak kullanılabilirlik açısından uygun tasarlanmış olmasına rağmen, bakanlığın bazı alt alanların (sub-domain) ve alt sayfaların tasarım bütünlüğüne uymadığı görülmektedir. Bu alt alan ve sayfalarda kırık bağlantılar bulunduğu görülmüştür. Alt sayfalar ve alt domainlerde menü linklerinin hiyerarşik olmadığı, ilişkisiz bir dizilimde olduğu görülmüştür. Linklerin hiyerarşik olarak diziliminin sağlanması kullanılabilirlik açısından uygun olacaktır. 'Bilgi Edinme' sayfasının tasarımı kullanılabilirlik açısından bilgisayar deneyimi zayıf kullanıcılarda sorun teşkil edebilecek bir yapıya sahiptir. 'Bilgi Edinme' sayfası bir kurumun direk dışarıya açılan kapısı olması nedeniyle, kullanıcı profili açısından her kesime hitap etmesi gerekmektedir.

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OPINIONS OF PRE-SERVICE SCIENCE TEACHERS ON THE CHEMISTRY LABORATORY II

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ABSTRACT: In science education laboratory is a teaching method that provides meaningful learning of concepts, permanent learning, and working individually or in groups for students. Applications such as laboratory constitute the basis of scientific studies. Since students actively participate in experimental work in the laboratory, their views related to laboratory courses become important. This study was conducted in order to determine pre-service science teachers' views on General Chemistry Laboratory II course. Qualitative research model was used in the study. The study was conducted with 45 students who are in their first year in science teacher education department at a university in the spring semester of the 2014-15 academic year. 14 open-ended questions prepared by the researchers were asked to the students participating in the study. The answers to the questions were analysed with descriptive analysis.

Key words: general chemistry laboratory, pre-service science teachers, experiment, student opinion

FEN BİLGİSİ ÖĞRETMEN ADAYLARININ GENEL KİMYA II LABORATUVARINA İLİŞKİN GÖRÜŞLERİ

ÖZET: Fen eğitiminde laboratuvar, kavramların anlamlı öğrenilmesi, öğrenmenin kalıcı olması ve öğrencilerin bireysel ya da gruplar halinde çalışmalarını sağlayan bir öğretim yöntemidir. Fen araştırmalarının temelini laboratuvar gibi uygulamalar oluşturmaktadır. Öğrenciler laboratuvarda deneysel çalışmalara aktif olarak katıldıkları için laboratuvar dersleri ile ilgili görüşleri önem kazanmaktadır. Bu çalışma fen bilgisi öğretmen adaylarının Genel Kimya II Laboratuvar dersi ile ilgili görüşlerini belirlemek amacı ile yapılmıştır. Çalışmada nitel araştırma modeli kullanılmıştır. 2014-15 akademik yılının bahar döneminde bir üniversitenin fen bilgisi öğretmenliği bölümü birinci sınıfta okuyan 45 öğrenci ile çalışma gerçekleştirilmiştir. Çalışmaya katılan öğrencilere araştırmacılar tarafından hazırlanan açık uçlu 14 adet soru yöneltilmiştir. Sorulara verilen yanıtlar betimsel analiz yöntemi ile analiz edilmiştir.

Anahtar Sözcükler: genel kimya laboratuvarı, fen bilgisi öğretmen adayları, deney, öğrenci görüşü

GİRİŞ

Fen bilimleri insanların gündelik yaşamı ve çevreyle doğrudan ya da dolaylı olarak ilgilidir. Fen bilimlerindeki konuların çoğu gündelik yaşamla ilgili olmasına karşın, konular öğrencilere soyut ve karmaşık gelmektedir (Akdeniz, Ayas ve Çepni, 1994). Ayrıca bilim ve teknolojideki hızlı gelişmeler bireylerin bilimsel okur-yazar olmasını gerektirmektedir. Bireyler bilimsel okur-yazar olarak yetiştiklerinde; günlük yaşamlarında karşılaştıkları çeşitli problemlere çözüm yolları önerebilir, bilgiye nasıl ulaşacağını bildiğinden bilgiye daha hızlı ulaşır, yeni bilgiler üretebilir, çağdaş teknolojileri etkili ve verimli bir şekilde kullanabilirler (Yaşar ve diğ., 1998, akt. Pekbay ve Kaptan, 2014). Milli Eğitim Bakanlığı, fen eğitiminin amaçları doğrultusunda İlköğretim programını yeniden yapılandırmış ve geleneksel öğrenme ortamlarının kullanıldığı ders plan ve programlarını ortadan kaldırarak bunun yerine öğrencilerin yaparak-yaşayarak öğrenmelerini sağlayıcı yeni yöntem ve süreçleri programlarda kullanmıştır. Bu yöntemler içerisinde fen eğitimi kapsamında en etkili olanlardan bir tanesi laboratuvar yöntemidir (Hamurcu, 1998). Laboratuvar, öğretilmek istenen bir konu veya kavramın öğrenciye; birinci elden kendisinin yapması gösteri deneyi şeklinde öğretildiği ortamdır (Yılmaz ve Morgil, 1999). Genel olarak fen öğretiminde öğrencilerin kazanması beklenen davranış değişikliklerinin laboratuvar ortamındaki uygulamalar sayesinde olduğu kabul görmektedir. Çünkü öğrenci öğrenmesi gereken konuyu kendisi yaparak yaşayarak öğrendiği için bilgiler daha kalıcı olmaktadır. Kimya öğretiminde de laboratuvar, gözlem ve deney öğrencilere birinci elden deneyim kazanmayı sağladığı için öğrenmede önemli bir etken olarak görülmektedir (Yılmaz, Uludağ ve Morgil, 2001). Bundan dolayı kimya derslerinin işlenirken teorik bilgi, deneye bağlı bilgiden yola çıkılarak verilmelidir. Öğrenciye kimya öğretiminde deneye bağlı bilgiden çıkarak bilgi aktarımı yapılmazsa, öğrencinin kalıcı bilgi elde etmesi mümkün olmayacaktır (Ayas, ve ark.,1997 akt. Ayas ve ark., 2002). Kimya konularının çoğu soyut olduğu için, laboratuvar yöntemi kullanmadan, kimya kavramlarını öğrencilere öğretmek ve kalıcı davranış değişikliğini sağlamak mümkün olmamaktadır. Bu nedenle fen bilgisi öğretmen adaylarına eğitim-öğretim sürecinde laboratuvar kullanımı ve uygulama becerisi kazandırmak laboratuvar çalışmalarına gereken önemi vererek mümkün olacaktır. Ayrıca fen derslerinin deneylerle birlikte işlenmesi soyut ve öğrenciye zor gelen kavramların öğretilmesini kolaylaştıracağı gibi fen bilgisi dersine ilişkin başarı ve tutumlarını arttıracak ve dersi daha çok sevmelerine neden olacaktır (Aydoğdu, 2000; Aycan, Arı, Türkoğuz, 2001; Ergin, Akgün, Küçüközer, Yakal, 2001). Öğrencilerin fen derslerine ve laboratuvar uygulamalarına yönelik olumlu tutumları başarılarını da olumlu yönde etkilemektedir (Feyzioğlu, 2009; Hofstein ve Naaman, 2007). Bu çalışmanın amacı fen bilgisi öğretmen adaylarının Genel Kimya II Laboratuvar dersi ile ilgili görüşlerini belirlemektir.

YÖNTEM

Araştırmanın Modeli

Fen Bilgisi öğretmen adaylarının Genel Kimya II Laboratuvar dersine yönelik görüşlerinin belirlenmesi amacını taşıyan bu çalışmada nitel araştırma yöntemi kullanılmıştır.

Çalışma Grubu

Etkinlik 2014-15 akademik yılı bahar döneminde Niğde Üniversitesi Eğitim Fakültesi Fen Bilgisi Öğretmenliği 1. sınıfa devam eden 45 öğrenci ile gerçekleştirilmiştir.

Veri Toplama Aracı

Çalışmaya katılan öğrencilere alan yazın araştırması sonunda araştırmacılar tarafından hazırlanan açık uçlu 14 adet soru yöneltilmiştir.

Verilerin Analizi

Sorulara verilen yanıtlar betimsel analiz yöntemi ile analiz edilmiştir.

Geçerlik ve güvenirlik

Bu çalışmanın iç geçerliğini arttırmak amacıyla öğrencilere sorulan sorular alan yazın incelemesi sonucunda hazırlanmış ve uzman kontrolü ile çalışma son haline ulaştırılmıştır. Kodlamayı yapan kişiler tarafından yapılan analizler birbirleri ile yüksek oranda uyumlu bulunmuştur. Araştırmanın dış geçerliğini sağlayabilmek için öğrencilerden elde edilen nitel bulguların hamlığı korunmuştur.

BULGULAR

Soru 1. Deneylerin günlük yaşamla ilişkisi

Öğrenciler deneylerin günlük yaşamla ilişkisinin olup olmadığını sorgulayan bu soruya değişen derecelerde olumlu görüş bildirmişlerdir: 40 öğrenci olumlu, bir öğrenci çoğunlukla olumlu ve dört öğrenci de kısmen olumlu görüşe sahip olduğunu belirtmiştir. Aşağıdaki tablo öğrencilerin bu soruya verdiği yanıtların dağılımını göstermektedir.

Tablo 1. Öğrencilerin yaptığı deneylerin günlük yaşamla ilişkisi üzerine görüşler

	f
Olumlu	40
Çoğunlukla olumlu	1
Kısmen olumlu	4

Soru 2. Deney ön hazırlığı

Öğrenciler deney öncesi ön hazırlığın gerekliliğini sorgulayan bu soruyla ilgili tamamen olumlu görüş bildirmişlerdir. Aşağıdaki tablo öğrencilerin bu soruya verdiği yanıtların dağılımını göstermektedir. Tablo'ya göre ön hazırlık yapılmazsa deneyde zorlanılır ve deney doğru yapılmaz, deney anlaşılmaz. Ön hazırlık teori ve deneyin yapılışı hakkında bilgilendirir, deney sırasında herhangi bir zarara uğranmamasını sağlar. Ön hazırlık ayrıca malzemenin nasıl kullanılacağı, deneye nasıl başlanacağı, deneyden nasıl bir sonuç çıkacağı hakkında bilgi verir. Ön hazırlık sayesinde öğrenciler daha bilinçli olacağından deneyi kısa sürede yapar.

Tablo 2. Öğrencilerin deney ön hazırlığı ile ilgili görüşleri

	f
Zorlanır, deneyi doğru yapamama	11
Deneyi anlama, anlamama	7
Teori, yapılış bilgisi	5
Yapılacakların bilgisi	4
Zarar vermemesi	3
Malzeme kullanım bilgisi	2
Deneye başlama, malzeme, üründen sonuç çıkarma	2
Bilinçli olma, kısa sürede yapma	2
Faydalanma	2
Ne yapılacak, nasıl ve niçin yapılacak	1
Kavram ve kullanılanların bilgisi	1
Rahat olma, çabuk kavrama	1
Malzeme, aşama	1
Deney öncesi donanım	1
Malzeme temini, teoriyi araştırıp kavrama, deneyi verimli yapma	1
Deneyi yorumlama	1
Deneyi yaparken ve sözlüde gerekli	1

Soru 3. Deneylerin öğreticiliği ve deney kazanımları

Deneylerin öğreticiliğini ve kazanımlarını sorgulayan bu soruyla ilgili öğrencilerin çoğunluğu olumlu görüş bildirirken bir öğrenci kararsız kalmıştır. Aşağıdaki tablo öğrencilerin bu soruya verdiği yanıtların dağılımını göstermektedir.

Tablo 3. Öğrencilerin yaptığı deneylerin öğreticiliği ve kazanımları üzerine görüşleri

	f
Olumlu	38
Kısmen olumlu	6
Kararsız	1

Deneylerin öğreticiliği ve kazanımlarıyla ilgili olarak olumlu görüşe sahip öğrencilerin verdikleri ifadelerin dağılımı aşağıdaki tabloda gösterilmektedir. Tablo'ya göre deneyler, kimyanın günlük hayatla ilişkisini kurmada ve bu alanda yapabileceklerini anlamada öğrencilere yardımcı olmaktadır. Deneylerle uygulaması yapıldığından teorik bilgilerin kalıcılığını sağlamaktadır.

Tablo 3.1.Olumlu görüş bildiren öğrenciler

	f
Günlük hayatta nasıl olduğu neler yapabileceğini anlama, malzemelerin kimyayla ilgisi	16
Teorik bilgilerin uygulanmasını yapıp kalıcılığı sağlama	5
Yeni bilgi	2
Gerekirse sabunu bile yapma	2
Deney, gözlem, kalıcı bilgi	2
Günlük yaşamda zorlukla karşılaşıldığında ve öğretmen olduğunda yapma	2
Hesap yapma, çözelti hazırlama	1
Deneye yönelik özgüven kazanma	1
Kuramları kavrayıp kanıtlama	1
Öğretmen olduğunda kolay deney yapma	1
Deney bilgisi	1
El-göz koordinasyonu	1

Deneylerin öğreticiliği ve kazanımlarıyla ilgili olarak kısmen olumlu görüşe sahip öğrencilerin verdikleri ifadelerin dağılımı aşağıdaki tabloda gösterilmektedir. Tablo'ya göre deneyler, gözlem becerisini geliştirmek ve günlük yaşamla ilişkiyi sağlamakla birlikte bazıları gereksiz ve öğretici değildir.

Tablo 3.2. Kısmen olumlu görüş bildiren öğrenciler

	f
Çok zor olanlar dışındakiler anlaşılır (bazı kimyasal maddeleri içeren ürünler konusunda dikkatli olma)	1
Bazıları günlük yaşamla ilgili	1
Gözlem becerisi geliştirme	1
Bazıları öğretici bazıları gereksiz	1
Fazla öğretici değil, insanı geliştirmiyor	1
Açıklama yok	1

Kararsız olan öğrenci deneylerin adını bile hatırlayamadığını belirtmiştir.

Soru 4. Öğrencilerin laboratuvarla ilgili duyguları

Laboratuvara yönelik duygularını sorgulayan bu soruyla ilgili öğrencilerin yaklaşık yarısı karışık duygulara sahipken, bir kısmı olumlu bir öğrenci de olumsuz duygu taşıdığını belirtmiştir. Aşağıdaki tablo öğrencilerin bu soruya verdiği yanıtların dağılımını göstermektedir.

Tablo 4. Öğrencilerin laboratuvarla ilgili duyguları üzerine görüşleri

	f
Karışık	25
Olumlu	19
Olumsuz	1

Laboratuvara yönelik olarak karışık duygulara sahip olan öğrencilerin verdikleri ifadelerin dağılımı aşağıdaki tabloda gösterilmektedir. Tablo'ya göre öğrenciler deneye göre dersten keyif olmakta ya da almamaktadır. Öğrenciler deneyleri eğlenceli bulmakla birlikte tehlikeli olduğunu düşündüğü deneylerde tedirgin olmaktadır.

Tablo 4.1. Karışık duyguları olan öğrenciler

	f
Bazen keyifli (paslanma, sabun vb.)	4
Keyif alıp almama deneye göre değişmesi	4
Eğlenceli, tehlikeli olduğunda tedirgin	2
Biraz endişe heyecan	1
Sözlü telaşı, deneyde keyifli, teoriği pratiğe aktarma keyifli	1
Genelde zevkli bazen sıkıcı	1
Sözlü korkusu, grup deneyi keyifli	1
Zor deneylere üzüntülü gelme, keyif almaya çalışma	1
Sözlü stresi korkusu ama şimdi zevk alma	1
Heyecan merak,sözlüde doğru cevap verince mutlu	1
Ne deneyi yapacağı beklentisi ama genelde olumlu	1
Heyecanlı ama sözlüde korkma	1
Tedirgin,teorik bilgi karmaşık,bazı deneyler zevkli,bazıları karmaşık-sıkıcı	1
Zor ve uzun deneyi yapamadığında sıkıcı, bazı deneyler keyifli	1
Hazırlıklı geldiği deneyden keyif alma yoksa almama	1
Normal duygu,çoğu deney keyifli	1

Laboratuvara yönelik olarak olumlu duygulara sahip olan öğrencilerin verdikleri ifadelerin dağılımı aşağıdaki tabloda gösterilmektedir. Tablo'ya göre öğrenciler bilgi edindikleri ve deney yeteneği geliştirdiği için keyif almakta, merak gidermekte ve deney yapmayı sevmektedir.

Tablo 4.2. Olumlu duyguları olan öğrenciler

	f
Bilgi edinme, deney yeteneği, uygulama yapma öğrenme (keyifli)	4
Heyecanlı (yeni bilgi)	2
Laboratuvar dersini sevme, deneyden keyif	2
Yeni bilgi, malzeme kullanma	1
Merak (yeni bilgi)	1
Yeni bilgi öğrenme	1
Heyecanlı ve istekli kolay deneylerde keyif alma	1

Deneyi sevme, eğlenme, öğrenme	1
Malzemeyi hazırlama, biran önce deneye başlamadan zevk alma	1
Açıklama yok	5

Olumsuz duygusu olan bir öğrenci laboratuvardan keyif almadığını belirtmiştir.

Soru 5. Deney yapma yeteneği

Deney yapma yeteneği kazanıp kazanmadıklarını sorgulayan bu soruyla ilgili öğrencilerin yaklaşık üçte ikisi olumlu görüş belirtirken üçte biri kısmen olumlu görüş bildirmiş, bir öğrenci is bu soruyu boş bırakmıştır. Aşağıdaki tablo öğrencilerin bu soruya verdiği yanıtların dağılımını göstermektedir.

Tablo 5. Öğrencilerin deney yapma yeteneği kazanmasına yönelik görüşleri

	f
Kazananlar	31
Kısmen kazananlar	13
Yanıtsız	1

Deney yapma yeteneği kazandıklarını belirten öğrencilerin verdikleri ifadelerin dağılımı aşağıdaki tabloda gösterilmektedir. Tablo'ya göre öğrenciler deneye hazırlıklı geldiklerinde ve gözetmen eşliğinde düzenek hazırlamada sıkıntı çekmeyeceklerini ifade etmişlerdir.

Tablo 5.1. Deney yapma yeteneğini kazanan öğrenciler

	f
Teorik bilgi ve ön hazırlık yapıldığında düzenek ve deney sıkıntı değil	1
Evet, gözetmen eşliğinde	1
Açıklama yok	29

Deney yapma yeteneği kısmen kazandıklarını belirten öğrencilerin verdikleri ifadelerin dağılımı aşağıdaki tabloda gösterilmektedir. Tablo'ya göre öğrenciler çoğu deney için deney yapma becerisi kazandıklarını, bazı deneyleri yardımla yapabileceklerini ifade etmişlerdir.

Tablo 5.2.Deney yapma yeteneğini kısmen kazanan öğrenciler

	f
Çoğu deney için deneyimli	4
Tam değil yardımla	3
Birçok deneyde tamam ama çözelti hazırlama deneyini yapamama	1
Çok düzenek kurmamasına rağmen yapabilme	1
Özgüveni olma ama tek başına tedirgin	1
Açıklama yok	3

Soru 6. Emniyet kurallarını uygulama

Emniyet kurallarını uygulayıp uygulamadıklarını sorgulayan bu soruyla ilgili öğrencilerin ikisi hariç olumlu görüş belirtmişlerdir. Aşağıdaki tablo öğrencilerin bu soruya verdiği yanıtların dağılımını göstermektedir.

Tablo 6. Öğrencilerin emniyet kurallarını uygulama üzerine görüşleri

	f
Evet	43
Tam değil	1
Yanıtsız	1

Öğrencilerin uyguladıkları emniyet kurallarına yönelik öğrencilerin verdikleri yanıtların dağılımı aşağıdaki tabloda gösterilmektedir. Tablo'ya göre öğrenciler genelde deneyde önlük ve eldiven giymekte ve saçlarını bağlamaktadır.

Tablo 6.1. Öğrencilerin uyguladıkları emniyet kuralları üzerine görüşleri

	f
Önlük ve eldiven giyme	9
Önlük ve eldiven giyme, saçı toplama	8
Önlük ve eldiven giyme	8
Önlük giyme, saçı toplama	3
Eldiven giyme	3
Önlük giyme	3
Eldiven giyme, zararlı şeylerden uzak durma	1
Önlük ve eldiven giyme, kimyasallara dikkat etme	1
Önlük ve eldiven giyme, çok hızlı hareket etmeme	1
Kimyasalla temasta el yıkama	1
Önlük giyme, saçı toplama, kimyasalla temasta dikkat etme, koşmama	1
Koşmama, tezgaha bir şey koymama	1
Önlük ve eldiven giyme, saçı toplama, aside önce su katma	1
Önlük ve eldiven giyme, kesici alet taşımama	1
Gözlük hariç uymaya çalışma	1
Eldiven giyme, gaz çıkışında solumama	1
Kendi ve diğerlerinin sağlığı için uyulması	1
İstisnalarla	1
Açıklama yok	5

Geri kalan iki öğrenciden biri bu soruyu boş bırakırken, diğer öğrenci emniyet kurallarını tam olarak uygulamadığını bazen takı-saat taktığını belirtmiştir.

Soru 7. Olumsuz Durumlar

Deneyde olumsuz bir durumla karşılaşıp karşılaşmadıklarını sorgulayan bu soruyla ilgili öğrencilerin yarıdan fazlası herhangi bir olumsuzlukla karşılaşmadığını belirtirken yaklaşık üçte biri karşılaştıklarını belirtmişlerdir. Aşağıdaki tablo öğrencilerin bu soruya verdiği yanıtların dağılımını göstermektedir.

Tablo 7. Öğrencilerin laboratuvarda olumsuz durumla karşılaşıp karşılaşmaması üzerine görüşleri

	f
Hayır	24
Evet	18
Hem evet hem hayır	1
Yanıtsız	2

Öğrenciler olumsuzlukla karşılaşmadıkları için herhangi bir açıklama yapmamışlardır. Bununla birlikte aşağıdaki tabloda gösterildiği gibi bu durumlarda deneyi tekrarladıklarını ve eğiticiden yardım aldıklarını belirten öğrenciler de vardır.

Tablo 7.1. Öğrencilerin laboratuvarda olumsuz durumla karşılaşmamasıyla ilgili görüşleri

	f
Yanlış yapılan deneyleri tekrarlama, eğiticiden yardımla deneyi yapma	2
Deney sonrası ellerini yıkadığından olumsuz durumla karşılaşmama	1
Açıklama yok	21

Öğrencilerin laboratuvarda deney yaparken karşılaştıkları durumlar aşağıdaki tabloda gösterilmektedir. Tablo'ya göre asit çözeltisi hazırlarken şişenin ısınması, kırılması, bazı deneylerde yetersiz kalan malzeme vb. nedenlerden dolayı olumsuzluk yaşamışlardır.

Tablo 7.2. Öğrencilerin laboratuvarda olumsuz durumla karşılaşması üzerine görüşleri

	f
Balonjojeye konan sülfürik asit ısındığından korkma	3
Bazı deney malzemelerinin gruplara yetmemesi	3
Koyulaşması gereken ama koyulaşmadığı durumlar	1
Bazı değerleri örneğin sıcaklığı fazla uygulama	1
Birkaç defa süblimleşmede beher oturmadığından suyun dökülmesi	1
Grup arkadaşlarının deneye ilgisizliği	1

4 kat fazla asit kullanma	1
Naftalinin kalitesizliğinden deneyin geç olması	1
Büretin musluğunu açarken kırıp elini kesme	1
Suyu fazla ısıtmak ve sabun deneyinde zorlanmak	1
Sabun deneyinde iki defa sonuç elde edememe	1
Tam yapılmasına rağmen deneyin olmaması	1
Bazı deney sonuçlarının çıkmaması, malzeme yetmemesi	1
Fazla ya da eksik madde kullanımında sonucun hatalı çıkması	1

Bir öğrenci olumsuz durumla karşılaşacağını sezdiğinde eğiticiyi çağırdığını belirtmiştir. İki öğrenci de bu soruyu boş bırakmıştır.

Soru 8. Eğiticinin katkısı

Eğiticinin katkısını sorgulayan bu soruyla ilgili öğrencilerin 43'ü eğiticinin katkısını olumlu bulurken, iki öğrenci bu soruyu boş bırakmıştır. Eğiticinin yaptığı katkı hakkında öğrencilerin verdiği yanıtların aşağıdaki tabloda özetlenmektedir. Tablo'ya göre eğitmen deneydeki zorlukları giderici, yol gösterici, yanlış ve eksiklerde uyarıcı, bilinmeyene yardımcı bir rol oynamıştır.

Tablo 8. Öğrencilerin eğiticinin katkısı üzerine görüşleri

	f
Deney zorluklarını giderici, yol gösterici, bilinmeyene yardımcı	9
Yanlış ve eksiklerde uyarma, doğruyu yaptırma	3
Bilinmeyeni söyleme, dikkat etme konusunda uyarma, güvenli deney yaptırma	2
Bilgili, bilinmeyende yardımcı	2
Günlük yaşamda kullanımı hakkında bilgilendirme	2
Yol gösterici, rehber	2
Sıkı, disiplinli ve ılımlı	1
Deneydeki eksikleri belirtme	1
Nasıl yapıldığını anlatma, teoriyi kolaylaştırma	1
Ders konularını deneyle pekiştirme, sonuçları gözlemleme	1
Ön bilgi vererek deneyi kolaylaştırma	1
Deney ortamı sağlama, konuyu kavratma	1
Deneyde yardımcı, korkmamayı öğretme	1
Takılınan yerlerde yardımcı, sözlüde korku yaşatıcı, deneyle ilgili bilgilendirici	1
Daha verimli ders olmasında etkili	1
Deneyin doğruluğu hakkında bilgi verici, sözlü yapma, hatalarda yardım etme	1
Deneyi kavramayı, sorunsuz-hatasız yapmayı sağlama	1
Deneyi nasıl yapacağını bilgilendirme	1
Deney bilgisi ve deneyin nasıl yapılacağını bilgilendirme	1
Eğiticiyle tedirgin olmama	1
Sakin, eğlenceli ve anlayışlıysa dinlenilme	1
Deney bilgisi veren, hatada uyaran	1
Yardımcı	1
Eksikleri sorup gidererek hızlı ve eksiksiz deney yapmayı sağlama	1
Bilgiyi Öğrenciye aktarabilme	1
Yeterli	1
Deneyi okuyup gerekenleri yapıp gördüğünde kalıcı	1
Açıklama yok	2

Soru 9. Deney grubuyla uyum

Deney grubuyla uyumu sorgulayan bu soruyla ilgili öğrencilerin büyük çoğunluğu uyumlu olduklarını ifade ederken az sayıda öğrenci uyumsuzluk da yaşadığını belirtmiştir. Aşağıdaki tablo öğrencilerin bu soruya verdiği yanıtların dağılımını göstermektedir.

Tablo 9. Öğrencilerin deney gruplarıyla uyum üzerine görüşleri

	f
Evet	41
Hem evet hem hayır	4

Öğrencilerin ideal grup elemanı sayısı hakkındaki görüşleri ise aşağıdaki tabloda özetlenmektedir. Tablo'ya göre grupların 4-6 kişilik olmasını isteyen öğrenciler çoğunluktadır.

Tablo 9.1. Öğrencilerin deney gruplarıyla uyumlu olup gruptaki kişi sayısı üzerine görüşleri

	f
5 kişi	8
6 kişi	7
4 kişi	6
5-6 kişi	4
4-5 kişi	3
7 kişi	2
En fazla 3-4 kişi	2
Daha az olmalı	1
3 olmalı	1
2-3 kişi olmalı	1
Açıklama yok	4

Grubuyla kısmen uyumlu olduğunu belirten öğrencilerin görüşleri ise aşağıdaki tabloda özetlenmektedir. Tablo'ya göre deneylere gruptaki herkes çalışıp geldiyse grup uyumlu çalışmakta ya da uyum süreci zaman almaktadır.

Tablo 9.2. Öğrencilerin deney gruplarıyla hem uyum hem uyumsuz olma üzerine görüşleri

	f
Birinci dönem grupta sivrilenlerden dolayı yoktu ama şimdi uyumlu	1
Çoğunluk çalışıp geldiyse uyumlu, sayı iyi, rahat çalışma	1
Grup değiştirince memnun olma, 5-6 kişilik grup ideal	1
Tek başına olunmalı	1

Soru 10. Raporun öğrenmeye katkısı

Raporun öğrenmeye katkısını sorgulayan bu soruyla ilgili öğrencilerin çoğunluğu olumlu, az bir kısmı ise kısmen olumlu görüş bildirmiş, bir öğrenci ise olumsuz görüş bildirmiştir. Aşağıdaki tablo öğrencilerin bu soruya verdiği yanıtların dağılımını göstermektedir.

Tablo 10. Öğrencilerin rapor hazırlamanın öğrenmeye katkısının olup olmaması üzerine görüşleri

	f
Var	40
Kısmen var	3
Yok	1
Yanıtsız	1

Rapor hazırlamanın öğrenmeye katkısına dair olumlu görüş bildiren öğrencilerin açıklamaları aşağıdaki tabloda özetlenmektedir. Tabloda gösterildiği gibi rapor yazılarak hazırlandığından konunun daha iyi öğrenilmesini sağlamakta ve kalıcı olmaktadır.

Tablo 10.1. Öğrencilerin rapor hazırlamanın öğrenmeye katkısı üzerine görüşleri

	f
Yazarak daha iyi öğrenme, kalıcı olma	4
Kalıcı olma	3
Araştırmayla bilgi elde etme	2
Bilgiyi tazeleyip tekrar etme	2
Araştırdıkça deneyi kavrama	2
Sınava çalışma, öğrenileni paylaşma	2
Deney sonuçlarına göre yorum yaparken deneyi anlamayı sağlama	2
Deney hakkında bilgiye sahip olma, deneyde zorluk çekmeme	2
Öğrenme, deneyi anlama	1
Öğretici	1
Verimli	1
Bilgi ve yorumları yazarak somutlaştırma	1

Kaynaklardan araştırma	1
Eğitici bilgilendirmeli ve ona göre rapor beklemeli	1
Araştırmayla öğrenme, yorum yeteneği geliştirme	1
Herkesin ortak yorumu olması	1
Yapılanları tekrar etme	1
Deneyi özetleme, yorum yaparak daha iyi öğrenme	1
Tahtadaki soruları araştırıp deneyle ilişkilendirme	1
İyi çalışmayla iyi öğrenme	1
Deneyin nasıl olduğu konusunda bilgilenme	1
Deneyi daha iyi kavrama	1
Araştırıp geldiği, uyguladığı ve neden sorusunu cevaplama	1
Teorik bilgi hazırladığından daha iyi öğrenme	1
Herkes kendi hazırlasa daha iyi kazanım elde edilmesi	1
Teorik bilgiyi ve günlük hayattaki yerini öğrenme	1
Açıklama yok	1

Rapor hazırlamanın öğrenmeye kısmen katkı yaptığını bildiren öğrencilerin açıklamaları aşağıdaki tabloda özetlenmektedir. Tabloda gösterildiği gibi rapor grupça değil bireysel hazırlanmalı ve sade olmalıdır.

Tablo 10.2. Öğrencilerin rapor hazırlamanın öğrenmeye kısmen katkısı olması üzerine görüşleri

	f
Kişisel yazılmadığından, ders öncesi hazırlanmalı	1
Araştırmanın zor olması, yazarken akla girmemesi	1
Teorik bilginin yeterli olması, gereksiz bilgilerin de yazılması	1

Rapor hazırlamanın öğrenmeye katkı sağlamadığını bildiren öğrencilerin görüşleri aşağıdaki tabloda özetlenmektedir. Tabloda gösterildiği gibi bu konuda açıklama yapan öğrenci raporun sadece hesaplamalar kısmının faydalı olduğunu ifade etmiştir.

Tablo 10.3. Öğrencilerin rapor hazırlamanın öğrenmeye katkısı olmaması üzerine görüşleri

	f
Teorik bilgi dersten önce yazılması, hesaplamalar kısmı yardımcı	1
Açıklama yok	1

Soru 11. Teorik dersle deney arasında ilişki

Deneyin teorik dersle ilişkisini sorgulayan bu soruyla ilgili öğrencilerin çoğunluğu olumlu görüş bildirmiştir. Aşağıdaki tablo öğrencilerin bu soruya verdiği yanıtların dağılımını göstermektedir

Tablo 11. Öğrencilerin teorik dersle deney arasındaki ilişki olup olmaması üzerine görüşleri

	f
İlişkili	38
Çok az ilişkili	2
Yanıtsız ya da farklı yanıt	5

Deneyin teorik dersle ilişkili olduğunu bildiren öğrencilerin ifadeleri aşağıdaki tabloda özetlenmektedir. Tablo'ya göre teori-uygulama ilişkisiyle teorik derste öğrenilenin laboratuvarda uygulamasının yapılması, böylece kalıcılığının sağlanması, deneyin teorik bilgiye ilgili olması ve teorik bilginin deneyle somutlaştırılması sağlanmaktadır.

Tablo 11.1. Öğrencilerin teorik dersle deney arasındaki ilişki üzerine görüşleri

	f
Teorik derste öğrenileni laboratuvarda uygulama /örn. mol hesabı)	10
Teorik derste öğrenileni laboratuvarda uygulamanın kalıcılığı sağlaması	9
Deneyin teorik bilgiyle ilgisi olması (örn. süblimleşme)	4
Teorik konuyu kavramada sıkıntı, deneyle somutlaştırma	2
Teorik dersin sıkıcı, laboratuvarın eğlenceli olması	2
Deney hesaplarını derste gördüğünden sıkıntı çekmeme	2
Teori ve laboratuvara aynı gün olduğundan bilgiyi rahatça kullanma	1
Deney yapılan konunun derste çıkması	1
Çözelti hazırlama ve hesaplama yapmanın kalıcı olması	1

Deneyde görüleni derste daha akıcı işleme	1
Laboratuvarla teorik kısmı görsel hale getirme	1
Teorik sıkıcı olması akılda kalmaması, laboratuvar kalıcı	1
Teoridekileri ispat etme	1
Teorik derste düşünüp yapma, laboratuvarda görerek yapma	1

Deneyin teorik dersle tam ilişkili olmadığını bildiren öğrencilerin ifadeleri aşağıdaki tabloda özetlenmektedir. Tablo'ya göre teorik ders soyut, laboratuvar somut olmakta ve bazı deneylerin teorik dersin içeriğinde olmaması teori-uygulama ilişkisini yansıtmamaktadır.

Tablo 11.2. Öğrencilerin teorik dersle deney arasındaki çok az ilişki üzerine görüşleri

	f
Teorik dersin soyut, laboratuvarın somut olması	1
Sabun ve yapıştırıcı yapımını derste görmeme	1

Soru 12. Lisede laboratuvar uygulaması yapma

Öğrencilerin lisede laboratuvar uygulaması yapıp yapmadıklarını sorgulayan bu soruyla ilgili öğrencilerin çoğunluğu olumsuz bir kısmı da olumlu görüş bildirmiştir. Aşağıdaki tablo öğrencilerin bu soruya verdiği yanıtların dağılımını göstermektedir.

Tablo 12. Öğrencilerin lisede laboratuvar uygulaması yapıp yapmadığı üzerine görüşleri

	f
Hayır	36
Evet	8
Hatırlamayan	1

Lisede laboratuvar uygulaması yapmamış olan bu konuyla ilgili öğrencilerin çoğunluğu herhangi bir açıklama yapmazken sadece 3 öğrenci görüş bildirmiştir. Aşağıdaki tablo bu durumu özetlenmektedir. Tablo'ya göre öğretmenin gösteri deneyi yapması ve düzenli bir laboratuvarın bulunmamasından dolayı öğrenciler lisede laboratuvar uygulaması yapmamışlardır.

Tablo 12.1. Öğrencilerin lisede laboratuvar uygulaması yapmama üzerine görüşleri

	f
Öğretmenin gösteri deneyi yapması	2
Düzenli laboratuvarın bulunmaması	1
Açıklama yok	33

Lisede laboratuvar uygulaması yapmış olan öğrencilerin bu konuyla ilgili görüşleri aşağıdaki tanoda özetlenmektedir. Tablo'ya göre öğrenciler konularıyla ilgili çeşitli deneyler yapmışlardır.

Tablo 12.2. Öğrencilerin lisede laboratuvar uygulaması yapma üzerine görüşleri

	f
Fazla değil (yanma, filtrasyon, süblimleşme, maddenin halleri, asit-baz, fiziksel-kimyasal değişim)	4
Haftada en az bir deney (konuyla ilgili)	2
Asit-baz, organik kimya deneyleri	1
Lise 1'de süzme deneyi	1

Soru 13. Laboratuvar Uygulamasının Süresi

Laboratuvar uygulamasının ideal süresi ile ilgili olarak öğrencilerin büyük çoğunluğu mevcut 2 saatin yeteri olduğunu, az sayıda öğrenci ise daha fazla olması gerektiği belirtmiştir. Aşağıdaki tablo öğrencilerin bu soruya verdiği yanıtların dağılımını göstermektedir.

Tablo 13. Öğrencilerin laboratuvar saati üzerine görüşleri

	f
Mevcut 2 saat yeterli olması; deneylerin uzun olmaması, kolay olması, fazlasının bıktırması	33
4 saat olmalı çünkü daha çok deneyin daha çok bilgi olması, unutmama, kavrama	4
2-3 saat uygun	2
3 saat uygun	2

İki katına çıkarılmalı, daha çok görselle anlama kolaylaştırılmalı	1
Bir ders daha fazla olmalı, laboratuvarı daha iyi anlama	1
İki katına çıkarılmalı, bilgi neden sonuç ilişkisi içerdiğinden daha çabuk öğrenme	1
Normalden fazla olmalı	1

Soru 14. Öneriler

Laboratuvar dersine yönelik önerileri sorgulayan bu soruyla ilgili öğrencilerin çoğunluğu bir öneride bulunmuş az sayıda dersin zaten etkili olduğunu belirterek herhangi bir öneride bulunmamıştır. Bir öğrencinin önerinsin olmadığını ifade etmiş, dört öğrenci de yanıt vermemiştir. Aşağıdaki tablo öğrencilerin bu soruya verdiği yanıtların dağılımını göstermektedir.

Tablo 14. Öğrencilerin önerileri

	f
Önerisi olanlar	33
Mevcut ders zaten etkili	7
Önerisi yok	1
Yanıtsız	4

Öğrencilerin laboratuvar dersiyle ilgili önerileri aşağıdaki tabloda özetlenmektedir. Tabloda gösterildiği gibi grupların daha az olması, eğiticinin zor deneylerde gösteri deneyi yapması ve laboratuvar uygulama süresinin artırılması en çok bahsedilen önerilerdendir.

Tablo 14.1. Öğrencilerin önerileri

	f
Grupların az olması	5
Rahat psikolojiyle deney yapma; eğiticinin zor deneyleri yapması ve bilgilendirmesi	3
Eğiticinin deneyin yapılışını anlatması (deneyin kolay yapılmasını sağlama)	3
Ders saatinin artırılması	3
Malzeme eksiğinin giderilmesi	2
Günlük yaşamla ilişkili olup ilgiyi çekmesi	2
Deneyle ilgili soru verilmesi, sonraki hafta sorularının tahtaya yazılması	2
Daha eğlenceli olması	2
Eğiticinin öğrenciye olumlu davranması	1
Daha dikkat çekici deney yapma	1
Ezber yerine öğretici olması	1
Sözlüden korktuğundan değil merak ettiğinden çalışması	1
Eğiticinin cevap yüzdesine bakıp soruyu yanıtlaması	1
İlk deneylerin basit ve günlük yaşamla ilişkili olması böylece ilgiyi çekmesi	1
Daha az kişiyle çalışma ve tüm malzemeleri barındıran bir laboratuvar olması	1
Açık havada deney yapma	1
Birden fazla eğiticinin görev alması	1
Deneyin kısa ve anlaşılır olması	1
Rapor yazılmaması çünkü derse gelmeden deneyi okumanın yeterli olması	1

SONUÇ VE TARTIŞMA

Genel Kimya II Laboratuvarı dersinde öğrencilerle yapılan bu araştırmanın sonuçları laboratuvarda yapılan deneylerden sadece sabun ve yapıştırıcı yapımının günlük yaşam ile ilişkisinin kurulduğu görülmüştür. Öğrencilerin ilk yıllarında olmaları ve lise öğrenimlerinde laboratuvar uygulamaları yapmamış olmaları nedeniyle kimyayla ilgili tüm kavramları bilememeleri nedeniyle bu dersi günlük yaşamla ilişkilendirmelerini zorlaştırmıştır. Öğrenciler deneylerin, günlük yaşamda çok sık karşılaştıkları olay ve olgularla bağlantısını kurabilmiş (örneğin sabun) ancak günlük yaşamda çok sık karşılaşmadıkları durumlarla ilişkilendirememişlerdir (örneğin paslanma).

Öğrenciler deneyi yapmadan önce bir hazırlığın gerekli olduğunu belirtmişlerdir. Ancak öğrenciler yeterince hazırlıklı gelmediklerinden konunun günlük yaşamla bağlantısını kurmakta sıkıntı çekmektedirler. Öğrenciler laboratuvarda yaptıkları deneylerin öğretici olduğu görüşündedirler. Zira genel kimya derslerinde gördükleri teorik bilgilerin uygulamasını yaptıklarını ve el becerisi kazandıklarını ifade etmişlerdir.

Öğrenciler laboratuvara hem olumlu hem de olumsuz duygularla geldiklerini belirtmişlerdir. Olumlu duygular; deney yapacakları için mutlu olmaları, deneyden keyif almaları, merak olarak belirtilirken olumsuz duygular; deneyi yapamayacağı korkusu, sözlüde yanlış cevap verme kaygısı, bazı deneylerin uzun sürmesi ve zor olması olarak ifade edilmiştir. Öğrencilerin ön hazırlığının yeterli olmadığı duydukları kaygıdan anlaşılmaktadır. Deneyle ilgili kavramlara yeterince çalışılırsa öğrencilerin olumlu duygularının artacağı düşünülmektedir. Öğrencilerin laboratuvara çok meraklı ve istekli olarak gelmemeleri de olumsuz tutum içinde olmalarının nedeni olabilir.

Yapılan uygulamalarla öğrencilerin tümü deneylerin çoğu için deney düzeneklerini kurabileceklerine inanmaktadırlar. Ancak birkaç öğrencinin belirttiği gibi derste tek eğiticinin değil birkaç gruptan sorumlu olacak eğiticilerin de görev alması gerekmektedir. Öğrencilerin hepsi genel laboratuvar kurallarına uyduklarını ifade etmişlerdir. Eldiven ve önlük giyilmesi ve saçın toplanması öğrencilerin en çok belirttikleri güvenlik kuralıdır. Bu malzemeler dönem başında eğitici tarafından zorunlu koşulduğu için öğrenciler tarafından alınmakta ve kullanılmaktadır. Öğrencilerin çoğunluğu laboratuvarda olumsuz bir durumla karşılaşmadıklarını belirtmişlerdir. Az sayıda öğrenci bazı deneyleri tekrarlamak zorunda kaldıklarını, deneyin sonucunu bulamadıklarını ifade etmişlerdir. Eğitici ile ilgili düşünceli olumlu olup, deneyde yol gösterdiği, deneylerine yardımcı olduğu, bilgi verici, dönüt verici ve sonuçları tartışmalarına yardımcı olduğunu belirtmişlerdir.

Öğrenciler grup arkadaşları ile uyum içerisinde çalıştıklarını ifade etmişler, çalışma gruplarının dört-altı kişilik olmasını istemişlerdir. Grupların oluşturulması eğitmen tarafından cinsiyet durumları göz önüne alınarak bölümde okuyan öğrencilerin çoğunluğunun kız öğrenci olması nedeniyle her grupta en az bir erkek öğrenci olmasına dikkat edilerek yapılmıştır. Öğrencilerin gruplardan genel memnuniyeti bu düzenlemenin olumlu olduğuna işaret etmektedir. Ayrıca laboratuvar dersinin mevcudu yaklaşık 30 kişi olduğundan dersin ve grup deneylerinin etkililiği için grubu mevcudundan daha çok sınıf mevcudunun azaltılması gerekmektedir.

Deney sonunda hazırlanan rapor için öğrencilerin çoğu olumlu görüş bildirmiştir. Raporların bireysel hazırlanması gerekirken öğrenci sayısının fazlalığı ve öğrencilerin birbirlerinden yararlanarak rapor yazma durumunu engellemek için gruptan tek bir rapor istenmekteydi. Gruptakiler dönüşümlü olarak raporun teorik kısmını yazmaktaydı diğer kısımlar ise deney bitiminde grupça hazırlanmaktaydı.

Dersin daha etkili olması için deneylerin sıkıcılığına karşı eğlenceli, çarpıcı sonuçlar veren deneyler yapılmalı, bazı tehlikeli deneylerde robotlardan yararlanılmalıdır. Üniversitede laboratuvar dersi veren öğretim elemanları liselerde fen bilimleri öğretmenleriyle ortak laboratuvar uygulamaları yapabilir, bu amaçla üniversite laboratuvarlarından yararlanılabilir. Yazarlar benzer bir uygulamayı Niğde'deki lise ve bilim sanat merkezi öğrencileriyle yapmışlar ve öğrencilerden ve öğretmenlerinden olumlu dönüt almışlardır.

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EKLER

EK 1. Kimya Laboratuvarı ile ilgili sorular

Aşağıdaki soruları cevaplayarak Genel Kimya II Laboratuvarı ile ilgili görüşlerinizi yazınız

1. Laboratuvarda yaptığınız deneylerin günlük yaşamla ilişkisi var mıdır? Günlük hayatta kullanım yerleri nerelerdir?
2. Laboratuvara gelmeden önce yapılacak deneyle ilgili ön hazırlık gerekli midir? Deney öncesi teorik bilgiye sahip olmalı mı? Neden?
3. Yaptığınız deneyler öğretici mi? Deneylerin kazanımı nedir?
4. Laboratuvara gelirken hangi duygularla geliyorsunuz? Deney yaparken keyif alıyor musunuz?
5. Deney yapma yeteneğini kazandığınızı düşünüyor musunuz? Deney düzeneklerini kendiniz kurabilir misiniz?
6. Laboratuvar emniyet kurallarını uyguluyor musunuz? Nasıl?
7. Laboratuvarda deney yaparken herhangi olumsuz bir durumla karşılaştınız mı? Karşılaştıysanız bu durumlar nelerdir?
8. Laboratuvarda, eğiticinin katkısı nasıldır?
9. Laboratuvarda çalıştığınız deney grubuyla uyumlu musunuz? Deney gruplarınızın kaç kişi olmasını isterdiniz?
10. Laboratuvar derslerinde rapor hazırlamanın öğrenmeye katkısı var mıdır? Açıklayınız.
11. Teorik dersleriniz ile laboratuvarda uygulamasını yaptığınız deneyler arasında ne ölçüde ilişki var? Kısaca açıklayınız.
12. Mezun olduğunuz lisede kimya laboratuvar uygulaması yaptınız mı? Yaptıysanız ne tür deneyler ya da uygulamalar yaptınız?
13. Bu dersin laboratuvar uygulaması haftada kaç ders saati olmalıdır? Neden?
14. Laboratuvar derslerinin daha etkin yürütülebilmesi için önerileriniz nelerdir?

EK 2. Genel Kimya Laboratuvarı II'de Yapılan Deneylerin Listesi

Deney No	Deneyin adı
1	Boyle Yasası
2	Gay-Lussac ve Charles Yasası
3	Asit ve baz titrasyonu (Nötralleşme tepkimeleri)
4	$BaSO_4$'ın çöktürülmesi (Çöktürme tepkimeleri ve verim hesabı)
5	Tepkime hızına sıcaklığın etkisi
6	Kimyasallardan elektrik eldesi
7	Elektroliz
8	Süblimleşme
9	Ekzotermik-Endotermik tepkimeler
10	Alüminyumun aktifliğinin araştırılması
11	Paslanma nedenleri
12	Akış hızına göre sıvıların viskozitesinin belirlenmesi
13	Sütten yapıştırıcı eldesi
14	Sabun yapımı

INVESTIGATING THE ECOLOGICAL FOOTPRINTS OF PROSPECTIVE TEACHERS

Safa ÖZGÜRLER
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ABSTRACT: The aim of this study is to investigate the ecological footprints of prospective teachers. In this scope the ecological footprints of the prospective teachers were analysed with regard to their state of taking environmental courses, the department they go to, and their gender. The scanning model, one of the descriptive research methods, was used for this research. The population of the research consisted of the prospective teachers studying in the departments of Science Teaching, Class Teaching, Pre-school Teaching, and Turkish Language Teaching in Amasya University in the educational year of 2013-2014.

The ecological footprint calculating scale was applied to the prospective teachers within the scope of the research. The data gathered from the research were analysed by the SPSS 18.0 statistics software. According to the results of the research, it was discovered that the prospective teachers have apparent footprints. Besides, the findings show that there is significant difference between the footprints of the prospective teachers. A significant difference couldn't be found with regard to the prospective teachers' state of taking the environmental courses. In addition, it was discovered that, when their footprints regarding the departments they go to was investigated, there wasn't any significant difference.

Keywords: Ecological Footprint, Environment, Prospective Teachers

ÖĞRETMEN ADAYLARININ EKOLOJİK AYAK İZLERİNİN İNCELENMESİ

ÖZET: Bu çalışmanın amacı öğretmen adaylarının ekolojik ayak izlerinin incelenmesidir. Bu kapsamda öğretmen adaylarının ekolojik ayak izleri çevre dersi alma durumu, öğrenim gördükleri bölüm ve cinsiyete göre analiz edilmiştir. Araştırmada betimsel araştırma yöntemleri içerisinden tarama modeli tercih edilmiştir. Çalışma 2013-2014 eğitim öğretim yılında Amasya Üniversitesi Eğitim Fakültesi' nin Fen Bilgisi Öğretmenliği, Sınıf Öğretmenliği, Okul Öncesi Öğretmenliği ve Türkçe Öğretmenliği programlarında öğrenim görmekte olan öğretmen adaylarının katılımı ile gerçekleşmiştir.

Çalışma kapsamında öğretmen adaylarına ekolojik ayak izi hesaplama ölçeği uygulanmıştır. Araştırmadan elde edilen veriler SPSS 18.0 istatistik programı ile analiz edilmiştir. Analizler neticesinde ulaşılan sonuçlara göre öğretmen adaylarının ekolojik ayak izlerinin yüksek olduğu tespit edilmiştir. Ayrıca elde edilen bulgulara göre öğretmen adaylarının ekolojik ayak izlerinde anlamlı bir farklılık saptanmıştır. Öğretmen adaylarının çevre dersi alma durumlarına göre ekolojik ayak izlerinde anlamlı bir farklılık gözlemlenmemiştir. Bununla birlikte öğretmen adaylarının öğrenim gördükleri bölümlere ekolojik ayak izleri incelendiğinde anlamlı bir farklılık bulunmadığı görülmektedir.

Anahtar Kelimeler: Ekolojik Ayak İzi, Çevre, Öğretmen Adayları

GİRİŞ

Ekolojik ayak izi, sürdürülebilir kalkınmayla beraber ortaya çıkan kavramlar biridir. İnsanlar yaşamlarını devam ettirirken bir yandan tabii kaynaklar yok olmakta bir yandan da fazla miktarda zararlı atık ortaya çıkmaktadır. Kullanılan tabii kaynak ve ortaya çıkan atıklar belirli oranlarda su ve toprak gerektirmektedir. Kullanılan kaynakların ve ortaya çıkan atıkların telafi edilmesi için gerekli olan verimli su toprak alanına ekolojik ayak izi denir (Schaller, 1999). Farklı bir tanımla ekolojik ayak izi, belli bir hayat kalitesi ve tüketim miktarına sahip insan topluluğunun ihtiyacı olan kaynakların üretildiği, oluşan zararlı atıkların da absorbe edildiği, karbon dioksit emiliminin olduğu, belirli sınırlardaki üretken alandır (Marin, 2004).

Ekolojik ayak izi kavramı ilk kez William Rees' in taşıma kapasitesi konusundaki bir seminerinin ardından gündeme gelmiştir. Ekolojik ayak izi hesabı, üretim, mal ve hizmet kullanımı ekolojik verimlilikle ilgilidir. Bu ekolojik verimlilik toprak alanına karşılık gelecek şekilde düzenlenir. Ekolojik ayak izi hesaplarını kolaylaştırmak adına tüketim kategorileri beş başlık altında toplanmıştır. Bu başlıklar gıda, ulaşım, barınma, tüketim malları ve hizmetlerdir. Ayrıca alt başlıklar da bulunabilir (Wackernagel & Rees. 1996).

Tabii kaynaklara karşı talep, sürdürülemeyen kaynak tüketimi, kirlilik ve karbon dioksit emisyonundaki yükselişle beraber artmaktadır. Yapılan araştırmalar 1972 Stockholm İnsan ve Çevre Konferansı' ndan itibaren dünyanın doğal refahında %33' lük bir gerileme ve insanın ekolojik baskısında %50' den fazla artış olduğunu göstermektedir. Bu oranlar biyosferin kendini yenileyebilme sınırını aşmaktadır (Bond, 2003).

İnsanların ekolojik ayak izlerinin azalması, dünyanın sürdürülebilir geleceği açısından önemlidir. Bilinçli tüketim alışkanlıkları, dış kaynaklardan ziyade öz kaynaklara yönelme, tasarruflu enerji kullanımı gibi tedbirler ekolojik ayak izlerinin küçülmesi için gerekli görülmektedir (Yeşil Kutu, 2007). Seyahat tercihleri, alışveriş yeri tercihleri, ne alındığı gibi günlük hayatımızla ilgili olan tercihler ve tabii kaynakların daha bilinçli ve tasarruflu kullanımı ile ekolojik ayak izi küçültülebilir. Ekolojik değerlerimizi, en az diğer önemli gördüğümüz alanlar kadar değerli görüp, bilinçli kullanmayı ve korumayı öğrenmeliyiz (Keleş ve Aydoğdu, 2010).

YÖNTEM

Araştırmanın Modeli

Bu çalışmada, betimsel araştırma yöntemleri içerisinden tarama modeli tercih edilmiştir. Tarama modeli, geçmişteki veya mevcut durumdaki şekli ile betimlemeyi hedefleyen araştırma modelidir (Karasar, 2007).

Örneklem

Bu araştırmanın çalışma grubunu Amasya Üniversitesi Eğitim Fakültesinde 2013-2014 eğitim öğretim yılında öğrenim görmekte olan toplam 496 öğretmen adayı oluşturmaktadır. Bunların 144' ü Fen ve Teknoloji Öğretmenliği, 217'si Sınıf Öğretmenliği, 92' si Türkçe Öğretmenliği ve 43'ü Okul Öncesi Öğretmenliği programlarında öğrenim görmektedirler.

Tablo 15. Öğretmen Adaylarının Bulundukları Bölümlere Göre Betimsel İstatistikleri

Bölümler	Öğrenci Sayıları
Fen ve Teknoloji Öğretmenliği	144
Sınıf Öğretmenliği	217
Türkçe Öğretmenliği	92
Okul Öncesi Öğretmenliği	43
Toplam	496

Ayrıca örneklem 151 erkek ve 344 bayan öğretmen adayından oluşmaktadır.

Tablo 16. Öğretmen Adaylarının Cinsiyetlerine Göre Betimsel İstatistikleri

Cinsiyet	Öğrenci Sayıları
Kız	344
Erkek	151
Toplam	496

Fen ve Teknoloji öğretmen adaylarının 66' sı son sınıfta, 78' i ise birinci sınıfta öğrenim görmektedirler. Sınıf öğretmeni adaylarının ise 132' si üçüncü sınıfta, 85' i ise birinci sınıfta öğrenim görmektedir. Türkçe ve Okul Öncesi öğretmen adaylarının tamamı son sınıfta öğrenim görmektedir.

Tablo 17. Öğretmen Adaylarının Bölüm ve Sınıflara Göre Betimsel İstatistikleri

Bölümler	Sınıflar			Toplam
	1. Sınıf	3. Sınıf	4. Sınıf	
Fen ve Teknoloji Öğretmenliği	78	0	66	144
Sınıf Öğretmenliği	85	132	0	217
Türkçe Öğretmenliği	0	0	92	92
Okul Öncesi Öğretmenliği	0	0	43	43
Toplam	163	132	201	496

Veri Toplama Aracı

Ekolojik Ayak İzi Hesaplama Ölçeği

Ekolojik ayak izi hesabı uzmanlık gerektiren bir konudur. Ekolojik ayak izi hesabı web tabanlı olarak birçok internet sitesinden yapılabilmektedir. Kişilerin ayak izlerinin global olarak ölçülebilmesi, "Küresel Ayak İzi Ağı" nın ekolojik ayak izi alanında yapılan çalışmalar için ana kaynaklardan biri olması, ekolojik ayak izi hesaplama ölçeğinin oluşturulması aşamasında ekolojik ayak izi kavramını literatüre sokan bilim insanlarından Mathis Wackernagel' in bulunması sebebiyle Earth Day Network' ün kullanıma sunmuş olduğu ölçme aracının güvenilir olduğu düşünülmüş ve bu çalışmada tercih edilmiştir (Meyer, 2004; Ryu, 2005; Kitzes ve Galli, 2007).

Ekolojik ayak izi hesaplama ölçeği, ekolojik ayak izi kavramının bileşenleri dikkate alınarak düzenlenmiş gıda (5 soru), eşya (3 soru), barınak (6 soru), ulaşım (4 soru) bileşenlerinde toplam 18 sorudan oluşmaktadır. Bu ölçek herkesin ulaşabileceği ve katılabileceği şekilde (http://www.earthday.net/footprint/index.asp) web sayfasında kullanıma sunulmuştur. Kişisel olarak ekolojik ayak izini hesaplayan bu ölçek, insanların tüketimini karşılayacak olan biyolojik üretim alnını baz almakta, hesap yapılırken ülkelerin değişik kullanım alanları, biyolojik üretim alanları, iklim şartları, nüfusu göz önünde bulundurulmaktadır.

Ekolojik Ayak İzi Hesaplama Ölçeğinin Değerlendirilmesi

Katılımcıların ekolojik ayak izi hesaplama ölçeğindeki cevapları, (http://www.earthday.net/footprint/index.asp) web sayfasında aynı şekilde işaretlenerek kişilerin gıda, eşya, barınak ve ulaşım ayak izleri ile birlikte toplam ayak izleri global hektar cinsinden belirlenmiştir. Böylece kişilerin halihazırdaki yaşam stillerini devam ettirdikleri takdirde kaç gezegene ihtiyaç duydukları belirlenmiştir.

BULGULAR

Ekolojik Ayak İzi Değerlerinin Cinsiyet, Çevre Dersi Alma ve Bölümlere Göre Analizi

Öğretmen adaylarının ekolojik ayak izlerini cinsiyete göre incelemek amacıyla araştırmaya katılan öğretmen adaylarının Ekolojik Ayak İzi Hesaplama Ölçeği' ne verdikleri cevaplara göre hesaplanan ekolojik ayak izi ortalamalarında cinsiyete göre anlamlı bir fark olup olmadığı araştırılmıştır.

Tablo 4' te öğretmen adaylarının Ekolojik Ayak İzi Hesaplama Ölçeği' ne verdikleri cevaplardan elde edilen verilere göre hesaplanan değerler bulunmaktadır. Bu değerler ortalama ve standart sapmalara ilişkin verilerdir. Bu veriler incelendiğinde kız ve erkek öğretmen adaylarının ekolojik ayak izi ortalamaları arasında bir fark olduğu görülmektedir. Ayrıca standart sapma değerlerinde de farklılık olduğu görülmektedir. Bununla birlikte öğretmen adaylarının Ekolojik Ayak İzi Hesaplama Ölçeği' ne verdikleri cevaplardan elde edilen verilere göre hesaplanan ekolojik ayak izi ortalamalarının cinsiyete göre t-Testi sonuçları bulunmaktadır.

Tablo 4. Çevresel Problemlere İlgi Anketi Puanlarının Cinsiyete Göre t-Testi Sonuçları

Cinsiyet	N	X	S	sd	t	p
Kız	344	2.18	0.30	493	2.427	0.016
Erkek	151	2.25	0.36			

Tablo incelendiğinde öğretmen adaylarının Ekolojik Ayak İzi Hesaplama Ölçeği' ne verdikleri cevaplara göre hesaplanan ortalamaları cinsiyete göre anlamlı bir farklılık göstermektedir, $t(493)= 2.427$, $p<.05$. Kız öğretmen adaylarının Ekolojik Ayak İzi Hesaplama Ölçeği' ne verdikleri cevaplara göre hesaplanan ekolojik ayak izi ortalamalarının (X= 2.18) erkek öğretmen adaylarının ekolojik ayak izi ortalamalarından (X= 2.25) düşük olduğu görülmektedir.

Öğretmen adaylarının ekolojik ayak izlerini çevre dersi almaya göre incelemek amacıyla araştırmaya katılan öğretmen adaylarının Ekolojik Ayak İzi Hesaplama Ölçeği' ne verdikleri cevaplara göre hesaplanan ekolojik ayak izi ortalamalarında çevre dersi alıp almama durumlarına göre anlamlı bir fark olup olmadığı araştırılmıştır.

Tablo 5' te öğretmen adaylarının Ekolojik Ayak İzi Hesaplama Ölçeği' ne verdikleri cevaplardan elde edilen verilere göre hesaplanan değerler bulunmaktadır. Bu değerler ortalama ve standart sapmalara ilişkin verilerdir. Bu veriler incelendiğinde çevre dersini alan ve almayan öğretmen adaylarının ekolojik ayak izi ortalamalarının birbirine yakın değerlerde olduğu görülmektedir. Ayrıca standart sapma değerlerinin de yine birbirine yakın değerlerde olduğu görülmektedir. Bununla birlikte öğretmen adaylarının Ekolojik Ayak İzi Hesaplama Ölçeği' ne verdikleri cevaplardan elde edilen verilere göre hesaplanan ekolojik ayak izi ortalamalarının çevre dersi alıp almama durumuna göre t-Testi sonuçları bulunmaktadır.

Tablo 5. Çevresel Problemlere İlgi Anketi Puanlarının Cinsiyete Göre t-Testi Sonuçları

Çevre Dersi	N	X	S	sd	t	p
Alan	198	2.21	0.33	494	0.522	0.602
Almayan	298	2.19	0.32			

Tablo incelendiğinde öğretmen adaylarının Ekolojik Ayak İzi Hesaplama Ölçeği' ne verdikleri cevaplara göre hesaplanan ortalamaları çevre dersi alıp almama durumuna göre anlamlı bir farklılık göstermemektedir, t(494)= .522, p>.05. Çevre dersini alan öğretmen adaylarının Ekolojik Ayak İzi Hesaplama Ölçeği' ne verdikleri cevaplara göre hesaplanan ekolojik ayak izi ortalamalarının (X= 2.21) çevre dersini almayan öğretmen adaylarının ekolojik ayak izi ortalamalarından (X= 2.19) yüksek olduğu görülmektedir. Ancak aradaki fark anlamlı bir farklılık ifade etmemektedir.

Öğretmen adaylarının ekolojik ayak izlerini öğrenim gördükleri bölümlere göre incelemek amacıyla araştırmaya katılan öğretmen adaylarının Ekolojik Ayak İzi Hesaplama Ölçeği' ne verdikleri cevaplara göre hesaplanan ekolojik ayak izi ortalamalarında öğrenim gördükleri bölümlere göre anlamlı bir fark olup olmadığı araştırılmıştır.

Tablo 6' da öğretmen adaylarının Ekolojik Ayak İzi Hesaplama Ölçeği' ne verdikleri cevaplardan elde edilen verilere göre hesaplanan değerler bulunmaktadır. Bu değerler ortalama ve standart sapmalara ilişkin verilerdir. Bu veriler incelendiğinde öğretmen adaylarının ekolojik ayak izi ortalamalarının öğrenim gördükleri bölümlere göre birbirine yakın değerlerde görülmektedir. Ayrıca öğretmen adaylarının standart sapma değerlerinin de yine bölümlere göre birbirine yakın değerlerde olduğu gözlenmektedir.

Tablo 7' de ise öğretmen adaylarının Ekolojik Ayak İzi Hesaplama Ölçeği' ne verdikleri cevaplardan elde edilen verilere göre hesaplanan ekolojik ayak izi ortalamalarının öğrenim gördükleri bölümlere göre ANOVA sonuçları bulunmaktadır.

Tablo 6. Ekolojik Ayak İzi Ortalama Ve Standart Sapma Değerleri

Bölümler	N	X	SS
Fen Bilgisi	144	2.23	0.32
Türkçe	92	2.19	0.31
Sınıf	217	2.20	0.33
Okul Öncesi	43	2.15	0.32

Analiz sonuçları, öğretmen adaylarının Ekolojik Ayak İzi Hesaplama Ölçeği' ne verdikleri cevaplardan elde edilen verilere göre, öğretmen adaylarının ekolojik ayak izi ortalamaları arasında öğrenim gördükleri bölümler bakımından anlamlı bir fark olmadığını göstermektedir, F(3,492) = .740, p>.05. Başka bir deyişle öğretmen adaylarının ekolojik ayak izi ortalamaları, öğrenim gördüklere bölümlere bağlı olarak anlamlı bir şekilde değişmemektedir.

Tablo 7. Ekolojik Ayak İzi Ortalamalarının Bölümlere Göre ANOVA Sonuçları

Varyansın Kaynağı	Kareler Toplamı	Sd	Kareler Ortalaması	F	P	Anlamlı Fark
Gruplararası	0.235	3	0.078	0.740	0.528	Yok
Gruplariçi	52.076	492	0.106			
Toplam	52.311	495				

TARTIŞMA

Bu çalışma kapsamında öğretmen adaylarının ekolojik ayak izlerinde cinsiyete, çevre dersi almaya ve öğrenim gördükleri bölümlere göre anlamlı bir farklılık olup olmadığı incelenmiştir. Ayrıca öğretmen adaylarının ekolojik ayak izi ortalamaları ile çevre bilgi, tutum, kullanım ve ilgi ortalamaları arasındaki ilişki ile ekolojik ayak izlerinin çevre okuryazarlığı boyutlarına göre yordanması araştırılmıştır. Buna göre bayan öğretmen adayları ile erkek öğretmen adaylarının ekolojik ayak izi ortalamaları arasında anlamlı bir farklılık bulunmaktadır. Bayan öğretmen adaylarının ekolojik ayak izi ortalamaları daha düşük olarak hesaplanmıştır.

Keleş (2007) tarafından gerçekleştirilen çalışmada, öğretmen adayları fen bilgisi dersi kapsamında sürdürülebilir kalkınma alanında bir eğitime alınarak, ekolojik ayak izleri ölçülmüş ve ekolojik ayak izinin düşürülmesi ile ilgili fikirleri alınmıştır. Elde edilen sonuçlara göre öğretmen adaylarının ekolojik ayak izi ortalamaları X=3.91 olarak hesaplanmıştır. Öğretmen adaylarının ekolojik ayak izlerinin bileşenlerine göre ortalamaları, gıda alanında X=1.70, mallar/hizmetler alanında X=1.03, barınak alanında X=1.01 ve ulaşım alanında X=0.17 olarak hesaplanmıştır. Buna göre ekolojik ayak izine en fazla etkisi olan bileşen gıda, en az etkisi olan bileşen ise ulaşım olarak ulaşım olarak belirlenmiştir.

Akıllı ve diğerleri (2008) tarafından gerçekleştirilen çalışmada, Akdeniz Üniversitesi İktisadi ve İdari Bilimler Fakültesi' nde öğrenim görmekte olan öğrenciler ve çalışmakta olan personellerin ekolojik ayak izleri incelenmiştir. Ulaşılan sonuçlara göre ekolojik ayak izi ortalamaları 4.83 gha olarak hesaplanmıştır. Bu ortalama Türkiye ortalamasının çok üstünde bir değerdir. Ekolojik ayak izi bileşenlerinden atık ayak izi 2.42 gha olarak hesaplanmıştır. Buna göre ekolojik ayak izi ortalamasının yüksek çıkmasındaki en büyük etkenin atık ayak izi bileşeni olduğu belirlenmiştir.

Keleş, Uzun ve Özsoy (2008) tarafından gerçekleştirilen çalışmada, Aksaray Üniversitesi Eğitim Fakültesi İlköğretim Bölümü' nün Fen Bilgisi Öğretmenliği, Sınıf Öğretmenliği ve Sosyal Bilgiler Öğretmenliği programlarında öğrenim görmekte olan öğretmen adaylarının ekolojik ayak izleri incelenmiştir. Bu amaçla 81 öğretmen adayına ekolojik ayak izi ölçeği uygulanmıştır. Elde edilen sonuçlara göre bayan öğretmen adaylarının ekolojik ayak izi ortalamaları (X=4.19), erkek öğretmen adaylarının ekolojik ayak izi ortalamalarından (X=3.86) yüksek çıkmıştır. Ancak aradaki fark istatiksel olarak anlam ifade etmemektedir. Ekolojik ayak izinin gıda bileşeni dikkate alındığında bayan öğretmen adaylarının ortalamalarının erkek öğretmen adaylarının ortalamalarından daha yüksek olduğu belirlenmiştir. Ulaşım, barınak ve mal hizmetler bileşenlerinde ise bayan öğretmen adaylarının ortalamaları ile erkek öğretmen adaylarının ortalamaları arasında anlamlı bir fark bulunmadığı saptanmıştır.

Meyer (2004) tarafından gerçekleştirilen araştırmada, su koruma ve çevre yönetimi alanlarında öğrenim görmekte olan kişiler üzerinde, ekolojik ayak izi kavramından eğitim aracı olarak faydalanılmıştır. Ulaşılan sonuçlara göre, ekolojik ayak izi kavramından faydalanılarak verilen eğitimin, katılımcıların sürdürülebilir yaşam konusundaki bilgi ve tutumlarının artmasında ve sürdürülebilir yaşama dönük sorumlu davranışlar edinmelerinde etkin rol oynadığı tespit edilmiştir.

Wada, İzumi ve Mashiba (2007) tarafından gerçekleştirilen çalışmada, Japonya' da halktan insanların ekolojik ayak izleri incelenmiştir. Buna göre bireylere ekolojik ayak izlerini düşürmeye yönelik farkındalık kazandırmak için çalışma yapılmış ve bu çalışma sonucunda web tabanlı bireysel ekolojik ayak izi hesaplama ölçeği oluşturulmuştur. Ulaşılan sonuçlara göre sürdürülebilir yaşamın devamlılığı için ekolojik ayak izi eğitiminin önemli rol oynadığı tespit edilmiştir.

Ryu ve Brody (2006) tarafından gerçekleştirilen çalışmada üniversiteden mezun olmuş bireylere verilen eğitimlerde ekolojik ayak izi eğitim aracı olarak kullanılmıştır. Ulaşılan sonuçlara göre ekolojik ayak izi kullanılarak verilen eğitimlerin, sürdürülebilir yaşamın devamlılığı konusunda öğrenmeyi, davranış ve algıları değiştirmeyi kolaylaştırdığı belirlenmiştir.

SONUÇ VE ÖNERİLER

Çalışmadan elde edilen sonuçlara göre öğretmen adaylarının ekolojik ayak izi ortalamaları ortalamanın üstünde olarak hesaplanmıştır. Gelecek nesillerin şekillenmesinde en önemli rolü öğretmenlerin oynayacağını düşünürsek, bu durum sürdürülebilir yaşamın devamlılığı için endişe verici diyebiliriz. Çevreci bir dünya görüşüne sahip nesillerin yetişmesi için öğretmenlerin de aynı görüşe sahip olması gerekir. Bunun için üniversite öncesi eğitim seviyelerinde, üniversitelerde ve mesleki hayatta çevre eğitimleri verilmelidir.

Verilecek çevre eğitimleri sürdürülebilir kalkınma, çevre okuryazarlığı ve ekolojik ayak izi gibi kavramları da kapsamalıdır. Bu sayede bireylerin güncel çevre konularından ve sorunlarından haberdar olmaları ve çevre farkındalıklarının oluşması sağlanabilir.

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A LABORATORY ACTIVITY BASED ON PREDICTION-OBSERVATION-EXPLANATION (POE) METHOD: SALT

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ABSTRACT: Salt is extremely important substance for life and it has fairly wide range of applications in different disciplines. In this study, misconceptions held by science teacher candidates about the formula of the salt, strength of acid and bases that is formed salt, type of the salt as acidic / basic / neutral have been investigated bu using the prediction-observation-explanation method. In this study a post-test design without a control group has been used. The study group consisted of a total of 43 third-year science teacher candidates attending the Department of Science Teaching of a Faculty of Education. Science teacher candidates realised experimental activity that was prepared according to prediction-observation-explanation method in the laboratory. Experimental activity contains preparing solutions of the potassium iodide, sodium chloride, ammonium nitrate, ammonium sulphate, sodium acetate and sodium carbonate, immersing the pH indicator card in the solutions, recording the colour change that will occur in the pH paper and the pH value for the corresponding colour on the scale. Teacher candidates have been asked to make prediction about types of the salt before the experimental activity. Teacher candidates have been asked to write their observations after the experimental activity. Teacher candidates have been asked to compare predictions and observations in the explanation section and asked to answer discussion questions. Predictions and observations made by teacher candidates and discussion questions answered by them have been discussed in the laboratory. Results of the study showed that more than half of the science teacher candidates could write the formula of the salt, strength of acid and bases that is formed salt and type of the salt as acidic / basic / neutral. According to the results, their predictions are compatible with observations. It was determined that few science teacher candidates have misconceptions. Some of the science teacher candidates expressed that memorizing knowledge were proved to be really true by the experimental activity conducted in accordance with the POE method. They expressed that misconceptions were noticed by working actively in the learning process in the interview. Important part of science teacher candidates expressed that POE create positive effects on the visual memory and provides permanent learning. Some of the science teacher candidates expressed that activities carried out by TGA is intertwined with a variety of scientific process skills including prediction, observation, experimentation, data recording, classification, drawing conclusion.

Keywords: Science education, prediction-observation-explanation method, misconception, salt, science teacher candidates.

TAHMİN-GÖZLEM-AÇIKLAMA (TGA) YÖNTEMİNE DAYALI BİR LABORATUVAR ETKİNLİĞİ: TUZ

ÖZET: Yaşam için son derece önemli olan tuz farklı disiplinlerde oldukça geniş kullanım alanı olan bir maddedir. Bu maddeyle ilgili fen bilgisi öğretmen adaylarının tuzun formülü, tuzu oluşturan asit ve bazın kuvvetli/zayıf olma durumu, tuzun asidik, bazik ve nötr olma durumu hakkında sahip oldukları kavram yanılgıları Tahmin-Gözlem-Açıklama (TGA) yöntemi kullanılarak araştırılmıştır. Araştırmada kontrol grupsuz son test desen kullanılmıştır. TGA yöntemine uygun olarak düzenlenen deneysel etkinlik Eğitim Fakültesi Fen Bilgisi Eğitimi Anabilim Dalında üçüncü sınıfta öğrenim görmekte olan 43 fen bilgisi öğretmen adayı ile laboratuvarda yapılmıştır. Deneysel etkinlik potasyum iyodür, sodyum klorür, amonyum nitrat, amonyum sülfat, sodyum asetat ve sodyum karbonat tuzlarının sulu çözeltilerinin hazırlanması, çözeltilere pH indikatör kağıtlarının batırılması, pH kağıdında gerçekleşecek renk değişimi ve skaladaki renge karşılık gelen pH değerinin kaydedilmesini içermektedir. Deneysel etkinlik öncesinde, öğretmen adaylarından tuzların türleriyle ilgili tahminde bulunmaları istenmiştir. Deneysel etkinlikten sonra öğretmen adaylarından gözlemlerini kaydetmeleri istenmiştir. Açıklama aşamasında ise tahminleriyle gözlemlerini karşılaştırmaları ve tartışma sorularını cevaplamaları istenmiştir. Öğretmen adaylarının yaptıkları tahmin ve gözlemler ile cevaplandırdıkları tartışma soruları laboratuvarda tartışılmıştır. Araştırma sonucunda fen bilgisi öğretmen adaylarının yarısından fazlasının tuzların formüllerini yazabildikleri, tuzu oluşturan asit ve bazı kuvvetli/zayıf olarak belirtebildikleri, tuzun asidik/bazik/nötr olma durumunu doğru olarak tahmin edebildikleri, tahminleriyle gözlemlerinin uyumlu olduğu saptanmıştır. Az sayıda öğretmen adayının ise kavram yanılgılarına sahip olduğu saptanmıştır. Yapılan görüşmede bazı öğretmen adayları ezbere bildikleri bilgilerin gerçekten doğru olduğunu TGA yöntemine uygun olarak gerçekleştirilen deneysel etkinlikle ispatladıklarını ve bazıları ise kavram yanılgılarını öğrenme sürecinde aktif çalışarak fark ettiklerini ifade etmişlerdir. Ayrıca öğretmen adaylarının önemli bir bölümü TGA'nın görsel hafızayı olumlu etkileyerek öğrenmede kalıcılığı sağlama bağlamında önemli olacağını belirtmiştir. Araştırma sonunda, bazı öğretmen adayları tarafından TGA ile yürütülen etkinliğin tahminde bulunma, gözlem yapma, deney yapma, verileri kaydetme, sınıflama, sonuç çıkarma olmak üzere çeşitli bilimsel süreç becerileri ile iç içe olduğu vurgulanmıştır.

Anahtar sözcükler: Fen eğitimi, Tahmin-gözlem-açıklama yöntemi, kavram yanılgısı, tuz, fen bilgisi öğretmen adayı.

GİRİŞ

Tahmin-gözlem-açıklama olarak üç aşamada gerçekleştirilen (Driver ve Bell, 1986; Çepni, 2011) TGA yöntemi öğrencilerin konuya ilişkin ön bilgilerinin (Çepni, 2011), kavram yanılgılarının belirlenmesi (Boo ve Watson, 2001; Atasoy, 2004), kavramların yapılandırılması (Driver & Bell, 1986) ve etkili bir öğretim için kullanılan bir yöntemdir (Liew ve Treagust, 1995). Yöntemin tahmin, gözlem ve açıklama aşamalarında bilimsel süreç becerileri aktif bir şekilde kullanılmaktadır.

Öğrenciler gözlem yapma, ölçme, sınıflama, verileri kaydetme, sayı ve uzay ilişkisi kurma, önceden kestirme, değişkenleri belirleme, sonuç çıkarma (yordama), hipotez kurma, model oluşturma, deney yapma, değişkenleri değiştirme ve kontrol etme ve karar verme becerilerini kullanarak deneysel etkinlikler yaparlar. Bu beceriler bilimsel süreç becerileridir ve öğrenmeyi kolaylaştıran araştırma yeteneği kazandıran, öğrencileri öğrenme ortamında aktif olmasını sağlayan, öğrenmelerinde sorumluluk alma duygusu geliştiren ve öğrenmenin kalıcılığını arttıran beceriler olarak ifade edilmektedir (Akdeniz, 2011).

I-Tahmin Aşaması

Bu aşama etkinlikte yer alan olayla ilgili tahmin yapma ve tahmini gerekçeli olarak ifade etmeyi içermektedir. Tahmin yapılacak olayın net bir biçimde anlaşılmış olması (Driver ve Bell, 1986) ve tahminlerin gerekçeli olarak ifade edilmesi son derece önemlidir (Kearney ve Treagust, 2001). Çünkü yapılan tahminler kavram yanılgılarını ortaya çıkarır (Liew ve Treagust, 1995). Ayrıca gözlem için öğrenciyi motive eder ve gözleme odaklanmayı sağlar (Driver ve Bell, 1986).

II-Gözlem Aşaması

Bu aşamada deneysel etkinlik gerçekleştirilir ve öğrenciden gözlem yapması istenir. Tüm öğrencilerin gözlem yapabilecekleri ve zihinsel çelişki oluşturacak bir etkinlik aşamayı daha da etkili kılar (Tao ve Gunstone, 1999). Gözlem aşamasında bir öğrencinin diğer öğrencilerin ifadelerinden etkilenmesini ve gözlem verilerinde değişiklik yapmasının önüne geçebilmek için olayın gerçekleşmesi ile gözlem etkinliği paralel yürütülmeli ve kaydedilmelidir (Driver ve Bell, 1986).

III-Açıklama Aşaması

Bu aşamada yapılan tahmin ve gözlem sonuçları öğretmen rehberliğinde karşılaştırılarak tartışılır ve açıklanır. Öğrencilerin yapacakları aşamalarda bütün ihtimalleri dikkate almaları ve alternatifleri düşünerek yorum yapmaları önemlidir (Driver ve Bell, 1986). Bireysel ya da grup halinde gerçekleştirilebilen yöntemde (Kearney ve Treagust, 2001);

- Etkinliğin iyi anlaşılması,
- Etkinlikle ilgili tahminleri ve gerekçeleri öğrencilerin kendi cümleleri ile açıklamaları,
- Etkinlikle ilgili tahminlerini gerek gözleme odaklanmaları gerekse tahminlerini yapacakları gözleme bağlı değiştirmemeleri için gözlem öncesinde tamamlamaları,
- Etkinliği gözlemlerken kaydetmeleri,
- Tahmin ve gözlemlerini karşılaştırmaları gereklidir (Köse, Coştu ve Keser, 2003).

Ulusal ve uluslararası alanyazın incelendiğinde TGA yönteminin başarıyı arttırdığı (Tao ve Gunstone 1999; Windschitl ve Andre, 1998; Kearney ve Treagust, 2001; Kearney, Treagust, Yeo ve Zadnik, 2001; Kearney, 2004; Bilen ve Aydoğdu, 2010; Bilen ve Köse, 2012a, 2012b; Karatekin ve Öztürk, 2012; Mısır ve

Saka, 2012a, 2012b; Akgün, Tokur ve Özkara, 2013; Yavuz ve Çelik, 2013); laboratuvara (Köseoğlu, Tümay ve Kavak, 2002; Russell, Lucas ve McRobbie, 2003; Karaer, 2007; Bilen ve Aydoğdu, 2010), derse (Mısır ve Saka, 2012a, 2012b; Öner Sünkür, Arıbaş, İlhan ve Sünkür, 2012; Yavuz ve Çelik, 2013) ve fen öğretimine yönelik tutum üzerinde olumlu etkileri olduğu görülmektedir (Bilen ve Köse, 2012b). TGA yönteminin kavramların yapılandırılmasını, anlamlı ve kalıcı öğrenmeyi (Bilen ve Aydoğdu, 2010; Özdemir, Köse ve Bilen, 2012; Yavuz ve Çelik, 2013), etkili bir şekilde ders işlemeyi, öğrencilerin kavram yanılgılarını yaparak yaşayarak fark etmelerini sağladığı (Bilen ve Köse, 2012b; Harman, 2014, 2015); problem çözme, uygulama (Mısır ve Saka, 2012a, 2012b) ve kavramsal anlama becerilerini geliştirdiği (Bilen, Köse ve Uşak, 2011; Mısır ve Saka, 2012a, 2012b) ve kavram yanılgılarının giderilmesinde etkili olduğu saptanmıştır (Bilen ve Köse, 2012a; Harman, 2014, 2015; Mısır ve Saka, 2012a; Öner Sünkür, İlhan ve Sünkür, 2013; Özdemir, Köse ve Bilen, 2012; Yavuz ve Çelik, 2013). TGA yönteminin konunun anlaşılmasını sağladığı (Tekin, 2008a, 2008b) ve yöntemin ispat için yapılan deneyleri kavramsal anlama bağlamında desteklediği belirlenmiştir (Tekin, 2008b). TGA yönteminin deneysel etkinliğe ilişkin ilgi, istek, merak (Karaer, 2007) ve motivasyonu arttırdığı; ilgi çekici olduğu (Mısır ve Saka, 2012a, 2012b; Tekin, 2008b); aktif katılımı sağladığı ve sosyalleşmeyi olumlu yönde etkilediği saptanmıştır (Mısır ve Saka, 2012a, 2012b). TGA yönteminin bilimsel süreç becerileri (Özyılmaz, 2008; Bilen ve Aydoğdu, 2012; Karatekin ve Öztürk, 2012), bilimin doğası (Bilen ve Aydoğdu, 2012) ve bilimsel bilgiye yönelik görüşler üzerinde olumlu etkileri olduğu ortaya konmuştur (Akgün, Tokur ve Özkara, 2013). TGA yönteminin kavram yanılgılarının saptanmasında etkili olduğu saptanmıştır (Harman, 2014, 2015; Liew ve Treagust, 1995; Tao ve Gunstone,1999; Kearney ve Treagust, 2001; Karaer, 2007; Bilen ve Aydoğdu, 2010; Bilen ve Köse, 2012a; Mısır ve Saka, 2012a; Özdemir, Köse ve Bilen, 2012; Öner Sünkür, İlhan ve Sünkür, 2013).

Bu araştırma fen bilgisi öğretmen adaylarının tuzun formülü, tuzu oluşturan asit ve bazın kuvvetli/zayıf olma durumu, tuzun asidik, bazik ve nötr olma durumu hakkında sahip oldukları kavram yanılgılarını TGA yöntemini kullanarak belirlemek amacıyla yapılmıştır.

YÖNTEM

Araştırmada kontrol grupsuz son test desen kullanılmıştır. Araştırmaya katılan örneklemde uygulamanın sonundaki deneysel işlemden kaynaklanan değişmeler ölçülür ve bir karara varılır. Bu desen türünde ön test uygulaması ve kontrol grubu yoktur (Sönmez ve Alacapınar, 2013).

Örneklem

Araştırmaya Eğitim Fakültesi Fen Bilgisi Eğitimi Anabilim Dalında üçüncü sınıfta öğrenim görmekte olan 43 fen bilgisi öğretmen adayı katılmıştır. 3. sınıfta öğrenim gören öğretmen adaylarının seçilme nedeni Genel Kimya I-II, Genel Kimya Laboratuvarı I-II ve Fen Bilgisi Laboratuvar Uygulamaları I-II derslerini almış olmalarıdır. Bu nedenle araştırmada amaçlı örnekleme yapılmıştır.

Veri toplama aracı

Alanyazın taraması yapılarak ve laboratuvar derslerine giren bir öğretim üyesinin görüşü alınarak hazırlanan ölçme aracındaki ifadelerin anlaşılır ve görünüş geçerliliği bakımından uygun olup olmadığını anlamak ve cevaplama süresini belirlemek için 20 öğrenci ile pilot uygulaması yapılmıştır. Uzman görüşü ve pilot uygulama sonuçları dikkate alınarak düzenlenen ölçme aracının son hali tablo 1'de verilmiştir.

Tablo 1. Veri Toplama Aracında Yer Alan Sorular

Aşamalar	Sorular
Tahmin	6 deney tüpü için deney tüplerindeki çözeltilere pH indikatör kağıtlarını batıralım. pH indikatör kağıtlarındaki renk değişimini dikkate alarak pH skalası ile yapacağınız karşılaştırmada pH değerinin kaç olmasını beklersiniz? Tahminlerinizi ve tahminlerinizin gerekçesini yazınız.
Gözlem	Deneysel etkinliğe ilişkin gözlemlerinizi kaydediniz.
Açıklama	Deneysel etkinlikle ilgili olarak yaptığınız tahminleri ve gözlemleri karşılaştırınız.
Tartışma	Tuzların formülerini yazınız.
	Tuzları oluşturan asit ve bazları yazınız.
	Tuzu oluşturan asit ve bazın kuvvetli/zayıf olma durumunu belirtiniz.
	6 deney tüpü için deney tüplerindeki çözeltilere pH indikatör kağıtları batırıldığında pH skalası ile yapacağınız karşılaştırmada pH değeri kaç olur? Yazınız.
	Aşağıda verilen ifadelerin doğru ya da yanlış olduklarını belirtiniz. Yanlış olan ifadelerin üzerini çizerek doğrusunu yazınız.

- Kuvvetli asit ve kuvvetli bazın tepkimesi sonucunda oluşan tuz nötr tuzdur.
- Kuvvetli asit ve zayıf bazın tepkimesi sonucunda oluşan tuz bazik tuzdur.
- Zayıf asit ve kuvvetli bazın tepkimesi sonucunda oluşan tuz asidik tuzdur.
- Zayıf asit ve zayıf bazın tepkimesi sonucunda oluşan tuz nötr, bazik veya asidik tuzdur.

Gerçekleştirilen uygulamaya ilişkin yapılan görüşmede öğretmen adaylarına "TGA yöntemine uygun olarak işlenen ders ile ilgili düşünceleriniz nedir?" sorusu yöneltilmiştir.

Uygulama

TGA yöntemine uygun olarak düzenlenen etkinlik Eğitim Fakültesi Fen Bilgisi Eğitimi Anabilim Dalında 3. sınıfta öğrenim gören 43 fen bilgisi öğretmen adayı ile birlikte 4 saatlik bir sürede laboratuvarda yapılmıştır. Etkinlikler sırasında öğretmen adayları laboratuvara 14-15 kişilik gruplar halinde alınmıştır. Her grup kendi içinde 2-3 kişilik daha küçük gruplara ayrılmıştır.

Tahmin Aşaması

Öğretmen adaylarından; 6 deney tüpü içindeki Potasyum iyodür, sodyum klorür, amonyum nitrat, amonyum sülfat, sodyum asetat ve sodyum karbonat çözeltilerine pH indikatör kağıtlarını batırdıklarında, pH indikatör kağıtlarındaki renk değişimi ve pH skalası arasında yapılacak karşılaştırmaya göre çözeltilerin pH değeri için tahminde bulunmaları ve tahminlerinin gerekçelerini yazmaları istenmiştir.

Gözlem Aşaması

Araç-gereçler: Potasyum iyodür, sodyum klorür, amonyum nitrat, amonyum sülfat, sodyum asetat, sodyum karbonat, saf su, pH indikatör kağıtları, 6 adet deney tüpü, tüplük, damlalık, spatül, baget, beher
Öğrencilerden 6 deney tüpü almaları ve tüplerin içerisine aşağıdaki tabloda belirtilen maddeleri ilave edip baget ile karıştırmaları istenmiştir.

Tüp no	İlave edilecek maddeler		
1	5 mL saf su	0.2 g	Potasyum iyodür
2	5 mL saf su	0.2 g	Sodyum klorür
3	5 mL saf su	0.2 g	Amonyum nitrat
4	5 mL saf su	0.2 g	Amonyum sülfat
5	5 mL saf su	0.2 g	Sodyum asetat
6	5 mL saf su	0.2 g	Sodyum karbonat

Daha sonra pH indikatör kağıtlarını çözeltilere batırmaları, pH indikatör kâğıtlarında gerçekleşen renk değişimini incelemeleri ve pH skalasından gözlemledikleri renk için pH değerini kaydetmeleri istenmiştir. pH değerlerini dikkate alarak tuz çözeltilerinin asidik, bazik ya da nötr özellikten hangisine sahip olduğunu belirlemeleri beklenmiştir.

Açıklama Aşaması

Öğretmen adaylarından yaptıkları tahmin ve gözlemleri önce kendi grupları içinde sonrada laboratuvarda yer alan tüm öğrencilerle karşılaştırmaları istenmiştir. Öğrencilerden kendilerine yöneltilen tartışma sorularını cevaplandırmaları istenmiştir. Deneysel etkinlik tamamlandıktan sonra TGA yönteminin tüm aşamaları ve sorular öğrencilerle birlikte tartışılmıştır.

Verilerin Analizi

Araştırmadan elde edilen veriler betimsel analiz yöntemi ile çözümlenmiştir. Araştırma öncesinde araştırma soruları ve kavramsal çerçeve ışığına veri analizi için bir çerçeve hazırlanmıştır. Verilerin hangi tema altına yazılacağı belirlenmiştir. Hazırlanan çerçeveye göre okunan veriler düzenlenmiş, anlamlı, mantıklı olacak şekilde birleştirilmiş ve tanımlanmıştır. Tanımlanan veriler açıklanarak birbiri ile ilişkilendirilmiş, verilere anlam kazandırılmıştır (Yıldırım ve Şimşek, 2011). Veri analizinde temalara yerleştirilen cevapların frekansları ve yüzdeleri hesaplanarak tablolar hazırlanmış ve yorumlanmıştır. Ayrıca veri analizi öğrenci cevaplarından doğrudan alıntılarla desteklenmiştir.

BULGULAR VE YORUM

Araştırmadan elde edilen bulgular tahmin, gözlem, açıklama ve tartışma olmak üzere dört bölüm halinde verilmiştir.

1-Tahmin Aşaması

Fen bilgisi öğretmen adaylarının tuzlu su çözeltilerinin pH değerlerinden hareketle tuzun asidik, bazik ve nötr olma durumu ile ilgili tahminlerine ait frekanslar ve yüzdeler Tablo 2' de verilmiştir.

Tablo 2. Fen Bilgisi Öğretmen Adaylarının Tuzlu Su Çözeltilerinin Ph Değerleri- Tuzun Asidik, Bazik ve Nötr Olma Durumu ile İlgili Tahminlerine Ait Frekanslar ve Yüzdeler

		Potasyum iyodür		Sodyum klorür		Amonyum nitrat		Amonyum sülfat		Sodyum asetat		Sodyum karbonat	
	Tuzun türü	**f**	**%**	**f**	**%**	**f**	**%**	**f**	**%**	**f**	**%**	**f**	**%**
pH<7	KA+ZB=AT	12	27,9	-	-	31*	72,1	34*	79,1	5	11,6	3	7,0
pH>7	ZA+KB=BT	8	18,6	2	4,7	11	25,6	6	14,0	37*	86,0	34*	79,1
pH=7	KA+KB=NT	21*	48,8	29*	67,4	-	-	2	4,7	1	2,3	5	11,6
	Boş	2	4,7	12	27,9	1	2,3	1	2,3	-	-	1	2,3
	Toplam	**43**	**100,0**	**43**	**100,0**	**43**	**100,0**	**43**	**100,0**	**43**	**100,0**	**43**	**100,0**

*:doğru. K: kuvvetli, Z: zayıf, A: asit, B: baz, AT: asidik tuz, BT: bazik tuz, NT: nötr tuz

Fen bilgisi öğretmen adaylarının yarısından fazlası deneysel etkinlikten önce potasyum iyodür ve sodyum klorürün nötr tuz, amonyum nitrat ve amonyum sülfatın asidik tuz ve sodyum asetat ve sodyum karbonatın bazik tuz olduğunu doğru olarak ifade etmiştir. Bazı öğrenciler ise altı tuz için tuzların türü ile tuzu oluşturan asit ve bazın kuvvetli ve zayıf olmasını yanlış belirtmiştir.

Öğrencilerin tahminlerine ait ifade ettikleri gerekçelerden bazı örnekler aşağıda verilmiştir.

Potasyum iyodür için öğrencilerin tahminlerine ilişkin ifade ettikleri gerekçeler:
"HI (KA), KOH (KB) oluğu için nötrdür. Bu yüzden pH=7'dir."
"KOH+HI -> KI+H_2O kuvvetli asit ve kuvvetli baz olduğu için nötr."
"Tuzu oluşturan HI kuvvetli asit ve KOH'da kuvvetli baz olduğu için suda yüzde yüz iyonlaşır. Nötrdür."
"pH 7'den küçüktür. Çünkü KI kuvvetli asit ve zayıf bazdan oluşmaktadır. Yani asidik tuzdur. pH<7"
"KOH + HI -> KI + H_2O, KOH: zayıf baz, HI: kuvvetli asit, KI: asidik tuz. pH<7"
"KOH + HI -> KI + H_2O, KOH: kuvvetli baz, HI: zayıf asit, KI: bazik tuz. pH>7"
"KOH: kuvvetli baz, HI: zayıf asit. Tepkimede KOH kuvvetli baz olduğu için tuzda bazik özellik gösterir. Bu yüzden pH>7 olur."
"Potasyum kuvvetli asittir. I zayıf bazdır. Bu yüzden pH 7'den küçük olur."

Sodyum klorür için öğrencilerin tahminlerine ilişkin ifade ettikleri gerekçeler:
"NaOH (KB) ve HCl (KA)'ten oluştuğu için nörtdür. Bu yüzden pH=7"
"NaOH+HCl -> NaCl+H_2O kuvvetli asit ve kuvvetli baz olduğu için nötr."
"Tuzu oluşturan HCl kuvvetli asit ve NaOH'da kuvvetli baz olduğu için suda yüzde yüz iyonlaşır. Nötrdür."

Amonyum nitrat için öğrencilerin tahminlerine ilişkin ifade ettikleri gerekçeler:
"HNO_3 (KA) ve NH_3 (ZB)'den meydana geldiği için asidiktir. Bu yüzden pH<7'dir."
"Kuvvetli baz ve zayıf asidin birleşmesinden meydana geldiği için pH'ı 7'den büyük olacak."
"Kuvvetli asit olur. pH>7"
"HNO_3 + NH_3 -> NH_4NO_3 + H_2O. zayıf baz (NH_3) ve kuvvetli asit (HNO_3)"
"Amonyumdan dolayı baziktir."

Amonyum sülfat için öğrencilerin tahminlerine ilişkin ifade ettikleri gerekçeler:
"H_2SO_4 (KA) ve NH_3 (ZB)'den meydana geldiği için asidiktir. pH<7'dir."
"Kuvvetli baz ve zayıf asidin birleşmesinden meydana geldiği için pH'ı 7'den büyük olacak. Çünkü baziktir."
"Kuvvetli asit olur. pH>7"
"H_2SO_4 + NH_3 -> $(NH_4)_2SO_4$ + H_2O. H_2SO_4 (KA) ve NH_3 (ZB)"
"Amonyumdan dolayı baziktir."

Sodyum asetat için öğrencilerin tahminlerine ilişkin ifade ettikleri gerekçeler:
"CH_3COOH (ZA) ve NaOH (KB)'den meydana geldiği için baziktir. pH>7'dir."
"Kuvvetli baz + kuvvetli asitten dolayı nötr"
"Kuvvetli baz olur. pH<7"
"CH_3COOH + NaOH -> CH_3COONa + H_2O. CH_3COOH (ZA) ve NaOH (KB)"

Sodyum karbonat için öğrencilerin tahminlerine ilişkin ifade ettikleri gerekçeler:
"NaOH (KB) ve H_2CO_3 (ZA)'ten meydana geldiği için baziktir. Bazikte pH>7'dir."
"Kuvvetli baz + kuvvetli asitten dolayı nötr"
"Kuvvetli baz olur. pH<7"
"NaOH + H_2CO_3 -> Na_2CO_3 + H_2O. NaOH (KB) ve H_2CO_3 (ZA)"

2-Gözlem Aşaması

Tahmin-gözlem-açıklama yönteminin ikinci aşaması olan gözlem aşamasında fen bilgisi öğretmen adaylarından kendilerine verilen formda belirtildiği şekilde deneyi yapmaları, gözlem yaparak gözlem verilerini yazmaları istenmiştir. Öğretmen adaylarının yazdıkları veriler incelenmiş ve bu gözlemlerden bir tanesi örnek olarak aşağıda sunulmuştur.

"1.tüpteki çözeltinin (potasyum iyodür + saf su) pH değeri pH=7 ve 2.tüpteki çözeltinin (sodyum klorür + saf su) pH değeri pH=7 olup iki çözelti de nötr özelliktedir. 3.tüpteki çözeltinin (amonyum nitrat + saf su) pH değeri pH<7 ve 4. tüpteki çözeltinin (amonyum sülfat + saf su) pH değeri pH<7 olup iki çözelti de asidik özelliktedir. 5. tüpteki çözeltinin (sodyum asetat + saf su) pH değeri pH>7 ve 6. tüpteki çözeltinin (sodyum karbonat + saf su) pH değeri pH>7 olup iki çözelti de bazik özelliktedir."

3-Açıklama Aşaması

Tahmin-gözlem-açıklama yönteminin açıklama aşamasında kavramların yeniden yapılandırılmasını sağlamak için yapılan tahmin ve gözlemler araştırmacının rehberliğinde laboratuvarda tartışılmıştır. Öğretmen adaylarının gözlemleri ile uyuşmayan tahminleri aşağıda sunulmuştur.

Potasyum iyodür için
"pH 7'den küçüktür. Çünkü KI kuvvetli asit ve zayıf bazdan oluşmaktadır. Yani asidik tuzdur. pH<7"
"KOH + HI -> KI + H_2O, KOH: zayıf baz, HI: kuvvetli asit, KI: asidik tuz. pH<7"
"KOH + HI -> KI + H_2O, KOH: kuvvetli baz, HI: zayıf asit, KI: bazik tuz. pH>7"
"KOH: kuvvetli baz, HI: zayıf asit. Tepkimede KOH kuvvetli baz olduğu için tuzda bazik özellik gösterir. Bu yüzden pH>7 olur."
"Potasyum kuvvetli asittir. I zayıf bazdır. Bu yüzden pH 7'den küçük olur."

Amonyum nitrat için öğrencilerin tahminlerine ilişkin ifade ettikleri gerekçeler:
"Kuvvetli baz ve zayıf asidin birleşmesinden meydana geldiği için pH'ı 7'den büyük olacak."
"Amonyumdan dolayı baziktir."

Amonyum sülfat için öğrencilerin tahminlerine ilişkin ifade ettikleri gerekçeler:
"Kuvvetli baz ve zayıf asidin birleşmesinden meydana geldiği için pH'ı 7'den büyük olacak. Çünkü baziktir."
"Amonyumdan dolayı baziktir."

Sodyum asetat için öğrencilerin tahminlerine ilişkin ifade ettikleri gerekçeler:
"Kuvvetli baz + kuvvetli asitten dolayı nötr"
"Kuvvetli baz olur. pH<7"

Sodyum karbonat için öğrencilerin tahminlerine ilişkin ifade ettikleri gerekçeler:
"Kuvvetli baz + kuvvetli asitten dolayı nötr"
"Kuvvetli baz olur. pH<7"

4-Tartışma aşaması

Fen bilgisi öğretmen adaylarının tuzların formüllerini adlandırmaya ilişkin verdikleri cevaplara ait frekans ve yüzdeler tablo 3'te verilmiştir.

Tablo 3. Fen Bilgisi Öğretmen Adaylarının Tuzların Formülleri ile İlgili Verdikleri Cevapların Frekans ve Yüzde Değerleri

	Potasyum iyodür		Sodyum klorür		Amonyum nitrat		Amonyum sülfat		Sodyum asetat		Sodyum karbonat	
	f	%	f	%	f	%	f	%	f	%	f	%
Doğru	38	88,4	42	97,7	24	55,8	25	58,1	37	86,0	33	76,7
Yanlış	2	4,7	1	2,3	17	39,5	16	37,2	5	11,6	8	18,6
Boş	3	7,0	-	-	2	4,7	2	4,7	1	2,3	2	4,7
Toplam	**43**	**100,0**	**43**	**100,0**	**43**	**100,0**	**43**	**100,0**	**43**	**100,0**	**43**	**100,0**

Tablo incelendiğinde öğretmen adaylarının yarısından fazlasının tuzların formüllerini doğru yazdıkları görülmektedir. Öğretmen adaylarının tamamına yakınının sodyum klorürün formülünü doğru yazabildiği saptanmıştır. Bu durum üzerinde tuzlara örnek olarak sıklıkla sodyum klorürün verilmesinin ve deneylerde yoğun olarak kullanılmasının etkili olduğu düşünülmektedir.

Fen bilgisi öğretmen adaylarının tuzu oluşturan asit ve bazın kuvvetli/zayıf olma durumu ile ilgili verdikleri cevapların yüzde ve frekans değerleri tablo 4'de verilmiştir.

Tablo 4. Fen Bilgisi Öğretmen Adaylarının Tuzu Oluşturan Asit ve Bazın Kuvvetli/Zayıf Olma Durumu ile İlgili Verdikleri Cevapların Yüzde ve Frekans Değerleri

Asit-Baz Türü	Potasyum iyodür		Sodyum klorür		Amonyum nitrat		Amonyum sülfat		Sodyum asetat		Sodyum karbonat	
	f	%	f	%	f	%	f	%	f	%	f	%
KA-KB	25*	58,1	40*	93,0	2	4,7	1	2,3	2	4,7	1	2,3
KA-ZB	4	9,3	-	-	28*	65,1	27*	62,8	-	-	-	-
ZA-KB	6	14,0	-	-	2	4,7	3	7,0	32*	74,4	34*	79,1
ZA-ZB	-	-	-	-	2	4,7	-	-	1	2,3	-	-
KA-?	1	2,3	2	4,7	2	4,7	4	9,3	-	-	1	2,3
?-KB	-	-	1	2,3	1	2,3	1	2,3	1	2,3	1	2,3
ZA-?	1	2,3	-	-	-	-	2	4,7	1	2,3	1	2,3
?-ZB	-	-	-	-	3	7,0	2	4,7	3	7,0	2	4,7
Boş	6	14,0	-	-	3	7,0	3	7,0	3	7,0	3	7,0
Toplam	**43**	**100,0**	**43**	**100,0**	**43**	**100,0**	**43**	**100,0**	**43**	**100,0**	**43**	**100,0**

*:doğru. K: kuvvetli, Z: zayıf, A: asit, B: baz, ?:asit ya da bazın kuvvetli/zayıf olma durumu belirtilmemiş.

Tablo incelendiğinde öğretmen adaylarının yarısından fazlasının tuzu oluşturan asit ve bazın kuvvetli/zayıf olma durumunu doğru ifade ettiği görülmektedir. Öğretmen adaylarının tamamına yakınının sodyum klorürü oluşturan asit ve baz türünü kuvvetli olarak ifade ettiği saptanmıştır. Bu sonucun sodyum hidroksit ve hidroklorik asidin deneylerde sık sık kullanılması ve kitaplarda kuvvetli baz - kuvvetli asit için verilen ilk örnekler olmalarından kaynaklandığı düşünülmektedir. Ayrıca fen bilgisi öğretmen adaylarının yarısından fazlası potasyum iyodür ve sodyum klorürün "*Kuvvetli asit ve kuvvetli bazdan oluşur*" gerekçesi ile nötr tuz, amonyum nitrat ve amonyum sülfatın "*Kuvvetli asit ve zayıf bazdan oluşur*" gerekçesi ile asidik tuz ve sodyum asetat ve sodyum karbonatın *"Zayıf asit ve kuvvetli bazdan oluşur."* gerekçesi ile bazik tuz olduğunu doğru olarak ifade etmiştir. Öğrencilerin önemli bir bölümü 37 öğrenci potasyum iyodür, 43 öğrenci sodyum klorür, 40 öğrenci ise amonyum nitrat, amonyum sülfat, sodyum asetat, sodyum karbonat oluşumuna katılan asit ve baz türlerini doğru ifade edebilmiştir. 6 öğrenci potasyum iyodür, 3 öğrenci ise amonyum nitrat, amonyum sülfat, sodyum asetat, sodyum karbonat oluşumuna katılan asit ve baz türlerini belirtememiştir.

Fen bilgisi öğretmen adaylarının tuzlu su çözeltilerinin pH indikatör kağıtları ile verecekleri rengin pH skalasında vereceği pH değerlerinden hareketle tuzun asidik, bazik ve nötr olma durumu ile ilgili tahminlerine ait frekanslar ve yüzdeler Tablo 5' de verilmiştir.

Tablo 5. Fen Bilgisi Öğretmen Adaylarının Tuzlu Su Çözeltilerinin Ph Değerleri- Tuzun Asidik, Bazik ve Nötr Olma Durumu ile İlgili Tahminlerine Ait Frekanslar ve Yüzdeler

	Tuzun türü	Potasyum iyodür		Sodyum klorür		Amonyum nitrat		Amonyum sülfat		Sodyum asetat		Sodyum karbonat	
		f	%	f	%	f	%	f	%	f	%	f	%
pH<7	KA+ZB=AT	10	23,3	3	7,0	31*	72,1	31*	72,1	2	4,7	5	11,6
pH>7	ZA+KB=BT	2	4,7	1	2,3	10	23,3	7	16,3	38*	88,4	36*	83,7
pH=7	KA+KB=NT	29*	67,4	26*	60,5	1	2,3	3	7,0	2	4,7	1	2,3
	Boş	2	4,7	13	30,2	1	2,3	2	4,7	1	2,3	1	2,3
	Toplam	**43**	100,0	**43**	100,0	**43**	100,0	**43**	100,0	**43**	100,0	**43**	100,0

*:doğru. K: kuvvetli, Z: zayıf, A: asit, B: baz, AT: asidik tuz, BT: bazik tuz, NT: nötr tuz

Deneysel etkinlikten sonra fen bilgisi öğretmen adaylarının yarısından fazlası potasyum iyodür ve sodyum klorürün nötr tuz, amonyum nitrat ve amonyum sülfatın asidik tuz ve sodyum asetat ve sodyum karbonatın bazik tuz olduğunu doğru olarak ifade etmiştir. Bazı öğrenciler ise altı tuz için tuzların türü ile tuzu oluşturan asit ve bazın kuvvetli ve zayıf olmasını yanlış belirtmiştir.

Fen bilgisi öğretmen adaylarının tuzu oluşturan asit ve bazın kuvvetli/zayıf olma durumuna bağlı olarak tuzun türü ile ilgili olarak verdikleri cevaplara ait frekans ve yüzde değerleri tablo 6'da verilmiştir.

Tablo 6. Fen Bilgisi Öğretmen Adaylarının Tuzun Türü ile İlgili Olarak Verdikleri Cevaplara Ait Frekans ve Yüzde Değerleri

	İfade doğrudur.		İfade yanlıştır.		Boş	
	f	%	f	%	f	%
Kuvvetli asit ve kuvvetli bazın tepkimesi sonucunda oluşan tuz nötr tuzdur.	43	100	-	-	-	-
Kuvvetli asit ve zayıf bazın tepkimesi sonucunda oluşan tuz bazik tuzdur.	-	-	43	100	-	-
Zayıf asit ve kuvvetli bazın tepkimesi sonucunda oluşan tuz asidik tuzdur.	-	-	43	100	-	-
Zayıf asit ve zayıf bazın tepkimesi sonucunda oluşan tuz nötr, bazik veya asidik tuzdur.	39	90,7	3	7,0	1	2,3

Tabloda da görüldüğü üzere öğretmen adaylarının tamamı "Kuvvetli asit ve kuvvetli bazın tepkimesi sonucunda oluşan tuz nötr tuzdur." ifadesinin doğru bir ifade olduğunu belirtmiştir. Öğretmen adaylarının tamamı "Kuvvetli asit ve zayıf bazın tepkimesi sonucunda oluşan tuz bazik tuzdur." ifadesinin yanlış bir ifade olduğunu, doğru ifadenin "Kuvvetli asit ve zayıf bazın tepkimesi sonucunda oluşan tuz asidik tuzdur." olduğunu belirtmiştir. Öğretmen adaylarının tamamı "Zayıf asit ve kuvvetli bazın tepkimesi sonucunda oluşan tuz asidik tuzdur." ifadesinin yanlış bir ifade olduğunu, doğru ifadenin "Zayıf asit ve kuvvetli bazın tepkimesi sonucunda oluşan tuz bazik tuzdur." olduğunu belirtmiştir. Öğretmen adaylarının %90,7'si "Zayıf asit ve zayıf bazın tepkimesi sonucunda oluşan tuz nötr, bazik veya asidik tuzdur." ifadesinin doğru olduğunu belirtirken 3 öğretmen adayının ise zayıf asit ve zayıf bazın tepkimesi sonucunda oluşan tuzun nötr olduğunu belirttiği saptanmıştır.

TARTIŞMA, SONUÇ VE ÖNERİLER

Araştırma sonucunda fen bilgisi öğretmen adaylarının yarısından fazlasının tuzların formüllerini yazabildikleri, tuzu oluşturan asit ve bazı kuvvetli/zayıf olarak belirtebildikleri, tuzun asidik/bazik/nötr olma durumunu doğru olarak tahmin edebildikleri, tahminleriyle gözlemlerinin uyumlu olduğu saptanmıştır. Az sayıda öğretmen adayının ise kavram yanılgılarına sahip olduğu saptanmıştır. Alanyazında da ifade edildiği üzere TGA yönteminin bireyin sahip olduğu kavram yanılgılarının saptanmasında (Harman, 2014, 2015; Liew ve Treagust, 1995; Tao ve Gunstone,1999; Kearney ve Treagust, 2001; Karaer, 2007; Bilen ve Aydoğdu, 2010; Bilen ve Köse, 2012a; Mısır ve Saka, 2012a; Özdemir, Köse ve Bilen, 2012; Öner Sünkür, İlhan ve Sünkür, 2013) ve giderilmesinde (Bilen ve Köse, 2012a; Harman, 2014, 2015; Mısır ve Saka, 2012a; Özdemir, Köse ve Bilen, 2012; Öner Sünkür, İlhan ve Sünkür, 2013; Yavuz ve Çelik, 2013) etkili olduğu ortaya konulmuştur.

Yapılan görüşmede bazı öğretmen adayları ezbere bildikleri bilgilerin gerçekten doğru olduğunu TGA yöntemine uygun olarak gerçekleştirilen deneysel etkinlikle ispatladıklarını ve bazıları ise kavram yanılgılarını öğrenme sürecinde aktif çalışarak fark ettiklerini ifade etmişlerdir. Alanyazında da TGA yönteminin bireyin sahip olduğu kavram yanılgılarını yaparak yaşayarak fark etmesi (Bilen ve Köse, 2012b; Harman, 2014, 2015) ve etkinliklere aktif katılım üzerinde etkili olduğu saptanmıştır (Mısır ve Saka, 2012a, 2012b). Ayrıca öğretmen adaylarının önemli bir bölümü TGA'nın görsel hafızayı olumlu etkileyerek öğrenmede kalıcılığı sağlama bağlamında önemli olacağını belirtmiştir. Benzer şekilde alanyazında da TGA yönteminin kavramların yapılandırılmasını, anlamlı ve kalıcı öğrenmeyi sağladığı saptanmıştır (Bilen ve Aydoğdu, 2010; Özdemir, Köse ve Bilen, 2012; Yavuz ve Çelik, 2013). Bazı öğretmen adayları tarafından TGA ile yürütülen etkinliğin tahminde bulunma, gözlem yapma, deney yapma, verileri kaydetme, sınıflama, sonuç çıkarma olmak üzere çeşitli bilimsel süreç becerileri ile iç içe olduğu vurgulanmıştır. Alanyazında da TGA yönteminin bilimsel süreç becerileri (Özyılmaz, 2008; Bilen ve Aydoğdu, 2012; Karatekin ve Öztürk, 2012) üzerinde etkili olduğu ortaya konulmuştur.

Laboratuvarlarda gruplar halinde gerçekleştirilen deneysel etkinliklerde bazı sıkıntılar yaşanabilir. Örneğin; bazı gruplarda yer alan üyelerin hepsinin aktif bir şekilde deneysel etkinliği yapmadığı görülür. Bu öğrenciler grupta çalışarak deney yapan arkadaşlarından daha sonra verileri alacaklarını, hatta aktif olarak deneyi yapan arkadaşlarının raporlarına bakarak kendi deney raporlarını yazabileceklerini düşünerek deney yapmadan boş boş otururlar ya da yapılan deneysel etkinlikleri olumsuz etkileyecek türden hareketler sergilerler. Bu tür olumsuz durumların önüne geçebilmek amacı ile deneysel etkinlik TGA yöntemine uygun olacak şekilde yürütülmüştür. Araştırma süresince deneysel etkinliği gerçekleştiren öğrenciler gözlemlenmiş, yapılan gözlemlerde tüm öğrencilerin tahmin, gözlem, açıklama ve tartışma olmak üzere bütün aşamalarda aktif olarak yer aldıkları görülmüştür. Öyle ki, öğrenciler deneysel etkinliğin tahmin, gözlem, açıklama aşamalarında bireysel, gözlem ve tartışma aşamalarında ise grup içerisinde diğer üyelerle işbirliği halinde çalışmıştır.

Araştırma sonucunda TGA yönteminin kavram yanılgılarının saptanması ve giderilmesi, bireyin sahip olduğu kavram yanılgısını bizzat fark etmesi, öğretim ve aktif katılım üzerinde olumlu etkileri olduğu saptanmıştır. Ayrıca öğretmen adaylarının TGA yönteminin bilgilerin ispatlanmasında, kalıcılığın sağlanmasında etkili olduğu ve bilimsel süreç becerilerini kapsadığına ilişkin görüş belirttikleri ortaya konulmuştur. TGA yönteminin öğrenmenin bilişsel, devinişsel ve duyuşsal boyutları üzerinde oluşturduğu olumlu etkiler nedeni ile deneysel etkinliklerde kullanılması önerilmektedir.

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DETERMINATION OF THE SCIENCE TEACHER CANDIDATES' UNDERSTANDING LEVEL OF SCIENCE PROCESS SKILLS: EXAMPLE OF THE STRENGTH OF THE ELECTROMAGNET

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ABSTRACT: It is extremely important and necessary to gain the skills as identifying variables, establishing hypothesis, changing and controlling variables. Because, individuals solve problems in daily life by using the science process skills and testing their hypothesis. Therefore, this study aims to determine last year science teacher candidates' understanding level of science process skills. For this purpose, teacher candidates have been asked to solve problem about "What are factor/factors that effect the strength of the electromagnet?" by determining variables, establishing hypotheses, changing and controlling variables. The study group consisted of a total of 90 last year science teacher candidates attending the Department of Science Teaching of a Faculty of Education. General screening model has been used in this study. The data obtained from this study have been analysed using descriptive analysis. More than half of the science teacher candidates expressed that when the number of coil is kept fixed, but the number of battery is increased, the strength of the electromagnet is increased. When the number of battery is kept fixed, but the number of coil is increased, the strength of the electromagnet is increased. The results of this study showed that some of the teacher candidates have been used interchangeably independent, controlled and dependent variable types. According to the results, some of the science teacher candidates expressed that temperature, the distance between material and electromagnets, the type, length and thickness of the nails, the type and mass of the matter effect on the strength of the electromagnet.

Keywords: science process skills, science teacher candidate.

FEN BİLGİSİ ÖĞRETMEN ADAYLARININ BİLİMSEL SÜREÇ BECERİLERİNİ ANLAMA DÜZEYLERİNİN BELİRLENMESİ: ELEKTROMIKNATISIN ÇEKİM GÜCÜ ÖRNEĞİ

ÖZET: Bireylerin günlük yaşamlarında karşılaştıkları bir problemi çözerken bilimsel süreç becerilerinden yararlanarak problemleri kuracakları hipotezleri test ederek çözebilecekleri düşünüldüğünde, hipotez test etmede değişkenleri belirleme, hipotez kurma, değişkenleri değiştirme ve kontrol etme becerilerinin kazanılması son derece önemli ve gereklidir. Bu gereklilikten hareketle, araştırmada son sınıf fen bilgisi öğretmen adaylarının bilimsel süreç becerilerini anlama düzeylerinin belirlenmesi amaçlanmıştır. Bu amaçla öğretmen adaylarından "Elektromıknatısın çekim gücü ne/nelere bağlıdır?" problem durumuna çözüm bulacak şekilde değişkenleri belirlemeleri, hipotezler kurmaları, değişkenleri değiştirmeleri ve kontrol etmeleri istenmiştir. Araştırmaya Eğitim Fakültesi Fen Bilgisi Eğitimi Anabilim Dalında son sınıfta öğrenim görmekte olan 90 fen bilgisi öğretmen adayı katılmıştır. Araştırma genel tarama modeli ile yürütülmüştür. Elde edilen veriler betimsel analiz yöntemi kullanılarak çözümlenmiştir. Araştırma sonucunda son sınıf fen bilgisi öğretmen adaylarının yarısından fazlasının sarım sayısı sabitken pil sayısı arttırıldığında veya pil sayısı sabitken sarım sayısı arttırıldığında elektromıknatısın çekim gücünün artacağını ifade ettikleri saptanmıştır. Bazı öğretmen adaylarının bağımsız, kontrol edilen ve bağımlı değişken türlerini birbirlerinin yerine kullandıkları görülmüştür. Bazı öğretmen adaylarının ise sıcaklık, elektromıknatıs ile çekilen madde arasındaki uzaklık, çivinin cinsi, çivinin uzunluğu ve çivinin kalınlığını, çekilen maddenin cinsi ve kütlesini elektromıknatısın çekim gücü üzerinde etkili olan bir değişken olarak ifade ettikleri belirlenmiştir.

Anahtar sözcükler: bilimsel süreç becerileri, fen bilgisi öğretmen adayı.

GİRİŞ

Gözlem yapma, ölçme, sınıflama, verileri kaydetme, hipotez kurma, verileri kullanma ve model oluşturma, değişkenleri değiştirme ve kontrol etme, deney yapma gibi bilimsel süreç becerileri (MEB, 2013) bilim insanlarının bilgi üretirken kullandıkları yöntemlerin fen öğretimine yansımasıdır. Son derece önemli olan bu beceriler bilimsel okuryazar toplumlarda çeşitli meslek gruplarındaki bireylerin sahip olması ve kullanması gereken, hayatın hemen her alanına uygulanabilen süreçleri içermektedir. Bilimsel süreç becerilerinden biri olan değişkenleri belirleme hem fen derslerinde hem de günlük hayatın hemen her alanında kullanılmaktadır. Bilimsel süreç becerilerini kullanmak günlük hayatta karşılaşılan olayları anlamayı, yorumlamayı ve öğrenilen bilgilerle ilişkilendirmeyi, yani bilimsel okur-yazar birey olmayı sağlamaktadır. Öğrencilerin laboratuvar çalışmalarında, derslerde ve günlük yaşamlarında olaylara bilim insanı gibi bakan, araştıran, sorgulayan, yaratıcı düşünceler üreten bireyler olmaları açısından bu becerilerin geliştirilmesi son derece önemli ve gereklidir. Bu nedenle bilimsel süreç becerilerinin bireylere kazandırılması için okul öncesinden başlanarak ilköğretim, ortaöğretim ve lise fen (fizik, kimya, biyoloji) derslerinde öğretimine yer verilmelidir. Bunun yanında fen derslerinde kullanılan ölçme değerlendirme etkinliklerinde de bu beceriler ölçülmelidir (Temiz ve Tan, 2009). Ders kitaplarındaki etkinlikler gerçekleştirilirken bilimsel süreç becerileri bir bütün olarak göz önünde tutulmalı ve bu beceriler vurgulanmalıdır (Durmaz ve Mutlu, 2012).

Bilimsel süreç becerileri gözlem yapma, ölçme, sınıflama, verileri kaydetme, sayı ve uzay ilişkisi kurma olarak temel beceriler; önceden kestirme, değişkenleri belirleme, sonuç çıkarma olarak nedensel beceriler ve hipotez kurma, model oluşturma, deney yapma, değişkenleri değiştirme ve kontrol etme, karar verme olarak deneysel beceriler olarak üç grupta incelenebilir. Bu beceriler öğrenmede kolaylık ve kalıcılık sağlayan, araştırma yeteneği kazandıran, öğrencilerin aktif katılımını destekleyen, sorumluluk almayı sağlayan becerilerdir (Akdeniz, 2011).

"Doğanın keşfedilmesi ve insan-çevre arasındaki ilişkinin anlaşılması sürecinde, bilimsel süreç becerilerini ve bilimsel araştırma yaklaşımını benimseyip karşılaşılan sorunlara çözüm üretmek" (MEB, 2013) ve "Günlük yaşam sorunlarına ilişkin sorumluluk alınmasını ve bu sorunları çözmede fen bilimlerine ilişkin bilgi, bilimsel süreç becerileri ve diğer yaşam becerilerinin kullanılmasını sağlamak" (MEB, 2013) tüm bireylerin fen okuryazarı olarak yetişmesini amaçlayan fen bilimleri dersi öğretim programının temel amaçları arasındadır. Fen okuryazarı bir bireyin fen bilimleri ile ilgili temel bilgilere (Biyoloji, Fizik, Kimya, Yer, Gök ve Çevre Bilimleri, Sağlık ve Doğal Afetler) ve doğal çevrenin keşfedilmesine ilişkin bilimsel süreç becerilerine sahip olması beklenir (MEB, 2013). Bununla birlikte alanyazın incelendiğinde öğrencilerin bilimsel süreç becerilerinden biri olan değişkenleri belirleme becerisi ile ilgili olarak (Laçin-Şimşek, 2010) bağımlı, bağımsız ve kontrol edilen değişken türlerini belirlemede güçlük yaşadıkları görülmektedir (Ateş, 2005; Ateş ve Bahar, 2002; Ayas-Kör, 2006; Aydoğdu, 2012; Bağcı-Kılıç, Yardımcı ve Metin, 2009; Durmaz ve Mutlu, 2012; Griffiths ve Thompson, 1993; Saka, 2012; Temiz ve Tan, 2009).

Bireylerin günlük yaşamlarında karşılaştıkları bir problemi çözerken bilimsel süreç becerilerinden yararlanarak problemleri kuracakları hipotezleri test ederek çözebilecekleri düşünüldüğünde, hipotez test etmede hipotez kurma, değişkenleri belirleme, değiştirme ve kontrol edebilme becerilerinin kazanılması son derece önemlidir. Bu nedenle bireylerin kendilerine verilen bir durumla ilgili bağımlı, bağımsız ve kontrol edilen değişkenleri belirleyebilmeleri ve bir sonraki adımda da sonuca ulaşabilmeleri için değişkenleri değiştirmeleri ve kontrol edebilmeleri gereklidir. Bu gereklilik ışığında araştırmada son sınıf fen bilgisi öğretmen adaylarının bilimsel süreç becerilerinden değişkenleri belirleme, hipotez kurma, değişkenleri değiştirme ve kontrol etme becerilerini anlama düzeylerinin belirlenmesi amaçlanmıştır.

YÖNTEM

Araştırmada, örneklemin mevcut durumunu ayrıntılı olarak betimlemek amacıyla (Karakaya, 2009) betimsel araştırma yöntemlerinden genel tarama modeli kullanılmıştır. Araştırmada mevcut durum üzerinde herhangi bir müdahalede bulunulmadan öğretmen adaylarının değişkenleri belirleme, hipotez kurma, değişkenleri değiştirme ve kontrol etme becerilerini anlama düzeyleri ayrıntılı bir şekilde tanımlanmış, açıklanmış ve değerlendirilmiştir.

Örneklem

Araştırmaya Eğitim Fakültesi Fen Bilgisi Eğitimi Anabilim Dalında dördüncü sınıfta öğrenim görmekte olan 90 fen bilgisi öğretmen adayı katılmıştır. Araştırmada genel kimya, fizik ve biyoloji laboratuvarı I-II ve fen bilgisi laboratuvar uygulamaları I-II dersleri ile bilimsel araştırma yöntemleri derslerini almış olmaları nedeni ile son sınıf fen bilgisi öğretmen adayları tercih edilmiştir. Bu nedenle araştırmada amaçlı örnekleme yapılmıştır.

Veri toplama aracı

Son sınıf öğretmen adaylarından "Elektromıknatısın çekim gücü ne/nelere bağlıdır?" problem durumuna çözüm bulacak şekilde değişkenleri belirlemeleri, hipotezler kurmaları, değişkenleri değiştirmeleri ve kontrol etmeleri istenmiştir.

Verilerin analizi

Araştırmadan elde edilen veriler betimsel analiz yöntemi ile çözümlenmiştir.

Anlama düzeylerinin belirlenmesinde Abraham, Grzybowski, Renner ve Marek (1992) tarafından belirlenen kriterler kullanılmıştır.

Anlama Düzeyleri	Kriterler
Tam anlama (TA)	Geçerli cevabın tamamını içeren cevaplar
Kısmi anlama (KA)	Geçerli cevabın tamamını içermeyen bir kısmını içeren cevaplar
Kavram yanılgısıyla kısmi anlama (KYKA)	Kısmen anlama ile birlikte kavram yanılgısı içeren cevaplar
Kavram yanılgısı (KY)	Bilimsel anlamda yanlış olan cevaplar
Anlamama (A)	Cevap vermeme, bilmiyorum, anlamadım vb. cevaplar
	Soruyu tekrarlama
	İlgili ya da net olmayan cevaplar

BULGULAR VE YORUM

Fen bilgisi öğretmen adaylarının "Elektromıknatısın çekim gücü ne/nelere bağlıdır?" problem durumu için kurdukları hipotez cümleleri tablo 1'de anlama düzeyleri frekans ve yüzde değerleri ile birlikte verilmiştir.

Tablo 1. Fen Bilgisi Öğretmen Adaylarının Kurdukları Hipotez Cümlelerine İlişkin Frekans ve Yüzde Değerleri

Anlama Düzeyi	Hipotez cümlesi	f	%
TA	Sarım sayısı sabitken pil sayısı artarsa elektromıknatısın çekim gücü artar. Pil sayısı sabitken sarım sayısı artarsa elektromıknatısın çekim gücü artar.	**57**	**63,3**
KA	Sarım sayısı sabitken pil sayısı artarsa elektromıknatısın çekim gücü artar.	8	8,9
	Pil sayısı sabitken sarım sayısı artarsa elektromıknatısın çekim gücü artar.	6	6,7
	Toplam	**14**	**15,6**
KYKA	Sarım sayısı sabitken pil sayısı artarsa elektromıknatısın çekim gücü artar. Çekilecek cisim ile mıknatıs arasındaki uzaklık artarsa elektromıknatısın çekim gücü azalır.	2	2,2
	Sarım sayısı sabitken pil sayısı artarsa elektromıknatısın çekim gücü artar. Çekilen maddenin cinsi değişirse elektromıknatısın çekim gücü değişir.	2	2,2
	Sarım sayısı sabitken pil sayısı artarsa elektromıknatısın çekim gücü artar. Çivinin cinsi değişirse elektromıknatısın çekim gücü değişir.	1	1,1
	Sarım sayısı sabitken pil sayısı artarsa elektromıknatısın çekim gücü artar. Sıcaklık artarsa elektromıknatısın çekim gücü artar.	1	1,1
	Pil sayısı sabitken sarım sayısı artarsa elektromıknatısın çekim gücü artar. Çivinin kalınlığı artarsa elektromıknatısın çekim gücü artar.	1	1,1
	Pil sayısı sabitken sarım sayısı artarsa elektromıknatısın çekim gücü artar. Çekilen maddenin cinsi değişirse elektromıknatısın çekim gücü değişir.	1	1,1
	Toplam	**8**	**8,9**
KY	Çekilecek cisim ile mıknatıs arasındaki uzaklık artarsa elektromıknatısın çekim gücü azalır. Çekilen maddenin cinsi değişirse elektromıknatısın çekim gücü değişir.	2	2,2
	Çekilecek cisim ile mıknatıs arasındaki uzaklık artarsa elektromıknatısın çekim gücü azalır.	1	1,1
	Çekilen maddenin cinsi değişirse elektromıknatısın çekim gücü değişir. Çekilen maddenin kütlesi artarsa elektromıknatısın çekim gücü azalır.	1	1,1
	Çekilen maddenin cinsi değişirse elektromıknatısın çekim gücü değişir.	1	1,1
	Sıcaklık artarsa elektromıknatısın çekim gücü azalır.	1	1,1

	Çekilen maddenin cinsi değişirse elektromıknatısın çekim gücü değişir.		
	Sıcaklık artarsa elektromıknatısın çekim gücü azalır. Çivinin kalınlığı artarsa elektromıknatısın çekim gücü artar.	1	1,1
	Toplam	**7**	**7,8**
A	Boş	4	4,4
TOPLAM		**90**	**100**

Tam anlama (TA), Kısmi anlama (KA), Kavram yanılgısıyla kısmi anlama (KYKA), Kavram yanılgısı (KY), Anlamama (A)

Tablo incelendiğinde öğretman adaylarının % 63,3'ünün tam anlama düzeyinde cevap verdiği görülmektedir. Bunun yanında öğretmen adaylarının % 15,6'sının kısmi anlama, % 8,9'unun kavram yanılgılı kısmi anlama, % 7,8'inin kavram yanılgısı ve % 4,4'ünün de anlamama düzeyinde olduğu anlaşılmaktadır. Tam anlama düzeyinde cevap veren öğretmen adayları sarım sayısı sabitken pil sayısındaki, pil sayısı sabitken sarım sayısındaki değişimin elektromıknatısın çekim gücü üzerinde doğru orantılı bir etki oluşturduğunu ifade etmişlerdir. Kısmi anlama düzeyinde cevap veren öğretmen adaylarının bazıları sadece pil sayısı, bazıları da sadece sarım sayısının elektromıknatısın çekim gücü üzerinde doğru orantılı bir etki oluşturduğunu ifade etmişlerdir. Kavram yanılgılı kısmi anlama düzeyinde cevap veren öğretmen adaylarının bazıları sarım sayısı sabitken pil sayısındaki artış ile birlikte çekilecek cisim ile mıknatıs arasındaki uzaklık, çekilen maddenin cinsi, çivinin cinsi ve sıcaklığın elektromıknatısın çekim gücü üzerinde etkili olduğunu ifade etmişlerdir. Kavram yanılgılı kısmi anlama düzeyinde cevap veren öğretmen adaylarından bazıları ise pil sayısı sabitken sarım sayısındaki artış ile birlikte çivinin kalınlığı ve çekilen maddenin cinsinin elektromıknatısın çekim gücü üzerinde etkili olduğunu ifade etmişlerdir. Kavram yanılgısı düzeyinde cevap veren öğretmen adayları çekilecek cisim ile mıknatıs arasındaki uzaklık, sıcaklık, çivinin kalınlığı, çekilen maddenin cinsi ve çekilen maddenin kütlesinin elektromıknatısın çekim gücü üzerinde etkili olduğunu ifade etmişlerdir.

Tablo 1'de verilen hipotez cümleleri değişken türlerinin analizi için tablo 2'de bağımsız düşünülerek ayrı ayrı verilmiştir.

Tablo 2. Fen Bilgisi Öğretmen Adaylarının Kurdukları Hipotez Cümlelerine İlişkin Frekans ve Yüzde Değerleri

Hipotez cümlesi	**f**	**%**
Sarım sayısı sabitken pil sayısı artarsa elektromıknatısın çekim gücü artar.	71	78,9
Pil sayısı sabitken sarım sayısı artarsa elektromıknatısın çekim gücü artar.	65	72,2
Çekilen maddenin cinsi değişirse elektromıknatısın çekim gücü değişir.	8	8,9
Çekilen maddenin kütlesi artarsa elektromıknatısın çekim gücü azalır.	1	1,1
Çekilecek cisim ile mıknatıs arasındaki uzaklık artarsa elektromıknatısın çekim gücü azalır.	5	5,6
Sıcaklık artarsa elektromıknatısın çekim gücü azalır.	2	2,2
Sıcaklık artarsa elektromıknatısın çekim gücü artar.	1	1,1
Çivinin cinsi değişirse elektromıknatısın çekim gücü değişir.	1	1,1
Çivinin kalınlığı artarsa elektromıknatısın çekim gücü artar.	1	1,1
Boş	4	4,4

Tablo incelendiğinde bazı öğretmen adaylarının çekilen maddenin cinsi ve kütlesi, çekilecek cisim ile mıknatıs arasındaki uzaklık, sıcaklık, çivinin cinsi ve kalınlığının elektromıknatısın çekim gücü üzerinde etkili olduğunu ifade ettikleri görülmektedir.

Öğretmen adaylarının kurdukları hipotez cümleleri ve değişken türleri analiz edilmiş ve 3, 4, 5, 6, 7, 8, 9, 10,11 nolu tablolarda verilmiştir.

"Sarım sayısı sabitken pil sayısı artarsa elektromıknatısın çekim gücü artar." hipotez cümlesine ilişkin öğretmen adaylarının ifade ettikleri değişken türlerine ait frekans ve yüzdeler Tablo 3'te verilmiştir.

Tablo 3. Öğretmen Adaylarının Kurdukları Hipotez ile İfade Ettikleri Değişken Türlerine Ait Frekans ve Yüzde Değerleri

	Anlama Düzeyi		**f**	**%**
Hipotez	TA	Sarım sayısı sabitken pil sayısı artarsa elektromıknatısın çekim gücü artar.	71	78,9
Bağımsız değişken	TA	Pil sayısı	53	58,9

	KYKA	Pil sayısı, Çivinin cinsi	3	3,3
	KY	Çekim gücü	11	12,2
		Sarım sayısı	3	3,3
		Elektromıknatıs ile çekilen madde arasındaki uzaklık	1	1,1
Kontrol edilen değişken	TA	Sarım sayısı	31	34,4
	KYKA	Sarım sayısı, Çivinin cinsi	13	14,4
		Sarım sayısı, Pil sayısı	2	2,2
		Sarım sayısı, Çivinin uzunluğu	1	1,1
	KY	Pil sayısı	10	11,1
		Çivinin cinsi	9	10,0
		Çekim gücü	1	1,1
	A	Boş	4	4,4
Bağımlı değişken	TA	Çekim gücü	55	61,1
	KY	Pil sayısı	10	11,1
		Sarım sayısı	3	3,3
		Çivinin cinsi	1	1,1
		Çivinin uzunluğu	1	1,1
	A	Boş	1	1,1

Tam anlama (TA), Kısmi anlama (KA), Kavram yanılgısıyla kısmi anlama (KYKA), Kavram yanılgısı (KY), Anlamama (A)

Tablo incelendiğinde öğretmen adaylarının yarısından fazlasının bağımsız ve bağımlı değişkeni, 1/3'ünden fazlasının ise kontrol edilen değişken türünü doğru ifade ettiği görülmektedir. Bazı öğretmen adaylarının bağımsız, kontrol edilen ve bağımlı değişken türlerini birbirinin yerine kullandıkları, bazı öğretmen adaylarının ise elektromıknatısın çekim gücü üzerinde etkili olmamasına karşın elektromıknatıs ile çekilen madde arasındaki uzaklık, çivinin cinsi ve çivinin uzunluğunu değişken olarak ifade ettikleri görülmektedir.

"Pil sayısı sabitken sarım sayısı artarsa elektromıknatısın çekim gücü artar." hipotez cümlesine ilişkin öğretmen adaylarının ifade ettikleri değişken türlerine ait frekans ve yüzdeler Tablo 4'de verilmiştir.

Tablo 4. Öğretmen Adaylarının Kurdukları Hipotez ile İfade Ettikleri Değişken Türlerine Ait Frekans ve Yüzde Değerleri

	Anlama Düzeyi		f	%
Hipotez	TA	Pil sayısı sabitken sarım sayısı artarsa elektromıknatısın çekim gücü artar.	65	72,2
Bağımsız değişken	TA	Sarım sayısı	44	48,9
	KY	Çekim gücü	13	14,4
		Pil sayısı	4	4,4
		Çivinin cinsi	3	3,3
		Elektromıknatıs ile çekilen madde arasındaki uzaklık	1	1,1
Kontrol edilen değişken	TA	Pil sayısı	30	33,3
	KYKA	Pil sayısı, Çivinin cinsi	15	16,7
	KY	Sarım sayısı	7	7,8
		Çivinin cinsi	4	4,4
		Çivinin uzunluğu	1	1,1
		Sıcaklık	1	1,1
		Çekim gücü	1	1,1
		Elektromıknatıs ile çekilen madde arasındaki uzaklık	1	1,1
	A	Boş	5	5,6
Bağımlı değişken	TA	Çekim gücü	46	51,1
	KY	Sarım sayısı	13	14,4
		Pil sayısı	2	2,2
		Çivinin cinsi	2	2,2
		Çivinin uzunluğu	1	1,1
	A	Boş	1	1,1

Tam anlama (TA), Kısmi anlama (KA), Kavram yanılgısıyla kısmi anlama (KYKA), Kavram yanılgısı (KY), Anlamama (A)

Tablo incelendiğinde öğretmen adaylarının yaklaşık yarısının bağımsız ve bağımlı değişkeni, 1/3'ününün ise kontrol edilen değişkeni doğru ifade ettiği görülmektedir. Bazı öğretmen adaylarının bağımsız, kontrol edilen ve bağımlı değişken türlerini birbirinin yerine kullandıkları, bazı öğretmen adaylarının ise elektromıknatısın çekim gücü üzerinde etkili olmamasına karşın sıcaklık, elektromıknatıs ile çekilen madde arasındaki uzaklık, çivinin cinsi ve çivinin uzunluğunu değişken olarak ifade ettikleri görülmektedir.

"Çekilen maddenin cinsi değişirse elektromıknatısın çekim gücü değişir." hipotez cümlesine ilişkin öğretmen adaylarının ifade ettikleri değişken türlerine ait frekans ve yüzdeler Tablo 5'te verilmiştir.

Tablo 5. Öğretmen Adaylarının Kurdukları Hipotez ile İfade Ettikleri Değişken Türlerine Ait Frekans ve Yüzde Değerleri

	Anlama Düzeyi		f	%
Hipotez	KY	Çekilen maddenin cinsi değişirse elektromıknatısın çekim gücü değişir.	8	8,9
Bağımsız değişken	KY	Çekilen maddenin cinsi	7	7,8
		Pil sayısı, Çivinin cinsi	1	1,1
Kontrol edilen değişken	KY	Pilin gücü	2	2,2
		Pilin gücü, Sarım sayısı	2	2,2
		Çekilen maddenin cinsi	2	2,2
		Çekilen maddenin büyüklüğü Elektromıknatıs ile çekilen madde arasındaki uzaklık	1	1,1
		Sıcaklık	1	1,1
Bağımlı değişken	KY	Çekim gücü	8	8,9

Kavram yanılgısı (KY)

Tablo incelendiğinde öğretmen adaylarının % 8,9'unun çekilen maddenin cinsini elektromıknatısın çekim gücü üzerinde etkili olan bir değişken olarak kabul ettikleri görülmektedir. Öğretmen adaylarının ifade ettikleri "*En çok demiri çekti. Alüminyum gibi cisimleri çekmez.*", "*Demir, nikel gibi manyetik özellik gösteren maddeler mıknatıs tarafından daha çok çekilir.*", "*Mıknatıs en çok toplu iğneyi çekti. Bakırı çekmedi.*", "*Demir, bakır, gümüş ve altın maddeleri elektromıknatısla tek tek çekmeye çalışırsak bazılarını çekemediğini bazılarını çektiğini görürüz.*" gerekçelerinden elektromıknatısın çekim gücü ile maddelerin manyetik olma/olmama durumu arasında kavram yanılgısı içeren bir ilişki kurdukları anlaşılmaktadır. Öğretmen adayları çekilen cismin demir, nikel, toplu iğne olma durumunda elektromıknatısın çekim gücünün artacağına, alüminyum olması durumunda ise elektromıknatısın çekim gücünün azalacağına inanmaktadır.

"Çekilen maddenin kütlesi artarsa elektromıknatısın çekim gücü azalır." hipotez cümlesine ilişkin öğretmen adaylarının ifade ettikleri değişken türlerine ait frekans ve yüzdeler Tablo 6'da verilmiştir.

Tablo 6: Öğretmen Adaylarının Kurdukları Hipotez ile İfade Ettikleri Değişken Türlerine Ait Frekans ve Yüzde Değerleri

	Anlama Düzeyi		f	%
Hipotez	KY	Çekilen maddenin kütlesi artarsa elektromıknatısın çekim gücü azalır.	1	1,1
Bağımsız değişken	KY	Çekilen maddenin kütlesi	1	1,1
Kontrol edilen değişken	KY	Çekilen maddenin cinsi	1	1,1
Bağımlı değişken	KY	Çekim gücü	1	1,1

Kavram yanılgısı (KY)

Tablo incelendiğinde 1 öğretmen adayının çekilen maddenin kütlesini elektromıknatısın çekim gücü üzerinde etkili olan bir değişken olarak kabul ettiği görülmektedir. Öğretmen adayının ifade ettiği "*Çekilecek maddenin kütlesi artarsa elektromıknatısın çekim gücü azalır. Aynı elektromıknatısa farklı kütlelerde aynı cins madde çekmek istersek örneğin 2g Fe, 4g Fe ve 8g Fe gibi.*" gerekçesinden çekilecek maddenin kütlesindeki artışla elektromıknatısın daha az sayıda cismi yerinden kaldıracağına inandığı anlaşılmaktadır. Bu durum öğretmen adayının 2g Fe çeken elektromıknatısın çekim gücünün, 4g Fe çeken elektromıknatısın çekim gücünden daha fazla olacağını düşündüğünü ortaya koymaktadır.

"Sıcaklık artarsa elektromıknatısın çekim gücü artar." hipotez cümlesine ilişkin öğretmen adaylarının ifade ettikleri değişken türlerine ait frekans ve yüzdeler Tablo 7'de verilmiştir.

Tablo 7. Öğretmen Adaylarının Kurdukları Hipotez ile İfade Ettikleri Değişken Türlerine Ait Frekans ve Yüzde Değerleri

	Anlama Düzeyi		f	%
Hipotez	KY	Sıcaklık artarsa elektromıknatısın çekim gücü artar.	1	1,1
Bağımsız değişken	KY	Çekim gücü	1	1,1
Kontrol edilen değişken	KY	Sarım sayısı	1	1,1
Bağımlı değişken	KY	Sıcaklık	1	1,1

Kavram yanılgısı (KY)

Tablo incelendiğinde 1 öğretmen adayının sıcaklığı elektromıknatısın çekim gücü üzerinde doğru orantılı etki oluşturan bir değişken olarak kabul ettiği görülmektedir. Öğretmen adayının ifade ettiği "*Sıcaklık artınca manyetik alan artar*." gerekçesinden sıcaklığın artışı ile artacak manyetik alan neticesinde elektromıknatısın çekim gücünün artacağına inandığı anlaşılmaktadır.

"Sıcaklık artarsa elektromıknatısın çekim gücü azalır." hipotez cümlesine ilişkin öğretmen adaylarının ifade ettikleri değişken türlerine ait frekans ve yüzdeler Tablo 8'de verilmiştir.

Tablo 8. Öğretmen Adaylarının Kurdukları Hipotez ile İfade Ettikleri Değişken Türlerine Ait Frekans ve Yüzde Değerleri

	Anlama Düzeyi		f	%
Hipotez	KY	Sıcaklık artarsa elektromıknatısın çekim gücü azalır.	2	2,2
Bağımsız değişken	KY	Sıcaklık	2	2,2
Kontrol edilen değişken	KY	Çivinin cinsi, Pil sayısı	1	1,1
		Çekilen cismin cinsi	1	1,1
Bağımlı değişken	KY	Sıcaklık	1	1,1
	KY	Çekim gücü	1	1,1

Kavram yanılgısı (KY)

Tablo incelendiğinde 2 öğretmen adayının sıcaklığı elektromıknatısın çekim gücü üzerinde ters orantılı etki oluşturan bir değişken olarak kabul ettikleri görülmektedir.

"Çekilecek cisim ile mıknatıs arasındaki uzaklık artarsa elektromıknatısın çekim gücü azalır." hipotez cümlesine ilişkin öğretmen adaylarının ifade ettikleri değişken türlerine ait frekans ve yüzdeler Tablo 9'da verilmiştir.

Tablo 9. Öğretmen Adaylarının Kurdukları Hipotez ile İfade Ettikleri Değişken Türlerine Ait Frekans ve Yüzde Değerleri

	Anlama Düzeyi		f	%
Hipotez	KY	Çekilecek cisim ile mıknatıs arasındaki uzaklık artarsa elektromıknatısın çekim gücü azalır.	5	5,6
Bağımsız değişken	KY	Elektromıknatıs ile çekilen madde arasındaki uzaklık	4	4,4
		Çekim gücü	1	1,1
Kontrol edilen değişken	KY	Çekilen cisim	4	4,4
		Pil sayısı, Sarım sayısı	1	1,1
Bağımlı değişken	KY	Çekim gücü	4	4,4
		Elektromıknatıs ile çekilen madde arasındaki uzaklık	1	1,1

Kavram yanılgısı (KY)

Tablo incelendiğinde 5 öğretmen adayının çekilecek cisim ile mıknatıs arasındaki uzaklığı elektromıknatısın çekim gücü üzerinde ters orantılı etki oluşturan bir değişken olarak kabul ettikleri görülmektedir. Bu bulgu öğretmen adaylarının mıknatısın çekilen cisme yakınlığının çekim gücü üzerinde etkili olduğunu düşündüklerini ortaya koymaktadır.

"Çivinin cinsi değişirse elektromıknatısın çekim gücü değişir." hipotez cümlesine ilişkin öğretmen adaylarının ifade ettikleri değişken türlerine ait frekans ve yüzdeler Tablo 10'da verilmiştir.

Tablo 10. Öğretmen Adaylarının Kurdukları Hipotez ile İfade Ettikleri Değişken Türlerine Ait Frekans ve Yüzde Değerleri

	Anlama Düzeyi		**f**	**%**
Hipotez	KY	Çivinin cinsi değişirse elektromıknatısın çekim gücü değişir.	1	1,1
Bağımsız değişken	KY	Çivinin cinsi	1	1,1
Kontrol edilen değişken	KY	Pil sayısı, sarım sayısı	1	1,1
Bağımlı değişken	KY	Çekim gücü	1	1,1

Kavram yanılgısı (KY)

Tablo incelendiğinde 1 öğretmen adayının çivinin cinsini elektromıknatısın çekim gücü üzerinde etkili olan bir değişken olarak kabul ettiği görülmektedir. Öğretmen adayının ifade ettiği "*Demir çivinin çekim gücü çoktur.*" gerekçesinden demirin mıknatıs tarafından çekilebilme özelliği nedeni ile elektromıknatıs yapımında kullanılması halinde çekim gücünün artacağına inandığı düşünülmektedir.

"Çivinin kalınlığı artarsa elektromıknatısın çekim gücü artar." hipotez cümlesine ilişkin öğretmen adaylarının ifade ettikleri değişken türlerine ait frekans ve yüzdeler Tablo 11'de verilmiştir.

Tablo 11. Öğretmen Adaylarının Kurdukları Hipotez ile İfade Ettikleri Değişken Türlerine Ait Frekans ve Yüzde Değerleri

	Anlama Düzeyi		**f**	**%**
Hipotez	KY	Çivinin kalınlığı artarsa elektromıknatısın çekim gücü artar.	1	1,1
Bağımsız değişken	KY	Çivinin kalınlığı	1	1,1
Kontrol edilen değişken	KY	Pil sayısı	1	1,1
Bağımlı değişken	KY	Çekim gücü	1	1,1

Kavram yanılgısı (KY)

Tablo incelendiğinde 1 öğretmen adayının çivinin kalınlığını elektromıknatısın çekim gücü üzerinde doğru orantılı etki oluşturan bir değişken olarak kabul ettiği görülmektedir. Öğretmen adayının ifade ettiği "*Mıknatısın kütlesi ve hacmi artarsa çekim gücü artar. Mıknatısın hacim ve kütle artışı yüzey alanını genişleteceğinden daha güçlü çekecektir.*" gerekçesinden çivinin kapladığı yüzey alanı ile manyetik alan arasında kavram yanılgısı içeren bir ilişki kurduğu anlaşılmaktadır.

TARTIŞMA, SONUÇ VE ÖNERİLER

Araştırma sonucunda son sınıf fen bilgisi öğretmen adaylarının yarısından fazlasının sarım sayısı sabitken pil sayısı arttırıldığında veya pil sayısı sabitken sarım sayısı arttırıldığında elektromıknatısın çekim gücünün artacağını ifade ettikleri; değişkenleri belirleme, hipotez kurma, değişkenleri değiştirme ve kontrol etme bilimsel süreç becerilerini anlama düzeylerinin tam anlama düzeyinde olduğu saptanmıştır. Bazı öğretmen adaylarının ise elektromıknatısın çekim gücü üzerinde etkili olmamasına karşın sıcaklık, elektromıknatıs ile çekilen madde arasındaki uzaklık, çivinin cinsi, çivinin uzunluğu ve çivinin kalınlığını, çekilen maddenin cinsi ve kütlesini değişken olarak ifade ettikleri belirlenmiştir.

Bu araştırmada bazı öğretmen adaylarının bağımsız, kontrol edilen ve bağımlı değişken türlerini birbirlerinin yerine kullandıkları saptanmıştır. Benzer şekilde alanyazında da değişkenleri belirleme becerisi ile ilgili olarak (Laçin-Şimşek, 2010) bağımlı, bağımsız ve kontrol edilen değişken türlerini belirlemede problem yaşandığı belirlenmiş (Ateş ve Bahar, 2002; Aydoğdu, 2012) ve bağımlı, bağımsız, kontrol edilen değişken türlerinin birbirinin yerine kullanıldığı saptanmıştır (Ayas-Kör, 2006; Durmaz ve Mutlu, 2012; Saka, 2012).

Bu araştırmada değişken türlerini birbirine karıştıran öğretmen adaylarının çoğunlukla bağımsız yerine bağımlı değişken, kontrol edilen yerine bağımsız değişken, bağımlı değişken yerine de bağımsız değişken yazdıkları saptanmıştır. Alanyazında yer alan çalışmalarda ise kontrol edilen değişken yerine çoğunlukla bağımlı değişken; bağımlı değişen yerine de bağımsız değişken yazıldığı; buna karşın bağımsız değişken yerine bağımlı değişken yazan katılımcı sayısının daha az olduğu saptanmıştır (Bağcı-Kılıç, Yardımcı ve Metin, 2009). Bağımlı ve bağımsız değişkenin birbiri ile karıştırıldığı, bağımlı ve bağımsız değişkenlerin kontrol edilen değişkenler olarak ifade edildiği ortaya konulmuştur (Ateş, 2005; Griffiths ve Thompson, 1993; Temiz ve Tan, 2009). Alanyazında bağımsız, bağımlı ve kontrol edilen değişken kavramları öğrenmeyi güçleştirdiği için bağımsız değişken yerine değiştirilen değişken, bağımlı değişken yerine cevap veren, ölçülen ya da gözlenen değişken ve kontrol edilen değişken yerine sabit tutulan değişken, sabitler, kontrol altına alınan ya da etkisi kontrol edilen değişken sözcüklerinin kullanılması gerektiği önerilmektedir (Ateş, 2005; Bağcı-Kılıç, Yardımcı ve Metin, 2009).

Bağımsız, bağımlı ve kontrol edilen değişken kavramlarını öğrenmek, akılda tutmak ve birbirleri ile karıştırmadan doğru bir şekilde ifade edebilmek güç olduğu için bağımsız değişken ile birlikte değiştirilen değişken, bağımlı değişken ile birlikte cevap veren, ölçülen ya da gözlenen değişken ve kontrol edilen değişken ile birlikte sabit tutulan değişken, sabitler, kontrol altına alınan ya da etkisi kontrol edilen değişken sözcükleri de kullanılmalıdır. Değişkenleri belirlemenin öğretiminde daha ilgi çekici ve eğlenceli etkinliklerle ders işlenmeli ve dikkat çekici materyaller kullanılarak somut uygulamalar yapılmalıdır.

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INVESTIGATION OF TECHNOLOGICAL PEDAGOGICAL CONTENT KNOWLEDGE OF SCIENCE TEACHER CANDIDATES

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ABSTRACT: The requirements of today's learning conditions have made the necessary changes on the preparation of the learning environment, the role of teachers and students and using technology. Teacher training institutions aim to gain the changes, and in this sense they are especially trying to integrate technology to their programs. Integrating the technology to the teaching activities by teachers began to be seen as professional competence. As a result of the training school to train qualified teachers set targets for the use of technology, Technological Pedagogical Content Knowledge (TPACK) concept was born. TPACK consists of 3 types of knowledge [Technological Knowledge (TK), Pedagogical Knowledge (PK) and Content Knowledge (CK)] and knowledge from their partnership/intersections [Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK), Pedagogical Content Knowledge (PCK)] that should have an educator. TPACK is the extent to support education at all stages of a lesson and to use technology in the educational environment. In this manner, it seems important for teacher candidates to examine their TPACK. This research aimed to determine TPACK of science teacher candidate and to compare their knowledge in terms of some variables. The research was carried out by 87 science teacher candidate (4th grade) at a university in Black Sea Region of Turkey. The survey research model was used in the study. Data were collected by using a TPACK scale. The scale has 47 items and 7 factors (technology knowledge, content knowledge, pedagogical knowledge, pedagogical content knowledge, technological content knowledge, pedagogy technological knowledge, and technological pedagogical content knowledge). Data were analyzed using descriptive statistics in SPSS. In the analysis, it was determined that average TPACK scores of participants were close to each other although they feels themselves most sufficient in PK dimension, and in least TCK dimension. The training of science teacher candidate is considered to be done by increasing the content of the relevant regulations and is recommended for TCK.

Key words: Technological pedagogical content knowledge, teacher training, science teacher candidate

FEN BİLGİSİ ÖĞRETMEN ADAYLARININ TEKNOLOJİK PEDAGOJİK ALAN BİLGİLERİNİN İNCELENMESİ

ÖZET: Günümüz öğrenme koşullarının gerekleri öğrenme ortamlarının hazırlanmasında, öğretmen ve öğrencinin rollerinde ve teknolojiye uyum doğrultusunda değişiklikleri gerekli kılmıştır. Öğretmen yetiştiren kurumlar da değişimleri yakalamayı ve bu anlamda özellikle programlarına teknolojiyi entegre edebilmeyi amaçlamaktadırlar. Bir öğretmenin konuyu teknolojiyle buluşturabilmesi mesleki bir yetkinlik olarak görülmeye başlamıştır. Eğitim fakültelerinin nitelikli öğretmen yetiştirmekte teknoloji kullanımına ilişkin hedefler belirlemesi sonucunda, alan bilgisi, pedagoji ve teknolojinin özel bir bileşimi olan Teknolojik Pedagojik Alan Bilgisi (TPAB) kavramı doğmuştur. TPAB bir eğitimcinin sahip olması gereken 3 bilgi türünden [Teknolojik Bilgi (TB), Pedagojik Bilgi (PB) ve Alan Bilgisi (AB)] ve bunların ortaklıklarından [Teknolojik Pedagojik Alan Bilgisi (TPAB); Teknolojik Pedagojik Bilgi (TPB), Bilgisi Teknolojik Alan Bilgisi (TAB); Pedagojik Alan Bilgisi (PAB)] oluşmaktadır. TPAB, bir dersin tüm aşamalarında öğretimi desteklemek ve eğitim ortamında teknolojiyi temellendirebilmekte ölçüttür. Bu noktadan hareketle hem bulundukları çağın gereği olarak hem de öğretmenlik mesleği açısından TPAB yönünden yeterli olması beklenen öğretmen adaylarının bu boyutlardaki bilgilerini incelemek önemli görülmektedir. Bu araştırmada fen bilgisi öğretmen adaylarının TPAB'larını belirlemek ve TBAP boyutlarını bazı değişkenler açısından karşılaştırmak amaçlanmıştır. Çalışma Batı Karadeniz Bölgesinde yer alan bir üniversitede 4. sınıfta öğrenim görmekte olan 87 fen bilgisi öğretmen adayıyla gerçekleştirilmiştir. Tarama modelinde gerçekleştirilen çalışmada veriler 47 madde ve 7 faktörden

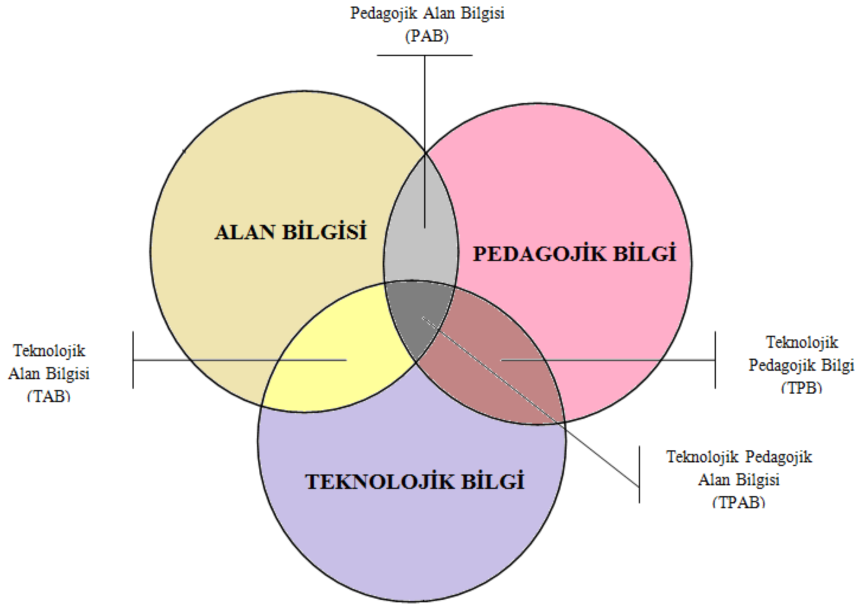
(teknoloji bilgisi, içerik bilgisi, pedagoji bilgisi, pedagojik içerik bilgisi, teknolojik içerik bilgisi, teknolojik pedagoji bilgisi, teknolojik pedagojik içerik bilgisi) oluşan TPAB Ölçeği kullanılarak toplanmıştır. Veriler, SPSS Programında betimsel istatistikler kullanılarak analiz edilmiştir. Analizlerde öğretmen adaylarının TPAB boyutları ortalama puanları birbirine yakın olmakla birlikte en çok PB boyutunda en az TAB boyutunda kendilerini yeterli gördükleri bulunmuştur. Fen bilgisi öğretmen adaylarının eğitiminde TAB'a yönelik içeriklerin artırılmasıyla ilgili düzenlemelerin yapılması gerektiği düşünülmekte ve önerilmektedir.

Anahtar Kelimeler: Teknolojik pedagojik alan bilgisi, öğretmen eğitimi, fen bilgisi öğretmen adayı

GİRİŞ

Günümüz bilgi-teknoloji ve iletişim çağında, fen ve teknoloji eğitiminin önemi giderek artmakta, gelişmiş ülkeler bu eğitimi ileriye götürebilecek yollar aramaktadır. Bu amaçla fen/bilim/bilgi okuryazarı nesiller yetiştirmekte, eğitime teknoloji entegrasyonunun yapılması etkili bir yol olarak görülmektedir (Pierson, 1999; Baran ve Canbazoğlu-Bilici, 2015). Eğitimde teknolojinin kullanımı özellikle ilköğretim düzeyindeki öğrencilerin soyut düşünmede zorlandıkları göz önünde bulundurulduğunda, fen kavramlarının öğrencilerin seviyesine uygun bir şekilde somutlaştırılmasında ve bunların görselleştirilmesinde önemli bir rol üstlenmektedir (Akpınar vd. 2005).

Teknolojinin eğitimdeki önemi öğretmen eğitiminde de kendini göstermektedir. Öğretmen yetiştirmede, alan bilgisi ile pedagoji ve teknolojinin birleştirildiği Teknolojik Pedagojik Alan Bilgisi (TPAB)'ne doğru bir yönelme yaşanmaktadır (TED, 2009). TPAB'ın temel bileşenleri Şekil 1'de sunulmuştur.



Şekil 1. TPAB Bileşenleri (Mishra ve Koehler, 2006)

TPAB öğretmenlerin ve öğretmen adaylarının sahip olması gereken 3 bilgi türünden [Teknolojik Bilgi (TB), Pedagojik Bilgi (PB) ve Alan Bilgisi (AB)] ve bunların kesişimlerinden meydana gelen bilgi türlerinden [Teknolojik Pedagojik Alan Bilgisi (TPAB); Teknolojik Alan Bilgisi (TAB); Pedagojik Alan Bilgisi (PAB)] oluşmaktadır (Mishra ve Koehler, 2006; Shin vd. 2009). Bu bilgi alanları bileşenlerine ait açıklamalar şu şekildedir (Mishra ve Koehler, 2006):

- Alan Bilgisi (AB): İlgili alanda yer alan ve öğrenilecek ya da öğretilecek konuyu kapsamaktadır.
- Pedagojik Bilgi (PB): Öğretim yöntemi, modeli, stratejisi ve tekniğinin yanı sıra öğretim yaklaşımlarına ilişkin bilgileri kapsamaktadır.
- Teknolojik Bilgi (TB): Klasik eğitim araçları ve gelişmiş teknolojileri içeren bilgilerdir.
- Pedagojik Alan Bilgisi (PAB): Konunun nasıl öğretileceğine ilişkin bilgileri içermektedir.
- Teknolojik Pedagojik Bilgi (TPB): Teknolojinin eğitim ortamında kullanımının ve bu teknolojinin eğitim üzerindeki etkisine ait bilgileri içermektedir.
- Teknolojik Alan Bilgisi (TAB): Teknoloji ve alan bilgisinin karşılıklı ilişkisini içeren bilgi alanıdır.
- Teknolojik Pedagojik Alan Bilgisi (TPAB): Teknoloji, pedagoji ve alan bilgisinin bileşiminden oluşan ve kompleks bir bilgi alanıdır.

TPAB temelde, Shulman (1987)'ın öğretmen yeterliliklerini teorik bir çerçevede ele aldığı Pedagojik Alan Bilgisi'ne teknolojik bilginin de entegre edilmesiyle oluşmaktadır (Baran ve Canbazoğlu-Bilici, 2015; Kaleli-Yılmaz, 2015). TPAB, öğretmenin öğrencisinin konuyu algılama ve anlamlandırma seviyesinin farkına varabilmesi ve seziyi kazanabilmesi anlamına gelmektedir. TPAB'ı gelişmiş bir öğretmen, bireylerde bilişsel seviyeyi geliştirmeye yönelik örnekler verebilen, çeşitli öğretim stratejileri kullanarak bilgiyi daha kapsamlı ve etkili olarak veren bir eğitimci olarak görülmektedir (Uşak, 2009). Bu noktada, öğretmen eğitimi programları öğretmen adaylarının teknolojiyi öğretmenliklerine aktarabilmelerini sağlamada önemli bir role sahiptir (Hofer ve Grandgennett, 2012). Öğretmen adayları, TPAB'ın öğretmenlik hayatlarındaki öneminin farkında olmalı ve kendilerini bu yönde geliştirmelidirler. Bu durum öğretmenlerin eğitim ortamında teknoloji kullanımını sağlayan kişiler olmalarından kaynaklanmaktadır (Heinich, Molenda, Russell ve Smaldino, 2002). Öğretmen adaylarının TPAB'a ilişkin eğitim alma, teknolojiye ulaşma ve teknolojiyi kullanma düzeyleri gibi birçok faktör TPAB'a ilişkin farkındalıklarını etkilemektedir.

Araştırmanın Amacı

Bu çalışmanın amacı, astronomi dersini alan fen bilgisi öğretmen adaylarının teknolojik pedagojik alan bilgilerinin (TPAB), fakültede ihtiyaç duyulan teknolojiye erişme, teknolojiyi kullanma, teknoloji kullanımıyla ilgili eğitim alma değişkenlerine göre farklılaşma durumlarının belirlenmesi amaçlanmaktadır. Bu amaç doğrultusunda araştırma problemi şu şekildedir: Fen bilgisi öğretmen adaylarının TPAB ölçeğinden aldıkları puan ortalamaları çeşitli değişkenler açısından anlamlı farklılaşma göstermekte midir? Araştırma problemi doğrultusunda alt problemler ise şu şekildedir:

1. Fen bilgisi öğretmen adaylarının TPAB ölçeğinden aldıkları puan ortalamalarıyla eğitim aldıkları fakültede ihtiyaç duyulan teknolojiye erişebilme düzeyleri arasında anlamlı bir farklılık var mıdır?
2. Fen bilgisi öğretmen adaylarının TPAB ölçeğinden aldıkları puan ortalamalarıyla teknoloji kullanımıyla ilgili eğitim alma durumları arasında anlamlı bir farklılık var mıdır?
3. Fen bilgisi öğretmen adaylarının TPAB ölçeğinden aldıkları puan ortalamalarıyla teknoloji kullanma düzeyleri arasında anlamlı bir farklılık var mıdır?

Teknoloji kullanımını içerisinde barındıran bir ders kapsamında, adayların TPAB ve bileşenlerine ilişkin görüşlerinin farklı değişkenlerle yordanmasıyla elde edilecek sonuçlar literatüre katkı sağlayacağı düşünülmektedir. Araştırma bulgularının öğretmen eğitiminde önemli olan bir konu alanına ışık tutacağından çalışma sonuçlarının kıymetli olduğuna inanılmaktadır.

YÖNTEM

Fen bilgisi öğretmen adaylarının teknolojik pedagojik alan bilgilerinin (TPAB) ve fakültede ihtiyaç duyulan teknolojiye erişme, teknolojiyi kullanma seviyesi ve teknoloji kullanımıyla ilgili eğitim alma değişkenlerine göre bu bilgilerin farklılaşıp farklılaşmadığının belirlenmesinin amaçlandığı araştırma tarama modelinde yürütülmüştür.

Çalışma Grubu

Araştırma, Batı Karadeniz Bölgesinde bulunan bir üniversitede, astronomi dersini alan 87 fen bilgisi öğretmen adayıyla gerçekleştirilmiştir.

Veri Toplama Araçları

Araştırmada veriler, Schmidt, Baran, Thompson, Mishra, Koehler ve Shin (2009) tarafından geliştirilen ve Öztürk ve Horzum (2011) tarafından Türkçeye uyarlanan Teknolojik Pedagojik Alan Bilgisi Ölçeği ile toplanmıştır. Ölçekte 47 madde yer almaktadır. Teknoloji bilgisi, alan bilgisi, pedagoji bilgisi, pedagojik alan bilgisi, teknolojik alan bilgisi, teknolojik pedagoji bilgisi, teknolojik pedagojik alan bilgisi olmak üzere yedi faktörden oluşmaktadır. Ölçeğin ana çalışma için hesaplanan Cronbach alpha değeri .96'dır.

Verilerin Analizi

Veriler, SPSS 22 Paket Programında betimsel istatistikler kullanılarak analiz edilmiştir. Katılımcıların ölçekte yer alan her bir faktördeki maddelerden aldıkları ortalama puanlarıyla toplam puanlarının "fakültede ihtiyaç duyulan teknolojiye erişme", "teknolojiyi kullanma seviyesi" ve "teknoloji kullanımıyla ilgili eğitim alma" değişkenlerine yönelik farklılaşıp farklılaşma durumu için bağımsız-t testi kullanılmıştır.

BULGULAR

Araştırmanın amacı doğrultusunda fen bilgisi öğretmen adaylarının TPAB Ölçeğinde yer alan her bir boyuta ilişkin elde edilen ortalama puanlarıyla ölçekten aldıkları toplam ortalama puanlara ilişkin betimsel istatistikler ve bu ortalama puanların fakültede ihtiyaç duyulan teknolojiye erişme, teknolojiyi kullanma seviyesi ve teknoloji kullanımıyla ilgili eğitim alma değişkenlerine göre farklılaşıp farklılaşmadığına ilişkin yapılan bağımsız t-testi sonuçları tablolar halinde bu bölümde yer almaktadır. Öğretmen adaylarının TPAB ölçeğinin her bir boyutu için aldıkları ortalama puanlara ilişkin betimsel istatistikler Tablo 1'de sunulmuştur.

Tablo 1. Katılımcıların TPAB ölçeğinden her bir boyut için aldıkları ortalama puanlara ilişkin betimsel istatistikler

Boyutlar	N	$\bar{X}$	SS
Teknoloji bilgisi	87	3,54	,71
Alan bilgisi	87	3,50	,47
Pedagojik bilgi	87	3,92	,45
Teknolojik alan bilgisi	87	3,39	,64
Pedagojik alan bilgisi	87	3,59	,54
Teknolojik pedagojik bilgi	87	3,76	,50
Teknolojik pedagojik alan bilgisi	87	3,72	,47
Toplam	87	3,63	,40

Tablo 1 incelendiğinde fen bilgisi öğretmen adaylarının en fazla pedagojik bilgi boyutunda ortalama puana ($\bar{X}$=3,92) sahip oldukları görülmektedir. Daha sonra sırasıyla teknolojik pedagojik bilgi ($\bar{X}$=3,76), teknolojik pedagojik alan bilgisi ($\bar{X}$=3,72), pedagojik alan bilgisi ($\bar{X}$=3,59), teknoloji bilgisi ($\bar{X}$=3,54), alan bilgisi ($\bar{X}$=3,50), teknolojik alan bilgisi ($\bar{X}$=3,39) gelmektedir. Katılımcıların son sınıf öğretmen adayları olması dolayısıyla tüm pedagojik dersleri almasından ötürü pedagojik bilgi boyutunda yüksek ortalama çıkması beklenebilir durum olarak karşımıza çıkmaktadır.

Fen bilgisi öğretmen adaylarının TPAB Ölçeğinde yer alan her bir boyut ve toplam puanlarına yönelik fakültede teknoloji erişim kolaylığına ilişkin verdikleri cevaplara göre yapılan bağımsız t-testi sonuçları Tablo 2'de yer almaktadır.

Tablo 2. Öğretmen adaylarının TPAB ölçeği boyutlarına ilişkin ortalama puanlarının fakültede teknoloji erişim kolaylığı değişkenine göre bağımsız t-testi sonuçları

	Fakültede teknoloji erişim kolaylığı	N	$\bar{X}$	SS	t	p
Teknoloji bilgisi	Evet	31	3,63	,69	,835	,406
	Hayır	56	3,49	,72		
Alan bilgisi	Evet	31	3,58	,45	1,274	,206
	Hayır	56	3,44	,47		
Pedagojik bilgi	Evet	31	3,91	,37	,051	,960
	Hayır	56	3,92	,49		
Teknolojik alan bilgisi	Evet	31	3,51	,62	1,267	,209
	Hayır	56	3,32	,65		
Pedagojik alan bilgisi	Evet	31	3,63	,62	,470	,639
	Hayır	56	3,57	,50		
Teknolojik pedagojik bilgi	Evet	31	3,92	,35	2,352	,021
	Hayır	56	3,66	,55		
Teknolojik pedagojik alan bilgisi	Evet	31	3,78	,47	,904	,369
	Hayır	56	3,69	,47		
Toplam	Evet	31	3,70	,39	1,286	,202
	Hayır	56	3,59	,40		

Tablo 2'ye bakıldığında katılımcıların boyutlara yönelik ortalama puanlarıyla toplam puanlarının fakültede teknoloji erişim kolaylığına 'evet' ve 'hayır' cevabı verme durumlarına göre anlamlı bir farklılık göstermediği bulunmuştur [t=,835, p>,05; t=1,274, p>,05; t=,051, p>,05; t=1,267, p>,05; t=,470, p>,05; t=2,352, p>,05; ; t=,904, p>,005; t=1,286, p>,05]. Bunun yanında genel olarak fakültede teknoloji erişim kolaylığına 'evet' diyen öğrencilerin diğerlerinden az da olsa daha fazla puan aldığı görülmektedir. Teknoloji kullanma seviyesi açısından katılımcıların kendilerini yeterli ve yetersiz görme durumlarına göre TPAB Ölçeğinde yer alan her bir boyut ve toplam puanlarına ilişkin yapılan bağımsız t-testi sonuçları Tablo 3'te yer almaktadır.

Tablo 3. Öğretmen adaylarının TPAB ölçeği boyutlarına ilişkin ortalama puanlarının teknoloji kullanma seviyesi değişkenine göre bağımsız t-testi sonuçları

	Teknoloji kullanma seviyesi	N	$\bar{X}$	SS	t	p
Teknoloji bilgisi	Yetersiz	25	2,83	,42	7,553	,000
	Yeterli	62	3,83	,59		
Alan bilgisi	Yetersiz	25	3,26	,41	3,012	,003
	Yeterli	62	3,59	,46		
Pedagojik bilgi	Yetersiz	25	3,92	,38	,106	,915
	Yeterli	62	3,91	,47		
Teknolojik alan bilgisi	Yetersiz	25	3,05	,54	3,309	,001
	Yeterli	62	3,53	,63		
Pedagojik alan bilgisi	Yetersiz	25	3,58	,58	,129	,897
	Yeterli	62	3,60	,54		
Teknolojik pedagojik bilgi	Yetersiz	25	3,47	,57	3,566	,001
	Yeterli	62	3,87	,43		
Teknolojik pedagojik alan bilgisi	Yetersiz	25	3,46	,38	3,405	,001
	Yeterli	62	3,82	,46		
Toplam	Yetersiz	25	3,37	,27	4,313	,000
	Yeterli	62	3,74	,39		

Tablo 3 incelendiğinde öğretmen adaylarının teknoloji kullanma seviyesi açısından kendilerini yeterli görüp görmeme durumlarına göre pedagojik bilgilerinde ve pedagojik alan bilgilerinde anlamlı farklılık bulunamamıştır [t=,106, p>,005; t=,129, p>,005]. Ancak teknoloji bilgisi, alan bilgisi, teknolojik alan bilgisi, teknolojik pedagojik bilgi, teknolojik pedagojik alan bilgisi ve toplam puanlara yönelik katılımcıların teknoloji kullanma seviyesi açısından kendilerini yeterli görüp görmeme durumlarına anlamlı bir fark bulunmuştur [t=7,553, p<,05; t=3,012, p<,05; t=3,309, p<,05; t=3,566, p<,05; t=3,405, p<,05; t=4,313, p<,05]. Teknoloji kullanma seviyesi açısından kendilerini yeterli gören öğretmen adaylarının teknoloji bilgisi ($\bar{X}$=3,83), alan bilgisi ($\bar{X}$=3,59), teknolojik alan bilgisi ($\bar{X}$=3,53), teknolojik pedagojik bilgi ($\bar{X}$=3,87), teknolojik pedagojik alan bilgisi ($\bar{X}$=3,82) ve toplam ($\bar{X}$=3,74) puanlarının diğer katılımcılardan daha fazla olduğu belirlenmiştir. Katılımcıların TPAB Ölçeğinde yer alan her bir boyut ve toplam puanlarına yönelik teknoloji kullanımı eğitimi alıp almadıklarına ilişkin verdikleri cevaplara göre yapılan bağımsız t-testi sonuçları Tablo 4'te yer almaktadır.

Tablo 4. Öğretmen adaylarının TPAB ölçeği boyutlarına ilişkin ortalama puanlarının teknoloji kullanımı eğitimi değişkenine göre bağımsız t-testi sonuçları

	Teknoloji kullanımı eğitimi	N	$\bar{X}$	SS	t	p
Teknoloji bilgisi	Evet	40	3,84	,72	3,834	,000
	Hayır	47	3,29	,59		
Alan bilgisi	Evet	40	3,65	,48	2,984	,004
	Hayır	47	3,36	,41		
Pedagojik bilgi	Evet	40	3,95	,53	,556	,580
	Hayır	47	3,89	,36		
Teknolojik alan bilgisi	Evet	40	3,50	,72	1,468	,146
	Hayır	47	3,30	,56		
Pedagojik alan bilgisi	Evet	40	3,64	,63	,717	,475
	Hayır	47	3,55	,47		
Teknolojik pedagojik bilgi	Evet	40	3,83	,53	1,351	,180
	Hayır	47	3,69	,48		
Teknolojik pedagojik alan bilgisi	Evet	40	3,79	,52	1,282	,203
	Hayır	47	3,66	,42		
Toplam	Evet	40	3,75	,43	2,702	,008
	Hayır	47	3,53	,34		

Tablo 4'e göre, fen bilgisi öğretmen adaylarının teknoloji kullanımı eğitimi alıp almama durumlarına göre pedagojik bilgilerinde, teknolojik alan bilgilerinde, pedagojik alan bilgilerinde, teknolojik pedagojik bilgilerinde, teknolojik pedagojik alan bilgilerinde ve toplam puanlarında anlamlı bir farklılık olmadığı ortaya çıkmıştır [t=,556, p>,05; t=1,468, p>,05; t=,717, p>,05; t=1,351, p>,05; t=1,282, p>,05; t=2,702, p>,05]. Buna ek olarak katılımcıların teknoloji bilgileri ve alan bilgilerinde teknoloji kullanımı eğitimi alıp almamaları açısından anlamlı bir fark bulunmuştur [t=3,834, p<,05; t=2,984, p<,05]. Buradan hareketle teknoloji kullanımı eğitim alan öğretmen adaylarının teknoloji bilgisi ($\overline{X}$=3,82) ve alan bilgisi ($\overline{X}$=3,65) puanlarının diğer öğretmen adaylarından daha fazla olduğu ortaya çıkarılmıştır.

TARTIŞMA

Teknolojinin kullanımı her alanda olduğu gibi eğitimde de çok önemlidir. Teknolojik bilgiyi içerisine alan Teknolojik Pedagojik Alan Bilgisi (TPAB), öğretmenlerin eğitim ortamında kullandıkları bilgi ve iletişim teknolojilerini sınıf içerisinde aktif bir şekilde kullanabilecek bir olgunluğa eriştirmeyi ifade etmektedir (Kaya, Emre ve Kaya, 2010). Bu çalışmada fen bilgisi öğretmen adaylarının TPAB boyutlarına yönelik düzeylerinin, fakültede ihtiyaç duyulan teknolojiye erişme, teknolojiyi kullanma seviyesi ve teknoloji kullanımıyla ilgili eğitim alma değişkenlerine göre farklılaşma durumları araştırılmıştır.

Öğretmen adaylarının ölçekten aldıkları puanlar sırasıyla Pedagojik Bilgi ($\overline{X}$=3,92), Teknolojik Pedagojik Bilgi ($\overline{X}$=3,76), Teknolojik Pedagojik Alan Bilgisi ($\overline{X}$=3,72), Pedagojik Alan Bilgisi ($\overline{X}$=3,59), Teknoloji Bilgisi ($\overline{X}$=3,54), Alan Bilgisi ($\overline{X}$=3,50), Teknolojik Alan Bilgisi ($\overline{X}$=3,39) şeklindedir. Ortalamalar incelendiğinde, öğretmen adaylarının ölçeğin geneline yönelik "katılıyorum" düzeyinde görüşe sahip olunduğu görülmektedir. Öğretmen adayları en çok Pedagojik Bilgi, en az ise Teknolojik Alan Bilgisi boyutunda görüş ortalamasına sahiptirler. Spesifik bir bilgi alanından bağımsız olarak eğitime ilişkin yöntem, program ve özel öğretim stratejileri bilgisini kapsayan Pedagojik Bilgi alanına (Grossman, 1990) yönelik görüşler ortalamasının yüksek olmasının, öğretmen adaylarının son sınıf öğrencileri olmalarından ve bu düzeye kadar öğretmenlik alan derslerini almalarından kaynaklandığı düşünülmektedir. Öğretmenlerin kara tahta kullanımından, bilgisayar kullanabilmeye kadar olan tüm teknolojik araçlara ilişkin bilgi yeterliliği olan Teknolojik Bilgi (Kaleli-Yılmaz, 2015) düzeyinin düşük olmasıysa düşündürücü bir sonuçtur. Bu bulgular ışığında, öğretmen adaylarının pedagojik bilgi alanında kendilerini yeterli gördüğü, ancak teknolojik bilgi alanında aynı düzeyde bir yetkinliğe sahip olmadıklarını düşündükleri sonucuna ulaşılmıştır. Alan yazın incelendiğinde, çalışmanın bu bulgusuyla paralellik gösteren TPAB'a yönelik benzer ölçme araçlarıyla belirlenen teknolojik bilgi boyutu ortalamasının düşük olduğu çalışmalar bulunmaktadır (Öztürk 2006; Yeşil, 2006; Chai, Koh ve Tsai, 2010; Özgün-Koca, Meagher ve Edwards, 2010; Bal, 2012; Bal ve Karademir, 2013).

Öğretmen adaylarının fakültelerinde teknolojiye ulaşabilmelerine yönelik görüşleri ve ölçek alt boyutları puan ortalamaları arasında anlamlı farklılık tespit edilmemiştir. Katılımcılardan 31'i fakülte içerisinde teknolojiye ulaşabildiklerini; 56'sı ulaşamadıkları belirtmişlerdir. Öğretmen yetiştiren kurumların, öğretmen adaylarının teknolojik pedagojik alan bilgilerini geliştirecek uygulamalara imkân sağlamaları gerektiği bilinmektedir (Sancar-Tokmak, Konokman ve Yelken, 2013). Öğretmen adaylarının çoğunluğunun bu teknolojilere ulaşamadıklarını söylemeleri düşündürücü bir sonuçtur. Diğer yandan araştırmanın diğer bir bulgusu olan teknolojik bilginin diğer bilgi boyutlarından düşük bir düzeyde olmasının nedeninin, fakültede teknolojiye ulaşamadıklarını belirtmeleriyle ilişkili olabileceği düşünülmektedir. Teknolojik araçları (örneğin bilgisayarı) kullanmanın teknolojiye yönelik öz yeterliliği geliştirdiğini gösteren çalışmalar mevcuttur (Kutluca ve Ekici, 2010; Sutton, 2011; Tezci, 2011). Alan yazındaki bu çalışmalar, çalışmanın bulgusunda tespit edilen eksikliğin ciddiyetini gösterir niteliktedir.

Teknoloji kullanma yeterliliklerine ilişkin görüşleri bakımından ölçek puan ortalamaları incelendiğinde; öğretmen adaylarının teknoloji bilgisi, alan bilgisi, teknolojik alan bilgisi, teknolojik pedagojik bilgi, teknolojik pedagojik alan bilgisi boyutlarında anlamlı farklılık tespit edilmiştir. Öğretmen adayları kendilerini, teknolojik cihazları kullanabilme; teknolojiye ilişkin bilgilerini eğitim ortamına aktarabilme; öğretmenlik alanında gerekli yöntem ve teknik bilgiye sahip olma ve buna teknolojiyi entegre etme konusunda kendilerini yeterli görmektedirler.

Öğretmen adaylarının teknolojiyle ilgili eğitim alma durumlarına göre bilgi boyutları incelediğindeyse; yalnızca teknoloji bilgi ve alan bilgisi boyutlarında anlamlı farklılık tespit edilmiştir. Teknoloji ile alınan eğitimin temel bilgi boyutlarında farklılaşmaya neden olurken, bu temel bilgi alanlarına teknolojinin entegresiyle oluşan kompleks bilgi alanlarında bir değişime neden olmaması dikkat çekicidir. Başka bir ifadeyle öğretmen adaylarına verilen teknoloji eğitimi, onların teknoloji paydaşlı bilgi alanlarında bir değişim meydana getirmemiştir. Çalışmanın bu bulgusu teknoloji eğitimi eksikliklerinin varlığını gösteren araştırmaları desteklemektedir (Cüre ve Özdener, 2008; Martinovic ve Zhang, 2012).

SONUÇ VE ÖNERİLER

Yapılan araştırma sonucunda öğretmen adaylarının TPAB bilgi boyutlarında, çeşitli değişkenler açısından yeterlilikleri araştırılmış ve bazı eksiklikler tespit edilmiştir. Öğretmen adayları öğretmenlik mesleğinin önemli bir kısmını oluşturan pedagojik bilgiye yönelik yeterliliğe sahip olduklarını belirtmekte ve teknolojik bilgi alanında kendilerini aynı düzeyde yeterli görmemektedirler. Teknoloji bilgisinin öneminin giderek arttığı ve "Fırsatları Artırma Teknolojiyi İyileştirme Hareketi (FATİH)" projesi kapsamında teknolojinin etkili kullanımı büyük çaplı çalışmalar yapıldığı bilinmektedir (Keleş, Öksüz ve Bahçekapılı, 2012). Bu teknolojik donanımı kullanabilecek teknolojik bilgiye sahip olamayan öğretmenlerin varlığı, bütün çalışmanın işlerliğini bozabilecek yapıda bir engel teşkil edebilir. Bu anlamda teknoloji bilgisinin iyileştirilmesi büyük önem taşımaktadır.

Çalışmada elde edilen bir diğer bulguysa öğretmen adaylarının fakültede teknolojiye ulaşamama konusundaki görüşleridir. Öğretmen eğitiminde, öğretmen adaylarına teknolojiye ulaşmaktan öte teknolojinin içerisinde yaşayacakları modeller oluşturulması bir gerekliliktir (Russell vd., 2003; Martinovic ve Zhang, 2012). Günümüz koşullarında katılımcıların teknolojiye ulaşamamaları, öğretmen eğitim sisteminin hedeflerini gerçekleştirebilmesine gölge düşürür yapıdadır. Bir öğretmen rehberlik yaparken, bilgi aktarırken ya da ders anlatımına ilişkin yöntem seçerken teknolojiden yararlanmalıdır. Bir öğretmen adayına bu yolu gösterebilecek bir alt yapı sağlanmalı, sağlanan alt yapının kullanımı konusunda özendirilmeli ve bu yöndeki çalışmalara öncelik tanınmalıdır.

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DETERMINATION OF THE EMOTIONAL INTELLIGENCE OF CANDIDATE TEACHERS STARTED DIFFERENT DEPARTMENT

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ABSTRACT: Candidate teachers who studying in education faculty which trained future teachers, have individual differences, encounter with many case/problem and hence emotional intelligence plays an important role to cope with them. The aim of this study is to reveal the relationship between emotional intelligence and graduated high school and economic level of candidate teachers who studied in different programs (science education, elementary mathematics teaching, classroom teaching, social studies teaching, pre-school teaching, computer and instructional technology teaching). Survey method carried out by the method in this research. The working group consists a total of 484 candidate teachers who were studying in 1th class of different department of a university in the western Black Sea region in the fall semester 2015-2016 academic year: 87 from science, 57 from elementary mathematics, 105 classroom, 74 social studies, 132 pre-school, 29 computer and instructional technology. Schutte Emotional Intelligence Scale was used for the data collection tool. The scale is a three-factor scale (Optimism/Mood Regulation, Utilisation of Emotions, Appraisal and Expression of Emotions) with 5-point likert type. SPSS 22 was used to analyze data and was benefited two factor variance analysis. As a result, seperately it was found that the interplay between the programs candidate teachers are enrolled in*graduated high school was not significant in predicting optimism, utilisation of emotions, appraisal and expression of emotions and emotional intelligence (p>0,05). Besides, it was determined that the interplay between the programs candidate teachers are enrolled in*economic level was not significant in predicting optimism, utilisation of emotions, appraisal and expression of emotions and emotional intelligence (p>0,05). It is suggested that different researches can be done about emotional intelligence in the subject field according to different perspectives and/or different variables during training candidate teachers.

Keywords: Emotional intelligence, candidate teachers, programme, economic level, graduated high school

FARKLI BÖLÜMLERDE ÖĞRENİME BAŞLAYAN ÖĞRETMEN ADAYLARININ DUYGUSAL ZEKÂLARININ İNCELENMESİ

ÖZET: Geleceğin öğretmenlerini yetiştiren eğitim fakültelerinde öğrenim gören bireysel farklılıklara sahip öğretmen adayları, birçok durumla/sorunla karşılaşmakta ve bunlarla mücadele edebilmelerin de duygusal zekâ önemli rol oynamaktadır. Bu araştırmanın amacı, farklı programlarda (fen bilgisi eğitimi, matematik öğretmenliği, sınıf öğretmenliği, sosyal bilgiler öğretmenliği, okul öncesi öğretmenliği, bilgisayar ve öğretim teknolojileri öğretmenliği) öğrenim gören öğretmen adaylarının duygusal zekâlarıyla mezun olunan lise türü ve ekonomik düzey arasındaki ilişkiyi ortaya koymaktır. Araştırmada tarama yöntemi kullanılmıştır. Çalışma grubu, 2015-2016 öğretim yılı güz döneminde Batı Karadeniz bölgesindeki bir üniversitenin farklı bölümlerinin birinci sınıfında öğrenim görmekte olan 87 fen bilgisi, 57 matematik, 105 sınıf, 74 sosyal bilgiler, 132 okul öncesi, 29 bilgisayar ve öğretim teknolojileri öğretmen adayı olmak üzere toplam 484 öğretmen adayından oluşmaktadır. Veri toplama aracı olarak, Schutte Duygusal Zekâ Ölçeği kullanılmıştır. Ölçek 5'li likert tipinde üç faktörlü (İyimserlik/Ruh Halini Düzenleme, Duyguların Değerlendirilmesi ve Duyguların Kullanımı) bir ölçektir. Verilerin analizinde SPSS 22 paket programı kullanılmış olup iki faktörlü varyans analizinden yararlanılmıştır. Sonuç olarak öğrenim görülen program*mezun olunan lise türü etkileşiminin, iyimserlik, duyguların değerlendirilmesi, duyguların kullanımı faktörleri üzerindeki ortak etkisinin ve duygusal zekâ üzerindeki ortak etkisinin ayrı ayrı anlamlı olmadığı bulunmuştur (p>0,05). Ayrıca, öğrenim görülen program*ekonomik düzey etkileşiminin, iyimserlik, duyguların değerlendirilmesi, duyguların kullanımı faktörleri üzerinde ve duygusal zekâ üzerinde istatistiksel olarak anlamlı bir farklılığa neden olmadığı saptanmıştır (p>0,05). Öğretmen adayların yetiştirilmelerinde duygusal zekâlarını farklı bakış açılarından ve/veya farklı değişkenlere göre konu alan araştırmalar yapılması önerilmektedir.

Anahtar Kelimeler: Duygusal zekâ, öğretmen adayı, program, ekonomik düzey, mezun olunan lise

GİRİŞ

Bireylerin meslek seçimlerinde, mesleki ve kişilik özellikleriyle ilgi ve yeteneklerinin uyum göstermesi bireyin verimli olması ve kendini gerçekleştirmesi açısından büyük önem taşıdığı düşünülmektedir. Bu durum öğretmenlik mesleği açısından da önemlidir. Öğretmenlik mesleğini seçen bireylerin yetiştirilmeleri oldukça kapsamlı ve çok boyutlu olan bir süreçtir (Kuru ve Uzun, 2008). 'Öğretmenlik mesleğine kimler yönelmelidir?' ve 'Adaylar nasıl eğitilmelidir?' gibi sorular yıllardır tartışılmakta ve bu tartışma güncelliğini hala korumaktadır. Türkiye'de öğretmen adayları, bilişsel süreçleri sorgulayan çoktan seçmeli soruları içeren bazı sınavlarla belirlenmektedir. Bu sınavların öğretmen adaylarının sadece bir/birkaç yönünü ölçebildiği açıktır. Buradan öğretmenlik mesleğinde çok önemli olan 'uygun kişilik' özelliğine yönelik bir değerlendirme yapılamadığını göstermektedir (Hotaman, 2011). Türkiye İstatistik Kurumu (TUİK) tarafından yapılan bir araştırmada vatandaşların % 82,4'nün üniversiteye girişiyle ilgili sınav sisteminin öğrencileri yeteneklerine uygun mesleklere yerleştirmediğin inandığını belirlemiştir (TUİK'ten aktaran: Hotaman, 2011). Benzer sonuçlar Türk Eğitim Derneği'nin (2009) yayınladığı 'Öğretmen Yeterlilikleri Raporu' kapsamında da vurgulanmaktadır. Bu raporda öğretmenlerin en az üçte birinin ilgi ve istekleri dışında zorunlu kalarak öğretmenlik mesleğini seçtiği bildirilmektedir. Bu raporda, sınıf öğretmenliğini seçenlerin % 38.8'inin ve branş öğretmenliğini seçenlerin % 32.2'sinin ilgi ve istekleri dışında seçim yaptıkları dikkat çekmektedir. Ubuz ve Sarı'nın (2008) 109 sınıf öğretmen adayıyla yürüttüğü araştırma sonuçlarıysa adayların yarısından fazlasının öğretmenlik mesleğini 'üniversite sınav sonuç puanının' yeterliliğini dikkate alarak seçim yaptığını göstermektedir.

Bireylerin ilk eğitimleri ailelerinde başlar. Belli bir dönemden sonra eğitim kurumlarında edinmiş olduğumuz bilgi ve tecrübelerimizle yeterli deneyim ve donanıma sahip nitelikli bireyler haline gelir ve kişiliğimizin gelişmesini sağlarız. Bu süreçte bireylerin yetişmelerindeki en önemli unsurlardan biri nitelikli eğitimciler/öğretmenlerdir. Nitelikli öğretmenlerin yetiştirilmesi, öncelikli olarak öğretmen yetiştiren kurumların sorumluluğundadır (Murat, Aslantaş ve Özgen, 2006). Geleceğinden kaygılı henüz mezun olmamış binlerce üçüncü ve dördüncü sınıf öğretmen adaylarının meslek yöneliminde hiçbir şekilde nitelik aranmadığı aksine istihdam edilebilirliğin öne çıktığı görülmektedir. Nitelikli öğretmen yetiştirebilmek için, öğretmenlik alanının korunması gerektiği, hatta sıkı bir giriş denetiminin gerekli olduğu söylenebilir. Şu an itibariyle değişik alan ve branşlarda yaklaşık 300 000 öğretmen fazlası olduğu dile getirilmekte fakat insan yetiştirme planlarının, toplumların gereksinim duyduğu alanlar dikkate alınarak ileriye yönelik çalışmalar sergilenmemektedir (Hotaman, 2011). Toplum mimarı olarak nitelenen ve takdir edilen öğretmenlik mesleği için yeni ve isabetli, bireylerin ilgi, yetenek ve kişilik özelliklerini dikkate alan, mesleğin gerekleriyle bireyin özelliklerini eşleştirerek seçme yapılmasına olanak sağlayan yeni bir modelin gerekli olduğu açıktır (Okçabol, 2004).

Eğitim sisteminin başarısı, öğretmenlerin niteliğiyle yakından ilişkilidir. Toplumu tüm yönleriyle etkileme gücüne sahip mesleklerin basında geldiğini, dolayısıyla da taşıdığı sorumluluk, toplumsal beklentiler ve kazandırması gerekli özellikler dikkate alındığında, öğretmenlik mesleğinin herkes tarafından yapılamayacak bir meslek grubu olduğu düşüncesine kolayca ulaşılmaktadır (Şimşek, 2005). Küçükahmet'e (1996) göre bir ülkede yeni nesillerin yetiştirilmesinden eğitim sisteminin işleticisi olan öğretmen sorumludur. Bu nedenle, günümüzde nitelikli insan modelinin yetiştirilmesi, nitelikli öğretmen adaylarının seçimi ve eğitimiyle yakından ilişkilidir. Öğretmenlik mesleğini seçen bireylerin kişilik olarak öğretmenlik mesleğinin gerektirdiği özelliklere de sahip olmaları gerekmektedir. Etkili iletişim becerisi yüksek, sevecen, coşkulu, sosyal, sabırlı, açık fikirli, esnek, anlayışlı, esprili, yüksek başarı odaklı, iddialı, çalışkan, cesaretlendirici, teşvik edici, destekleyici, öğretmekten zevk alan, yeniliklere ve kendini geliştirmeye ve değiştirmeye açık olan, demokratik, entelektüel ve yaratıcı olma gibi özelikleri taşımaları sağlanmalıdır. Bu kişilik özelliklerini yansıtabilmelerindeyse bireylerin duygusal zekâları etkin bir rol oynamaktadır. Duygusal zekâları yüksek öğretmenler mesleklerini yapmaktan mutlu olan, görevlerini daha iyi bir şekilde yapmaya gayret eden, sınıf içi davranışlarında nitelikli tavırlar gösteren ve nihayetinde öğrenci yetişmesinde büyük katkıları olan bireyler olacaklarına inanılmaktadır.

Duygusal zekâ (emotional intelligence, EI) kavramı 1995'te yayınlanan bir kitapla (Goleman, Duygusal Zekâ Neden IQ'dan Daha Önemlidir?) popüler bir kavram haline gelmiştir (Özyalçın Oskay, Erdem ve Yılmaz, 2008). Goleman'a (2015) göre duygusal zekâ kişiliğin bir yansımasıdır ve bilişsel zekâ (Cognitive Intelligence, CI) ile birlikte bireyin karar alma sürecinin bileşenidirler. Gerçekte Goleman kitabında, bilişsel zekâsı yüksek yani IQ'su (Intelligence Quotient) yüksek bireylerin hayattaki başarısızlıklarını irdelemekte ve bunu duygusal zekâlarının düşüklüğüyle yani EQ'nun (Emotional Quotient) düşüklüğüyle açıklamaktadır. Ona göre duygusal zekâ bireylerin eyleme geçebilme, problemler karşısında kararlı şekilde devam edebilme, empati kurabilme ve karşısındaki yönlendirebilme, kendini kontrol edip ruh halini olumlu şekilde düzenleyebilme, olaylar ve durumlar karşısında ümidini koruyabilme yetileri vb. yetkinliklerin birleşimidir. Doğuştan gelen bir yönü olmakla beraber edinilen deneyimlerle geliştirilebilirdir. Bu nedenlerle birey yetiştiren öğretmenlerin EQ'larının yüksek olması gerektiği açıktır. Öğretmenlerin yetiştirilmeleri süreçlerinde öğrenim gördükleri pedagojik derslerde EQ'larını yükselttikleri veya yükseltmeleri gerektiği düşünülebilir. Burada dikkat edilmesi gereken durum, öğretmen adaylarının öğrenim süreçlerindeki EQ gelişimi pedagojik derslerin dışındaki (önceki öğrenimleri, ekonomik durumları, öğrenim gördükleri program gibi) değişkenlere de bağlı olduğu gerçeğidir.

Son yıllarda yoğun bir araştırma konusu haline gelen (örn. Göçet, 2006; Özdemir, 2015; Şirin, 2007) duygusal zekâ kavramının farklı programlarda öğrenim gören öğretmen adayları için mezun olunan lise türü ve ekonomik düzeye göre incelenmesinin alana katkı sağlayacağı düşünülmektedir. Duygusal zekâ konusunda ulusal ve uluslararası literatürde farklı değişkenleri ele alarak yapılan çalışmalar mevcuttur (Austin, Evans, Goldwater ve Potter 2005; İkiz ve Totan 2012; Yılmaz ve Özkan, 2011). Göçet (2006) üniversite öğrencilerinin duygusal zekâ düzeyleriyle stresle başa çıkma tutumları arasındaki ilişkiyi araştırmıştır. Araştırma sonucunda duygusal zekâyla stresle başa çıkma tutumları arasında anlamlı düzeyde ilişki olduğu, duygusal zekâ düzeyi yüksek olan bireylerin stresle daha iyi başa çıkabildiklerini ve kız öğrencilerle erkek öğrencilerin duygusal zekâları arasında anlamlı fark olduğu ortaya konmuştur. İkiz ve Totan (2012) öz-duyarlığın duygusal zekâyı açıklayıcı etkisini üniversite öğrencilerinde incelemişlerdir. Çalışmada, öz-duyarlık alt alanlarının duygusal zekânın alt alanları üzerinde istatistiksel olarak anlamlı etkileri olduğu, öz sevecenlik ve bilinçlilik alanlarının duygusal zekâyı arttırdığı, öz yargılama ve aşırı özdeşleşme alanlarının duygusal zekânın stresle başa çıkma ve genel ruh sağlığı alanlarını olumsuz etkilediği tespit edilmiştir. Ayrıca duygusal zekâ alanlarında cinsiyete göre anlamlı farklılık olduğu ancak cinsiyetin öz-duyarlık alanlarında etkisinin olmadığı belirlenmiştir. Özdemir (2015) eğitim fakültesi öğrencilerinin duygusal zekâlarıyla yaşam doyumlarının ne düzeyde olduğunu, duygusal zekâlarıyla yaşam doyumları arasındaki ilişkiyi, duygusal zekânın yaşam doyumunu yordama durumu ve duygusal zekâyla yaşam doyumları arasındaki ilişkiyi çeşitli değişkenler (alan, bölüm/anabilim dalı, sınıf düzeyi) açısından incelemiştir. Araştırma sonucunda, eğitim fakültesi öğrencilerinin duygusal zekâ ve yaşam doyumları genel olarak ortalamanın üzerinde olduğu, duygusal zekâ toplam ve alt boyutlarıyla yaşam doyumları arasında pozitif yönde ve anlamlı ilişki olduğu belirlenmiştir. Duygusal zekâ alt boyutlarıyla yaşam doyumları arasında, yaşam doyumuyla en yüksek ilişkinin duygusal zekâ iyi oluş alt boyutuyla en düşük ilişkinin sosyallik alt boyutuyla olduğu tespit edilmiştir. Duygusal zekâ düzeyinin öğrenim görülen alana göre öz kontrol alt boyutu hariç anlamlı düzeyde farklılaşmadığı, öz kontrol alt boyutunda eşit ağırlık alanı lehine, yaşam doyumundaysa eşit ağırlık ve sözel alanları lehine anlamlı düzeyde farklılaştığı bulunmuştur. Duygusal zekâ düzeyinde öğrenim görülen bölümlere göre anlamlı bir farklılaşmanın olmadığı ve duygusallıkla sosyallik alt boyutları hariç diğer boyutlarda ve yaşam doyumunda dördüncü sınıfların lehine anlamlı bir farklılaşma olduğu ortaya konmuştur. Şirin (2007) özel dershanelerde çalışan öğretmenlerin duygusal zekâ düzeyleriyle stresle başa çıkma tarzları arasındaki ilişki incelemiştir. Araştırma sonucunda, öğretmenlerin duygusal zekâ düzeyleriyle stresle başa çıkma tarzları arasında anlamlı bir ilişki olduğu belirlenmiştir. Yılmaz ve Özkan (2011) hemşirelik öğrencilerinin duygusal zekâ düzeylerinin yaş, sınıf, yaşanan yer, mezun olunan okul, aile tipi, anne-baba eğitim düzeyi gibi bağımsız değişkenlerle ilişkisini inceledikleri çalışmanın sonucunda, hemşirelik öğrencilerinin orta düzeylerde duygusal zekâya sahip olduğunu ve öğrencilerin duygusal zekâlarının geliştirilmeye ihtiyacı olduğunu tespit etmişlerdir. Austin, Evans, Goldwater ve Potter (2005) tıp fakültesi öğrencileriyle yaptıkları çalışmanın sonucunda da duygusal zekâsı yüksek olan öğrencilerin iletişim becerileri ile ilgili daha olumlu duygular ifade ettikleri belirlenmiştir.

Yukarıda belirtilen literatür doğrultusunda konu alanında yeni/farklı bakış açılarıyla yürütülen çalışmalara ihtiyaç olduğu düşünülmektedir. Bu anlamda öğretmen adaylarının yetiştirilme süreçlerinde öğrenimlerinin duygusal zekâ gelişimlerini yordayabilmek için fakülteye nasıl bir yeterlilikte geldiklerinin tespit edilmesi gerektiğine inanılmaktadır. Böylelikle lisans öğrenimlerinde dikkat edilmesi gereken durumların tespiti ve gelişimlerinin yönü üzerinde görüş belirtmenin mümkün olacağı düşünülmektedir. Bu araştırmanın amacı, farklı programlarda öğrenim gören birinci sınıf öğretmen adaylarının duygusal zekâlarıyla mezun olunan lise türü ve ekonomik düzey arasındaki ilişkiyi ortaya koymaktır. Bu amaç doğrultusunda aşağıdaki sorulara cevap aranmıştır:

1. Araştırmaya katılan birinci sınıf öğretmen adaylarının öğrenim gördükleri program*mezun olunan lise türü etkileşiminin duygusal zekâ alt boyutları ve duygusal zekâ puanları arasında anlamlı bir ilişki var mıdır?
2. Araştırmaya katılan birinci sınıf öğretmen adaylarının öğrenim gördükleri program*ekonomik düzey etkileşiminin duygusal zekâ alt boyutları ve duygusal zekâ puanları arasında anlamlı bir ilişki var mıdır?

YÖNTEM

Bu bölümde çalışma yöntemi, çalışma grubu, veri toplama aracı ve verilerin analiziyle ilgili bilgiler sunulmuştur.

Araştırma nicel perspektifte yürütülmüştür. Araştırma yöntemi olarak tarama yönteminden yararlanılmıştır. Tarama yöntemi, seçilen bir örneklem üzerinde zaman içinde gerçekleşen değişiklikler ya da mevcut bir durumun/olayın iç yüzünün araştırıldığı sıklıkla kullanılan bir araştırma yöntemidir (Aypay, 2015).

Çalışma Grubu

Çalışma grubu, 2015-2016 öğretim yılı güz döneminde Batı Karadeniz bölgesindeki bir üniversitenin farklı bölümlerinin birinci sınıfında öğrenim görmekte olan fen bilgisi, matematik, sınıf, sosyal bilgiler, okul öncesi, bilgisayar ve öğretim teknolojileri öğretmen adayı olmak üzere toplam 484 öğretmen adayından oluşmaktadır. Çalışma grubunu oluşturan öğretmen adaylarına ilişkin bilgiler Tablo 1'de yer almaktadır.

Tablo 1. Çalışma Grubunu Oluşturan Öğretmen Adayları

	Öğrenim Görülen Program	N
Schutte Duygusal Zekâ Ölçeği	Fen Bilgisi Eğitimi	87
	Matematik Öğretmenliği	57
	Sınıf Öğretmenliği	105
	Sosyal Bilgiler Öğretmenliği	74
	Okul Öncesi Öğretmenliği	132
	Bilgisayar ve Öğretim Teknolojileri Öğretmenliği	29
	Toplam	**484**

Veri Toplama Aracı

Veri toplama aracı olarak Schutte, Malouff, Hall, Haggerty, Cooper, Golden ve Dornheim (1998) tarafından geliştirilen Schutte Duygusal Zekâ Ölçeği bilinen ölçekten yararlanılmıştır. Bu çalışmada kullanılan ölçek Austin, Saklofske, Huang ve McKenney (2004) tarafından güncellenerek 41 madde şeklinde düzenlenen ve Tatar, Tok ve Saltukoğlu (2011) tarafından Türkçe'ye uyarlanan ölçektir. 5'li likert tipindeki ölçeğin üç faktörlü (İyimserlik/Ruh Halini Düzenleme, Duyguların Değerlendirilmesi ve Duyguların Kullanımı) bir yapısı mevcuttur. Ölçekten en düşük 41 en fazla 205 puan almak mümkündür. Ölçeğin Türkçe'ye uyarlanmış halinin Cronbach-Alpha iç tutarlık katsayısı .82'dir. Alt boyutlarının Cronbach-Alpha iç tutarlık katsayıları sırasıyla .75, .39 ve .76 olarak tespit edilmiştir (Tatar, Tok ve Saltukoğlu, 2011).

Verilerin Analizi

Elde edilen verilerin analizinde SPSS 22 paket programı kullanılmıştır. Örneklemin genel özelliklerinin belirlenmesinde betimsel istatistikten değişkenlere ait çıkarımsal istatistiklerden yapılmıştır. Öğretmen adaylarının öğrenim görülen program*mezun olunan lise türü etkileşiminin duygusal zekâ alt boyutları ve duygusal zekâ puanlarına etkisi olup olmadığına yönelik ve öğrenim görülen program*ekonomik düzey etkileşiminin duygusal zekâ alt boyutları ve duygusal zekâ puanlarına etkisi olup olmadığına yönelik iki yönlü ANOVA analizi yapılmıştır. Gözlenen ilişkilerin istatistiksel olarak anlamlılığı 0,05 düzeyinde sınanmış ve elde edilen bulgular tablolar halinde gösterilerek yorumlanmıştır.

BULGULAR

Bu bölümde yapılan analizlere ilişkin bulgular yer almaktadır. Farklı programlarda öğrenim gören öğretmen adaylarının duygusal zekâ puanlarının öğrenim görülen programlardaki birinci sınıflarından oluşturulan betimsel istatistikleri Tablo 2'de yer almaktadır.

Tablo 2. Öğretmen Adaylarının Öğrenim Gördüğü Programlara Ait Betimsel İstatistikleri

	Öğrenim Görülen Program	N	Xort.	SS
Schutte Duygusal Zekâ Ölçeği	Fen Bilgisi Eğitimi	87	3,71	,428
	Matematik Öğretmenliği	57	3,70	,471
	Sınıf Öğretmenliği	105	3,73	,398
	Sosyal Bilgiler Öğretmenliği	74	3,63	,415
	Okul Öncesi Öğretmenliği	132	3,80	,448
	Bilgisayar ve Öğretim Teknolojileri Öğretmenliği	29	3,70	,477
	Toplam	484	3,73	,435

Tablo 2 incelendiğinde, öğretmen adaylarının öğrenim gördükleri programa göre elde edilen puanların ortalamaları 3,63 ile 3,80 arasında değiştiği görülmüştür. En yüksek ortalamanın Okul Öncesi Öğretmenliği programında öğrenim gören öğretmen adaylarının, en düşük ortalamanın Sosyal Bilgiler Öğretmenliği programında öğrenim gören öğretmen adaylarının olduğu görülmektedir. Öğretmen adaylarının öğrenim gördükleri program ve mezun olunan lise türünün duygusal zekâ ölçeğinden aldıkları puanların değişimlerini belirlemek için betimsel istatistikleri Tablo 3'te yer almaktadır.

Tablo 3. Mezun Olunan Lise Türüyle Öğrenim Görülen Programların Betimsel İstatistikleri

Öğrenim Görülen Program	Mezun Olunan Lise Türü	N	Xort.	SS
Fen Bilgisi Eğitimi	Genel Lise	34	3,62	,531
	Meslek Lisesi	12	3,91	,268
	Anadolu Lisesi	39	3,72	,341
	Anadolu Öğretmen Lisesi	1	4,35	.
	Fen Lisesi	1	3,51	.
	Toplam	**87**	**3,71**	**,428**
Matematik Öğretmenliği	Genel Lise	2	3,49	,589
	Meslek Lisesi	2	3,73	,068
	Anadolu Lisesi	26	3,75	,445
	Anadolu Öğretmen Lisesi	25	3,65	,523
	Fen Lisesi	2	3,74	,566
	Toplam	**57**	**3,70**	**,471**
Sınıf Öğretmenliği	Genel Lise	23	3,70	,377
	Meslek Lisesi	7	3,69	,542
	Anadolu Lisesi	61	3,78	,377
	Anadolu Öğretmen Lisesi	12	3,54	,435
	Toplam	**103**	**3,73**	**,398**
Sosyal Bilgiler Öğretmenliği	Genel Lise	28	3,63	,347
	Meslek Lisesi	16	3,68	,358
	Anadolu Lisesi	27	3,64	,525
	Anadolu Öğretmen Lisesi	3	3,42	,197
	Toplam	**74**	**3,63**	**,415**
Okul Öncesi Öğretmenliği	Genel Lise	14	3,74	,406
	Meslek Lisesi	64	3,85	,414
	Anadolu Lisesi	25	3,70	,550
	Anadolu Öğretmen Lisesi	27	3,82	,447
	Toplam	**130**	**3,80**	**,448**
Bilgisayar ve Öğretim Teknolojileri Öğretmenliği	Genel Lise	3	3,81	,494
	Meslek Lisesi	24	3,69	,494
	Anadolu Lisesi	1	3,76	.
	Toplam	**28**	**3,70**	**,477**
Toplam	Genel Lise	104	3,66	,429
	Meslek Lisesi	124	3,79	,420
	Anadolu Lisesi	179	3,73	,429
	Anadolu Öğretmen Lisesi	68	3,70	,479
	Fen Lisesi	3	3,66	,421
	Toplam	**479**	**3,73**	**,435**

Tablo 3'te, öğretmen adaylarının öğrenim gördükleri programla mezun olunan lise türüne göre aldıkları duygusal zekâ toplam puan ortalamalarının 3,42 ile 4,35 arasında değiştiği görülmektedir. En yüksek ortalama Fen Bilgisi Öğretmenliği programında öğrenim gören öğretmen adaylarının Anadolu Öğretmen Lisesi mezunu olanları, en düşük ortalamaysa Sosyal Bilgiler Öğretmenliği programında öğrenim gören öğretmen adaylarının Anadolu Öğretmen Lisesi mezunu olduğu belirlenmiştir. Öğretmen adaylarının öğrenim gördükleri program*mezun olunan lise türü etkileşiminin duygusal zekâ toplam puan ortalamaları üzerinde anlamlı farklılık olup olmadığına yönelik yapılan iki yönlü ANOVA sonuçları Tablo 4'te yer almaktadır.

Tablo 4. Öğrenim Görülen Program*Mezun Olunan Lise Türü Etkileşimine Göre Ölçekten Alınan Puan Ortalamalarına İlişkin İki Yönlü ANOVA Sonuçları

Varyansın Kaynağı	Kareler toplamı (KT)	Sd	Kareler Ortalaması (KO)	F	p
Öğrenim Görülen Program	1,226	5	,245	1,290	,267
Mezun Olunan Lise Türü	,249	4	,062	,327	,860
Öğrenim Görülen Program* Mezun Olunan Lise Türü	**2,026**	**15**	**,135**	**,711**	**,775**

Tablo 4'te yapılan iki yönlü ANOVA analizi sonucunda, öğretmen adaylarının duygusal zekâ puanlarının öğrenim gördükleri program*mezun olunan lise türü etkileşiminin duygusal zekâ puan ortalamaları üzerinde anlamlı bir farklılık olmadığı tespit edilmiştir (p>0.05). Öğretmen adaylarının duygusal zekâ alt boyutlarından iyimserlik faktörüne göre puanların öğrenim gördükleri program ve mezun olunan lise türüne ilişkin betimsel istatistikleri Tablo 5'te yer almaktadır.

Tablo 5. Ölçeğin İyimserlik Faktörü Puanlarının Mezun Olunan Lise Türü ve Öğrenim Görülen Programa Göre Betimsel İstatistikleri

Öğrenim Görülen Program	Mezun Olunan Lise Türü	N	Xort.	SS
Fen Bilgisi Eğitimi	Genel Lise	34	3,79	,646
	Meslek Lisesi	12	4,15	,373
	Anadolu Lisesi	39	3,91	,372
	Anadolu Öğretmen Lisesi	1	4,48	.
	Fen Lisesi	1	3,64	.
	Toplam	87	3,90	,508
Matematik Öğretmenliği	Genel Lise	2	3,46	,938
	Meslek Lisesi	2	3,72	,056
	Anadolu Lisesi	26	3,92	,551
	Anadolu Öğretmen Lisesi	25	3,80	,631
	Fen Lisesi	2	3,88	,505
	Toplam	57	3,84	,580
Sınıf Öğretmenliği	Genel Lise	23	3,90	,430
	Meslek Lisesi	7	3,99	,718
	Anadolu Lisesi	61	3,97	,419
	Anadolu Öğretmen Lisesi	12	3,70	,498
	Toplam	103	3,93	,456
Sosyal Bilgiler Öğretmenliği	Genel Lise	28	3,83	,355
	Meslek Lisesi	16	3,80	,384
	Anadolu Lisesi	27	3,71	,619
	Anadolu Öğretmen Lisesi	3	3,52	,520
	Toplam	74	3,77	476
Okul Öncesi Öğretmenliği	Genel Lise	14	3,85	,342
	Meslek Lisesi	64	4,03	,465
	Anadolu Lisesi	25	3,81	,698
	Anadolu Öğretmen Lisesi	27	3,98	,625
	Toplam	130	3,96	,543
Bilgisayar ve Öğretim Teknolojileri Öğretmenliği	Genel Lise	3	3,86	,532
	Meslek Lisesi	24	3,92	,584
	Anadolu Lisesi	1	4,12	.
	Toplam	28	3,92	,560
Toplam	Genel Lise	104	3,83	,489
	Meslek Lisesi	124	3,98	,488
	Anadolu Lisesi	179	3,89	,512
	Anadolu Öğretmen Lisesi	68	3,85	,605
	Fen Lisesi	3	3,80	,381
	Toplam	479	3,90	,516

Tablo 5'te, öğretmen adaylarının öğrenim gördükleri program ve mezun olunan lise türünden duygusal zekâ ölçeği alt boyutlarından iyimserlik faktörüne göre elde edilen puanların ortalamaları 3,46 ile 4,48 arasında değiştiği görülmüştür. En yüksek ortalamanın Fen Bilgisi Eğitimi programında öğrenim gören Anadolu Öğretmen Lisesi mezunu öğretmen adaylarının, en düşük ortalamaysa Matematik Öğretmenliği programında öğrenim gören Genel Lise mezunu öğretmen adaylarının olduğu belirlenmiştir. Öğretmen adaylarının öğrenim gördükleri program*mezun olunan lise türü etkileşiminin iyimserlik faktörü toplam puan ortalamaları üzerinde anlamlı farklılık olup olmadığına yönelik yapılan iki yönlü ANOVA sonuçları Tablo 6'da yer almaktadır.

Tablo 6. Ölçeğin İyimserlik Faktörü Puanlarının Öğrenim Görülen*Mezun Olunan Lise Türü Etkileşimine İlişkin İki Yönlü ANOVA Sonuçları

Varyansın Kaynağı	Kareler toplamı (KT)	Sd	Kareler Ortalaması (KO)	F	p
Öğrenim Görülen Program	1,529	5	,306	1,147	,335
Mezun Olunan Lise Türü	,568	4	,146	,532	,712
Öğrenim Görülen Program* Mezun Olunan Lise Türü	**3,256**	**15**	**,217**	**,814**	**,662**

Tablo 6'da, yapılan iki yönlü ANOVA analizi sonucunda, öğretmen adaylarının öğrenim gördükleri program*mezun olunan lise etkileşiminin iyimserlik faktöründen alınan puan ortalamaları üzerinde anlamlı bir farklılığın olmadığı anlaşılmaktadır (p>0.05). Öğretmen adaylarının duygusal zekâ alt boyutlarından duyguların değerlendirilmesi faktörü puanlarının öğrenim gördükleri program ve mezun olunan lise türüne ait betimsel istatistikleri Tablo 7'de yer almaktadır.

Tablo 7. Ölçeğin Duyguların Değerlendirilmesi Faktörü Puanlarının Mezun Olunan Lise Türü ve Öğrenim Görülen Programa Göre Betimsel İstatistikleri

Öğrenim Görülen Program	Mezun Olunan Lise Türü	N	Xort.	SS
Fen Bilgisi Eğitimi	Genel Lise	34	3,63	,636
	Meslek Lisesi	12	3,94	,498
	Anadolu Lisesi	39	3,68	,453
	Anadolu Öğretmen Lisesi	1	4,02	.
	Fen Lisesi	1	3,36	.
	Toplam	87	3,70	,539
Matematik Öğretmenliği	Genel Lise	2	3,40	,339
	Meslek Lisesi	2	3,74	,028
	Anadolu Lisesi	26	3,70	,530
	Anadolu Öğretmen Lisesi	25	3,59	649
	Fen Lisesi	2	3,63	,618
	Toplam	57	3,64	,566
Sınıf Öğretmenliği	Genel Lise	23	3,59	,492
	Meslek Lisesi	7	3,62	,429
	Anadolu Lisesi	61	3,74	,401
	Anadolu Öğretmen Lisesi	12	3,49	,715
	Toplam	103	3,67	,470
Sosyal Bilgiler Öğretmenliği	Genel Lise	28	3,60	,463
	Meslek Lisesi	16	3,64	,416
	Anadolu Lisesi	27	3,70	,564
	Anadolu Öğretmen Lisesi	3	3,39	,220
	Toplam	74	3,69	,483
Okul Öncesi Öğretmenliği	Genel Lise	14	3,72	,494
	Meslek Lisesi	64	3,85	,515
	Anadolu Lisesi	25	3,68	,593
	Anadolu Öğretmen Lisesi	27	3,76	,552
	Toplam	130	3,78	,535
Bilgisayar ve Öğretim Teknolojileri Öğretmenliği	Genel Lise	3	3,78	,554
	Meslek Lisesi	24	3,74	,536
	Anadolu Lisesi	1	3,76	.
	Toplam	28	3,75	,517
Toplam	Genel Lise	104	3,63	,528
	Meslek Lisesi	124	3,80	,499
	Anadolu Lisesi	179	3,71	,482
	Anadolu Öğretmen Lisesi	68	3,64	,608
	Fen Lisesi	3	3,54	,464
	Toplam	479	3,70	,518

Öğretmen adaylarının öğrenim gördükleri program ve mezun olunan lise türünden duygusal zekâ ölçeği alt boyutlarından duyguların değerlendirilmesi faktörüne göre aldıkları puanların ortalamalarının 3,36 ile 4,02 arasında değiştiği belirlenmiştir. En yüksek ve en düşük ortalama Fen Bilgisi Eğitimi programında öğrenim gören öğretmen adaylarında olup, en yüksek ortalama Anadolu Öğretmen Lisesi mezun olmaları, en düşük ortalamaysa Fen Lisesi mezun olmaları olarak belirlenmiştir. Öğretmen adaylarının öğrenim gördükleri program*mezun olunan lise türü etkileşiminin duyguların değerlendirilmesi faktörü toplam puan ortalamaları üzerinde anlamlı farklılık olup olmadığına yönelik yapılan iki yönlü ANOVA sonuçları Tablo 8'de yer almaktadır.

Tablo 8. Ölçeğin Duyguların Değerlendirilmesi Faktörü Puanlarının Öğrenim Görülen Program*Mezun Olunan Lise Türü Etkileşimine İlişkin İki Yönlü ANOVA Sonuçları

Varyansın Kaynağı	Kareler toplamı (KT)	Sd	Kareler Ortalaması (KO)	F	P
Öğrenim Görülen Program	1,240	5	,248	,912	,473
Mezun Olunan Lise Türü	,513	4	,128	,471	,757
Öğrenim Görülen Program* Mezun Olunan Lise Türü	**1,862**	**15**	**,124**	**,456**	**,961**

Tablo 8'de yapılan iki yönlü ANOVA analizi sonucunda, öğretmen adaylarının duygusal zekâ alt boyutlarından duyguların değerlendirilmesi faktörüne göre öğrenim gördükleri program*mezun olunan lise türü etkileşiminin duygusal zekâ alt boyutlarından duyguların değerlendirilmesi faktöründen alınan puan ortalamaları üzerinde anlamlı bir farklılık olmadığı anlaşılmaktadır ($p>0.05$). Öğretmen adaylarının duygusal zekâ alt boyutlarından duyguların kullanılması faktörü puanların öğrenim gördükleri program ve mezun olunan lise türüne ilişkin betimsel istatistikleri Tablo 9'da yer almaktadır.

Tablo 9. Ölçeğin Duyguların Kullanılması Faktörü Puanlarının Mezun Olunan Lise Türü ve Öğrenim Görülen Programa Göre Betimsel İstatistikleri

Öğrenim Görülen Program	Mezun Olunan Lise Türü	N	Xort.	SS
Fen Bilgisi Eğitimi	Genel Lise	34	3,48	,553
	Meslek Lisesi	12	3,61	,354
	Anadolu Lisesi	39	3,58	,401
	Anadolu Öğretmen Lisesi	1	4,03	.
	Fen Lisesi	1	3,50	.
	Toplam	87	3,55	,458
Matematik Öğretmenliği	Genel Lise	2	3,58	,824
	Meslek Lisesi	2	3,58	,235
	Anadolu Lisesi	26	3,45	,537
	Anadolu Öğretmen Lisesi	25	3,57	,416
	Fen Lisesi	2	3,75	,824
	Toplam	57	3,52	,483
Sınıf Öğretmenliği	Genel Lise	23	3,64	,372
	Meslek Lisesi	7	3,51	,546
	Anadolu Lisesi	61	3,58	,526
	Anadolu Öğretmen Lisesi	12	3,50	,390
	Toplam	103	3,58	,479
Sosyal Bilgiler Öğretmenliği	Genel Lise	28	3,42	,393
	Meslek Lisesi	16	3,57	,320
	Anadolu Lisesi	27	3,52	,490
	Anadolu Öğretmen Lisesi	3	3,61	,292
	Toplam	74	3,50	,413
Okul Öncesi Öğretmenliği	Genel Lise	14	3,60	,432
	Meslek Lisesi	64	3,61	,432
	Anadolu Lisesi	25	3,59	,512
	Anadolu Öğretmen Lisesi	27	3,62	,484
	Toplam	130	3,61	,454
Bilgisayar ve Öğretim Teknolojileri Öğretmenliği	Genel Lise	3	3,58	,545
	Meslek Lisesi	24	3,46	,436
	Anadolu Lisesi	1	3,08	.
	Toplam	28	3,46	,437
Toplam	Genel Lise	104	3,52	,460
	Meslek Lisesi	124	3,57	,415
	Anadolu Lisesi	179	3,55	,492

	Anadolu Öğretmen Lisesi	68	3,59	,431
	Fen Lisesi	3	3,67	,600
	Toplam	479	3,55	,457

Tablo 9'da, öğretmen adaylarının öğrenim gördükleri ve mezun olunan lise türünden duygusal zekâ ölçeği alt boyutlarından duyguların kullanılması faktörüne göre elde edilen puanların ortalamaları 3,08 ile 4,03 arasında değiştiği görülmektedir. En yüksek ortalama Fen Bilgisi Eğitimi programında öğrenim gören öğretmen adaylarının Anadolu Öğretmen Lisesi mezunu olanlarda, en düşük ortalamaysa Bilgisayar ve Öğretim Teknolojileri Öğretmenliği programında öğrenim gören öğretmen adaylarının Anadolu Lisesi mezunu olanlarda olduğu belirlenmiştir. Öğretmen adaylarının öğrenim gördükleri program*mezun olunan lise türü etkileşiminin duygusal zekâ alt boyutlarından duyguların kullanılması faktörü toplam puan ortalamaları üzerinde anlamlı farklılık olup olmadığına yönelik yapılan iki yönlü ANOVA sonuçları Tablo 10'da yer almaktadır.

Tablo 10. Ölçeğin Duyguların Kullanılması Faktörü Puanlarının Öğrenim Görülen Program*Mezun Olunan Lise Türü Etkileşimine İlişkin İki Yönlü ANOVA Sonuçları

Varyansın Kaynağı	Kareler toplamı (KT)	Sd	Kareler Ortalaması (KO)	F	P
Öğrenim Görülen Program	,420	5	,084	,392	,855
Mezun Olunan Lise Türü	,404	4	,101	,471	,757
Öğrenim Görülen Program* Mezun Olunan Lise Türü	**1,295**	**15**	**,086**	**,403**	**,978**

Tablo 10'da yapılan iki yönlü ANOVA analizi sonucunda, öğretmen adaylarının duygusal zekâ alt boyutlarından duyguların kullanılması faktörüne göre öğrenim gördükleri program*mezun olunan lise türü etkileşiminin duygusal zekâ alt boyutlarından duyguların kullanılması faktöründen alınan puan ortalamaları üzerinde anlamlı bir farklılık olmadığı anlaşılmaktadır (p>0.05). Öğretmen adaylarının öğrenim gördükleri program ve ekonomik düzeyin duygusal zekâ ölçeğinden aldıkları puanların değişimlerini belirlemek için betimsel istatistikleri Tablo 11'de yer almaktadır.

Tablo 11. Ekonomik Düzeylerle Öğrenim Görülen Programlardan Oluşan Betimsel İstatistikler

Öğrenim Görülen Program	Ekonomik düzey	N	Xort.	SS
Fen Bilgisi Eğitimi	Düşük	19	3,74	,312
	Orta	66	3,71	,460
	Toplam	85	3,72	,429
Matematik Öğretmenliği	Düşük	6	3,58	,317
	Orta	51	3,71	,487
	Toplam	57	3,70	,471
Sınıf Öğretmenliği	Düşük	11	3,75	,496
	Orta	91	3,71	,388
	Yüksek	2	4,12	,103
	Toplam	104	3,72	,398
Sosyal Bilgiler Öğretmenliği	Düşük	16	3,64	,365
	Orta	57	3,64	,431
	Yüksek	1	3,25	.
	Toplam	74	3,63	,415
Okul Öncesi Öğretmenliği	Düşük	19	3,78	,450
	Orta	111	3,80	,452
	Toplam	130	3,79	,450
Bilgisayar ve Öğretim Teknolojileri Öğretmenliği	Düşük	4	3,38	,584
	Orta	25	3,78	,457
	Toplam	29	3,73	,486
Toplam	Düşük	75	3,70	,405
	Orta	401	3,73	,442
	Yüksek	3	3,83	,504
	Toplam	479	3,72	,436

Tablo 11'de, öğretmen adaylarının öğrenim gördükleri program ve ekonomik düzeyden alınan duygusal zekâ puanlarından elde edilen ortalamalarının 3,25 ile 3,80 arasında değiştiği belirlenmiştir. En yüksek ortalama Okul

Öncesi Öğretmenliği programında öğrenim gören öğretmen adaylarının orta ekonomik düzey, en düşük ortalamaysa Sosyal Bilgiler Öğretmenliği programında öğrenim gören öğretmen adaylarının yüksek ekonomik düzeyde olduğu belirlenmiştir. Öğretmen adaylarının öğrenim gördükleri program*ekonomik düzey etkileşiminin duygusal zekâ toplam puan ortalamaları üzerinde anlamlı farklılık olup olmadığına yönelik yapılan iki yönlü ANOVA sonuçları Tablo 12'de yer almaktadır.

Tablo 12. Öğretmen Adaylarının Öğrenim Gördükleri Program*Ekonomik Düzey Etkileşimine Göre Duygusal Zekâ Ölçeği'nden Alınan Puan Ortalamalarına İlişkin İki Yönlü ANOVA Sonuçları

Varyansın Kaynağı	Kareler toplamı (KT)	Sd	Kareler Ortalaması (KO)	F	P
Öğrenim Görülen Program	1,750	5	,350	1,835	,105
Ekonomik Düzey	,321	3	,107	,561	,641
Öğrenim Görülen Program* Ekonomik Düzey	**1,363**	**7**	**,195**	**1,021**	**,415**

Tablo 12'de yapılan iki yönlü ANOVA analizi sonucunda, öğretmen adaylarının duygusal zekâ puanlarının öğrenim gördükleri program*ekonomik düzey etkileşiminin duygusal zekâ puan ortalamaları üzerinde anlamlı bir farklılık olmadığı anlaşılmaktadır (p>0.05). Öğretmen adaylarının öğrenim gördükleri program ve ekonomik düzeyin duygusal zekâ ölçeğinden aldıkları duygusal zekâ alt boyutlarından iyimserlik faktörüne göre puanların değişimlerini belirlemek için betimsel istatistikleri Tablo 13'te yer almaktadır.

Tablo 13. Ölçeğin İyimserlik Faktörü Puanlarının Ekonomik Düzey ve Öğrenim Görülen Programa Göre Betimsel İstatistikleri

Öğrenim Görülen Program	Ekonomik düzey	N	Xort.	SS
Fen Bilgisi Eğitimi	Düşük	19	4,03	,464
	Orta	66	3,85	,519
	Toplam	85	3,90	,511
Matematik Öğretmenliği	Düşük	6	3,78	,545
	Orta	51	3,85	,588
	Toplam	57	3,84	,580
Sınıf Öğretmenliği	Düşük	11	3,94	,548
	Orta	91	3,92	,447
	Yüksek	2	4,20	,339
	Toplam	104	3,92	,454
Sosyal Bilgiler Öğretmenliği	Düşük	16	3,70	,495
	Orta	57	3,79	,477
	Yüksek	1	3,93	.
	Toplam	74	3,77	476
Okul Öncesi Öğretmenliği	Düşük	19	3,92	,675
	Orta	111	3,95	,526
	Toplam	130	3,95	,548
Bilgisayar ve Öğretim Teknolojileri Öğretmenliği	Düşük	4	3,43	,774
	Orta	25	4,02	,494
	Toplam	29	3,94	,593
Toplam	Düşük	75	3,87	,569
	Orta	401	3,90	,509
	Yüksek	3	4,12	,287
	Toplam	479	3,89	,517

Tablo 13'ten de anlaşılacağı gibi, öğretmen adaylarının öğrenim gördükleri program ve ekonomik düzeyden öğretmen adayların duygusal zekâ ölçeği alt boyutlarından iyimserlik faktörüne göre elde edilen puanların ortalamaları 3,70 ile 4,20 arasında değiştiği görülmüştür. En yüksek ortalama, Sınıf Öğretmenliği programında öğrenim gören öğretmen adaylarının yüksek ekonomik düzey, en düşük ortalamaysa Sosyal Bilgiler Öğretmenliği programında öğrenim gören öğretmen adaylarının düşük ekonomik düzeyde olduğu belirlenmiştir. Öğretmen adaylarının öğrenim gördükleri program*ekonomik düzey etkileşiminin duygusal zekâ alt boyutlarından iyimserlik faktörü toplam puan ortalamaları üzerinde anlamlı farklılık olup olmadığına yönelik yapılan iki yönlü ANOVA sonuçları Tablo 14'te yer almaktadır.

Tablo 14. Ölçeğin İyimserlik Faktörünü Puanlarının Öğrenim Gördükleri Program*Ekonomik Düzey Etkileşimine İlişkin İki Yönlü ANOVA Sonuçları

Varyansın Kaynağı	Kareler toplamı (KT)	Sd	Kareler Ortalaması (KO)	F	P
Öğrenim Görülen Program	1,666	5	,333	1,248	,286
Ekonomik Düzey	,633	3	,211	,790	,500
Öğrenim Görülen Program* Ekonomik Düzey	**2,312**	**7**	**,330**	**1,236**	**,281**

Tablo 14'te yapılan iki yönlü ANOVA analizi sonucunda, öğretmen adaylarının duygusal zekâ alt boyutlarından iyimserlik faktörüne göre öğrenim gördükleri program*ekonomik düzey etkileşiminin duygusal zekâ alt boyutlarından iyimserlik faktöründen alınan puan ortalamaları üzerinde anlamlı bir farklılık olmadığı anlaşılmaktadır ($p>0.05$). Öğretmen adaylarının öğrenim gördükleri program ve ekonomik düzeyin duygusal zekâ ölçeğinden aldıkları duygusal zekâ alt boyutlarından duyguların değerlendirilmesi faktörüne göre puanların değişimlerini belirlemek için betimsel istatistikleri Tablo 15'te yer almaktadır.

Tablo 15. Ölçeğin Duyguların Değerlendirilmesi Faktörü Puanlarının Ekonomik Düzey ve Öğrenim Görülen Programa Göre Betimsel İstatistikleri

Öğrenim Görülen Program	Ekonomik düzey	N	Xort.	SS
Fen Bilgisi Eğitimi	Düşük	19	3,69	,466
	Orta	66	3,70	,562
	Toplam	85	3,70	,538
Matematik Öğretmenliği	Düşük	6	3,61	,416
	Orta	51	3,64	,584
	Toplam	57	3,64	,566
Sınıf Öğretmenliği	Düşük	11	3,75	,763
	Orta	91	3,64	,423
	Yüksek	2	4,28	,169
	Toplam	104	3,66	,470
Sosyal Bilgiler Öğretmenliği	Düşük	16	3,66	,493
	Orta	57	3,64	485
	Yüksek	1	3,13	.
	Toplam	74	3,64	,483
Okul Öncesi Öğretmenliği	Düşük	19	3,77	,488
	Orta	111	3,77	,542
	Toplam	130	3,77	,533
Bilgisayar ve Öğretim Teknolojileri Öğretmenliği	Düşük	4	3,44	,523
	Orta	25	3,83	,518
	Toplam	29	3,77	,527
Toplam	Düşük	75	3,70	,518
	Orta	401	3,70	,518
	Yüksek	3	3,90	,673
	Toplam	479	3,70	,517

Tablo 15'den de anlaşılacağı gibi, öğretmen adaylarının öğrenim gördükleri program ve ekonomik düzeyinden duygusal zekâ ölçeği alt boyutlarından duyguların değerlendirilmesi faktörüne göre elde edilen puanların ortalamaları 3,13 ile 4,28 arasında değişmektedir. En yüksek ortalama Sınıf Öğretmenliği programında öğrenim gören öğretmen adaylarının yüksek ekonomik düzey, en düşük ortalamaysa Sosyal Bilgiler Öğretmenliği programında öğrenim gören adaylarının yüksek ekonomik düzeye sahip olanlarda olduğu belirlenmiştir. Öğretmen adaylarının öğrenim gördükleri program*ekonomik düzey etkileşiminin duygusal zekâ alt boyutlarından duyguların değerlendirilmesi faktörü toplam puan ortalamaları üzerinde anlamlı farklılık olup olmadığına yönelik yapılan iki yönlü ANOVA sonuçları Tablo 16'da yer almaktadır.

Tablo 16. Ölçeğin Duyguların Değerlendirilmesi Faktörü Puanlarının Öğrenim Gördükleri Program*Ekonomik Düzey Etkileşimine İlişkin İki Yönlü ANOVA Sonuçları

Varyansın Kaynağı	Kareler toplamı (KT)	Sd	Kareler Ortalaması (KO)	F	P
Öğrenim Görülen Program	1,743	5	,349	1,294	,265
Ekonomik Düzey	,136	3	,045	,168	,918
Öğrenim Görülen Program* Ekonomik Düzey	**1,761**	**7**	**,252**	**,934**	**,480**

Tablo 16’da yapılan iki yönlü ANOVA analizi sonucunda, öğretmen adaylarının duygusal zekâ alt boyutlarından duyguların değerlendirilmesi faktörüne göre öğrenim gördükleri program*ekonomik düzey etkileşiminin duygusal zekâ alt boyutlarından duyguların değerlendirilmesi faktöründen alınan puan ortalamaları üzerinde anlamlı bir farklılık olmadığı anlaşılmaktadır (p>0.05). Öğretmen adaylarının öğrenim gördükleri program ve ekonomik düzeyin duygusal zekâ ölçeğinden aldıkları duygusal zekâ alt boyutlarından duyguların kullanılması faktörüne göre puanların değişimlerini belirlemek için betimsel istatistikleri Tablo 17’de yer almaktadır.

Tablo 17. Ölçeğin Duyguların Kullanılması Faktörü Puanlarının Ekonomik Düzey ve Öğrenim Görülen Programa Göre Betimsel İstatistikleri

Öğrenim Görülen Program	Ekonomik düzey	N	Xort.	SS
Fen Bilgisi Eğitimi	Düşük	19	3,47	,416
	Orta	66	3,57	,476
	Toplam	85	3,55	,460
Matematik Öğretmenliği	Düşük	6	3,13	,256
	Orta	51	3,57	,483
	Toplam	57	3,52	,483
Sınıf Öğretmenliği	Düşük	11	3,52	,448
	Orta	91	3,57	,490
	Yüksek	2	3,83	,000
	Toplam	104	3,57	,481
Sosyal Bilgiler Öğretmenliği	Düşük	16	3,57	,251
	Orta	57	3,50	,425
	Yüksek	1	2,36	.
	Toplam	74	3,50	,413
Okul Öncesi Öğretmenliği	Düşük	19	3,55	,422
	Orta	111	3,61	,469
	Toplam	130	3,60	,462
Bilgisayar ve Öğretim Teknolojileri Öğretmenliği	Düşük	4	3,29	,308
	Orta	25	3,50	,450
	Toplam	29	3,47	,435
Toplam	Düşük	75	3,48	,386
	Orta	401	3,57	,469
	Yüksek	3	3,35	,845
	Toplam	479	3,55	,459

Tablo 17’de, öğretmen adaylarının öğrenim gördükleri program ve ekonomik düzeyinden duygusal zekâ ölçeği alt boyutlarından duyguların kullanılması faktörüne göre elde edilen puanların ortalamaları 2,36 ile 3,83 arasında değiştiği görülmektedir. En yüksek ortalama Sınıf Öğretmenliği programında öğrenim gören öğretmen adaylarının yüksek ekonomik düzey, en düşük ortalamaysa Sosyal Bilgiler Öğretmenliği programında öğrenim gören öğretmen adaylarının yüksek ekonomik düzeyinde olduğu belirlenmiştir. Öğretmen adaylarının öğrenim gördükleri program*ekonomik düzey etkileşiminin duygusal zekâ alt boyutlarından duyguların kullanılması faktörü toplam puan ortalamaları üzerinde anlamlı farklılık olup olmadığına yönelik yapılan iki yönlü ANOVA sonuçları Tablo 18’de yer almaktadır.

Tablo 18. Ölçeğin Duyguların Kullanılması Faktörü Puanlarının Öğrenim Gördükleri Program*Ekonomik Düzey Etkileşimine İlişkin İki Yönlü ANOVA Sonuçları

Varyansın Kaynağı	Kareler toplamı (KT)	Sd	Kareler Ortalaması (KO)	F	P
Öğrenim Görülen Program	2,434	5	,487	2,325	,042
Ekonomik Düzey	1,446	3	,482	2,301	,076
Öğrenim Görülen Program* Ekonomik Düzey	**2,537**	**7**	**,362**	**1,731**	**,100**

Tablo 18’de yapılan iki yönlü ANOVA analizi sonucunda, öğretmen adaylarının duygusal zekâ alt boyutlarından duyguların kullanılması faktörüne göre öğrenim gördükleri program*ekonomik düzey etkileşiminin duygusal zekâ alt boyutlarından duyguların kullanılması faktöründen alınan puan ortalamaları üzerinde anlamlı bir farklılık olmadığı anlaşılmaktadır (p>0.05).

TARTIŞMA, SONUÇ VE ÖNERİLER

Farklı programlarda öğrenim gören birinci sınıf öğretmen adaylarının duygusal zekâlarıyla mezun olunan lise türü ve ekonomik düzey arasındaki ilişkiyi ortaya koymak amacıyla yürütülen çalışmanın birinci alt probleminde katılımcıların öğrenim gördüğü programlar*mezun olunan lise türüne göre duygusal zekâ alt boyutları ve duygusal zekâ puanları üzerinde anlamlı farklılığın olup olmadığı incelenmiştir. Elde edilen sonuçlarda, öğretmen adaylarının duygusal zekâ puanlarının öğrenim gördükleri program*mezun olunan lise türü etkileşiminin duygusal zekâ puan ortalamaları üzerinde anlamlı bir farklılık olmadığı belirlenirken, puan ortalamalarına bakıldığında en yüksek ortalamanın Fen Bilgisi Eğitimi programında öğrenim gören öğretmen adaylarının Anadolu Öğretmen Lisesi mezunu olanları, en düşük ortalamanınsa Sosyal Bilgiler Öğretmenliği programında öğrenim gören öğretmen adaylarının Anadolu Öğretmen Lisesi mezunu olanları olarak belirlenmiştir. Bu durumun sebebi aynı lise türünden mezun olan öğretmen adaylarından lisans öğreniminde sayısal bölümde öğrenim görenlerin sözel bölümde öğrenim görenlere göre bilişsel zekâlarıyla birlikte duygusal zekâlarını da geliştirdikleri olmuş olabilir. Benzer şekilde, öğretmen adaylarının öğrenim gördükleri program*mezun olunan lise türü etkileşiminin ayrı ayrı duygusal zekâ alt faktörlerinden alınan puan ortalamaları üzerinde anlamlı bir farklılık olmadığı sonucuna ulaşılmıştır. Öğretmen adaylarının öğrenim gördükleri program ve mezun olunan lise türünden duygusal zekâ ölçeği alt boyutlarından iyimserlik faktörüne göre elde edilen puanların ortalamaları arasında en yüksek ortalama Fen Bilgisi Eğitimi programında öğrenim gören öğretmen adaylarının Anadolu Öğretmen Lisesi mezunu olanları, en düşük ortalamaysa Matematik Öğretmenliği programında öğrenim gören öğretmen adaylarının Genel Lise mezun olanları olarak belirlenmiştir. Tarhan (2011) duygusal zekânın bir basamağını ümit besleyebilmek olarak belirtmektedir. Yani, hayata pozitif/iyimser/olumlu bakan kişilerin duygusal zekâlarını geliştirip, huzurlu bir hayat sürebilecekleri söylenmektedir. Anadolu Lisesinden mezun öğretmen adaylarının Genel Liseye göre geleceğe pozitif baktıkları, daha gayretli oldukları düşünüldüğünde, çalışmanın sonucunun Tarhan'la örtüştüğü söylenebilir. Duyguların değerlendirilmesi faktörüne göre elde edilen puanların ortalamalarındaysa en yüksek ve en düşük ortalama Fen Bilgisi Eğitimi programında öğrenim gören öğretmen adaylarında olup, en yüksek ortalama Anadolu Öğretmen Lisesi mezunu olanları en düşük ortalamaysa Fen Lisesi mezunu olanları olarak belirlenmiştir. Bu durumun sebebiyse öğretmen adaylarının seçtikleri program aynı olsa da mezun oldukları okullar duygusal zekâlarını etkilemiş olabilir. Anadolu Öğretmen Lisesinden mezun olan öğretmen adaylarında öğretmenlik mesleğine yönelik mesleki derslerin de bulunması duygusal zekâlarını geliştirmiş, eğitim seviyesinin çok başarılı olduğunu düşündüğümüz Fen Liselerindeyse yoğun olarak akademik derslere maruz kalmaları bilişsel zekâlarının baskın olmasına sebep olmuş olabilir. Son faktör olan duyguların kullanılması faktörüne göre elde edilen puanların ortalamalarından da en yüksek ortalama Fen Bilgisi Eğitimi programında öğrenim gören öğretmen adaylarının Anadolu Öğretmen Lisesi mezunu olanları, en düşük ortalamaysa Bilgisayar ve Öğretim Teknolojileri Öğretmenliği programında öğrenim gören öğretmen adaylarının Anadolu Lisesi mezunu olanları olarak belirlenmiştir. Aynı okullardan mezun olan öğretmen adaylarının tercih ettikleri programların farklı olmasında duygusal zekâlarının farklılığı söz konusu olabilir.

Araştırmaya katılan öğretmen adaylarının öğrenim görülen program*ekonomik düzeylerine göre duygusal zekâ alt boyutları ve duygusal zekâ puanları üzerindeki anlamlı farklılığın incelendiği araştırmanın ikinci problemine ilişkin olarak ulaşılan sonuçlar ayrı ayrı incelenecek olursa, öğretmen adaylarının öğrenim gördükleri program*ekonomik düzey etkileşiminin duygusal zekâ puan ortalamaları üzerinde anlamlı bir farklılık ortaya çıkarmadığı tespit edilmiştir. Bunun yanında ortalamalara bakıldığında, duygusal zekâ puanlarından en yüksek ortalamanın Okul Öncesi Öğretmenliği programında öğrenim gören öğretmen adaylarından orta ekonomik düzey, en düşük ortalamanınsa Sosyal Bilgiler Öğretmenliği programında öğrenim gören öğretmen adaylarından yüksek ekonomik düzeye sahip olanlar olarak belirlenmiştir. Bu durumun sebebi Okul Öncesi öğretmen adaylarının Sosyal Bilgiler öğretmen adaylarına göre duygusal zekâlarını kullanabilme yetilerinin daha fazla geliştiğinin göstergesi olup, diğer yandan ekonomik düzeyin gelişmişliğinin duygusal zekâyı etkilemediği söylenebilir. Diğer yandan faktörlere ilişkin sonuçlara bakıldığında, öğretmen adaylarının ayrı ayrı faktörlere göre öğrenim gördükleri program*ekonomik düzey etkileşiminin alınan puan ortalamaları üzerinde anlamlı bir farklılık oluşturmadığı belirlenmiştir. Ortalamalar bazında, öğretmen adaylarının öğrenim gördükleri program ve ekonomik düzey açısından iyimserlik, duyguların değerlendirilmesi ve duyguların kullanımı faktörlerine göre elde edilen puanların ortalamalarından en yüksek ortalama Sınıf Öğretmenliği programında öğrenim gören öğretmen adaylarının yüksek ekonomik düzey, en düşük ortalamaysa Sosyal Bilgiler Öğretmenliği programında öğrenim gören öğretmen adaylarının düşük ekonomik düzey olarak belirlenmiştir. Bu durumun sebebi olarak sınıf öğretmen adaylarının sınıf ortamında öğrencilerle daha çok ekilişim halinde oldukları göz önüne alınırsa, sosyal bilgiler programında öğrenim gören öğretmen adaylarına göre duygusal zekâlarını yönetebilmelerinde daha etkili oldukları söylenebilir.

Bu araştırmada, farklı programlarda (fen bilgisi eğitimi, matematik öğretmenliği, sınıf öğretmenliği, sosyal bilgiler öğretmenliği, okul öncesi öğretmenliği, bilgisayar ve öğretim teknolojileri öğretmenliği) öğrenim gören öğretmen adaylarının duygusal zekâlarıyla mezun olunan lise türü ve ekonomik düzey arasındaki ilişki incelenmiştir. Öğretmen adayların yetiştirilmelerinde duygusal zekâlarını farklı bakış açılarından ve/veya farklı değişkenlere göre konu alan araştırmalar yapılması önerilmektedir.

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PROSPECTIVE MATHEMATICS TEACHERS' VIEWS ABOUT THE EXAMS IN HIGHER EDUCATION

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ABSTRACT: The aim of this study is to reveal the views of prospective mathematics teachers about exams they had taken during their learning periods. The study was conducted with 150 prospective mathematics teachers studying at mathematics teacher program in an education faculty of a state university. Qualitative research method was used in this study and a form comprised of open ended questions was used to gather data. Data obtained were analyzed by descriptive and content analysis techniques. At the end of the study, it was determined that prospective mathematics teachers felt themselves stressed before the exams, excited during the exams, and happy after the exams they had taken. Also, it was found that many factors originating from student, teacher, exam environment, lesson, time, and family affected the exam difficulty. The findings indicate that prospective mathematics teachers needed motivation before the exams, they did not want the exam proctors to distract their attention during the exams, and they wanted them to have an attitude which made students feel relaxed after the exams. In terms of preparedness for exams, prospective mathematics teachers prepared for the exams in their own rooms individually a week before the exams, they used mostly their course books, they were afraid of their field exams more, and they prepared less for the exams related to general knowledge. In addition, it was observed that prospective mathematics teachers wanted the kind of exams which did not exceed one hour and mostly including 25 multiple choice questions and five open ended questions. Lastly, prospective mathematics teachers wanted to have exams in a quiet environment, to be detected whether they had a preparation for cheating or not before the exams, to be free for accessory equipment sharing and to have the opportunity for checking their own examination papers after the exams.

Key words: prospective mathematics teachers, exam anxiety, triggering factors, teacher education

MATEMATİK ÖĞRETMENİ ADAYLARININ LİSANS EĞİTİMLERİ SIRASINDA GİRDİKLERİ SINAVLARA İLİŞKİN GÖRÜŞLERİ

ÖZET: Bu çalışmanın amacı, matematik öğretmeni adaylarının öğrenim süreleri boyunca girdikleri sınavlara ilişkin düşüncelerini ortaya çıkarmaktır. Araştırma, bir devlet üniversitesindeki eğitim fakültesinin matematik öğretmenliği programında okuyan toplam 150 matematik öğretmeni adayıyla yürütülmüştür. Nitel araştırma yaklaşımının kullanıldığı bu araştırmada, veri toplama aracı olarak açık uçlu sorulardan oluşan bir form kullanılmıştır. Elde edilen veriler, betimsel ve içerik analizi teknikleri kullanılarak analiz edilmiştir. Çalışmanın sonucunda, matematik öğretmeni adaylarının kendilerini sınav öncesinde stresli, sınav sırasında heyecanlı ve sınav sonrasında mutlu hissettikleri belirlenmiştir. Ayrıca, sınavların iyi veya kötü geçmesini öğrenciden, öğretmenden, sınav ortamından, dersin kendisinden, zamandan ve aileden kaynaklı birçok faktörün etkilediği tespit edilmiştir. Matematik öğretmeni adaylarının sınav öncesinde motive edilmeye ihtiyaç duydukları, gözetmenlerin sınav sırasında dikkat dağıtmamalarını, sınav sonrasında ise öğrencileri rahatlatıcı tavırlar sergilemelerini istedikleri ortaya çıkmıştır. Bununla birlikte, matematik öğretmeni adaylarının sınavlara bir hafta öncesinde bireysel olarak kendi odalarında hazırlandıkları, kaynak olarak daha çok ders kitaplarını kullandıkları, alan derslerinin sınavlarından daha fazla korktukları, genel kültür ile ilgili derslere ise daha az çalıştıkları açığa çıkmıştır. Ayrıca, matematik öğretmeni adaylarının sınavların bir saati geçmeyecek şekilde daha çok 25 soruluk çoktan seçmeli ve beş soruluk açık uçlu olmasını istedikleri görülmüştür. Son olarak, matematik öğretmeni adaylarının sessiz ortamlarda sınava girmeyi arzuladıkları, sınav öncesinde öğrencilerin kopya hazırlayıp hazırlamadıklarının kontrol edilmesini, sınav sırasında araç-gereç yardımının serbest olmasını ve sınav sonrasında gerekli olması halinde yazılı kâğıtlarını görmeyi talep ettikleri ortaya çıkmıştır.

Anahtar sözcükler: matematik öğretmeni adayları, sınav kaygısı, tetikleyici faktörler, öğretmen eğitimi

GİRİŞ

Eğitim sistemlerinin birincil amacı, nitelikli bireyler yetiştirmenin yanı sıra öğrencilerin iyi birer vatandaş olabilmelerini sağlamaktır (Çelikten, Şanal ve Yeni, 2005). Öğrenci, öğretmen, eğitim-öğretim programları, yönetici, eğitim uzmanı, bilgi-iletişim teknolojisi, alt yapı ve finansal kaynaklardan meydana gelen bileşenlerin eğitim sistemini şekillendirdiği bilinmektedir (Şişman, 2007). Eğitimde hedeflenen noktaya ulaşabilmek tüm bu bileşenlerin ilişkilendirilmesi ile mümkün olabilir (Nartgün, 2008; Paliç ve Keleş, 2011).

Son zamanlarda akıl yürütme becerisini kullanan, yaratıcı düşünebilen, bireysel farklılıkların farkında olabilen ve bilgiye ulaşma yollarını bilen öğrenciler yetiştirilmeye çalışılmakta ve bu niteliklere sahip öğrenciler yetiştirecek olan öğretmenlerin yetiştirilmesi hedeflenmektedir (Umay, 2004). Bu hedeflere ulaşabilmek için nitelikli öğretmenlere ihtiyaç duyulmaktadır. Nitelikli öğretmenler, çevresinde olup biten gelişmelerden ve yeniliklerden haberdar olan, bu gelişmeleri alan öğretimiyle birleştirebilen bireyler olmalıdır (Baki, 2000). Bunların yanında öğretmenin, öğrencilerinin öğrenme gereksinimlerini, ön-şart davranışlarını, varsa eksikliklerini ortaya çıkartmak amacıyla ölçme ve değerlendirmeyi de sağlıklı bir şekilde yapması beklenmektedir (Gültekin, 2003). Bu bağlamda, ölçme değerlendirme süreci sonunda öğrencilerin ulaşmaları beklenen bilgi, beceri ve tutumlarının belirlenmesi önemlidir (Semerci, 2008; Slavin, 1997; Tekin, 1993; Tuckman, 1988; Turgut, 1990; Woolfolk, 1995). Dolayısıyla, öğrenme sürecinin değerlendirilmesinin gerektiği ve değerlendirmenin öğrenmenin ayrılmaz bir parçası olduğu unutulmamalıdır (Milli Eğitim Bakanlığı [MEB], 2013).

Eğitim-öğretim sürecinde öğrencilerin belirlenen amaçlara ulaşıp ulaşmadıklarını tespit etmek ve öğrenme eksikliklerini belirlemek için ölçme ve değerlendirmeye ihtiyaç duyulmaktadır (Çeçen, 2011). Bu bağlamda, öğretim elemanları / üyeleri sınavlarda öğrencilerin motivasyonlarını artırıcı ve sınav ortamlarında öğrencileri rahatlatmaya yönelik önlemler alması gerekmektedir. Dolayısıyla, sınav yapma öğrencilere sadece not verme amacı gütmemeli, sınav yaparken öğrencilerin kendilerini rahat hissetmelerinin sağlanması, bu anlamda sınavın sağlıklı geçmesi için tüm hazırlıkların yapılması, öğrencilerin endişe ve heyecanlarının en aza indirilmesine yönelik motivasyonlarının artırılması büyük önem taşımaktadır.

Sınav kaygısı, bir sınav veya değerlendirme durumunda yaşanan, kişilerin gerçek performansını ortaya koymasını olumsuz etkileyen bilişsel, duyuşsal, davranışsal özellikleri olan ve kişide gerginlik meydana getiren hoş olmayan bir duygu atmosferidir (Spielberger, 1980). Öğrencilerdeki sınav kaygısının bir kavram olarak ele alınması ve sınav kaygısı ile ilgili çalışmaların ivme kazanması 1950'lı yıllardan sonra başlamıştır (Erözkan, 2004). Ardından, bu konuyla ilgili ulusal ve uluslararası alanda pek çok çalışma yapılmıştır (Allen, 1970; Baltaş, 2002; Bolger, 1990; Carver ve Scheier, 1994; Casbarro, 2005; Dentado ve Diener, 1986; Devito ve Kubis, 1983; Donegan ve Trepanier-Street, 1998; Kirkland ve Hollandswort, 1980; Stöber, 2004; Trent ve Maxwell, 1980). Türkiye'de sınavlarla ilgili yapılan araştırmaların büyük çoğunluğu üniversite seçme sınavı (YGS ve LYS), ALES, KPSS, OKS ya da SBS'ye ve bu sınavlara girecek öğrencilere yöneliktir. Ancak öğretmen adaylarının lisansta girdikleri sınavlara ilişkin neler düşündükleri ile ilgili bir çalışmaya rastlanmamıştır.

Eğitim-öğretim, ulaşılan bilgiyi derinlemesine anlamayı, anlaşılan bilgiyi yapılandırarak yeni bilgiye ulaşabilmeyi, onu analiz ve sentez ederek değerlendirmeyi ön gören bir süreçtir (Hollins, 2011). Bu sürecin verimli geçmesinde, öğretmen adaylarının lisans dönemindeki donanımlarının güçlü olması çok önemlidir. Bu bağlamda, öğretmen adaylarının göreve başladıklarında etkili öğretimler gerçekleştirmeleri açısından lisansta aldıkları eğitimin önemli olduğunu vurgulayan pek çok çalışma mevcuttur (Arslan ve Özpınar, 2008; Erginer, 1995; Hill, Rowan ve Ball, 2005; Küçük, Demir ve Baran 2010; Peker, 2009; Smith, 2000; Ubuz, 2002). Ancak, lisans döneminde alınan eğitimin yanı sıra uygulanan ölçme-değerlendirme sürecinde yaşanan olumlu ya da olumsuz deneyimler de öğretmen adaylarının meslek yaşamlarında başarılı olabilmeleri için önem arz etmektedir. Buradan hareketle, lisans eğitiminde öğretmen adaylarının süreç boyunca girdikleri sınavlar hakkında neler düşündükleri, sınavlarda neler hissettikleri ve sınavlarla ilgili beklentilerinin neler olduğu önemli bir araştırma konusu olarak ortaya çıkmaktadır. Bu çalışma ile matematik öğretmeni adaylarının lisans eğitimleri sırasında girdikleri sınavlara ilişkin duygu ve düşüncelerini belirlemek amaçlanmıştır.

YÖNTEM

Bu bölümde; araştırma deseni, çalışma grubu, veri toplama aracı ve verilerin analizi ile ilgili bilgiler yer almaktadır.

Araştırma Deseni

Bu çalışmada, nitel araştırma deseni kullanılmıştır. Nitel araştırmalarda, araştırmacının genelleme amacı olmamasına rağmen çalışmanın sonuçları genele ışık tutabilir (Yıldırım ve Şimşek, 2008; Çepni, 2014). Ayrıca, nitel araştırmaların keşfedici bir özelliğe sahip olması, üzerinde çok fazla çalışılmamış konuları aydınlatmada araştırmacılara yardımcı olabilmektedir (Neuman, 2012).

Çalışma Grubu

Araştırma, 2015-2016 eğitim-öğretim yılı güz döneminde bir devlet üniversitesinin eğitim fakültesinin ilköğretim matematik öğretmenliği programında okuyan toplam 150 matematik öğretmeni adayıyla yürütülmüştür. Çalışma grubu tespit edilirken, maksimum çeşitlilik örnekleme yöntemi kullanılmış ve örneklemde çalışılan probleme taraf olabilecek kişilerin çeşitliliği maksimum derecede sağlanmıştır (McMillan ve Schumacher, 2006; Yıldırım ve Şimşek, 2008). Öğretmen adaylarına ait bazı demografik özellikler Tablo 1'de sunulmuştur.

Tablo 1. Öğretmen Adaylarının Bazı Demografik Özellikleri

		1. Sınıf		2. Sınıf		3. Sınıf		4. Sınıf		Toplam	
Özellikler	**Kategoriler**	**f**	**%**	**f**	**%**	**f**	**%**	**f**	**%**	**f**	**%**
Cinsiyet	Erkek	11	7.3	9	6.0	14	9.3	12	8.0	46	30.7
	Kız	32	21.3	25	16.7	24	16.0	23	15.3	104	69.3
Mezun olunan lise	Fen Lisesi	1	0.7	0	0	0	0	0	0	1	0.7
	Anadolu Öğretmen Lisesi	18	12.0	10	6.7	5	3.3	5	3.3	38	25.3
	Anadolu Lisesi	17	11.3	22	14.7	17	11.3	10	6.7	66	44.0
	Düz Lise	6	4.0	1	0.7	15	10.0	19	12.7	41	27.3
	Süper Lise	0	0	1	0.7	1	0.7	0	0	2	1.3
	Açık Öğretim Lisesi	1	0.7	0	0	0	0	0	0	1	0.7
	Sağlık Meslek Lisesi	0	0	0	0	0	0	1	0.7	1	0.7
Mezun olunan bölüm	Eşit Ağırlık	1	0.7	4	2.7	0	0	4	2.7	9	6.0
	Sayısal	42	28.0	30	20.0	38	25.3	31	20.7	141	94.0

Tablo 1 incelendiğinde, öğretmen adaylarının çoğunun kız, Anadolu lisesi mezunu ve sayısal bölümden mezun oldukları anlaşılmaktadır.

Veri Toplama Aracı

Çalışmada veri toplama aracı olarak 11 açık uçlu sorudan oluşan bir form kullanılmıştır. Araştırma kapsamında kullanılan formdaki sorular hazırlanırken literatürden faydalanılmış ve iki uzmanın görüşlerine başvurulmuştur. Alanında uzman akademisyenlerin düşünceleri alınarak formda yer alan soruların kapsam ve yordama geçerlilikleri sağlanmıştır. Ayrıca, hazırlanan sorular pilot uygulama sürecinde 10 öğretmen adayına okutturulmuş ve anlaşılmayan yerler düzeltilmiştir. Bununla birlikte, bir Türkçe öğretmeni soruların anlaşılır olup olmadığını inceledikten sonra sorulara son hali verilmiştir. Son olarak, 25 matematik öğretmeni adayı ile pilot uygulama yapılmış ve soruların anlaşılırlığı denetlenmiştir.

Verilerin Analizi

Veriler, nitel veri analiz yöntemlerinden betimsel ve içerik analiz yöntemleri birlikte kullanılarak analiz edilmiştir. Öncelikle, veriler Word dosyası şeklinde kayıt edilmiş, daha sonra öğretmen adaylarının sorulara verdikleri cevaplar betimsel analize tabi tutulmuştur. Ardından, aynı verilerden içerik analizi ile kod ve kategoriler oluşturulmuştur. Araştırmacı, kod ve kategorileri belirledikten sonra, kodların frekans ve yüzde değerlerini hesaplamıştır. Matematik öğretmeni adaylarından bazıları açık uçlu soruları cevaplarken aynı cevap içerisinde birden fazla koda ilişkin fikir belirttiğinden, kodlara ilişkin frekansların toplamı, araştırmadaki toplam öğretmen adayı sayısından farklı çıkabilmektedir. Veriler tablolar halinde sunulmuştur. Nitel bir araştırmada, bireylerden doğrudan alıntılara yer verilmesi araştırmanın geçerliğinin sağlanması bakımından önemlidir (Yıldırım ve Şimşek, 2008). Bu nedenle, bu çalışmada doğrudan alıntılara yer verilmiştir.

Araştırmanın güvenilirlik hesaplaması için yazıya dönüştürülen veriler içerisinden rastgele seçilen üç tanesi iki araştırmacı tarafından ayrı ayrı kodlanmıştır. Araştırmacıların oluşturdukları kodlar arasındaki tutarlılık [Görüş birliği / (Görüş birliği + Görüş ayrılığı)] formülü kullanılarak (Miles ve Huberman, 1994) 0.89 olarak hesaplanmıştır. Öğretmen adayları, araştırmanın etiği gereği; K1, K2, K3, … , K150 biçiminde kodlanmıştır.

BULGULAR

Öğretmen adaylarının sınav öncesinde, sırasında ve sonrasında neler hissettiklerine yönelik görüşlerinden oluşturulan kodlara ait frekans ve yüzde değerleri Tablo 2'de verilmiştir:

Tablo 2. Öğretmen Adaylarının Sınav Öncesinde, Sırasında ve Sonrasında Hissettikleri

Kodlar	Sınav Öncesi		Sınav Sırası		Sınav Sonrası	
	f	%	f	%	f	%
1.Stresli	53	35.3	9	6.0	7	4.7
2.Heyecanlı	45	30.0	21	14.0	-	-
3.Bildiklerimi unutmuş gibi	13	8.7	10	6.7	-	-
4.Rahat	7	4.7	17	11.3	36	24.0
5.Panik	4	2.7	16	10.7	-	-
6.Mutlu	1	0.7	-	-	43	28.6
7.Duygusuz	-	-	1	0.7	1	0.7
8.Düşük not alma korkusu	-	-	-	-	2	1.3
9.Düşünceli	3	2.0	2	1.3	-	-
10.Hasta	1	0.7	-	-	-	-
11.Kendinden emin	2	1.3	-	-	-	-
12.Meraklı	4	2.7	-	-	1	0.7
13.Pişman	1	0.7	-	-	1	0.7
14.Sakin	4	2.7	2	1.3	-	-
15.Sinirli	-	-	-	-	2	1.3
16.Soruları yapamama korkusu	7	4.7	-	-	-	-
17.Soruları yetiştirememe korkusu	-	-	5	3.3	-	-
18.Şaşkın	-	-	1	0.7	-	-
19.Şüpheci	2	1.3	-	-	1	0.7
20.Umursamaz	1	0.7	-	-	-	-
21.Umutsuz	-	-	-	-	1	0.7
22.Üzgün	-	-	-	-	9	6.0
23.Yorgun	1	0.7	-	-	1	0.7

-: Bilgi yok.

Tablo 2 incelendiğinde, sınav öncesinde "stresli", "heyecanlı", "bildiklerini unutmuş gibi", sınav sırasında "heyecanlı", "rahat", "panik", sınav sonrasında ise "mutlu" ve "rahat" kodlarının ön plana daha çok çıktığı anlaşılmaktadır. Öğretmen adaylarının ön plana çıkan bu kodlara yönelik verdikleri cevaplardan bazıları sırasıyla aşağıda sunulmuştur:

Sınav Öncesinde
"Sınavdan önce kendimi çok fazla stresli hissediyorum çünkü hocaların soru sorma biçimlerini tahmin edemiyorum. (K24)"
"Çok heyecanlı oluyorum, acaba nasıl not alacağım fikri beynimi kemiriyor. (K21)"
"Çalıştığım şeyleri hatırlamıyormuşum gibi hissediyorum. (K73)"

Sınav Sırasında
"İlk başta heyecanım devam ediyor ama sonra geçiyor. (K9)"
"Soruları görünce biraz rahatlıyorum... (K23)"
"Yapamadığım soru ile karşılaşınca panik oluyorum... (K37)"

Sınav Sonrasında
"Sınav bittiği için çok mutlu oluyorum. (K74)"
"Sınav bittiği için rahatlıyorum. (K53)"

Öğretmen adaylarının sınavların iyi veya kötü geçmesini etkileyen faktörlere ilişkin görüşlerinden oluşturulan kodlara ait frekans ve yüzde değerleri Tablo 3'te verilmiştir:

Tablo 3. Öğretmen Adaylarına Göre Sınavların İyi veya Kötü Geçmesini Etkileyen Faktörler

Kategoriler	Kodlar	f	%
Öğrenci	1.Konu hâkimiyeti (sınava çalışıp çalışmama)	35	23.3
	2.Sınav anındaki psikolojik durum	23	15.3
	3.Heyecanlı olup olmama	22	14.7
	4.Stresli olup olmama	17	11.3
	5.Hasta olup olmama	10	6.7
	6.Başarma inancı (özgüven)	7	4.7
	7.Dikkatli olup olmama	7	4.7
	8.Yorgun olup olmama	3	2.0
	9.Sınava son gün çalışma	2	1.3
	10.Kopya çekip çekmeme	1	0.7
Öğretmen	11.Hocaların sınav anındaki tutumu	24	16.0
	12.Sınav sorularının anlaşılır olup olmaması	1	0.7
Sınav Ortamı	13.Ses veya gürültü	14	9.3
	14.Oturma düzeni	2	1.3
Ders	15.Dersin zorluk derecesi	8	5.3
	16.Bazı sınavların çakışması	3	2.0
Zaman	17.Sınavın süresi	5	3.3
Aile	18.Aile baskısı	1	0.7

Tablo 3 incelendiğinde, öğretmen adaylarına göre sınavların iyi veya kötü geçmesini etkileyen faktörlerin "öğrenci", "öğretmen", "sınav ortamı", "ders", "zaman" ve "aile" olmak üzere altı kategori altında toplandığı görülmektedir. Bu kategoriler altındaki "konu hâkimiyeti", "sınav anındaki psikolojik durum", "heyecanlı olup olmama", "hocaların sınav anındaki tutumu", "ses veya gürültü", dersin zorluk derecesi", "sınavın süresi" ve "aile baskısı" kodlarının ön plana daha çok çıktığı anlaşılmaktadır. Öğretmen adaylarının 1, 2, 3, 11, 13, 15, 17 ve 18 numaralı kodlara verdikleri cevaplardan bazıları aşağıda sunulmuştur:

"Eğer konulara hâkimsem sınav iyi geçer… (K1)"
"Sınav anındaki ruh hali, hastalık gibi faktörler. (K80)"
"Stres ve heyecan kötü geçmesini sağlar. (K5)"
"Hocalar da çok önemli, özellikle gözetmenlik yapanlar. Hocanın yüzündeki sert, imalı bakış bile beni çok etkiliyor. (K47)"
"Sesten rahatsız oluyorum. Özellikle konservatuar bölümündeki arkadaşların davul seslerinden... (K93)"
"Dersin zorluk derecesi sınavın iyi veya kötü geçmesinde önemli faktörlerden biri. (K75)"
"Zaman kesinlikle sınavların iyi ve kötü geçmesini etkileyen bir faktör… (K86)
"Ailem çok fazla stres oluşturuyor, kötü geçerse ne yaparım düşüncesi sonucunda hastalanıyorum. (K82)"

Öğretmen adaylarının gözetmenlerin sınav öncesinde, sırasında ve sonrasında kendilerine nasıl davranmalarını istedikleri ile ilgili görüşlerinden oluşturulan kodlara ait frekans ve yüzde değerleri Tablo 4'te verilmiştir:

Tablo 4. Öğretmen Adaylarının Gözetmenlerin Sınavlarda Kendilerine Nasıl Davranmalarını İstedikleri

Kodlar	Sınav Öncesi		Sınav Sırası		Sınav Sonrası	
	f	%	f	%	f	%
1.Motive etmeliler.	34	22.7	-	-	-	-
2.Sert davranmamalılar.	21	14.0	21	14.0	-	-
3.Dikkat dağıtmamalılar.	-	-	54	36.0	-	-
4.Rahatlatıcı tavırlar sergilemeliler.	-	-	20	13.3	19	12.7
5.Sınav sorularını çözmeliler.	-	-	-	-	7	4.7
6.Aceleci davranmamalılar.	-	-	-	-	2	1.3
7.Anlayışlı olmalılar.	-	-	4	2.7	-	-
8.Bol puan vermeliler.	-	-	-	-	3	2.0
9.Duygusuz davranmamalılar.	-	-	1	0.7	5	3.3
10.Düşük not alanların nedenlerini araştırmalılar.	-	-	-	-	1	0.7
11.Ek süre vermeliler.	-	-	-	-	4	2.7
12.Güler yüzlü olmalılar.	2	1.3	-	-	3	2.0
13.Herkese eşit davranmalılar.	-	-	2	1.3	-	-
14.Kopya çekilmemesi konusunda önlemler almalılar.	2	1.3	-	-	-	-

15.Öğrencilere kopya çekiyormuş gibi baskı yapmamalılar.	-	-	5	3.3	-	-
16.Öğrencileri tehdit etmemeliler.	2	1.3	4	2.7	-	-
17.Öğrencilerin yerlerini değiştirilmemeliler.	2	1.3	-	-	-	-
18.Önyargılı davranmamalılar.	-	-	-	-	2	1.3
19.Sınav hakkında bilgi vermeliler.	10	6.7	-	-	-	-
20.Sınav kâğıtlarını adaletli okumalılar.	-	-	-	-	2	1.3
21.Sınav notlarını derse yansıtmamalılar.	-	-	-	-	3	2.0
22.Sınavda çıkacak soruları söylemeliler.	1	0.7	-	-	-	-
23.Soru sorulmasına izin vermeliler.	-	-	3	2.0	-	-
24.Yüksek beklenti içinde olmamalılar.	-	-	-	-	3	2.0

-: Bilgi yok.

Tablo 4 incelendiğinde, sınav öncesinde "motive etme", "sert davranmama", sınav sırasında "dikkat dağıtmama", "sert davranmama", "rahatlatıcı tavırlar sergileme", sınav sonrasında ise "rahat tavırlar sergileme" ve "sınav sorularını çözme" kodlarının ön plana daha çok çıktığı anlaşılmaktadır. Öğretmen adaylarının ön plana çıkan bu kodlara yönelik verdikleri cevaplardan bazıları sırasıyla aşağıdaki gibidir:

Sınav Öncesinde
"Sınavın kolay olduğunu, yapılabilir derecede olduğunu söyleyip bizi motive ediyorlar. Bence böyle yapmaları güzel. Ben de böyle olmasını isterim. (K12)"
"Hocalarımız ya da öğretmenlerimiz … çok sert davranmamalarını tercih ederim. (K123)"

Sınav Sırasında
"Başıma gelip beklediklerinde sinir oluyorum. (K133)"
"Bazen çok sert davranıyorlar. Sert davranmaları sınavı etkiliyor. (K73)"
"Rahatlatıcı tavırlar sergilesinler. (K23)"

Sınav Sonrasında
"Bizlerle biraz konuşarak bizleri rahatlatabilirler. (K4)"
"Soruları çözmeliler. (K33)"

Öğretmen adaylarının sınavlara ne zaman ve nasıl çalıştıkları ile ilgili görüşlerinden oluşturulan kodlara ait frekans ve yüzde değerleri Tablo 5'te verilmiştir:

Tablo 5. Öğretmen Adaylarının Sınavlara Ne Zaman ve Nasıl Çalıştıkları

Kategoriler	Kodlar	f	%
Ne Zaman	1.Bir hafta önce	56	37.3
	2.Birkaç gün önce	28	18.7
	3.İki hafta önce	15	10.0
	4.Sınav yaklaştıkça	12	8.0
	5.Derse göre değişir.	10	6.7
	6.Günü gününe	9	6.0
	7.Son gün	6	4.0
	8.Sınav haftası	5	3.3
	9.Sınav akşamı	4	2.7
	10.İki-üç hafta önce	3	2.0
	11.Bir-iki hafta önce	2	1.3
	12.Bir ay önce	1	0.7
	13.Çalışmam gerektiğini hissettiğim zaman	1	0.7
Nasıl	14.Bireysel	88	58.7
	15.Arkadaşlarla	40	26.7
	16.Derse göre değişir. (bireysel veya arkadaşlarla)	19	12.6

Tablo 5 incelendiğinde, öğretmen adaylarının sınavlara daha çok bir hafta önce ve bireysel olarak çalıştıkları anlaşılmaktadır. Öğretmen adaylarının 1, 2, 3, 14, 15 ve 16 numaralı kodlara verdikleri cevaplardan bazıları aşağıda sunulmuştur:

"Bir hafta önce. (K2)"
"Bir veya iki gün önce. (K111)"
"Sınavlara kesinlikle 2 hafta önceden çalışmaya başlıyorum… (K93)"

"Bireysel çalışıyorum. (K109)"
"Arkadaşlarla birlikte çalışıyoruz. (K118)"
"Bazı sınavlarda bireysel bazılarında ise arkadaşlarla çalışıyoruz. (K39)"

Öğretmen adaylarının hangi derslere daha çok ve daha az çalıştıklarına ilişkin görüşlerinden oluşturulan kodlara ait frekans ve yüzde değerleri Tablo 6'da verilmiştir:

Tablo 6. Öğretmen Adaylarının Hangi Derslere Daha Çok ve Daha Az Çalıştıkları

Kategoriler	Kodlar	f	%
Daha Çok Çalışılan Dersler	1.Alan dersleri	50	33.3
	2.Öğretmenlik meslek bilgisi dersleri	38	25.3
	3.Alan eğitimi dersleri	25	16.7
	4.Genel kültür dersleri	16	10.7
	5.Tüm dersler	6	4.0
	6.Hiçbir ders	5	3.3
	7.Sözel dersler	4	2.7
	8.Genel yetenek dersleri	1	0.7
Daha Az Çalışılan Dersler	9.Genel kültür dersleri	59	39.3
	10.Öğretmenlik meslek bilgisi dersleri	37	24.7
	11.Alan dersleri	5	3.3
	12.Alan dışı dersler	3	2.0
	13.Seçmeli dersler	3	2.0
	14.Genel yetenek dersleri	2	1.3
	15.Sayısal dersler	2	1.3
	16.Sözel dersler	1	0.7

Tablo 6 incelendiğinde, öğretmen adaylarının alan derslerine daha çok; genel kültür derslerine ise daha az çalıştıkları anlaşılmaktadır. Öğretmen adaylarının 1, 2, 3, 9, 10 ve 11 numaralı kodlara verdikleri cevaplardan bazıları aşağıda sunulmuştur:

"Alan derslerinden korkuyorum, kalırım diye. (K4)"
"Öğretmenlik meslek bilgisi dersleri çünkü sözel oldukları için ezber yapmada bazen zorlanıyorum. (K8)"
"Alan eğitimi derslerinden daha çok çalışıyorum. Çünkü kredisi çok yüksek dersler. (K51)"
"Genel kültür çünkü genelde bilindik konular olduğu için. (K3)"
"Sınıf yönetimi gibi meslek derslerini az bir çalışmayla yapabildiğim için. (K15)"
"Genelde alan dersleri geride kalıyor. Bir şeyler bildiğimi düşündüğüm için… (K71)"

Öğretmen adaylarının sınavlara hangi kaynaklardan ve nerede çalıştıkları ile ilgili görüşlerinden oluşturulan kodlara ait frekans ve yüzde değerleri Tablo 7'de verilmiştir:

Tablo 7. Öğretmen Adaylarının Sınavlara Hangi Kaynaklardan ve Nerede Çalıştıkları

Kategoriler	Kodlar	f	%
Kaynaklar	1.İlgili dersin kitapları	133	88.7
	2.Derste tutulan notlar (defter)	89	59.3
	3.Lise ders kitapları	22	14.7
	4.İnternet	14	9.3
	5.KPSS kitapları	8	5.3
	6.Fotokopiler	2	1.3
	7.Hocaların önerdiği kitaplar	2	1.3
	8.Makaleler	1	0.7
Sınava Çalışılan Yerler	9.Kendi odasında	54	36.0
	10.Etüt odasında	40	26.7
	11.Evde	27	18.0
	12.Kütüphanede	8	5.3
	13.Sessiz ortamlarda	6	4.0
	14.Yalnız kalınabilecek bir ortamda	5	3.3
	15.Fark etmez.	3	2.0
	16.Derse göre değişir.	2	1.3
	17.Okulda	1	0.7

Tablo 7 incelendiğinde, öğretmen adaylarının sınavlara ilgili dersin kitaplarından, derste tutulan notlardan ve lise ders kitaplarından daha çok çalıştıkları görülmektedir. Ayrıca, öğretmen adaylarının sınavlara kendi odalarında, etüt odalarında ve evde daha fazla çalıştıkları anlaşılmaktadır. Öğretmen adaylarının 1, 2, 3, 9, 10 ve 11 numaralı kodlara verdikleri cevaplardan bazıları aşağıda sunulmuştur:

"Dersin kitabından çalışıyorum. (K25)"
"Kendi notlarım önemlidir. Onlardan çalışıyorum. (K104)"
"Lisedeki kitaplarımdan çalışıyorum. (K39)"
"Daha verimli olduğu için kendi odamda çalışıyorum. (K150)"
"Etüt odasında çalışıyorum, çünkü herkes çalıştığından daha kolay adapte oluyorum. (K4)"
"Evde çalışıyorum, çünkü en sakin yer orası. (K19)"

Öğretmen adaylarının sınavlarda ne tür soruların sorulmasına yönelik görüşlerinden oluşturulan kodlara ait frekans ve yüzde değerleri Tablo 8'de verilmiştir:

Tablo 8. Öğretmen Adaylarının Sınavlarda Ne Tür Soruların Sorulmasına Yönelik İstekleri

Kategoriler	Kodlar	f	%
Sınav Çeşitleri	1.Çoktan seçmeli	74	49.3
	2.Açık uçlu	42	28.0
	3.Karışık	19	12.7
	4.Doğru-yanlış	10	6.7
	5.Boşluk doldurma	3	2.0
Diğer	6.Derse göre değişir.	18	12.0
	7.Fark etmez.	2	1.3

Tablo 8 incelendiğinde, öğretmen adaylarının sınavlarda çoktan seçmeli, açık uçlu ve karışık türden soruların sorulmasını daha çok istedikleri anlaşılmaktadır. Öğretmen adaylarının ilk üç koda verdikleri cevaplardan bazıları aşağıda sunulmuştur:

"Çoktan seçmeli çünkü o an cevap aklıma gelmediyse şıkta görüp yapabiliyorum. (K1)"
"Açık uçlu çünkü hocalar fazla puan verebiliyor. (K9)"
"Hepsinden azar azar karışık sorular sorulmalı, çünkü hocalar öğrenciyi her türde değerlendirmeye almalılar. (K22)"

Öğretmen adaylarının sınav yapılan ortamların nasıl olması gerektiği ile ilgili görüşlerinden oluşturulan kodlara ait frekans ve yüzde değerleri Tablo 9'da verilmiştir:

Tablo 9. Öğretmen Adaylarının Sınav Yapılan Ortamların Nasıl Olması Gerektiği İle İlgili İstekleri

Kategori	Kodlar	f	%
Sınav Ortamının Özellikleri	1.Sessiz olmalı	64	42.7
	2.Sıralar geniş ve rahat olmalı	20	13.3
	3.Sıcak olmalı	17	11.3
	4.Havadar olmalı	13	8.7
	5.Kalabalık olmamalı	10	6.7
	6.Aydınlık olmalı	6	4.0
	7.Ne sıcak ne de ne soğuk olmalı	5	3.3
	8.Dikkat dağıtıcı şeyler olmamalı	3	2.0
	9.Geniş olması	3	2.0
	10.Temiz olmalı	3	2.0
	11.Düzenli olmalı	2	1.3
	12.Sıralarda, duvarlarda ve tahtada yazı olmamalı	1	0.7

Tablo 9 incelendiğinde, öğretmen adaylarının sınav ortamlarının sessiz, sıcak, sıraların geniş ve rahat olmasını istedikleri anlaşılmaktadır. Öğretmen adaylarının ilk üç koda yönelik verdikleri cevaplardan bazıları aşağıda sunulmuştur:

"Sınav ortamı sesten, gürültüden uzak bir ortam olmalı. (K127)"
"Sıralar geniş ve rahat olmalı. (K9)"
"Sıcak bir ortam olmasını isterim. (K114)"

Öğretmen adaylarının sınav öncesinde, sırasında ve sonrasında nelerin serbest ve nelerin yasak olmasına ilişkin görüşlerinden oluşturulan kodlara ait frekans ve yüzde değerleri Tablo 10'da verilmiştir:

Tablo 10. Öğretmen Adaylarının Sınavlarda Nelerin Serbest ve Nelerin Yasak Olmasına İlişkin İstekleri

Kodlar	Sınav Öncesi		Sınav Sırası		Sınav Sonrası	
	f	%	f	%	f	%
1.Öğrencilerin kopya hazırlayıp hazırlamadıkları kontrol edilmeli	10	6.7	-	-	-	-
2.Sınavda çıkacak konular hakkında bilgi verilmeli	7	4.7	-	-	-	-
3.Araç-gereç yardımı serbest olmalı	-	-	35	23.3	-	-
4.Kopya içerikli her şey yasak olmalı	-	-	18	12.0	-	-
5.İhtiyaç halinde sınav kâğıtlarına bakabilmek serbest olmalı	-	-	-	-	14	9.3
6.Sınav soruları derste çözülmeli	-	-	-	-	11	7.3
7.Sınav hakkında konuşmak yasak olmalı	-	-	-	-	11	7.3
8.Birlikte tekrar yapmak yasak olmalı	1	0.7	-	-	-	-
9.Cevap anahtarına bakmak serbest olmalı	-	-	-	-	4	2.7
10.Defter, kitap yasak olmalı	1	0.7	-	-	-	-
11.Defterlere veya kitaplara bakmak serbest olmalı	-	-	7	4.7	-	-
12.Ek süre vermek serbest olmalı	-	-	-	-	1	0.7
13.Gözetmenlerin dikkat dağıtması (sınıfta dolaşmak gibi) yasak olmalı	-	-	5	3.3	-	-
14.Gözetmenlerin öğrencilerin sınav kâğıtlarına bakması yasak olmalı	-	-	2	1.3	-	-
15.Hesap makinesi veya sözlük kullanımı serbest olmalı	-	-	4	2.7	-	-
16.İnternete girmek serbest olmalı	2	1.3	-	-	-	-
17.İstenilen yerde oturmak serbest olmalı	1	0.7	4	2.7	-	-
18.Konuşmak yasak olmalı	4	2.7	1	0.7	-	-
19.Notlara bakmak serbest olmalı	6	4.0	-	-	-	-
20.Notlara bakmak yasak olmalı	2	1.3	-	-	-	-
21.Sınav salonu dışında konuşmak yasak olmalı	-	-	-	-	3	2.0
22.Sınav hakkında konuşmak serbest olmalı	-	-	-	-	1	0.7
23.Soru sormak serbest olmalı	4	2.7	7	4.7	-	-
24.Soru sormak yasak olmalı	-	-	9	6.0	-	-
25.Süre ile ilgili bilgi vermek yasak olmalı	-	-	2	1.3	-	-
26.Telefon serbest olmalı	-	-	1	0.7	-	-
27.Telefon yasak olmalı	2	0.7	8	5.3	-	-
28.Telefonlar kapatılmalı	2	1.3	-	-	-	-
29.Tuvalet ihtiyacı için tolerans gösterilmeli	1	0.7	5	3.3	-	-
30.Yer değiştirmek yasak olmalı	3	2.0	-	-	-	-
31.Yiyecek-içecek yasak olmalı	1	0.7	-	-	-	-
32.Yiyecek-içecek serbest olmalı	-	-	5	3.3	-	-

-: Bilgi yok.

Tablo 10 incelendiğinde, sınav öncesinde "öğrencilerin kopya hazırlayıp hazırlamadıkları kontrol edilmeli", "sınavda çıkacak konular hakkında bilgi verilmeli", sınav sırasında "araç-gereç yardımı serbest olmalı", "kopya içerikli her şey yasak olmalı", sınav sonrasında ise "ihtiyaç halinde sınav kâğıtlarına bakabilmek serbest olmalı", "sınav soruları derste çözülmeli" ve "sınav hakkında konuşmak yasak olmalı" kodlarının ön plana daha çok çıktığı anlaşılmaktadır. Öğretmen adaylarının ön plana çıkan bu kodlara yönelik verdikleri cevaplardan bazıları sırasıyla aşağıda sunulmuştur:

Sınav Öncesinde
"Hocalarımızın öğrencilerin kopya hazırlayıp hazırlamadıklarını kontrol etmelerini isterim. (K71)"
"Hocaların sınavda sorulacak soruların hangi konularla ilgili olduğunu daha önceden bizlere söylemelerini çok isterim. (K15)"

Sınav Sırasında
"Silgi, kalem tıraş alışverişi serbest olmalı… (K16)"
"Kopya kesinlikle olmamalı. Kopya çekenler benim hakkıma giriyorlar. Bazen o kadar çalışıyorum onlar kopya ile hemen halledebiliyorlar. (K51)"
Sınav Sonrasında
"Kâğıtlarımıza notlar açıklandıktan sonra bakabilelim. (K12)"
"…Sınavdan sonraki derste sorular çözülmeli. (K39)"
"Sınavla ilgili konuşmak yasak olabilir. (K67)"

Öğretmen adaylarının açık uçlu sorulardan oluşan sınavlarda kaç soru sorulmasına ve bu sınavların sürelerinin ne kadar olması gerektiğine ilişkin görüşlerinden oluşturulan kodlara ait frekans ve yüzde değerleri Tablo 11'de verilmiştir:

Tablo 11. Öğretmen Adaylarının Açık Uçlu Sınavlarda Kaç Soru Sorulmasına ve Bu Sınavların Sürelerinin Ne Kadar Olmasına İlişkin İstekleri

Kategoriler	Kodlar	f	%
Soru Sayısı	1.Beş soru	32	21.3
	2.On soru	27	18.0
	3.Dört-beş soru	5	3.3
	4.Fark etmez.	4	2.7
	5.Dört soru	3	2.0
	6.En az on soru	3	2.0
	7.Yedi soru	2	1.3
	8.Beş-altı soru	2	1.3
	9.Beş-on soru	2	1.3
	10.Beş ya da on soru	2	1.3
	11.Sekiz soru	2	1.3
	12.Diğer (2, 6, 2-3, 6-7, 5-8 soru)	5	3.3
Sınav Süresi	13.Bir saat	91	60.7
	14.50 dakika	11	7.3
	15.Derse göre değişir.	5	3.3
	16.Her soruya bir-üç dakika	3	2.0
	17.Bir buçuk saat	2	1.3
	18.Sınav süresi öğretmene bırakılmalı	2	1.3
	19.Diğer (2 saat, her soruya on dakika, 30 dakika, 35 dakika, 45 dakika, 70 dakika, 50-75 dakika, 60-80 dakika, 90 dakika ve sınav süresi öğrencilerle kararlaştırılmalı)	10	6.7

Tablo 11 incelendiğinde, öğretmen adaylarının açık uçlu sınavlarda beş soru sorulmasını ve sınavların süresinin bir saat olması gerektiğini daha fazla dile getirdikleri anlaşılmaktadır. Öğretmen adaylarının 1 ve 13 numaralı kodlara verdikleri cevaplardan bazıları aşağıda sunulmuştur:

"5 soru, açık uçlu sınavlarda ideal oluyor, yapabildiğini zaten yapıyorsun. (K1)"
"Açık uçlu sınavlarda bir saat verilmelidir. Çünkü soruları düşünmek, yorumlamak, kağıda dökmek uzun zaman alıyor. (K50)"

Öğretmen adaylarının çoktan seçmeli sorulardan oluşan sınavlarda kaç soru sorulmasına ve bu sınavların sürelerinin ne kadar olması gerektiğine ilişkin görüşlerinden oluşturulan kodlara ait frekans ve yüzde değerleri Tablo 12'de verilmiştir:

Tablo 12. Öğretmen Adaylarının Çoktan Seçmeli Sınavlarda Kaç Soru Sorulmasına ve Bu Sınavların Sürelerinin Ne Kadar Olmasına Yönelik İstekleri

Kategoriler	Kodlar	f	%
Soru Sayısı	1.25 soru	33	22.0
	2.20 soru	29	19.3
	3.20-25 soru	17	11.3
	4.Soru sayısı süreye bağlıdır.	8	5.3
	5.30 soru	4	2.7
	6.25-30 soru	3	2.0
	7.15-20 soru	2	1.3
	8.Diğer (16, 33, 40, 50, 20-30, 25-35, 30-35, 40-50 soru)	8	5.3
Sınav Süresi	9.Bir saat	97	64.7
	10.Her soruya 1 dakika	16	10.7
	11.Her soruya 2 dakika	5	3.3
	12.30 dakika	5	3.3
	13.40 dakika	5	3.3
	14.25 dakika	3	2.0

	15.75-90 dakika	2	1.3
	16.Her soruya 1,5 dakika	2	1.3
	17.35 dakika	2	1.3
	18.30-40 dakika	2	1.3
	19.Derse göre değişir.	2	1.3
	20.Diğer (her soruya 3 dakika, 45 dakika, 50 dakika, 60 dakika, 75 dakika)	5	3.3

Tablo 12 incelendiğinde, öğretmen adaylarının çoktan seçmeli sınavlarda 25 soru sorulmasını ve sınavların süresinin bir saat olması gerektiğini daha fazla ifade ettikleri anlaşılmaktadır. Öğretmen adaylarının 1 ve 9 numaralı kodlara verdikleri cevaplardan bazıları aşağıda sunulmuştur:

"Çoktan seçmelide 25 soru yeterli. (K50)"
"Çoktan seçmeli sınavlarda 25 soru soruluyorsa bir saat idealdir. (K75)"

TARTIŞMA ve SONUÇ

Bu araştırma, öğretmen adaylarının öğrenim süreleri boyunca girdikleri sınavlara ilişkin düşüncelerinim değerlendirilmesine yönelik yapılan bir çalışmadır.

Öğretmen adayları kendilerini sınav öncesinde "stresli", "heyecanlı", "bildiklerini unutmuş gibi", sınav sırasında "heyecanlı", "rahat", "panik", sınav sonrasında ise "rahat" ve "mutlu" olarak hissettiklerini ifade etmişlerdir. Dolayısıyla, öğretmen adaylarının sınav öncesinde ve sırasında sınavla ilgili kaygılandıkları, sınav sonrasında ise kendilerini daha iyi hissettikleri anlaşılmaktadır. Erözkan, (2004) çalışmasında, üniversite son sınıf öğrencilerinin alt sınıflara göre daha kuruntulu tutum içinde olduklarını ayrıca sınav kaygısının öğrencilerin akademik anlamda amaçlarına ulaşmalarını engellediğini ortaya koymuştur. Aysan, Thompson ve Hamarat (2001) da çalışmalarında, sınav kaygısının yaşa bağlı olarak artış gösterdiğini ileri sürmüşlerdir. Eğitim süresince sınav öncesinde ve sınav sırasında yaşanan kaygının ortadan kaldırılması ya da aza indirgenebilmesi, öğretmen adaylarının akademik hayatta başarılı olmalarına, günlük ve öğrenim hayatlarında karşılaşacakları pek çok sıkıntıyı giderebilmelerine ve bu sorunların üstesinden gelmelerine yardımcı olacaktır. Ayrıca, öğretmen adaylarının süreç boyunca girdikleri sınavların günlük yaşamın bir parçası olduğuna alışmalarına yardımcı olunarak, sınav kaygısından uzak, motivasyonları yüksek bir şekilde derslerde daha başarılı olmaları sağlanabilir.

Sınavların iyi veya kötü geçmesini etkileyen faktörlerin "öğrenci", "öğretmen", "sınav ortamı", "ders", "zaman" ve "aile" başlıkları altında toplandığı açığa çıkmıştır. "Konu hâkimiyeti", "sınav anındaki psikolojik durum", "heyecanlı olup olmama", "hocaların sınav anındaki tutumu", "ses veya gürültü", dersin zorluk derecesi", "sınavın süresi" ve "aile baskısı" gibi durumların bu başlıklar altında daha çok ortaya çıktığı belirlenmiştir. Güler ve Çakır (2013), babadan algılanan tutumların sınav kaygısının yordayıcısı olmadığını, annelerin sıkı denetim ve kontrol biçimindeki tutumlarının öğrencilerin sınav kaygısını artırdığını belirlemişlerdir. Bu sonuç, çalışmanın aile baskısına yönelik bulgusuyla benzerlik göstermektedir. Ayrıca, öğretmen adaylarının sınavlarla ilgili kaygı yaşamalarının nedenlerinden biri de ailelerine yük olmak istememeleri olabilir (Eraslan, 2005). Öğrenme sürecinin değerlendirilmesinin gerektiği ve değerlendirmenin öğrenmenin ayrılmaz bir parçası olduğu (MEB, 2013) göz önünde bulundurulursa, öğretmen adaylarının sınavların iyi ya da kötü geçmesine yükledikleri anlamların önemli olduğu söylenebilir. Çünkü bu faktörler onların günlük hayatlarına ve akademik başarılarına olumlu ya da olumsuz yansıyabilir.

Öğretmen adaylarının, öğretim elemanlarından / üyelerinden sınav öncesinde "motive etme", "sert davranmama", sınav sırasında "dikkat dağıtmama", "sert davranmama", "rahatlatıcı tavırlar sergileme", sınav sonrasında ise "rahat tavırlar sergileme" ve "sınav sorularını çözme" gibi isteklerinin olduğu tespit edilmiştir. Kumral (2009) çalışmasında, sınav dönemlerinde öğrencilerin yaşadığı stresin öğretim elemanlarının / üyelerinin sınav döneminde öğrencileri birer potansiyel suçlu olarak görmelerinden kaynaklandığını ifade etmiştir. Aynı çalışmada, öğretim elemanlarının / üyelerinin süreçte ele alınan konulardan sınavda çıkması muhtemel sorulara yönelik bilgilendirmelerde bulunmaları, öğrenciler tarafından olumlu görülen tutumlar olarak ifade edilmiştir. Bu sonuç, çalışmanın bazı bulgularıyla paralellik göstermektedir. Öğretim elemanlarının / üyelerinin sınav ortamlarında gergin olmaları, adayların motivasyonunu düşürebilir. Dolayısıyla, öğretim elemanlarının / üyelerinin öğrencilere sert davranmadan ve onların dikkatlerini dağıtmadan onlara karşı yumuşak tavır almaları önemli görülmektedir.

Öğretmen adaylarının sınavlara daha çok bir hafta önce ve bireysel olarak çalıştıkları elde edilen sonuçlar arasındadır. Öğretmen adaylarının sınavlara bir hafta kala çalışılmaları istenilen bir durum değildir. Demir ve Bütüner (2014) çalışmalarında, öğretmen adaylarının sınavlara sınav gecesinde ders geçme odaklı olarak çalıştıklarını belirlemişlerdir. Öğretmen adaylarının bu alışkanlıklarını terk etmelerini sağlayacak bir takım önlemler alınmalıdır. Bu durum, yapılandırmacı yaklaşımda benimsenen öğretmen rolüne de uymamaktadır. Ayrıca, öğretmen adaylarının sadece sınavlarda ders çalışmalarının yeterli olmadığına, süreç boyunca çalışmaları gerektiğine inandırılmasını sağlayacak önlemler alınması gerekmektedir. Böylece, öğretmen adayları düzenli ders çalışma alışkanlığı kazanacak, süreçte derslerle iç içe olacak ve dersleri uğraşılmaya değer bulacaktır. Bununla birlikte, öğretmen adaylarının daha çok bireysel ders çalıştıkları sonucundan hareketle, adayların bireysel anlamalarını sağlayabilecek ortamları tercih ettikleri söylenebilir. Ancak yapılandırmacı yaklaşımda grup çalışması yöntemine yapılan vurgu dikkate alınırsa, ders sürecindeki etkinliklerin bu yönteme göre planlanması ve uygulanması adayların sınavlara hazırlanırken grup çalışması yöntemini tercih etmelerine yardımcı olabilir.

Öğretmen adaylarının alan derslerine daha çok, genel kültür derslerine ise daha az çalıştıkları tespit edilmiştir. Bu durum, eğitim fakültelerinde okutulan genel kültür derslerinin çok fazla önemsenmediğine yönelik bir sonuç olabilir. Bir başka açıdan bakıldığında, genel kültür derslerinin lisede de görülmesinden dolayı öğrencilerin bu dersleri kolay olarak algılaması ya da bu derslerin öğrenilmesinin alan derslerine göre daha basit olması bu duruma sebep olarak gösterilebilir.

Öğretmen adaylarının sınavlara daha çok ilgili dersin kitabından, derste tutulan notlardan ve lise ders kitaplarından çalıştıkları ortaya çıkmıştır. Bu durum, öğretmen adaylarının ders çalışma kaynaklarının çeşitliliğinin bir göstergesi olabilir. Ayrıca, öğrencilerin sınavlara daha çok kendi odalarında, etüt odalarında ve evde çalıştıkları belirlenmiştir. Öğretmen adaylarının sınavlara hazırlanırken daha çok bu ortamlarda ders çalışmaları üniversite kütüphanesinin yetersiz oluşundan veya kalabalık oluşundan kaynaklanmış olabilir. Belki de evde, yurtta ve kendi odalarında çalışmak öğretmen adaylarının daha rahat olmalarına sebebiyet vermektedir.

Öğretmen adaylarının sınavlarda çoktan seçmeli, açık uçlu ve karışık türden soruların sorulmasını daha çok istedikleri belirlenmiştir. Özellikle, öğrencilerin sınav sorularının çoktan seçmeli olması yönündeki isteklerine bakılırsa, ortaöğretimde ve üniversiteye hazırlanma sürecinde alıştıkları bir sınav türü olması nedeniyle bunu sürdürmek istemeleri beklenen bir durumdur.

Öğretmen adaylarının sınav ortamlarının özellikle sessiz, sıcak, sıraların geniş ve rahat olmasını istedikleri görülmüştür. Güneş (2008) çalışmasında, öğretmenlerin öğretim programına göre hazırlanan kaynaklardan yararlanmalarının, yapılandırmacı öğrenme ortamı oluşturmaları için yeterli olmadığını ortaya koymuştur. Dolayısıyla, sınav ortamının öğrenme ortamı kadar uygun olması gerektiği unutulmamalıdır. Öğretmen adaylarının başarılarının artmasında uygun öğrenme ortamlarının tasarlanmasının önemini göz önüne alırsak, benzer şekilde bu durumun sınav ortamlarına da yansıtılması gerekmektedir.

Öğretmen adaylarının sınav öncesinde "kopya hazırlanıp hazırlanmadığının kontrol edilmesi", "sınavda çıkacak konular hakkında bilgi verilmesi"; sınav sırasında "araç-gereç yardımının serbest olması", "kopya içerikli her şeyin yasak olması"; sınav sonrasında ise "ihtiyaç halinde sınav kâğıtlarına bakabilmenin serbest olması", "sınav sorularının derste çözülmesi" ve "sınav hakkında konuşmanın yasaklanması" yönünde öneriler verdikleri tespit edilmiştir. Özdemir ve Üzel (2010) çalışmalarında, öğretmen adaylarının öğrencilerine tarafsız davranan, sınav sorularını basitten karmaşığa göre hazırlayan, derste anlatmadığı konularla ilgili soyu sormayan, öğrencinin sınav sonrası kâğıdına bakmasına izin veren, değerlendirme kriterleri açık olan, not kaygısı oluşturmayan, ödev yapmaya özendiren ve ödev yapan öğrencileri ödüllendiren öğretim elemanlarını / üyelerini tercih ettiklerini belirtmiştir. Bu durum, çalışmanın bazı bulgularını destekler niteliktedir. Buradan, öğretmen adaylarının sınav kaygısı duymayacakları, severek ve isteyerek ders çalışacakları bir sınav ortamı hazırlayan öğretim elemanlarına / üyelerine ihtiyaç duydukları söylenebilir.

Son olarak öğretmen adaylarının açık uçlu sınavlarda beş, çoktan seçmeli sınavlarda yirmi beş soru sorulmasını ve sınavların süresinin bir saati geçmemesini arzu ettikleri elde edilen sonuçlar arasındadır. Öğrencilerin bu şekilde düşünmelerinde, alan ve alan eğitimi derslerinin sınavlarında hocaların genelde açık uçlu beş soru sormaları ayrıca öğretmenlik meslek bilgisi ve genel kültür derslerinin sınavlarının daha çok çoktan seçmeli 25 soruluk sınavlar şeklinde yapılması ve bu sınavların bir saati geçmemesi etkili olmuş olabilir.

ÖNERİLER

Araştırmanın sonuçları dikkate alınarak yeni araştırmalar için aşağıdaki öneriler sunulmuştur:

1.Öğretmen adaylarının önerilerinden yola çıkarak sınavlarda sessiz ortamların hazırlanması, sınav öncesinde öğrencilerin kopya hazırlayıp hazırlamadıklarının kontrol edilmesi, sınav sırasında araç-gereç yardımının serbest bırakılması ve sınav sonrasında gerekli olması halinde yazılı kâğıtlarının görülmesi sağlanabilir.

2.Bazı öğrencilerin sınavlara üniversite kütüphanelerinde çalıştıkları dikkate alınarak, kütüphanelerin imkânlarının artırılması faydalı olabilir.

3.Öğretim elemanları / üyeleri, sınav kaygısı ile başa çıkma konusunda öğretmen adaylarını cesaretlendirme yoluna gidebilirler.

4.Sınav kaygısı ile başa çıkma bağlamında üniversitelerin rehberlik ve psikolojik danışma bölümü öğretim elemanlarının / üyelerinin ya da son sınıf öğrencilerinin yürütücülüğünde çeşitli grup rehberliği etkinlikleri düzenlenebilir.

5.Öğretmen adaylarının süreç boyunca girdikleri sınavların günlük yaşamın bir parçası olduğuna alışmalarına yardımcı olunabilir. Böylece, adayların sınav kaygısından uzak, motivasyonu yüksek bir şekilde derslerde daha başarılı olmalarına zemin hazırlanabilir.

6.Öğretmen adaylarının spor, sanat ve sosyal etkinliklere ya da öğrenci kulüplerine yönelmeleri sağlanabilir. Bu konularda öğretim elemanlarına / üyelerine ve fakülte yöneticilerine önemli sorumluluklar düşmektedir.

7.Bu çalışmanın sonuçlarına, bir devlet üniversitesinin eğitim fakültesinin ilköğretim matematik öğretmenliği programında öğrenim gören öğretmen adaylarının düşüncelerinden elde edilen bulgularla ulaşılmıştır. Üniversitelerin (devlet-vakıf) farklı ana bilim dallarında (sınıf, okul öncesi öğretmenliği vb.) öğrenim gören öğretmen adayları ile karşılaştırmalı daha kapsamlı araştırmalar yapılabilir.

8.Bu çalışma, sadece öğretmen adayları ile yapılmış olup daha geniş kapsamlı bir inceleme için öğretim elemanlarının / üyelerinin, öğretmenlerin, ortaokul ve ortaöğretim öğrencilerinin görüşleri alınabilir.

9.Öğretmen adaylarının sınav öncesindeki, sırasındaki ve sonrasındaki durumlarını daha iyi ortaya çıkarabilmek için gözlemler yapılabilir.

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THE IMAGES OF SCIENTIST ON MIDDLE SCHOOL STUDENTS WHO MAKE PROJECT TO SCIENCE FAIR AND ITS EFFECTS ON THEIR LIVES

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ABSTRACT: The aim of this study is to determine the images of scientists on middle school students who make project to science fair and its effects on their lives. The research was conducted in the spring term of 2014-2015 academic year in Ankara. It was designed as a case study in qualitative research methodology. Totally 34 students attended to the research. The 17 of them made project in TUBITAK 4006 Science Fair and the other 17 who selected randomly in school did not make a project. Data were collected through DAST (draw a scientist test) test developed by Chambers (1983). Beside this, an open-ended questionnaire which was developed by researchers used to determine students who make project to science fair and its effects on their lives. The results were obtained from comparing two groups' responds. Content analysis was used for the analysis of data. While making content analysis, it was pointed out that the original expressions were used in the determined categories. To ensure the validity and reliability, the data was analyzed on the basis of consensus. The findings were interpreted according to calculation of the repetition frequencies of the specified code in each category. The results showed that students who made project and not made projects have same perceptions on physical properties of the scientists. However, the expression frequencies of the students who made project like "continuously drink coffee, his eyes swollen and a man working hard in its time separation" and "science cannot be an age limit for producing scientific information regarding the age of the people," are take attention. The opinions about scientists produce scientific knowledge and share this information (broadcasting) has only expressed by the students on the project group. According to the result of the experiences in the process of preparation for the science fair showed that there was a positive effect for learning, increased their curiosity towards science, enjoyed them this experience. Beside these, the impact of the project on the career choices of students examined and the majority of the students stated that the project contribute to their career choices.

Key words: The images of scientist, science fair, DAST, science education.

BİLİM FUARINA PROJE ÜRETEN ORTAOKUL ÖĞRENCİLERİNİN BİLİM İNSANI İMAJLARI VE BİLİM FUARININ ÖĞRENCİ YAŞANTILARINA ETKİSİ

ÖZET: Bu araştırmanın amacı bilim fuarına proje üreten ortaokul öğrencilerinin sahip oldukları bilim insanı imajını belirlemek ve kendi yaşantılarına etkisini araştırmaktır. Araştırma 2014-2015 eğitim öğretim yılı ikinci döneminde Ankara'da gerçekleştirilmiştir. Araştırma nitel araştırma metodolojisinden durum çalışması olarak tasarlanmıştır. Çalışma grubu Tübitak 4006 Bilim Fuarı Projesine katılan ve proje geliştiren 17, projede görev almayan ve rastgele seçilen 17 olmak üzere toplam 34 öğrenci oluşturmaktadır. Veri toplama aracı olarak Chambers (1983) tarafından geliştirilen DAST (Bir Bilim İnsanı Çiz) testi kullanılmıştır. Ayrıca bilim fuarına proje hazırlayan öğrencilerin deneyimlerinin kendi yaşantılarına olan etkisini belirlemek için araştırmacılar tarafından hazırlanan açık uçlu sorular kullanılmıştır. Bilim fuarına proje hazırlayan öğrencilerin bilim insanı imajı ve bilim fuarının kendi yaşantılarına etkisi, bilim fuarı hazırlık sürecine katılmayan öğrenciler ile karşılaştırılarak belirlenmiştir. Verilerin analizinde içerik analizi kullanılmıştır. İçerik analizi sırasında var olan kategorilerde, verilen cevap içerisinde belirtilen ifadelerin kullanılmasına özen gösterilmiştir. Geçerlik ve güvenirliğin sağlanması için veriler görüş birliğine dayalı olarak analiz edilmiştir. Her bir kategoride belirlenen kodun tekrarlanma sıklıkları hesaplanarak bulgular yorumlanmıştır. Araştırma sonuçlarında bilim insanının fiziksel özelliklerine ilişkin proje geliştiren ve geliştirmeyen öğrencilerin algıları benzer olmakla birlikte, bilim fuarına katılan öğrencilerin fiziksel özelliklere yönelik; "sürekli kahve içen, gözleri şişmiş ve çok çalışmaktan kendine vakit ayırmayan bir insandır" şeklindeki görüşleri ve "bilim insanının yaşına yönelik bilimsel bilgi üretmede yaş sınırı olamaz" gibi ifadelerinin sıkılığı dikkat çekmektedir. Bilim insanlarının bilimsel bilgi üretmesi ve bu bilgileri paylaşması (yayın yapma) konusundaki görüşler sadece proje grubundaki öğrenciler tarafından ifade edilmiştir. Bilim fuarına hazırlık sürecinde edinilen deneyimin kendi hayatlarına ne kattığı yönündeki görüşleri incelendiğinde ise, fen dersini öğrenmeye yönelik olumlu bir etkisi olduğu, bilime karşı

meraklarının arttığı, bu deneyimin kendilerine keyif, verdiği şeklindeki ifadeleri dikkat çekmektedir. Projenin öğrencilerin meslek seçimlerine etkisi incelenmiş ve öğrencilerin büyük bir çoğunluğunun meslek seçimlerine katkı sağladığını ifade ettikleri belirlenmiştir.

Anahtar Sözcükler: bilim insanı imajı, bilim fuarı, DAST, fen eğitimi.

GİRİŞ

Öğrencilerin bilim insanı hakkındaki imajları fen eğitiminde önemli bir araştırma konusudur (Örneğin: Chambers, 1983; Karaçam, 2016; Cakmakci, Tosun, Turgut, Orenler, Sengul, & Top, 2011; Leblebicioğlu, Metin, Yardımcı, & Çetin, 2011; Kaya, Dogan, & Öcal, 2008; Erten, Kıray, & Şen-Gümüş, 2013). Çünkü bilim insanı algısı öğrencinin bilime olan yaklaşımını ortaya koymada önemli bir ipucu olmaktadır. Diğer bir taraftan bilim insanları da toplumun bilime, biliminde topluma olan algısını oluşturmada önemli bir rol oynamaktadır (Martín-Sempere, Garzón-García, & Rey-Rocha, 2008). Finson (2002)'a göre öğrencilerin sahip oldukları bilim insanı algıları onların bilime ilişkin tutumlarını, kontrol odaklarını, öz yeterlikleri ile kariyerlerini bilimle ilgili alanlardan seçmeleriyle de ilişkilidir. Bu doğrultuda bu çalışmayla bilim fuarlarının bilim insanı algılarına etkisini değerlendirmek araştırmacıların sonuçlarına paralellik gösterip göstermediğini belirlemek ve benzer çalışmalara yön vermek amaçlanmıştır.

Bilim fuarları öğrencilerin ilgi alanlarına göre belirledikleri araştırmaları yapmaları ve araştırmalarının sonuçlarını sergileyebilecekleri, kendileri ve izleyiciler için eğlenerek öğrenebilecekleri bir ortam oluşturmayı amaçlamaktadır (Türkiye Bilimsel ve Teknolojik Araştırma Kurumu [TÜBİTAK], 2016). Bu süreçte öğrenciler oldukça aktif katılımla çalışmalarını sürdürmek zorundadır. Bunun amacı bir anlamda yapılandırmacı yaklaşımın ön gördüğü yaparak yaşayarak kalıcı öğrenmeler yaşamasını sağlamaktır. Gerber, Cavallo ve Marek (2001), bilgiyi edinme süreci içerisinde bireyler ne kadar çok aktif olursalar, o kadar kısa sürede kalıcı öğrenmeleri gerçekleştirebileceklerini belirtmişlerdir. Bozdoğan (2007) özellikle ilköğretim düzeyinde edinilen bilgilerin, somut olarak sunulması, yapılan çalışmalarda bireylerin kalıcı öğrenmelerine daha çok etkisinin olduğunu ortaya koyduğunu ifade etmiştir. Jeffs ve Smith, (2005), informal ortamlarda, bilinçli bir şekilde, doğal öğrenmelerin gerçekleştiğini ve bireylerin "ne öğrendiklerini" keşfetmeleri konusunda cesaretlendirici bir rol üstlendiğini belirtmiştir. Ancak okulların sahip oldukları olanaklar belirli sınırlar içerisinde kalmaktadır. Bu nedenle okuldaki eğitime ek olarak hazırlanacak informal öğrenme ortamları; öğrenme için gerekli olan desteğin yanı sıra, kendini ifade edebilme, özgüven, akran iletişimi gibi sosyal becerileri arttırması ve bilginin sosyal etkileşimle kazanılmasına da imkân sağlamaktadır (Doğan, Çavuş, & Güngören, 2011; Bozdoğan, 2007; Gerber, Cavallo, & Marek, 2001). Yaşar ve Baker (2003) eğitimcilerin, bilim fuarlarındaki uygulamaların öğrencilerin bilgi, beceri ve tutumlarını gelişimleri ile gelecekte başarılı bir kariyer oluşturmalarını sağlayacak en iyi yol olarak gördüklerini ifade etmiştir. Bu doğrultuda bilim fuarlarının bireylerin bilim insanını algılamadaki etkilerini incelemek gerekmektedir.

Bilim insanı imgesi/algısı/imajı kavramı ilk olarak 1957 yılında Mead ve Metraux tarafından araştırılmaya başlanmıştır. Daha sonraki yıllarda yazılı doküman hazırlama tekniğiyle birlikte Likert tipi ve anlamsal farklılık ölçekleri geliştirilerek öğrencilerin bilim insanı algıları betimlenmeye çalışılmıştır (Karaçam, 2016). 1980'li yıllara gelindiğinde ise Chambers (1983), Mead ve Metraux(1957)'un sonuçlarını temel alarak Bir Bilim İnsanı Çiz Testi (Draw –A Scientist Test - DAST) isimli ölçeği geliştirmiştir (Toğrol Yontar, 2000). Bu ölçek çok sayıda araştırmacı tarafından farklı yaş gruplarındaki katılımcıların bilim insanına yönelik imajlarını belirmede kullanılmıştır. Chambers, Amerika Birleşik Devletleri, Avusturalya ve Kanada'dan 4807 okul öncesinde beşinci sınıfa kadar okuyan çocuk üzerinde yaptığı araştırmasında, bilim insanlarının genellikle *erkek, laboratuvar önlüklü, gözlüklü, sakallı, dağınık saçlı, deney malzemeleri ile meşgul kişiler* olarak algılandıklarını belirlemiştir (Ağgül Yalçın, 2012). Chambers (1983) araştırmasını farklı sınıf düzeyi, cinsiyet gibi değişkenlerle de ilişkilendirerek sunmuştur.

Karaçam (2016) çalışmasında, bilim imajına ilişkin alanyazınındaki çalışmaları bazı değişkenlerle arasındaki ilişkiyi incelemelerine göre sınıflandırmıştır. Buna göre cinsiyet, öğrenim düzeyi, kültür, öğrenim alanı, sosyo-ekonomik düzey gibi değişkenlerle bilim insanı imajı arasındaki ilişkiler araştırmacılarca incelenmiş araştırma alanlarıdır (Karaçam, 2016). Bunun yanında bazı araştırmacılar ise ders kitapları (Karaçam, Aydın, & Digilli, 2014), bilim kampı (Leblebicioğlu ve diğ., 2011), üstün yetenekli öğrenciler (Bayri, Köksal, & Ertekin, 2016), kanıt temelli uygulamalar (Çakmakçı ve diğ., 2011) gibi araştırmalarla da katılımcıların bilim insanı imajını belirlemeye çalışılmıştır. Ancak bilim fuarına katılan öğrencilere yönelik çalışmalara erişilen alanyazınında bilim insanı imajına yönelik çalışmalara rastlanmamıştır. Bu araştırmanın amacı da bu konuya eğilerek yeni çalışmalara ve araştırmacılara ışık tutmaktır. Araştırmanın problem cümlesi "Bilimsel faaliyetlerin (Bilim Fuarı) ortaokul öğrencilerinin sahip oldukları bilim insanı imajına ve kendi yaşantılarına etkisi nasıldır?" olarak belirlenmiştir.

YÖNTEM

Araştırma Modeli

Bilimsel faaliyetlerin bilim insanı imajı ve öğrenci yaşantılarına etkisini belirlemeyi amaçlayan bu araştırma, 2014-2015 eğitim öğretim yılı ikinci dönemi boyunca Ankara'da bir ortaokulda gerçekleştirilmiştir. Araştırma nitel araştırmalardan durum çalışması olarak tasarlanmıştır. Yin durum çalışmasını "güncel bir olgunun gerçek yaşam bağlamında, özellikle bağlam ve olguların sınırlarının kesin olarak belli olmadığı durumlarda görgül olarak araştırılması" şeklinde ifade etmektedir (Yin, 1994 s.13 akt. Merriam, 1998, s.27).

Çalışma Grubu

Çalışma grubunu Tübitak 4006 Bilim Fuarı Projesi kapsamında çalışan ve bu süreçte proje geliştiren 17 öğrenci ile aynı okulda öğrenim gören ancak proje kapsamında yer almayan ve rastgele seçilen 17 olmak üzere toplam 34 ortaokul öğrencisi oluşturmaktadır. Öğrenciler 5-8. sınıf aralığında farklı sınıf seviyelerinde öğrenim görmektedir ve yaşları 11 ile 14 arasında değişmektedir.

Veri Toplama Araçları ve Verilerin Analizi

Veri toplama aracı olarak Chambers (1983) tarafından geliştirilen DAST (Bir Bilim İnsanı Çiz) testi kullanılmıştır. DAST, öğrencilerin bilim insanlarına yönelik tutumları hakkında bilgi sağlamak için hazırlanmış açık uçlu bir testtir. Çalışmada öğrencilerden "bilim insanı" denince zihinlerinde canlanan resmi çizmeleri istenmiştir. DAST'ın geçerliği öğrencilerin çizdikleri bilim insanı resmine yönelik sorulan destekleyici ve detaylandırıcı sorular ile sağlanmıştır. Bununla birlikte projede çalışan öğrencilerin deneyimlerinin kendi yaşantılarına olan etkisini belirlemek için araştırmacılar tarafından hazırlanan açık uçlu sorular yoluyla da veri toplanmıştır. Öğrencilerin favori bilim insanlarını belirlemek amaçlı bir soruya da yer verilmiştir. Verilerin analizinde içerik analizi kullanılmıştır. İçerik analizinin amacı okuyucuya benzer ifadelerin bir araya getirilerek daha anlamlı sunulmasını sağlamaktır (Yıldırım, & Şimşek, 2006). İçerik analizi sırasında kategorilerde anlamsal kaymalara neden olmamak için, verilen cevap içerisinde belirtilen ifadelerin kullanılmasına özen gösterilmiştir. Geçerlik ve güvenirliğin sağlanması için de araştırmacılar arasında görüş birliğine dayalı analize özen gösterilmiştir. Bunun sonucunda her bir kategoride belirlenen kodun tekrarlanma sıklıkları hesaplanmış ve buna göre bulgular yorumlanmıştır.

BULGULAR

Bilim İnsanının Fiziksel Özelliklerine İlişkin Bulgular

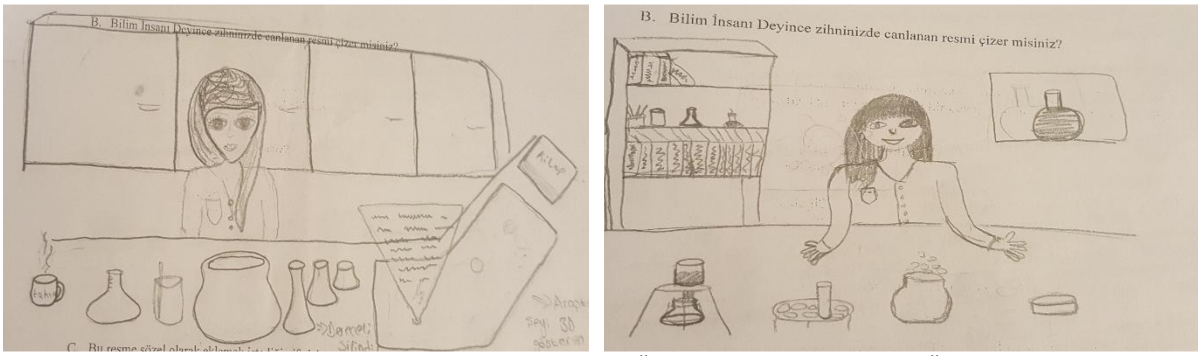
Bilim insanının fiziksel özelliklerine ilişkin proje geliştiren ve geliştirmeyen öğrencilerin bilim insanının "Laboratuvar Önlüklü ve gözlüklü" olması bakımından algılarının benzer olduğu gözlenmiştir. Proje geliştirmeyen grupta bilim insanının kirli, kötü kokan ve dağınık kıyafetler giydiğine, saçlarının dağınık ya da kabarık ve sakallı olduğuna ilişkin bulguların sıklığı dikkat çekmektedir. Bununla birlikte proje geliştiren öğrencilerin bilim insanının fiziksel özellikleri; rahat kıyafetler giyen, gözlüklü ve sakalsız olduğu belirlenmiştir. Ayrıca bu öğrenciler bilim insanlarını sürekli kahve içen, gözleri şişmiş ve çok çalışmaktan kendine vakit ayıramayan bir insandır şeklindeki görüşleri dikkat çekmektedir.

Bilim İnsanın Yaşına İlişkin Bulgular

Bilim fuarına proje geliştirmeyen grupta yer alan öğrencilerden bilim insanının yaşının 60 ve üzerinde olduğunu ifade eden öğrencilerin oranının yüksek olduğu gözlenmiştir. Bununla birlikte proje geliştiren öğrencilerin bilim insanının yaşına yönelik "*yaşla ilgili değil yeter ki bilimsel bilgi üretsin", "bilimin yaşı olmaz", "yaş sınırı yoktur kendine güvenen başarabilirim diyen herkes bilim insanı olabilir", "yaş sınırlaması olmaz"* gibi ifadeleri sık kullandıkları belirlenmiştir.

Bilim İnsanının Cinsiyetine İlişkin Bulgular

Proje geliştirmeyen grupta yer alan 17 öğrenciden 16'sı, bilim insanının cinsiyetini "erkek" olarak ifade etmiştir. Proje geliştiren grupta yer alan 17 öğrencinin 12'si ise bilim insanının cinsiyetini "kadın", 5'i "erkek" olarak ifade etmiştir. Aşağıda bazı öğrencilerin çizimlerine yer verilmiştir.



Şekil 1. Proje Grubunda Yer Alan Bazı Öğrencilerin Çizimlerine Örnekler

Bilim İnsanının Kullandığı Bilimsel Araçlara İlişkin Bulgular

Proje geliştiren grupta bilim insanının kullandığı araç gereçlere yönelik verilen örneklerin oldukça çeşitli olduğu (beherglas, koruyucu gözlük, deney tüpü, güç kaynağı, sac-sac ayağı, kitap-ansiklopedi, bilgisayar, laptop vb., 3D hologram, ispirto ocağı, erlen, dereceli silindir, balon joje, kimyasal madde, DNA modeli, atom modeli, termometre, plazma küresi, mikroskop, mıknatıs) gözlenmiştir. Ancak proje geliştirmeyen gruptaki öğrencilerin ise yalnızca "beher, mikroskop, deney tüpü, teknolojik aletler" gibi araçları çizmiş ya da ifade etmiş oldukları ve örneklerin sınırlı çeşitlilikte olduğu belirlenmiştir.

Bilim İnsanının Uğraştığı İşlere İlişkin Bulgular

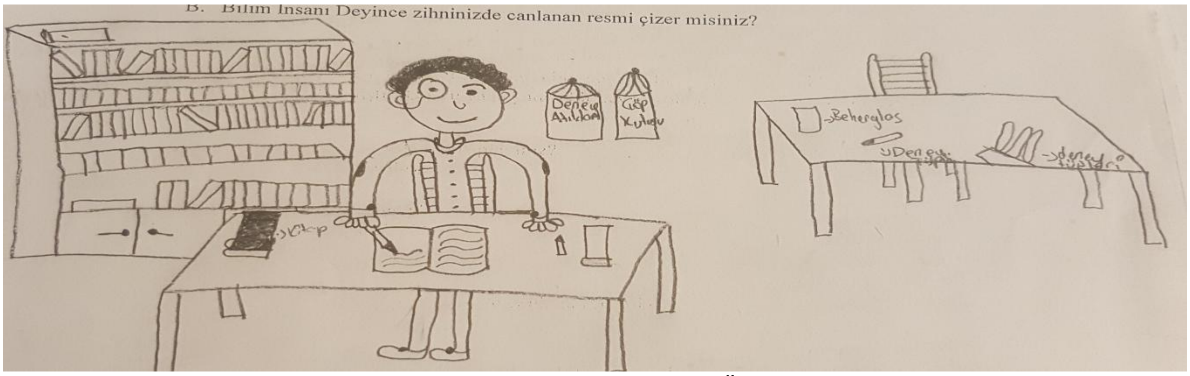
Bilim insanlarının uğraştığı işlere ilişkin elde edilen bulgular Tablo 1'de sunulmuştur.

Tablo 1. Bilim İnsanının Uğraş Alanına Yönelik Öğrenci Görüşlerinin Dağılımı

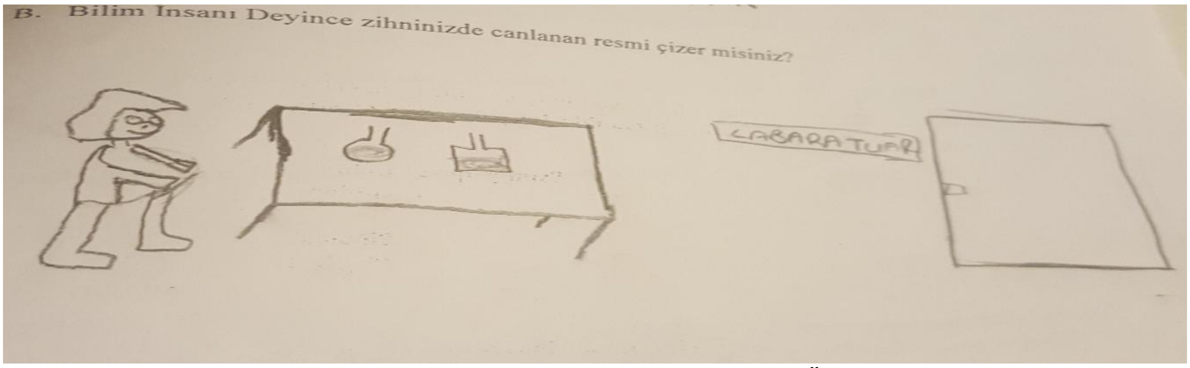
Uğraş alanı	Proje Geliştiren Grup (f)	Proje Geliştirmeyen Grup (f)
Deney	5	6
Araştırma	5	2
Bilimsel bilgi üretir (teori, kanun..)	4	-
Yayın yapar	1	-
Bilinmeyeni bulmaya çalışır	3	-
Fen bilimleri / Bilim	1	7
İcat	5	3
Teknoloji	1	2
Laboratuvar	1	1
Hayvanlar	1	-
İnsan hayatı (yararlı işler)	4	3
Doğa	1	-
Dünya	1	-
Sürekli çalışır	1	-
Keşif yapar	2	-
Proje	1	-
Toplam	**37**	**25**

Öğrencilerin bilim insanlarının hangi işlerle uğraştıklarına yönelik görüşleri incelendiğinde proje geliştiren öğrencilerin bu konuda daha fazla görüş belirttikleri belirlenmiştir. Her iki grup tarafından da bilim insanlarının daha çok deney ve araştırma yaptığı ifade edilmiş olmakla beraber, bilim insanlarının en önemli görevi olan bilimsel bilgi üretmesi ve bu bilgileri paylaşması (yayın yapma) konusundaki görüşler sadece proje geliştiren öğrenciler tarafından ifade edilmiştir.

Proje geliştiren gruptaki öğrenciler tarafından ifade edilen bilinmeyeni bulmaya çalışma, hayvanlar, doğa, dünya, proje, keşif yapma ve sürekli çalışma kategorileri proje geliştirmeyen öğrenciler tarafından ifade edilmemiş ayrıca bu öğrencilerin büyük bir çoğunluğu kendilerine yöneltilen soru kökünden etkilenerek bilim cevabını verdikleri belirlenmiştir. Öğrenciler bilim insanlarının teknologlar gibi icatlar yaptıklarını da belirtmişlerdir. Buna paralel olarak proje geliştiren gruptan 1, proje geliştirmeyen gruptan ise 2 öğrenci bilim insanlarının teknolojiyle uğraştıklarını belirtmiştir.



Şekil 2. Proje Grubunda Yer Alan Bir Öğrencinin Çizimi



Şekil 3. Proje Geliştirme Sürecinde Yer Almayan Bir Öğrencinin Çizimi

Favori Bilim İnsanına İlişkin Bulgular

Öğrencilerin favori bilim insanlarına yönelik görüşleri Tablo 2'de sunulmuştur.

Tablo 2. Öğrencilerin Favori Gösterdikleri Bilim İnsanlarının Proje Geliştiren ve Geliştirmeyen Gruplara Göre Dağılımı

Bilim insanı	Proje Geliştiren Grup (f)	Proje Geliştirmeyen Grup (f)
Einstein	11	14
Edison	7	6
Graham Bell	6	1
Lemark	1	
Mendel	1	1
Newton	2	
Leonardo Da Vinci	2	
Democritus	2	
Darwin	1	
Pastör	1	
Rutherford	1	
Madame Cruie	1	
Steve Jops	1	
Stephen Hawking	1	
Öğretmenim	2	
Toplam	40	22

Öğrencilerin favori bilim insanları incelendiğinde % 40'ının Einstein'ı favori gösterdiği belirlenmiştir. Daha sonra en çok favori olarak gösterilenler ise Edison ve Graham Bell olmuştur. Ayrıca proje geliştiren grupta favori olarak gösterilen bilim insanlarının çeşitliliği dikkat çekmekle birlikte 2 öğrenci kendi ders öğretmenini de favorisi olan bilim insanlarına dâhil etmiştir. Sanata olan katkılarıyla tanınan Da Vinci'de proje geliştiren öğrenciler tarafından favori gösterilmiştir.

Bilim Fuarına Proje Geliştirmenin Öğrenci Yaşantısına Katkısına İlişkin Bulgular

Bu araştırmanın ikinci problemi bilim fuarına katılarak proje hazırlayan öğrencilerin bu deneyimlerinin kazanımlarını belirlemektir. Bu doğrultuda bu deneyimin kendi hayatlarına ne kattığı yönünde görüşleri sorulmuştur. Elde edilen bulgular Tablo 3'te sunulmuştur.

Tablo 3. Bilim Fuarının Öğrencinin Kendi Yaşantısına Etkisine Yönelik Görüşler

Kategoriler	f
Fen öğrenmeye olumlu katkı	3
Bilime karşı merakın artması	3
Keyif /heyecan/Mutluluk	3
Bildiklerimi anlatma/gösterme	2
Hayatın içinde bilimi görme	2
Tecrübe	1
Öğrendiklerini hayatta kullanma	1
Kendini değerli hissetme	1
Eğlendim	1
Fen dersine bakış açısının değişmesi	1
Bilime bakış açısının değişmesi	1
Daha çok öğrenmeliyim	1
Özgüven artışı	1
Meslek seçimi	1

Öğrenciler fen dersini öğrenmeye karşı *olumlu* bir etkisi olduğunu belirtmişlerdir. Ayrıca bilime karşı *meraklarının arttığını*, bu deneyimin kendilerine *keyif, heyecan ve mutluluk verdiğine* dikkat çekmişlerdir. Bunun yanında *bilimi hayatın içerisinde farkına varmalarını* ve *öğrendikleri bilgilerini kendi hayatlarına uygulamak* için sabırsızlandıklarını belirten öğrenciler olmuştur. Bilim fuarının öğrencilerin *kendi bilgilerini başkalarına anlatma* ve *bildiklerini gösterme* fırsatı da sağladığı ifade edilmiştir. Bu konuda *tecrübe kazandığını, kendini değerli hissettiğini, özgüvenin arttığını* ve *eğlendiğini* belirten öğrenciler de olmuştur. Bir öğrenci *fen dersine karşı bakış açısının değiştiğini* ifade ederken başka bir öğrenci ise *bilime karşı bakış açısının değiştiğini* ifade etmiştir. Bir öğrenci de *meslek seçimine katkı* sağladığını belirtmiştir.

Projenin öğrencilerin meslek seçimlerine etki edip etmediği de sorgulanmıştır. Buna göre öğrencilerin büyük bir çoğunluğu etkilediğini belirtirken, bir öğrenci etkilemediğini, iki öğrencinin de bu soruya cevap vermedikleri tespit edilmiştir. Etkilediğini belirten öğrencilerden üçü doktor olmaya karar verdiğini de ifade etmiştir. Bir öğrenci laboratuvarda araştırma yapabileceği bir meslek istediğini ifade etmiştir.

SONUÇ

Yeni kuşağın kariyerini bilim ve mühendislik gibi alanlara yönlendirmede doğru bilim ve bilim insanı imajına sahip olması gerekmektedir (Ambusaidi, Al-Muqeemi, & Al-Salmi, 2015). Bunu başarmak için ise doğru programlanmış bir öğrenme ortamı ve öğretmen önemli bir rol üstlenmektedir. Bu doğrultuda bilim fuarı gibi informal bir öğrenme ortamı oluşturmak öğretmenlerin ödevlerindendir. Ülkemizde özellikle TÜBİTAK tarafından 4006 koduyla öğretmenlerin desteklendiği bilim fuarı projeleri giderek artış göstermekte ve farklı eğitim seviyelerinde (ilkokul, ortaokul, lise) öğretmenlerce planlanmaktadır. Bu araştırmanın amacı da bu proje kapsamında gerçekleştirilen bilim fuarının ortaokul öğrencilerinin sahip oldukları bilim insanı imajına ve kendi yaşantılarına etkisini araştırmaktır. Bireylerin bilim insanı algılarını tespit etmeye yönelik farklı ülke, çalışma grubunda yapılan çalışmalar oldukça farklı değişken barındırmasına karşın aslında bireylerin birbirine benzer algılara sahip olduklarını göstermiştir. Genelde bilim insanını beyaz önlüklü, gözlüklü, kimyasal maddeler ve malzemelerle çevrili laboratuvar, çalışma odası veya mağara gibi kapalı ortamlarda yalnız çalışan bir erkek tanımladıklarını belirtmişlerdir (Karaçam, 2016). Bu araştırmada da benzer fiziksel özellikler hem proje geliştiren hem de geliştirmeyen öğrenciler tarafından belirtilmiştir. Ancak proje geliştirmeyen öğrenciler tarafından daha çok kullanılması dikkat çekmektedir.

Bilim insanının cinsiyetine ilişkin yapılan çalışmalar incelendiğinde bireylerin bilim insanını zihinlerinde daha çok "erkek" olarak canlandırdığını göstermektedir (Yontar, 2000; Chambers, 1983; Flick, 1990; Nuhoğlu & Afacan, 2011; Demirbaş, 2009). Ancak bu çalışmada proje geliştiren grupta yer alan öğrencilerin çoğunun bilim insanını "kadın" olarak resimlemeleri dikkat çekmektedir. Bu durumun projeyi yürüten öğretmenin kadın olmasından kaynaklanabileceği düşünülmektedir. Bu sonuç öğretmenin öğrenci yaşamındaki etkisi ve öğrenciye bakış açısı kazandırmadaki etkin rolü bakımından önem taşımaktadır. Alanyazında bilim insanın yaşına yönelik öğrencilerin algılarının genellikle orta yaş ve üzeri olduğu gözlenmektedir (Kara &Akarsu, 2013; Erdoğan-Camcı, 2013; Song & Kim, 1999; Korkmaz & Kavak, 2010). Araştırmada proje geliştiren öğrencilerin genel olarak herhangi bir yaş aralığı ifade etmektense bilimsel bilgi üretmede yaş sınırının olmayacağına yönelik yapmış oldukları yorumlar, ön plana çıkmaktadır. Ayrıca bu durum bilimsel bir faaliyetin içinde aktif olarak yer almanın ve bilimsel bilgi üretmenin o yaş seviyesinde de gerçekleştirilebileceğine olan inancın ve öz yeterliğin bir göstergesi olabileceği düşünülmektedir.

Yaşar ve Baker (2003) birçok çocuğun bilime olan ilgisinin bilim fuarında edindikleri tecrübelerden kaynaklandığını belirtmişlerdir. Ayrıca bilim fuarlarının öğrencilerin oldukça eğlendikleri yeni şeyler öğrendikleri ortam olarak görüldüğünü ifade etmişlerdir. Bu araştırmadaki sonuçlarda Yaşar ve Baker'in (2003) çalışmasını destekler niteliktedir. Öğrenciler bilime dair tecrübe kazandıklarını, hayatın içinde bilimi görme ve bileme karşı merakın artması, keyif, heyecan ve mutluluk gibi ifadeleri kullandıkları belirlenmiştir. Ayrıca bir bilimsel faaliyet içinde yer alan öğrencilerin bilim insanının kullandığı araçlara göstermiş oldukları çizimlere dair örneklerin çeşitliliği de bilim fuarında edinilen deneyimi ortaya koymaktadır.

Öğrencilerin bilim insanının uğraş alanı ile ilgili açıklamaları incelendiğinde proje geliştiren öğrencilerin daha çeşitli uğraş alanları ifade ettiklerini göstermektedir. Bilim insanlarının en çok "deney ve araştırma" yaptığı her iki grup tarafından da belirtilmiştir. Ağgül ve Yalçın'ın (2012) öğretmen adaylarıyla gerçekleştirmiş olduğu çalışmada "deney yapma, düşünme, gözlem yapma ve araştırma-inceleme yapma" yine yaygın bilim insanı aktivitesi olarak ifade edildiği belirlenmiştir. Araştırmanın bu bulguları Buldu (2006), Song ve Kim (1999)'in araştırma sonuçlarıyla da paralellik göstermektedir. Ancak bu araştırmalardan farklı olarak öğrencilerin bilimsel bilgi üretimine olan dikkatleri olmuştur. Bilim insanlarının en önemli görevi olan bilimsel bilgi üretmesi ve bu bilgileri toplumla paylaşması konusundaki görüşlerin sadece proje deneyimi yaşayan öğrenciler tarafından ifade edilmesi oldukça dikkat çekici bir sonuç olarak değerlendirilmektedir. Bu durumun bilim fuarı sırasında hazırladıkları projeleri rapor olarak sunmaları ve kendilerini bilim insanları ile özleştirmiş olmalarından kaynaklandığı düşünülmektedir.

Bireylerin favori bilim insanlarına yönelik araştırmalar incelendiğinde Ağgül-Yalçın'ın (2012) yapmış olduğu bir çalışmada en çok saygı duyulan bilim insanı olarak öğretmen adayları Einstein'ı görürken bunu Edison ve İbn-i Sina izlemektedir. Yine Nuhoğlu ve Afacan'ın (2013) ilköğretim öğrencilerinin bilim insanına yönelik düşüncelerinin değerlendirildiği çalışmalarında Edison, Demirbaş'ın (2009) araştırmasında ise Einstein favori bilim insanı olarak gösterilmiştir. Bu araştırmada benzer bir sonuç izlenmiştir. Öğrenciler en çok favori bilim insanı olarak Einstein'ı belirtmiş, onu Edison izlerken üçüncü sırada Graham Bell yer almıştır. Bu sonuçlar alanda yine favori bilim insanını araştıran araştırmalarla paralellik göstermektedir (Song & Kim, 1999). Bununla birlikte proje grubunda yer alan öğrencilerin favori gösterdikleri bilim insanlarının çeşitliliği proje geliştirme sürecinin araştırma ve sorgulama bağlamında öğrenciye katkısı açısından önemli olduğu düşünülmektedir. Ayrıca proje grubunda yer alan öğrencilerin favori bilim insanı olarak kendi öğretmenlerini göstermeleri yine öğretmenin öğrenci yaşamında en önemli rol modellerden biri olduğunu kanıtlar niteliktedir.

Araştırma sonuçları bilim fuarı projesinde görev almanın fen öğrenmeye, bilime bakış açısının değişmesi gibi olumlu katkılarının olduğunu göstermiştir. Bilim fuarına katılan öğrencilerin bu sürecin meslek seçimlerine katkı sağladığını ifade ettikleri belirlenmiştir. Bun karşın Yaşar ve Baker (2003), tüm bilim fuarlarının başarıyla sonuçlanmadığının da altını çizmiştir. Bazı öğretmenler öğrencilerin yapmış oldukları çalışmalarda akademik bir yarışmaya dönüştürdüğünü ve öğrencilerin yarışma içinde olmalarını sağladıklarını belirtmiştir. Bu durum ödül ya da yüksek puan kazanamayan öğrenciler için bilim fuarının hayal kırıklığına uğramasına neden olacaktır. Bu bağlamda bu türde araştırmalar yürütülürken önceliğin projenin başarıya ulaşmasından çok öğrencinin bilime yönelik tutumunu ve motivasyonunu artırmak ve sürecin öğrenci yaşamında bilimi sevdirmek adına bir pencere açmak olduğu unutulmamalıdır.

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ADVANCED EDUCATION TECHNOLOGY: VIRTUAL REALITY SIMULATION FOR MARINE FIRE FIGHTING TRAINING

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ABSTRACT: There are mandatory education programs for safety of life at sea. One of these programs is fire-fighting training on board ship. The fire-fighting training is an applied training which necessarily consists of basic and advanced levels. Because it is applied training, it has some advantages and also some disadvantages. In the applied fire training a real fire is started and real fire extinguisher is used. That's why these trainings are very expensive, harmful to human health and environment and have risk for human life. The developing technologies are promising to eliminate these disadvantages. One of these technologies is virtual reality. It is possible to simulate realistic environment and make the trainings very close to real fire-fighting using virtual reality glasses and some other equipment such as heat generator, breathing apparatus, fireman outfits etc. Thus, the trainers will realistically feel the fire while the risk for human life and damage to environment will be eliminated. Besides, the training expenditures will be reduced because the real equipment is not used. Even more, it is possible to simulate different environments and scenarios for different types of ships and different fire types. In this study, the fire-fighting training of seafarers is inspected and the contribution of virtual reality technology to these trainings is discussed.

Key words: environment, marine, risk, virtual reality, fire training

İLERİ EĞİTİM TEKNOLOJİSİ: GEMİLERDE YANGINLA MÜCADELE EĞİTİMİNDE SANAL GERÇEKLİK SİMÜLASYONU

ÖZET: Gemilerde can güvenliği ile ilgili zorunlu eğitimler mevcuttur. Bu eğitimlerden biri gemilerde yangın eğitimleridir. Gemilerde yangın eğitimleri uygulamalı eğitimler olup, temel ve ileri düzeyde verilmesi uluslararası bir zorunluluktur. Bu eğitimlerin uygulamalı olmasının avantajları olduğu gibi bazı dezavantajları da vardır. Uygulamalı eğitimlerde gerçek yangın çıkarılmakta ve gerçek yangın söndürücüler kullanılmaktadır. Bu nedenle bu eğitimler çok pahalı, çevreye ve insana zararlı ve insan hayatı açısından riskli hale gelmektedir. Yeni gelişen teknolojiler bu dezavantajları ortadan kaldırabilecek potansiyele sahiptir. Bunlardan biri sanal gerçeklik teknolojisidir. Sanal gerçeklik gözlükleri ve ekstra donanımlar (ısı, solunum cihazı, yangın giysisi vs.) kullanılarak oluşturulacak ortamlarda gerçeğe yakın eğitimler vermek mümkündür. Bu sayede öğrencilerde gerçek bir yangın hissi oluşturulurken kendilerine gelebilecek sağlık ve hayati riskler ortadan kaldırılmış ve çevreye hiçbir zarar verilmemiş olacaktır. Bunun yanında yangın malzemeleri kullanılmadığı için eğitim maliyetlerinde ciddi bir düşüş olacaktır. Ayrıca simülasyon ile çok farklı ortamlar ve senaryolar geliştirilerek farklı tipteki gemilere ve farklı yangın tiplerine göre senaryolar oluşturmak mümkün olacaktır. Bu çalışmada gemi adamlarının yangın eğitimi incelenerek sanal gerçeklik ortamının bu eğitime kazandıracağı avantajlar ele alınmıştır.

Anahtar sözcükler: çevre, gemi, risk, sanal gerçeklik, yangın eğitimi

GİRİŞ

Günümüzde konusu ve kapsamı eğitim olan her disiplin için teknolojiden yararlanmak artık bir zorunluluk olmuştur. Çağımız dijital çağ olarak anılmaktadır. Başarı için sürdürebilirlilik çok önemli bir kavramdır ve her sektörde olduğu gibi eğitim sektöründe de geçerliliği olan bir olgudur. Rekabet yalnızca endüstriyel sahalarda değil aynı zamanda eğitim sahalarında da geçerlidir ve hatta denilebilir ki, eğitim sektörü en başta gelmektedir. Dünyamız kabuk değiştiriyor ve tam anlamıyla dijital gençlik ya da nesil yetişiyor. Elbette bunlara kayıtsız kalınamaz. Bu nedenle eğitim artık bir sektör olmuştur. Modern dünyanın teknolojide hızla yol alması karşısında eğitim bilimlerinin buna kayıtsız kalması düşünülemez. Teknoloji, yetişen yeni nesillerin en önemli materyalleridir. Dolayısıyla teknoloji ve eğitim bir bütündür.

Sanal gerçeklik aslında insanoğlunun doğal hayatı içerisinde yabancı olmadığı bir durumdur. Rüyalar aslında sanal alemde yaşadıklarımızdır. Hiçbir insan rüyalarını kontrol edemez. Ancak insan eliyle oluşturulabilecek bir sanal gerçeklik ortamları daha kontrol edilebilir ortamlar olabilir. Bunun için ileri teknolojiler gereklidir. Bu sayede sanal gerçeklik ortamları ile istenilen simülasyonlar gerçekleştirilerek her türlü amaca uygun şekilde kullanılmaları sağlanabilir. Günümüzde tıptan, askeri amaçlara, eğitimden eğlence sektörüne kadar geniş yelpazede kendine kullanma alanları bulmuş olan sanal gerçeklik ortamları aslında onlarca yıl öncesinde keşfedilmişlerdir.

Sanal gerçeklik alanında ilk çalışma 1962 yılında Mortan Heilig tarafından yapılmıştır [1]. İnsanın tüm duyu organları ile bir tiyatro oyununu hissetmesini hayal ediyordu ve bunu ilk icadı olan Sensorama adlı bir makinesi ile başarmıştı. Makine geniş açılı üç boyutlu stereoskobik görüntü, vücut sarsma mekanizması, stereo ses çıkışı ve aromatik koku salınım yapan özelliklere sahipti. Sensorama, geliştirildiği yıl itibariyle izleyiciyi ortamın içine çekebilecek her türlü donanıma sahipti. Ancak Heilig yeteri kadar finansal destek bulamadğı için ilk düşü olan Sensorama' yı tozlu raflara kaldırmak zorunda kalmıştı.

Günümüzün sanal gerçeklik ortamlarına çok benzeyen çalışma ise 1968 yılında Amerikalı bir bilgisayar mühendisi olan Ivan Sutherland ve öğrencisi Bob Sproull tarafından yapılmıştı. Çalışmaları görüntünün çift mercekli bir dürbün yardımıyla bir ekrana aktarıldığı ve çok ağır olan bir kasktan oluşmaktaydı. Kask ağır olduğu için tavandan asılı bir donanım ile kontrol edilebilmekteydi ve bu nedenle bu buluşlarına "The Sword of Damocles" adını vermişlerdi. Sword of Damocles, sunduğu arayüz ve gerçeklik algısı bakımından günümüz kasklarıyla karşılaştırıldığında ilkel bir izlenim yaratsa bile modern kasklı ekranların gelişiminde önemli bir kilometre taşı olmuştur.

Sanal gerçeklik kavramı, tarihsel gelişim süreci içerisinde üretilen cihazların hiçbiri günümüzdeki anlamında kullanılmıyordu ve ilk olarak 1987 yılında klasik müzik yazarı ve aynı zamanda bir bilgisayar uzmanı olan Jaron Lanier tarafından ortaya atılmıştı. Benzeri özelliklere sahip cihazlar bu kavramın ortaya atılmasından sonra bir ünvan edinmiş oldular. İlerleyen yıllar içerisinde bilgisayar sektörü ve oyun programlarının hızla gelişim gösterdiği yıllar olduğundan sanal gerçeklik ortamları ile ilgili çalışmalarda artmaya başlamıştır. Virtual Boy, 1995 yılında geliştirilmiş ve üç boyutlu görüntü sağlayan ilk mobilize oyun konsolu olarak karşımıza çıkmaktadır. Bu oyun konsolu, fiyatının pahalı olması, uzun süre kullanımının yorucu olması ve kötü pazarlama sebebiyle piyasada fazla tutunamamıştır.

Son yıllarda yeniden gözde olmaya başlayan ve popülerliği hızla artan sanal gerçeklik teknolojisi kullanım kolaylığı, esnek ara yüzü, ucuz olması ve son derece basit yapılı olmaları ile göze çarpmaktadır. Özellikle sanal gözlükler ile oyun alanında çok önemli aşamalar kaydedilmiştir. Bu özellikleri ile sanal gerçeklik yalnızca eğlence sektöründe değil aynı zamanda eğitim sektörünün de ilgi odağı olmaktadır. Sanal gerçeklik ortamlarla eğitim daha ilgi çekici, daha eğlenceli ve bilgilerin, öğrencilerin sanal olarak oluşturulan ortamlarda interaktif etkileşimde bulunmasından dolayı, daha kalıcı ve net bir şekilde aktarımı söz konusu olabilmektedir. Yani bilgiyi edinme süreleri öğrenme sürelerinin artmasından dolayı kısalmaktadır. Özetle sanal gerçeklik ortamları ile eğitim materyallerinin geliştirilmesi ve öğrenim hayatına adapte edilmesi oldukça kolay ve etkili bit yol olacaktır.

Bu bildiride geleceğin gemi kaptanı ve gemi makineleri işletme mühendislerinin yetiştirildiği İTÜ Denizcilik Fakültesinde yer alan yangın eğitim merkezinin teknolojik modernizasyonu ve eğitimin teknolojik araç ve gereçlerle nasıl geliştirilebileceği ile ilgili araştırmaların sonuçlarına yer verilmiştir. Sanal gerçeklik ortamları ile gemi adamlarının temel ve ileri yangın eğitimlerinde kullanılmasının önemine vurgu yapılmış ve uygulanabilir bir yöntemden söz edilmiştir. Böylece daha ucuz, daha güvenli, ve daha çevreci ortamlarda yangın eğitimleri için simülasyonların sanal gerçeklik ortamlarında kullanılmasının önemi gösterilmiştir.

YÖNTEM

Eğitimde Yapılandırıcı Metot ve Sanal Gerçeklik

19. yüzyıla kadar örgün eğitimde dersler genellikle okuma-yazma eğitimi şeklinde gerçekleştirilmekteydi. Bu klasik yöntem modern dünyanın ihtiyacına cevap vermekte yetersiz kalmaya başlayınca araştırmacılar eğitimde yönlendirici ara yüzlerin etkisini araştırmaya başlamışlardı. Uygulamalı öğrenme olarak da bilinen bu çalışmaların ilk isimlerinden birisi Johann Heinrich Pestalozzi'dir. Pestalozzi öğrencilerin öğrenme sürecinde fiziksel aktiviteler yaparak ve duyularını daha aktif kullanarak öğrenmelerini önermiştir [4].

Özellikle bilgi edinme sürecinde pasif alıcı durumundan, aktif katılımcı duruma geçiş için öğretim yöntemlerinde önemli değişimler gerekmekteydi [5]. Bu ihtiyaçlara yanıt olarak, 1990'lı yıllardan itibaren yapılandırmacı öğrenme teorisine dayalı öğretime ilgi artmış [6-8]. Yapılandırmacı öğrenme, öğrenenin bilgiyi pasif olarak edinmesi değil, bilgiyi aktif olarak oluşturduğu bir süreç olarak anlaşılmaktadır [9].

Yapılandırmacı yaklaşıma en uygun pedagojik etkinlikler deney, tartışma, proje gerçekleştirme gibi faaliyetlerdir. Roussou (2004), bir sınıfta yapılandırmacı yaklaşımla öğretim yapabilmek için dinamik bir öğrenme ortamı hazırlamak ve mümkün olduğunca öğrenme ortamında fikirlerin test edilip, deneyimlenmesi gerektiğini ileri sürmüştür [10]. Kabul gören bu yaklaşımdan dolayı günümüzde yeni öğretim programlarının bireylerin daha bilgili ve üretken olmalarını sağlamak için esnek, ilgi çekici, yenilikçi ve yaratıcı olmaları gerektiği görüşü yaygınlaşmıştır. Özellikle bilişim teknolojilerinin okullarda yeni öğretim programlarını desteklemek amacıyla kullanılması ve bu programlarla bütünleşebilmesi okul içinde ve dışında gerçekleşen öğrenmelerin dönüşümünde önemli hale gelmiştir. Buna göre, sanal gerçeklik ile eğitimde yapılandırıcı uygulamalar gerçekleştirmek oldukça başarılı sonuçlar doğuracaktır.

Gelişen teknoloji öğrencilerin karmaşık içerikli konuları, sanal gerçeklik cihazları aracılığıyla eğlenceli ve kolay bir şekilde öğrenmelerini sağlayacaktır. Ayrıca öğrenciler bu ortamdaki nesneler ile etkileşime geçip onlar hakkında daha çok şey öğrenebilecektir. Bu sayede öğrencilere istenilen bilgi çok net ve açık bir şekilde anlatılabilecek, öğrencilerin konuyu doğru şekilde anlayacak ve öğrenme yüzdelerinde önemli ölçüde artışlar sağlanabilecektir.

Gemiadamlarının Yangın Eğitimleri: Klasik Yöntem

Bir gemi adamı iki farklı yangın eğitiminden geçerek, yeterliliğini kanıtlayan bir sertifika alması gerekmektedir. Bu yangın eğitimleri sırasıyla temel yangın eğitimi ve ileri yangın eğitimidir. Her iki yangın eğitimleri teorik ve uygulamalı olacak şekilde verilmektedir. Uluslar arası denizcilik örgütü (IMO); STCW sözleşmesi ile yangın eğitimlerinin içeriği ve şekli ile ilgili gerekli asgari standartları belirlemiştir. Bunlara ilave olarak eğitim kurumlarının müfredatlarının hazırlamasında yardımcı bir rehber niteliği taşıyan "IMO model kurslar" geliştirmiştir [11,12].

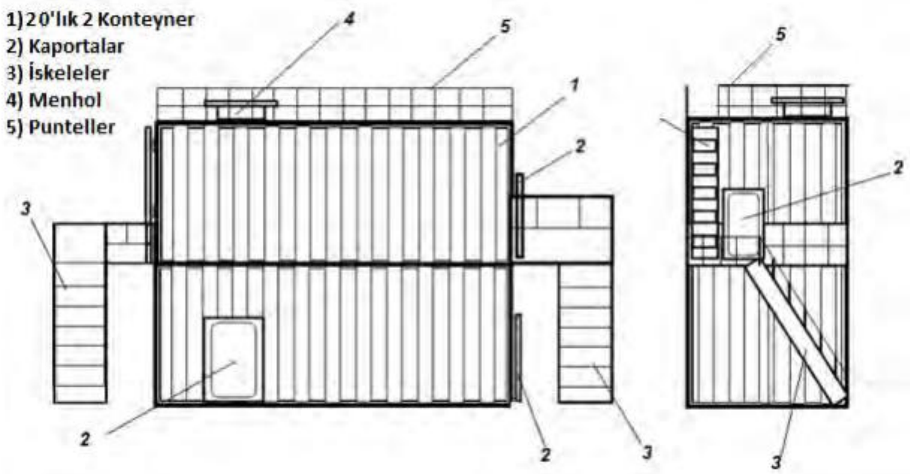
Temel yangın eğitimleri gemiadamı olmaya aday herkes için temel bir eğitimdir ve operasyon düzeyi yeterliliğine (gemi kaptanı ve ikinci kaptanı ile gemi baş mühendisi ve ikinci mühendisi ehliyetlerinin altında yer alan tüm yeterlilikler) sahip her gemiadamı sınıfı için uygulanmak zorundadır.

İleri Yangın Eğitimleri uluslar arası STCW sözleşmesinde yer alan ikinci tip yangın eğitimleridir ve Yönetim düzeyi yeterliliğine aday gemiadamlarına verilir. Bu eğitimi, yangınla mücadele faaliyetlerinde planlama ve yönetmekle sorumlu olan gemi adamları (yönetim düzeyi ehliyetlerine sahip gemi adamları: Kaptan ve ikinci kaptanı ile gemi baş mühendisi ve ikinci mühendisi), özellikle organizasyon, taktik ve komuta alanında olmak üzere yangınla mücadele tekniklerine yönelik ileri eğitim konularını kapsamaktadır.

Her iki tip yangın eğitimleri uygulamalar da içermektedir. Uygulamalı eğitimler gerçek gemi koşullarının simüle edildiği açık alan ve kapalı alanlardan ibarettir. Uygulamalarla öğrencilere çeşitli beceri ve yetenek düzeyi kazandırılmaya çalışılan bu sahalarda bulundurulması zorunlu olan araç ve gereçlerle, ekipman ve donanımlar T.C. Ulaştırma, Denizcilik ve Haberleşme Bakanlığının 2014 yılında çıkardığı "Gemiadamları Eğitim ve Sınav Yönergesi" nin Ek-31' de yer almaktadır (Şekil 1). Beklenen beceri düzeyi çıktıları şu şekildedir [13]:

- Farklı tipteki taşınabilir yangın söndürücüleri kullanabilme,
- Solunum cihazlarını kullanabilme,
- Küçük ölçekli yangınların söndürülebilmesi,
- Jet ve sprey su kullanarak büyük ölçekli yangınların söndürülebilmesi,
- Köpük, kimyasal toz ya da uygun kimyasal söndürücülerle yangın söndürme,
- Solunum cihazı olmaksızın, can halatıyla yüksek genleşmeli köpüğün uygulandığı bir bölmeye girebilme ve buradan geçebilme,
- Duman ortamında ve etrafı kapalı bir ortamda solunum cihazı kullanarak yangınla mücadele etmek,
- Su sisi veya başka bir uygun yangın söndürücü maddesi kullanarak yoğun duman ve yangın bulunan bir yaşam mahallinde veya simüle edilmiş bir makine dairesinde yangın söndürme,
- Akaryakıt yangınını sis aplikatörü, su püskürtme nozulları, kuru kimyasal toz veya köpük nozulları kullanarak söndürme,
- Solunum cihazı takarak duman dolu bir alanda kurtarma gerçekleştirebilme.

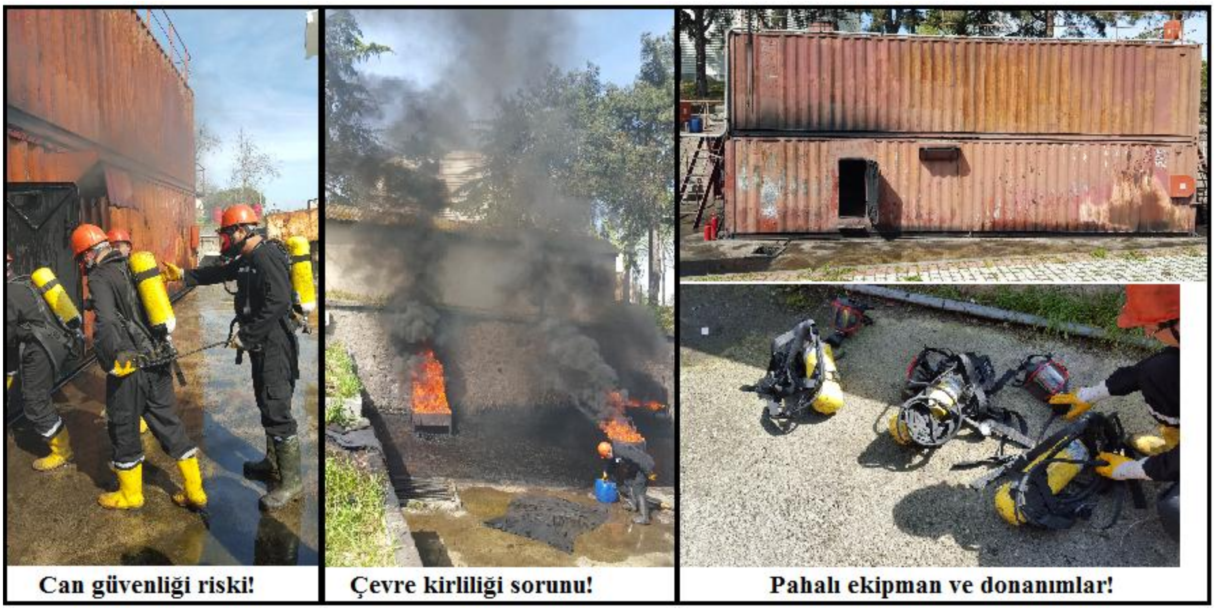
Şekil 1. Açık alan yangın uygulaması



Şekil 2. Gemiadamları eğitim ve sınav yönergesi ek-31' e göre istenen platform

Yangın Eğitiminde Teknolojik Yaklaşım: Önerilen Yöntem (Sanal Gerçeklik Yaklaşımı)

Klasik yöntemle yapılması istenen zorunlu yangın eğitimleri oldukça teferruatlı, donanımlı ve pahalı bir metottur. Ayrıca eğitimlerde öğrencilerin tecrübesizliği de dikkate alındığında tehlikeli bir yoldur. Bunun yanında çevre kirliliği de bu işin sıkıntılı başka bir boyutudur (Şekil 3). Özellikle kapalı mahalde yapılan uygulamalarda öğrencilerin sevk ve idaresi ve kontrolleri çok zorlaşmaktadır. Amacı gemi güvenliğinin sağlanması olan bu zorunlu eğitimlerde, öğrencilerin güvenliği riske atılmaktadır.



Şekil 3. İTÜ Denizcilik Fakültesi yangım eğitim sahası

Teknolojinin gelişmesi ile birlikte eğitsel uygulamalardaki bu riskler tamamen ortadan kaldırılması mümkündür. Günümüzde eğitim simülatörleri bu amaç için geliştirilmiş ve teknolojik açıdan en ileri düzeyde araç-gereçlerdir. Yangın eğitimleri için de bu amaçla simülatör tasarımları gerçekleştirilebilir. Bu bildiride temel düzey ve ileri düzey yangın eğitimleri için örnek bir simülasyondan söz edilmiştir.Bilindiği üzere bilgisayar tabanlı oyun programları ve bunların donanımları son yıllarda hızla gelişmiş ve hak ettiği yerine ulaşmıştır. Özellikle her yaştan insana hitap ediyor olması, kolay ulaşılabilmesinin yanında daha çevreci ve ekonomik uygulamalardır. Bu uygulamaların eğitim faaliyetlerinde de bir araç olarak kullanılması, bu sahalardaki gelişmelere bakıldığında, kaçınılmazdır. "Virtual Reality 3D" oyun gözlükleri veya diğer adıyla "Sanal Gerçeklik" gözlükleri oldukça popüler bir oyun donanımıdır (Şekil 3). Bu araçlarla bir ortamı bire bir simüle edilebilir. Kişi bu gözlüklerle gerçek bir ortamdaymış gibi hareket edebilmektedir. Geriye uygun ortam ve koşulların bilgisayar oyun programlarıyla geliştirmekten başka bir şey değildir.

Bu sayede istenilen eğitimler sanal ortamlarda uygulamalı olarak çok daha pratik, ekonomik ve hızlı bir şekilde yapılabilmektedir. Yapılan bir çalışmada bir yangın simülatörü için gerekli olabilecek yazılım ve donanımlar Tablo 1 'de verilmiştir [14]. Donanım bakımından böyle bir sistemin maliyeti 3000 USD civarındadır. Bu tür oyun programlarında yazılım daha pahalı olmaktadır. Ancak gerçek saha uygulamalarına göre ucuz bir yöntem olduğu rahatlıkla söylenebilir.

Tablo 18. Bir yangın simülatörü çevre birimleri ve özellikleri [14].

	Category	Specification
H/W	CPU	Xeon 2.66 GHz
	RAM	4GB (667 MHz)
	VGA	Quadro FX5600
	HDD	750GB (SATA2)
S/W	OS	WindowsXP
	Fire simulation	FDS 4.0
	FDS input editor	PyroSim 2006
	Graphics API	DirectX 9.0C
	Graphics library	OGRE3D 1.49
	3D Modeling	3DSMAX 2008
	Compiler	VisualC++ 2005

YORUMLAR

Genellikle sanal gerçeklik cihazı, kullanıcının hareketlerini algılayan sensörler ve elektronik devreler içeren bir kart, küçük iki ekrana sahip gözlük ve üç boyutlu görüntüler oluşturan bilgisayar ile çalışmaktadır. Bir konuda deneyim elde etmek için gerekli malzemeye ulaşılamadığında ya da ekonomik sorunlardan dolayı gerçek saha tesisleri kurmaya imkânlar el vermediğinde, sanal gerçeklik bir çözüm olarak karşımıza çıkmaktadır. Cihazın eğitimde kullanımı yaygınlaşmaktadır. Örneğin, Coğrafya dersinde öğrenci öğrendiği dağ, nehir ya da ovaya gidip, kendi gözleriyle görme hissini yaşayacak, tarih dersinde ise bir anlaşma imzalanıyorsa, orada kimlerin olduğunu kendi gözleriyle görüp, imzalanan belgede yazanları okuyabilecek. Bu bilgiler yaşanarak öğrenildiği için unutulmayacak bir deneyim olacak ve öğrencilerin öğrenme kapasitesini artıracaktır. Mimari çalışmalarda da, henüz proje aşamasında olan bir evin içerisinde gezip dolaşmayı sağlayabilecek özelliktedirler. Turizmde de tatile gidilmek istenen yeri önceden gezip görme olanağı sunabilirler. Sanal gerçeklikte teknolojisi üzerinde biraz daha çalışılarak, tıp alanında da kullanılabileceği bilim insanları tarafından söylenmektedir. Örneğin, öğrenciler sanal bir kadavra üzerinde çalışabilir ya da önemli bir ameliyat öncesi, doktorlar sanal olarak ameliyatın pratiğini yapıp, operasyonun başarısı artırabileceği ifade edilmektedir.

Şekil 4. Sanal gerçeklik gözlüğü

SONUÇLAR

Sanal gerçeklik ortamlarının eğitim sektöründe yararlanılması halinde sağlanan faydalar aşağıdaki şekilde özetlenebilir:

- Sanal gerçeklik teknolojileri eğitim sektöründe pahalı, can ve mal güvenliği riski taşıyan, deneyim isteyen tehlikeli uygulamalar için önerilebilir yapılandırıcı bir eğitim yöntemidir.
- Senaryolar üretmek eğitimcinin hayal gücü ile sınırlıdır.
- Eğitimin her kesiminde (Coğrafya, Tarih, Matematik vs.) kullanılabilirler.
- Sağlık açısından çok ciddi riskler taşımamaktadır.
- Çok büyük alan veya hacimlere ihtiyaç duyulmamaktadır.
- Kullanımı son derece basittir.
- Amaca göre yerli imkânlarla üretmek ve geliştirmek kolaydır.
- Öğrenciler için hem eğlenceli hem de kolay öğretici araçlardır.

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SIR CUMFERENCE SERIES (A MATH ADVENTURE) TURKISH MATHEMATICS EDUCATION PROGRAMS' COMPATIBILITY TALE BOOKS'

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ABSTRACT: The purpose of this research, Cindy Neuschwander's "Sir Cumference series (A Math Adventure)" fairy tale book called the elemantary school reveal the situation is no place for achievements in mathematics curriculum. In this study, because it allows to examine the scope of the research aims to evaluate the suitability of fairy tale books and teaching material document analysis method was used. As a data source in the study implemented in Turkey Education Programs' and the have benefited from Neuschwander table book. Within the framework of the fairytale book "Sir Cumference series" has been used fairy tale books. Tales developed by the researchers in the study of the book 'Tales book in the mathematics curriculum outcomes data collection form' is used. Offering by addressing the compatibility with the tale of the curriculum according to the findings of this research, especially that focus on concepts in fairy tales, so is determined to focus on more conceptual dimension of the operational aspect highlighted in the curriculum. Therefore, the primary school teachers' in math class when the species is advisable to include time-based events.

Key words: "Sir Cumference series (A Math Adventure)", mathematics education curriculum.

"SÖR ÇEPÇEVRE'NİN MATEMATİK MACERALARI" ADLI MASAL KİTAPLARININ TÜRK MATEMATİK ÖĞRETİM PROGRAMINA UYUMLULUĞU

ÖZET: Bu araştırmanın amacı, Neuschwander'ın "Sir Cumference Series (A Math Adventure)" adlı masal kitaplarının öğretim programı ile uyumluluğunu ortaya koymaktır. Bu çalışmada, araştırmanın amacına uygunluğu ve öğretim materyali kapsamında değerlendirilen masal kitaplarını incelemeye olanak sağlaması sebebiyle doküman inceleme yöntemi kullanılmıştır. Araştırmada veri kaynağı olarak Türkiye'de uygulanan öğretim programlarından ve Neuschwander'ın masal kitaplarından yararlanılmıştır. Masal kitabı çerçevesinde "Sör Çepçevre'nin Matematik Maceraları" adlı masal kitapları kullanılmıştır. Masal kitaplarının incelenmesinde araştırmacı tarafından geliştirilen 'Masal kitaplarında matematik öğretim programı kazanımları veri toplama formu' kullanılmıştır. Masalların öğretim programına uyumluluğunu ele alarak sunan bu araştırmanın bulgularına göre, masallarda özellikle kavramlar üzerinde durulduğu, bu yüzden de öğretim programlarda vurgulanan işlemsel boyuttan daha çok kavramsal boyuta ağırlık verildiği belirlenmiştir. Bu sonuçlara dayalı ilköğretim öğretmenlerinin matematik derslerinde zaman zaman masal gibi olaya dayalı türlere yer vermesi önerilebilir.

Anahtar sözcükler: "Sör Çepçevre'nin Matematik Maceraları" masal kitapları serisi, matematik öğretim programları.

GİRİŞ

Bilgi çağının yaşandığı günümüzde eğitimdeki temel amacın öğrencilere mevcut bilgiyi aktarmaktan çok bilgiye ulaşma yollarını kazandırmak ve edinilen bilginin yeni durumlara uygulayabilmesini sağlamak olduğu belirtilmektedir. Bu yüzden, öğrenilen bilgiyi günlük hayatında kullanabilen, karşılaştığı problemleri çözebilen, düşüncelerini paylaşabilen, ekip çalışması yapabilen, kendine güvenen araştırmacı bireylerin yetiştirilmesi amaçlanmaktadır. Bu becerilerin kazandırılmasında matematik dersi önemli bir yer tutmaktadır (Baki, 2008). Matematik, anne karnında hayat buluşumuzdan ölüme dek geçen her anda bizimle iç içe olmuş, hayatımızla bütünleşmiştir. Bebeklik döneminde annemizin söylediği ninnilerden, dinlediğimiz masallara, okuduğumuz hikâyelere, oynadığımız oyunlardan, söylediğimiz tekerlemelere ve bilmecelere kadar yaşamın her alanında matematikle iletişim halinde olmuşuzdur. İnsan için bu kadar önem taşıyan insanın ayrılmaz bir parçası olan matematik nedir? Matematik herkesin en azından temel eğitime başladığı yıllarda tanıştığı, sevdiği ya da nefret ettiği, bazen de korktuğu bir bilim dalıdır (Umay, 2002).

İlköğretim matematik öğretim programı; matematiği anlayabilen, günlük hayatında kullanabilen bireyler yetiştirmeyi hedeflemektedir. Bu amaçla, matematik öğretim programının hazırlanması sürecinde, ulusal ve uluslararası alanlarda yapılan araştırmalar, gelişmiş ülkelerin matematik programları ve ülkemizdeki matematik eğitimi deneyimleri temel alınarak hazırlanmıştır (MEB, 2005, 2009, 2013, 2015). Amerika'daki Matematik Öğretmenleri Ulusal Konseyi (National Council of Teachers of Mathematics-NCTM), matematik eğitiminde uluslararası düzeyde kabul gören bir kuruldur (NCTM, 2000). Bu kurulun çalışmaları, bugün dünyada matematik eğitimi alanında çalışan pek çok araştırmacı için referans kabul edilmektedir (Cai 2003; Reys, Reys, Lapan, Holliday ve Wasman, 2003; Riordan ve Noyce, 2001). NCTM, 2000 yılında Okul Matematiği İçin Prensipler ve Standartlar (Principles and Standards of School Mathematics) adlı bir doküman yayımlamıştır. Bu dokümanda, okul öncesi dönemden 12. sınıfın sonuna kadar farklı düzeylerde matematiğin genel ilkelerinin neler olması, matematiksel içerik ve süreçlerin hangi standartları sağlaması gerektiği belirtilmiştir. Bu dokümana göre içerik standartları; 'sayılar-işlemler, cebir, geometri, ölçme, veri analizi-olasılık' olmak üzere beş ana başlık altında toplanmıştır. Bununla birlikte, Türkiye'de de güncellenen ilkokul ve ortaokul matematik öğretim programlarında da öğrenme alanları benzer bir biçimde ele alınmıştır (MEB, 2013, 2015).

Yenilenen eğitim sisteminde, çocukların erken yaşlarda okula başlaması (Örge Onuk, 2013) bilişsel, duyuşsal ve dil becerilerinin geliştirilmesinde (Taşdemir, 2005; Gökşen, 2009; Asutay, 2013) çocukların ilgisini çeken (Lüle Mert, 2012), beceri alanına hitap eden, hayal ve ilgi dünyasına cevap veren, olaya dayalı türlerin evde-okulda kullanımı (Örge Onuk, 2013) ve okul programlarını destekleyici olması (Taşdemir, 2005) önemlidir görülmektedir. Bu türlerden çocukların en severek okudukları ve okutturdukları tür olan masallar (URL 1), genellikle yaşanmamış, yaşanması mümkün olmayan olaylar ya da yaşanmış ancak sonradan anlatıla gelerek olağanüstülüklere bürünmüş olayları anlatan bir sözlü edebiyat ürünüdür (Elçin, 2004; Yalçın ve Aytaş, 2003). Türk Dil Kurumu (TDK) Türkçe Sözlükte masalı: "genellikle halkın yarattığı, ağızdan ağza, kulaktan kulağa sürüp gelen, çoğunlukla insanların veya tanrıların başından geçen, olağan dışı olayları anlatan hikâye" olarak tanımlanmaktadır. Bazı araştırmacılar da (Yaldız, 2006; Yalçın, 2002; Ciravoğlu, 1999) masalı, "olağanüstü olaylarla biçimlenmiş, içinde ahlaksal ve dinsel öğretiler barındıran kısa öyküler biçimindeki anlatılar" olarak tanımlamıştır. Fantastik bir yapıya sahip olan masalların (Asutay, 2013), çocukların gelişimine birçok önemli ve değerli katkıları vardır. Çocukların, özellikle davranış kurallarını öğretme ve çevrelerini kavramsallaştırmasını sağlayabilen masallardan (Türkyılmaz, 2009), öğretim aracı olarak da faydalanılmaktadır (URL 1; Akal, 2000). Şahin (2011) çalışmasında, öğrenme-öğretme etkinliklerinde masallardan faydalanan öğretmenlerin, çocukların çeşitli yönlerden gelişimlerine etkilerini doğrudan gözlemleyebildiklerini ortaya koymuştur.

Masalların öğretimsel anlamda katkılarına ilişkin (Gökşen, 2009), masal kahramanlarının her daim kendi işini kendilerinin yaptıklarını, masallardaki dev, korsan, şövalye, peri kızı, kral, pamuk prenses, cüceler, padişah vb. gibi karakterlerin masal kahramanlarının yerine kendilerini tehlikeye atmadığını, yalnızca rehber olduklarını ve gerektiğinde malzeme sağladıklarını belirterek, masalları yaparak yaşayarak öğrenme ile ilişkilendirmiştir. Böylece bugün eğitimde gelinen noktaya masallar sayesinde binlerce yıl önce gelindiğini dile getirmiştir. Çok köklü, belki de en eski bir yazın çeşidi olan masalların (Asutay, 2013) insanlığın düş gücü ile yaşıt ve ondan canlı bir parça olduğu, içinde doğasıyla birlikte insana özgü ne varsa barındırdığı, çocuklara iyi ile kötüyü belki de en iyi anlatabilen sımsıcak öykülerdir.

Eğitim-öğretimde bu denli önem taşıyan masalların, öğretimde kullanılmasına yönelik çalışmaların daha çok Türkçe öğretiminde çocuk edebiyatında (Temizyürek, 2008; Lüle Mert, 2012; Çetinkaya, 2007; Okur, 2003; Derman, 2002; Örge Onuk; 2013) ve yabancı dil öğretiminde (İşler ve Dursun, 1998) ele alındığı görülmektedir. Ancak matematik öğretiminde kullanılmasını içeren yeterince araştırmaya rastlanmamıştır.

Sonuç olarak geniş ve çok boyutlu düşünmenin başladığı soyut işlemler dönemi olan 9-11 yaşları arası, çocuk edebiyatı açısından düşünce stratejileri ile kavram bilgisinin arttığı dönemken (Trim, 2004), araştırmaların genellikle okul öncesi ya da ilkokulun ilk sınıflarındaki öğrencilerle yapıldığı söylenebilir (Derman, 2002; Çetinkaya, 2007; Şahin, 2011). Ancak eğlenceli olmanın yanında öğretici yönü de bulunan masalların küçük yaş grupların dışındaki gruplarda da faydalı olabileceği düşünülmektedir. Bu nedenle; araştırmada adı geçen yazarın masal kitaplarında yer alan kazanımlar ile Türkiye'de uygulanan ilköğretim matematik dersi öğretim programına uygunluğuna, programdaki kazanımların masallarda geçen durumları karşılayıp-karşılamadığı ve kazanımlara ne sıklıkla yer verildiği incelenmiştir.

Araştırmanın Amacı

Çalışmanın amacı, "Sir Cumference Series (A Math Adventure)" adlı masal kitaplarında yer alan kazanımlarla Türkiye'de uygulanan matematik öğretim programına uygunluğunu, programdaki kazanımların masallarda geçen durumları karşılayıp-karşılamadığını ortaya çıkarmaktır. Araştırmada aşağıdaki sorulara cevap aranmıştır:
1. "İlk Yuvarlak Masa" kitabının öğretim programı ile uyumluluğu nasıldır?
2. "Pi Ejderhası" kitabının öğretim programı ile uyumluluğu nasıldır?

3. “Kralın onlukları” kitabının öğretim programı ile uyumluluğu nasıldır?
4. “Açı Diyarının Büyük Şövalyesi” kitabının öğretim programı ile uyumluluğu nasıldır?
5. “Konideki Kılıç” kitabının öğretim programı ile uyumluluğu nasıldır?
6. “Çetre Adası” kitabının öğretim programı ile uyumluluğu nasıldır?
7. “Viking Haritası” kitabının öğretim programı ile uyumluluğu nasıldır?

Öğretimde kullanılacak olan masallar

Araştırmanın doküman incelemesinde kullanacağı masallar, Türkçe çevirisi “Prof. Dr. Enis Sınıksaran” tarafından yapılan Cindy Neuschwander’ın “Sir Cumference Series (A Math Adventure)” adlı yedi kitaplık serisinin kitapları yayınlandığı yıla göre:

- 1997 yılında “İlk Yuvarlak Masa”
- 1999 yılında “Pi Ejderhası”
- 2009 yılında “Kral’ın Onlukları”
- 2001 yılında “Açı Diyarının Büyük Şövalyesi”
- 2003 yılında “Konideki Kılıç”
- 2006 yılında “Çetre Adası”
- 2006 yılında “Viking Haritası”

olarak sıralanabilir. Bu masallar aşağıda özetlenmiş olarak sunulmuştur.

İlk Yuvarlak Masa

İncelenecek birinci kitap, "İlk Yuvarlak Masa" çokgenler kavramını ele almaktadır. Bu masalda Ölçer-Biçerler'in askerlerini sınıra yığdığını gören Kral Arthur onların bir savaş hazırlığında olduğunu düşünüp en güvendiği şövalyelerini acil toplantıya çağırır. Ancak toplantı masası uygun değildir. Kral Arthur bu sıkıntısını toplantıya eşi Leydi Çap ve oğulları Yarıçap ile birlikte katılan Sör Çepçevre'ye anlatır. Sör Çepçevre de eşi Leydi Çap'a anlatır. Leydi Çap'ın fikirlerinden yola çıkılarak çokgen şeklinde birçok masa yapılır, ancak uygun masa bir türlü bulunamaz. Yarıçap sayesinde doğru masa için uygun şekil bulunur. Leydi Çap'ın ölçümleri sonucunda masanın yapımına karar verilir ve ilk yuvarlak masa yapılır.

Pi Ejderhası

İncelenecek ikinci kitap, "Pi Ejderhası" pi sayısının bulunmasını ele almaktadır. Bu masalda yemek yerken birden Sör Çepçevre'nin midesi yanar. Yarıçap doktorun odasından ilaç alıp babasına içirir ve Sör Çepçevre bir ejderhaya dönüşür. Babasını tekrar eski haline döndürmek için doktorun odasına giden Yarıçap üzerinde ejderha başı olan bir şişe bulur. Şişenin üzerinde ' Çemberin Ölçüleri' başlığıyla yazan yazıda babasına vermesi gereken ilacın ölçeğini bulması gerektiği yazıyormuş. Yarıçap yazılanlardan yola çıkarak çember şeklindeki birçok nesne ile ölçüm yapmış ve çevreyi genişliğe böldüğünde hep aynı sayı $3\frac{1}{7}$ çıktığını görmüş. Babasına $3\frac{1}{7}$ ölçeğinde iksir vererek eski haline dönüşmesini sağlamış.

Kral'ın Onlukları

İncelenecek üçüncü kitap, “Kral’ın Onlukları” basamak değeri kavramını ele alan bir masaldır. Bu masalda Sör Çepçevre ve eşi Leydi Çap, yaşadıkları ülkenin kralı olan Kral Arthur’a bir sürpriz doğum günü partisi hazırlarlar. Ülkedeki herkes bu partiye davetlidir. Ancak Leydi Çap’ın yapılacak yemeklerin miktarını ve hazırlanacak yatakların sayısını bilmesi için bir anda biriken çok büyük ve düzensiz kalabalıkta kaç kişi olduğunu hesaplaması gerekmektedir.

Açı Diyarının Büyük Şövalyesi

İncelenecek dördüncü kitap, "Açı Diyarının Büyük Şövalyesi" açı ve açı ölçüsü kavramını ele almaktadır. Bu masalda en büyük hayali çok iyi bir şövalye olmak isteyen Sör Çepçevre ve Leydi Çap'ın oğulları Yarıçap artık büyümüş ve zorlu göreve hazırdır. Görevi uzun zamandır kayıp olan komşu ülkenin hükümdarı Kral Lel'i kurtarmaktır. Uzun uğraşlar sonucunda Kralın hapsedildiği kaleye ulaşan Yarıçap'ın; ejderhalara yem olmadan Kral Lel'i kurtarması için doğru kapıları açması gerekmektedir. Ancak doğru kapıları açabilmesi için kapılara denk gelen açıların ölçüsünü bulmak zorundadır.

Konideki Kılıç

İncelenecek beşinci kitap, "Konideki Kılıç" geometrik cisimler kavramını ele almaktadır. Bu masalda Kral Arthur kendisine varis aramaktadır. Bunun için kılıcı Eskalibar'ı bir yere saklar ve bulmacayı çözüp kılıcını bulan kişinin varisi olacağını söyler. Sör Çepçevre ve Leydi Çap'ın oğulları Yarıçap'ın en yakın arkadaşı Köşe de varis olmak istemektedir. Bunun için Yarıçap'la beraber Eskalibar'ı aramaya koyulurlar. Bulmacanın yazılı olduğu parşömenin üstündeki geometrik şekillerin açınımlarından yola çıkarak kılıcın kalede bir geometrik şeklin içinde saklı olduğu sonucuna varırlar. Birçok geometrik şekille ilgili ölçüp yapıp sonunda kılıcı bir koninin içinde bulurlar.

Çetre Adası

İncelenecek altıncı kitap, "Çetre Adası" kare ve dikdörtgenin alanını ele almaktadır. Bu masalda Sör Çepçevre ve Leydi Çap'ı ziyarete gelen yeğenleri Evra gündüz hep beraber oynadıkları oyunu çok beğenir ve akşam tek başına oyunu oynar. Bu sırada oyun kutusunun üstündeki yazıyı fark eder. Uyuduktan sonra bu yazıyla ilgili değişik rüyalar görmesi üzerine Çetre Adası'ndaki sırrı çözmeye karar verir ve sabah uyanır uyanmaz Yarıçap'la beraber Çetre Adası'na giderler. Adayı koruyan ejderhaya yem olmadan adanın sırrını çözmeleri için doğru odaları ulaşmaları gerekiyor. Doğru odaları bulmak için de odanın şeklinin içindeki karelerinin dışındaki kenar sayısıyla ilişkisini bulmaları gerekmektedir.

Viking Haritası

İncelenecek yedinci kitap, "*Viking Haritası*" koordinat sistemi kavramını ele almaktadır. Bu masalda Yarıçap ve kuzeni Evra ormanda gezerken yollarını kaybederler. Karanlık çöktüğü için kampa kurmaya karar verirler. Kamp kurmayı düşündükleri yere ulaştıklarında karşılarına ağaç dallarıyla örtülü bir kapı çıkar. İçeri girdiklerinde bunun bir mağara olduğunu anlarlar ve içerideki eşyaları incelemeye başlarlar. Evra fıçının içinde bir harita bulur. Haritanın üzerinde Viking Xaxon Yelpaze sakalın bu haritayı koordinatçı İnkel'in hazinesin bulunması için çizdiği yazıyormuş. İki kuzen hazineyi bulmaya karar verirler. Haritadaki x ve y koordinatlarından yola çıkarak hazineyi bulurlar.

YÖNTEM

Araştırmada, doküman inceleme yönteminden yararlanılmıştır. Doküman inceleme yönteminde araştırılmak istenen konuyla ilgili kitaplar, dergiler, biyografiler, günlükler gibi birbirinden farklı yazılı ve görsel materyaller incelenir (Balcı, 2001). Bu çalışmada doküman inceleme yöntemi, araştırmanın amacına uygunluğu ve öğretim materyali kapsamında değerlendirilen masal kitaplarını incelemeye olanak sağlaması sebebiyle kullanılmıştır.

Veri Kaynakları ve Verilerin Toplanması

Araştırmada veri kaynağı olarak Türkiye'de uygulanan 'İlkokul ve Ortaokul Matematik Dersi Öğretim Programı'ndan ve 'Cindy Neuschwander'ın masal kitaplarından yararlanılmıştır. Masal kitabı çerçevesinde "Sir Cumference series (A Math Adventure)" adlı masal kitapları kullanılmıştır. Araştırmada kullanılan öğretim materyallerinin künyeleri aşağıda verilmiştir:

- ✓ İlkokul ve Ortaokul Matematik Dersi Öğretim Programları (MEB, 2015, 2013)
- ✓ İlk Yuvarlak Masa
- ✓ Pi Ejderhası
- ✓ Kral'ın Onlukları
- ✓ Açı Diyarının Büyük Şövalyesi
- ✓ Konideki Kılıç
- ✓ Çetre Adası
- ✓ Viking Haritası

Masal kitaplarının incelenmesinde araştırmacı tarafından geliştirilen "Masal Kitaplarında Matematik Öğretim Programı Kazanımları Veri Toplama Formu" kullanılmıştır. Veri toplama formu geliştirilirken öncellikle literatür taranarak masal kitaplarında matematik kazanımlarının incelenmesi için kullanılabilecek bir veri toplama aracı olup olmadığı belirlenmeye çalışılmıştır. Daha sonra araştırmanın amacı, araştırma soruları ve kapsamı bağlamında masalların hangi ölçütlerle incelenebileceği tartışılmış, bu doğrultuda üç matematik eğitimi uzmanı ile iki Türkçe eğitimi uzmanının görüşlerine başvurulmuştur. Bu bağlamda verilerin; masal kitabının adı, öğrenme alanı, alt öğrenme alanı, kazanım ve frekans başlıkları altında toplanmasına karar verilmiştir.

Veri toplama formunda öğrenme alanı başlığı; masal kitaplarında matematik kazanımlarının kullanıldığı öğrenme alanını, alt öğrenme alanı başlığı masallarda geçen cümlelerde matematiğin vurgulandığı alt öğrenme alanlarını belirtmektedir. Kazanımlar başlığı; masal kitaplarında yer alan cümlelerle ait kazanımları, sayfa numarası başlığı; masalın kazanımın geçtiği sayfa numaralarını, örnek cümleler başlığı; masalda kazanıma uygun cümlelerden oluşan alıntıları ve frekans başlığı ise masalların içeriğinde matematik kazanımlarının kaç defa kullanıldığını göstermektedir.

Verilerin Analizi

Araştırmada toplanan veriler, içerik analizi yardımıyla çözümlenmiştir. Bu bağlamda araştırmaya ilişkin veriler, masal kitabının adı, sınıf düzeyi, öğrenme alanı, alt öğrenme alanı ve kazanımları, frekans çerçevesinde içerik kodlaması yapılarak tablolar oluşturulmuştur. Araştırmanın güvenirliği ise üçgenleme yapılarak sağlanmıştır. Veriler, alan uzmanı olan iki araştırmacı ve bir matematik öğretmeni tarafından bağımsız bir şekilde analiz edilmiş, daha sonra yapılan kodlamaların uyuşum yüzdesi hesaplanmıştır (Miles ve Huberman, 1994). Yapılan hesaplama sonucunda üç ayrı incelemenin uyuşum yüzdesi %83,6 olarak tespit edilmiştir.

BULGULAR

İncelemeler sonucunda ulaşılan bulgular; ilkokul ve ortaokul matematik dersi öğretim programına ilişkin bulgular olmak üzere aşağıdaki şekilde sunulmuştur.

"İlk Yuvarlak Masa" Adlı Masal Kitabının İlköğretim Matematik Dersi Öğretim Programına İlişkin Bulguları

Masal kitabının ortaokul (5-8.sınıflar) matematik dersi öğretim programlarına ilişkin bulgular tablo halinde verilmiştir.

Tablo 1. "İlk Yuvarlak Masa" Adlı Masal Kitabının Matematik Öğretim Programına İlişkin Bulgular

Öğrenme Alanı	**Alt Öğrenme Alanı**	**Kazanımlar**	**Sayfa No**	***f***
Geometri ve Ölçme	Üçgenler ve Dörtgenler	5.2.2.1. Çokgenleri isimlendirir, oluşturur ve temel elemanlarından kenar, iç açı, köşe ve köşegeni tanır.	6, 8, 9, 11, 12	5
		5.2.2.3. Dikdörtgen, paralelkenar, eşkenar dörtgen ve yamuğun temel özelliklerini anlar.	11	1
	Temel Kavramlar ve Çizimler	5.2.1.1. Doğru, doğru parçası ve ışını açıklar ve sembolle gösterir.	13, 14	2
	Çember	6.3.3.1. Çember çizerek merkezini, yarıçapını ve çapını belirler.	20, 29	2
	Çokgenler	7.3.2.1. Düzgün çokgenlerin kenar açı özelliklerini açıklar.	17, 18	2
		7.3.2.3. Dikdörtgen, paralelkenar, yamuk ve eşkenar dörtgeni tanır; açı özelliklerini belirler.	16	1
	Çember ve Daire	7.3.3.3. Daire ve daire diliminin alanını hesaplar.	24	1
Olasılık	Bir Olayın Olma Olasılığı	8.5.1.1. Bir olaya ait olası durumu belirler.	18	1

Tablo 1'de İlk Yuvarlak Masa masal kitabının matematik öğretim programında yer alan "Geometri ve Ölçme" ve "Olasılık" öğrenme alanlarına ait kazanımlara yer verilmiştir. Tablo 1 incelendiğinde "Geometri ve Ölçme" öğrenme alanının 'Üçgenler ve Dörtgenler' alt öğrenme alanı ilişkin kazanımlara daha çok yer verilmiştir (6 defa). Bunun yanı sıra 'Temel Kavramlar ve Çizimler' (2 defa), 'Çember' (2 defa), 'Çokgenler' (3 defa), 'Çember ve Daire' (1 defa), "Olasılık" öğrenme alanının 'Bir Olayın Olma Olasılığı' alt öğrenme alanına ilişkin kazanımlara (1 defa) yeteri kadar yer verilmediği görülmüştür. Matematik öğretim programında ilk önce dörtgenler daha sonra da dörtgenlerden yola çıkarak paralelkenar, eşkenar dörtgen ve yamuk ile ilgili kazanımlar anlatılmaktadır. Yazar da bundan yola çıkarak bu masal kitabında 'Üçgenler ve Dörtgenler' alt öğrenme alanı ile ilgili kazanımlara daha fazla yer vermiş olabilir.

"Pi Ejderhası" Adlı Masal Kitabının Matematik Öğretim Programına İlişkin Bulguları

Masal kitabının ortaokul (5-8.sınıflar) matematik dersi öğretim programlarına ilişkin bulgular tablo halinde verilmiştir.

Tablo 2. Pi Ejderhası Adlı Masal Kitabının Matematik Öğretim Programına İlişkin Bulgular

Öğrenme Alanı	Alt Öğrenme Alanı	Kazanımlar	Sayfa No	*f*
Geometri ve Ölçme	Çember	5.2.3.2. Pergel ve cetvelle çember çizerek Merkezini, yarıçapını ve çapını adlandırır.	31	1
		6.3.3.4. Çapı veya yarıçapı verilen bir çemberin uzunluğunu hesaplar.	13, 17	2
		6.3.3.3. Bir çemberin uzunluğunun çapına oranının sabit bir değer olduğunu ölçüm yaparak belirler	13, 17, 18, 21, 24, 30	6

Tablo 2'de Pi Ejderhası masal kitabının matematik öğretim programında yer alan "Geometri ve Ölçme" öğrenme alanına ilişkin kazanımlarına yer verilmiştir. Tablo 2 incelendiğinde "Geometri ve Ölçme" öğrenme alanının 'Çember' alt öğrenme alanına ilişkin kazanımlara 9 defa yer verildiği görülmüştür. Ortaokul matematik öğretim programında 6.sınıf 'Çember' alt öğrenme alanı ile ilgili toplam 4 kazanım yer almaktadır. Bu kazanımlardan biri de pi sayısı ile ilgilidir (6.3.3.3). Programda yer alan etkinlikte çember şeklindeki birçok geometrik şeklin uzunluğu ve çapı hesaplanır. Daha sonra uzunluğun çapa oranının her seferinde;

$$3\frac{1}{7} = (3{,}14)$$

olduğu sonucuna ulaşılır. Bu sonuçtan sonra öğrencilere bu özel sayıya pi denildiği vurgulanır. π ile ilgili problemler verildiğinde kullanılması istenen yaklaşık değer her seferinde; "π'yi 3 alınız, $\frac{22}{7}$ alınız ya da 3,14 alınız" gibi ifadelerle belirtilir.

"Kral'ın Onlukları" Adlı Masal Kitabının Matematik Öğretim Programına İlişkin Bulguları

Masal kitabının ortaokul (5-8.sınıflar) matematik dersi öğretim programlarına ilişkin bulgular tablo halinde verilmiştir

Tablo 3. Kral'ın Onlukları Adlı Masal Kitabının Matematik Öğretim Programına İlişkin Bulgular

Öğrenme Alanı	Alt Öğrenme Alanı	Kazanımlar	Sayfa No	*f*
Sayılar ve işlemler	Doğal Sayılarla İşlemler	4.1.1.1. 4, 5 ve 6 basamaklı doğal sayıları okur ve yazar.	19, 22	2
		4.1.1.2. 4, 5 ve 6 basamaklı sayıların bölüklerini ve basamaklarını, basamaklarındaki rakamların basamak değerlerini belirler.	22, 28	2
		4.1.1.3. 4, 5 ve 6 basamaklı sayıları çözümler.	20	1
		5.1.1.2. En çok dokuz basamaklı doğal sayıların bölüklerini basamaklarını ve rakamların basamak değerini belirtir.	17	1
		5.1.2.2. İki basamaklı doğal sayılarla toplama ve çıkarma işlemlerinde uygun stratejiyi seçerek kullanır.	9	1
Cebir	Cebirsel İfadeler	6.2.2.1. Aritmetik dizilerin kuralını harfle ifade eder; kuralı harfle ifade edilen, dizinin istenilen terimini bulur.	24	1
Olasılık	Bir Olayın OlmaOlasılığı	8.5.1.3. Eşit şansa sahip olan olaylarda çıktının eş olasılıklı olduğunu ve bu değerin $\frac{1}{n}$ olduğu açıklar.	13	1
		8.5.1.1. Bir olaya ait olası durumları belirler.	12	1

Tablo 3 'te Kralın Onlukları masal kitabının matematik öğretim programında yer alan "Sayılar ve İşlemler" , "Cebir" ve "Olasılık" öğrenme alanlarına ait kazanımlara yer verilmiştir. Tablo 3 incelendiğinde "Sayılar ve İşlemler" öğrenme alanının 'Doğal Sayılarla İşlemler' alt öğrenme alanına ait kazanımlara daha çok yer verilmiştir (7 defa). Bunun yanı sıra "Cebir" öğrenme alanının 'Cebirsel ifadeler' alt öğrenme alanlarına ilişkin kazanımlara (1 defa), "Olasılık" öğrenme alanının 'Bir Olayın Olma Olasılığı' alt öğrenme alanına ilişkin kazanımlara (2 defa) yeteri kadar yer verilmediği görülmüştür. Matematik öğretim programında "Sayılar ve İşlemler" öğrenme alanı bütün sınıflarda ilk öğrenme alanıdır. Yani diğer bütün öğrenme alanlarının temelinde bu öğrenme alanı vardır. Yazarın da bunu göz önünde bulundurup "Sayılar ve İşlemler" öğrenme alanına daha fazla yer verdiği söylenebilir. Ayrıca masalda matematik kavramlarından 'doğru' kavramından da bahsedilmektedir.

"Açı Diyarının Büyük Şövalyesi" Adlı Masal Kitabının Matematik Öğretim Programına İlişkin Bulguları

Masal kitabının ilkokul 4.sınıf ve ortaokul (5-8.sınıflar) matematik dersi öğretim programlarına ilişkin bulgular tablo halinde verilmiştir.

Tablo 4. Açı Diyarının Büyük Şövalyesi Masal Kitabının Matematik Öğretim Programına İlişkin Bulgular

Öğrenme Alanı	Alt Öğrenme Alanı	Kazanımlar	Sayfa No	*f*
Ölçme	Temel Geometrik Kavramlar	4.2.1.9. Açının kenarlarını ve köşesini belirler, açıyı isimlendirir ve sembolle gösterir.	4	1
		4.2.1.5. Ölçüsü verilen bir açıyı çizer.	5	1
		4.2.1.6. Açıların ölçülerini tahmin eder ve tahminlerini açıyı ölçerek kontrol eder.	16, 21, 22	3
		4.2.1.4.Açıları standart ölçme araçlarıyla ölçerek açıları; dar, dik geniş ve doğru açı olarak belirler.	17, 19, 23	3
		4.2.1.3. Açıları standart olmayan birimlerle ölçerek standart açı ölçü biriminin gerekliliğini anlar.	30	1
Geometri ve Ölçme	Temel eometrik Kavramlar	5.2.1.5. Kareli veya noktalı kağıt üzerinde 90° lik bir açıyı referans alarak da, dik ve geniş açıları oluşturur.	15	1
		5.2.1.4. Kareli veya noktalı kâğıt üzerinde bir doğru parçasına paralel doğru parçaları inşa eder; çizilmiş doğru parçalarının paralel olup olmadığını yorumlar.	32	1
	Açılar	6.3.1.1. Açıyı başlangıç noktaları aynı olan iki ışının oluşturduğu şekil olarak tanır ve sembolle gösterir.	14	1
	Çember	6.3.3.1. Çember çizerek merkezini, yarıçapını ve çapını belirler.	8, 14, 17	3
		7.3.3.2. Çember ve çember parçasının uzunluğunu hesaplar.	30	1
	Dönüşüm Geometrisi	8.3.3.2. dönmenin şekil üzerindeki her bir noktanın bir nokta etrafında belirli bir açıyla saat veya tersi yönünde dönüşüme tabi olduğunu ve şekil görüntüsünün eş olduğunu keşfeder.	4, 8	2

Tablo 4'de 'Açı Diyarının Büyük Şövalyesi' masal kitabının matematik öğretim programında yer alan 4.sınıf "Ölçme" öğrenme alanı ile 5, 6, 7 ve 8.sınıf "Geometri ve Ölçme" öğrenme alanına ait kazanımlara yer verilmiştir. Tablo 4 incelendiğinde "Ölçme" öğrenme alanının 'Açı ve Açı Ölçüsü' alt öğrenme alanına ait kazanımlara daha çok yer verilmiştir (8 defa). Bunun yanı sıra "Geometri ve Ölçme" öğrenme alanının alt öğrenme alanlarına ilişkin kazanımlara 'Temel Geometrik Kavramlar' (2 defa), 'Açılar' (1 defa), 'Çember' (4 defa), 'Dönüşüm Geometrisi' (2 defa) yeteri kadar yer verilmediği görülmüştür. 'Açı ve Açı Ölçüsü' alt öğrenme alanına daha çok yer verilmesi; bu alt öğrenme alanının diğer alt öğrenme alanlarının temeli niteliğinde olması şeklinde açıklanabilir. Ayrıca kitapta paralellik ve eğim kavramlarından da bahsedilmektedir.

"Konideki Kılıç" Adlı Masal Kitabının Matematik Öğretim Programına İlişkin Bulguları

Masal kitabının ilkokul 4.sınıf ve ortaokul (5-8.sınıflar) matematik dersi öğretim programlarına ilişkin bulgular tablo halinde verilmiştir.

Tablo 5. Konideki Kılıç Masal Kitabının Matematik Öğretim Programına İlişkin Bulgular

Öğrenme Alanı	Alt Öğrenme Alanı	Kazanımlar	Sayfa No	*f*
Ölçme	Uzunluk Ölçme	4.3.4.4. Doğrudan ölçebileceği bir uzunluğu en uygun uzunluk ölçme birimleriyle tahmin eder.	25	1
Geometri ve Ölçme	Geometrik Cisimler	5.2.5.1. Geometrik cisimleri tanır ve Temel özelliklerini belirler.	9, 10, 12, 14	4
		5.2.2.1. Çokgenleri isimlendirir, oluşturur ve temel elemanlarından kenar, iç açı, köşe ve köşegeni tanır.	11	1
		8.3.4.1. Dik prizmaları tanır ve temel özelliklerini belirler.	12	1
		8.5.4.2. Dik dairesel silindirin temel Elemanlarını belirler; inşa eder ve açınımını çizer.	12, 13, 14, 17	4
		8.3.4.6. Dik koniyi tanır, temel elemanlarını belirler; inşa eder ve açınımını çizer.	13, 14, 17, 18, 19, 22, 24, 25, 29	11
		8.3.4.5. Dik piramidi tanır ve temel elemanlarını belirler; inşa eder ve açınımını çizer.	10, 12, 14	4

Tablo 5'te Konideki Kılıç masal kitabının matematik öğretim programında yer alan 4.sınıf "Ölçme", 5 ve 6.sınıf "Geometri ve Ölçme" öğrenme alanlarına ait kazanımlara yer verilmiştir. Tablo 5 incelendiğinde "Geometri ve Ölçme" öğrenme alanının 'Geometrik Cisimler' alt öğrenme alanına ilişkin kazanımlara daha çok yer verilmiştir (25 defa). Bunun yanı sıra "Ölçme" öğrenme alanının 'Uzunluk Ölçme' alt öğrenme alanına ilişkin kazanımlara yeteri kadar yer verilmediği (1 defa) görülmüştür. Masal kitabında birçok geometrik cisim ile ilgili ölçüm yapıldığı anlatılmaktadır; ancak tablo5'e bakıldığında 'Uzunluk Ölçme' öğrenme alanı ile ilgili sadece bir kazanıma yer verildiği görülmektedir. İlkokul matematik programında 4.sınıf 'Uzunluk Ölçme' alt öğrenme alanı ile ilgili beş tane kazanım bulunmaktadır. Yazar bunlardan sadece bir tanesine yer vermiştir. Ayrıca ortaokul matematik öğretim programı 5.sınıf 'Uzunluk Ölçme' alt öğrenme alanı ile ilgili kazanımlara da yer verilmemiştir. Kitapta uzunluk ölçme birimlerinden biri olan santimetreye de değinilmektedir.

"Çetre Adası" Adlı Masal Kitabının Matematik Öğretim Programına İlişkin Bulguları

Masal kitabının ilkokul 4.sınıf ve ortaokul (5-8.sınıflar) matematik dersi öğretim programlarına ilişkin bulgular tablo halinde verilmiştir.

Tablo 6. Çetre Adası Masal Kitabının Matematik Öğretim Programına İlişkin Bulgular

Öğrenme Alanı	Alt Öğrenme Alanı	Kazanımlar	Sayfa No	*f*
Ölçme	Geometrik Cisimler ve Şekiller	4.2.1.2. Kare ve dikdörtgenin kenar özelliklerini belirler.	3	1
	Alan Ölçme	4.3.2.3. Kare ve dikdörtgenin alanını toplama ve çarpma işlemleri ile ilişkilendirir.	5, 8	2
		4.3.2.2. Şekillerin alanının bu alanları kaplayan birim karelerin sayısı olduğunu belirler.	17, 29	2
Geometri ve Ölçme	Çember	6.3.3.1. Çember çizerek merkezini, yarıçapını ve çapını belirler.	18	2
		6.3.3.4. Çapı veya yarıçapı verilen bir çemberin uzunluğunu hesaplar.	22	1
	Çember ve Daire	7.3.3.3.Dairenin ve daire diliminin alanını hesaplar.	29	1

Tablo 6'de Çetre Adası masal kitabının matematik öğretim programında yer alan 4.sınıf "Ölçme", 6 ve 7.sınıf "Geometri ve Ölçme" öğrenme alanlarına ait kazanımlara yer verilmiştir. Tablo 6 incelendiğinde "Ölçme" öğrenme alanının 'Alan Ölçme' alt öğrenme alanına ilişkin kazanımlara daha çok yer verilmiş (4 defa). Oysa "Geometrik Şekiller ve Çizimler'" (1defa), 'Uzunluk Ölçme' (2 defa), "Geometri ve Ölçme" Öğrenme alanının alt öğrenme alanına ilişkin kazanımlara 'Çember' (3 defa), 'Çember ve Daire' (1 defa) yeteri kadar yer verilmediği görülmüştür.

3.7. "Viking Haritası" Masal Kitabının Matematik Öğretim Programına İlişkin Bulguları

Masal kitabının ortaokul (5-8.sınıflar) matematik dersi öğretim programlarına ilişkin bulgular tablo halinde verilmiştir.

Tablo 7. Viking Haritası Masal Kitabının Matematik Öğretim Programına İlişkin Bulgular

Öğrenme Alanı	Alt Öğrenme Alanı	Kazanımlar	Sayfa No	*f*
Geometri ve Ölçme	Açılar	6.3.1.3. Bir doğrunun üzerindeki veya dışındaki bir noktadan doğruya dikme çizer.	4	1
		6.2.1.4. Aynı düzlemdeki iki doğrunun birbirine göre durumlarını belirler.	4	1
	Doğru, Doğru Parçası ve Işın	6.2.1.1.Doğru ile nokta arasındaki ilişkiyi açıklar.	32	1
Sayılar ve İşlemler	Tam Sayılar	6.1.3.1.Tam sayıları yorumlar ve sayı doğrusunda gösterir.	32	1
Cebir	Doğrusal Denklemler	7.2.2.1.Koordinat sistemini özellikleriyle tanır ve sıralı ikilileri gösterir.	4, 12, 13, 15, 16, 19, 23, 31	15

Tablo 7'de Viking Haritası masal kitabının matematik öğretim programında yer alan "Geometri ve Ölçme", "Sayılar ve İşlemler" ve "Cebir" öğrenme alanlarına ilişkin kazanımlara yer verilmiştir. Tablo 7 incelendiğinde; "Cebir" öğrenme alanının 'Doğrusal Denklemler' alt öğrenme alanına ilişkin kazanımlara daha çok yer verilmiştir (15 defa). Oysa "Geometri ve Ölçme" öğrenme alanının alt öğrenme alanına ilişkin kazanımlara 'Açılar' (2 defa), 'Doğru, Doğru Parçası ve Işın' (1 defa), "Sayılar ve İşlemler" öğrenme alanına 'Tam Sayılar' alt öğrenme alanına ilişkin kazanımlara (1 defa) yeteri kadar yer verilmediği görülmüştür. Ayrıca masal kitabında matematiksel kavramlardan, diklik kavramı ve matematiksel birimlerden uzunluk ölçme birimi olan kilometreye de değinilmektedir.

TARTIŞMA, SONUÇ ve ÖNERİLER

Masalların öğretim programına uyumluluğunu ele alarak sunan bu araştırmanın bulgularına göre, masallarda özellikle kavramlar üzerinde durulduğu, bu yüzden de öğretim programlarda vurgulanan işlemsel boyuttan daha çok kavramsal boyuta ağırlık verildiği belirlenmiştir. Özellikle kavramlara duyulan ihtiyaca, kavramlar arası ilişkilere dikkat çekilen bir öğretim ortamının varlığından söz edilebilmektedir.

Yazarın *'İlk Yuvarlak Masa'* adlı kitabında; "Geometri ve Ölçme" ve "Olasılık" öğrenme alanlarına ait kazanımlara sıklıkla yer verdiği belirlenmiştir. Bunun yanı sıra 'Temel Kavramlar ve Çizimler' (2 defa), 'Çember' (2 defa), 'Çokgenler' (3 defa), 'Çember ve Daire' (1 defa), "Olasılık" öğrenme alanının 'Bir Olayın Olma Olasılığı' alt öğrenme alanına ilişkin kazanımlara (1 defa) yer verildiği ortaya çıkmıştır. Bu açıdan bakıldığında masal kitaplarının Türk Matematik Öğretim Programlarında yer alan bazı kazanımlarla uyumlu iken bazı kazanımlarla uyumlu olmadığı söylenebilir.

Yazarın *'Pi Ejderhası'* adlı kitabında; "Geometri ve Ölçme" öğrenme alanının 'Çember' alt öğrenme alanına ilişkin kazanımlara 9 defa yer verildiği görülmüştür. Bunun nedeninin Ortaokul matematik öğretim programında 6.sınıf 'Çember' alt öğrenme alanı ile ilgili toplam 4 kazanımın yer alması, bu kazanımlardan birinin de pi sayısı ile ilgilidir olması olabilir. Programda yer alan etkinlikte çember şeklindeki birçok geometrik şeklin uzunluğu ve çapı hesaplanır. Daha sonra uzunluğun çapa oranının her seferinde '3, 14' sayısına ulaşıldığı, sonra öğrencilere bu özel sayıya 'pi' denildiği vurgulanır. Açıkça görülmektedir ki öğretim programında bu konunun önemi oldukça büyüktür. Buna paralel olarak yazarın *'Pi Ejderhası'* alı masal kitabında bu konuya çok fazla yer verdiğini görmekteyiz. Programdaki kazanımların bu masal kitabında geçen durumları karşıladığı söylenebilir.

Yazarın *'Kral'ın Onlukları'* adlı kitabında; "Cebir" öğrenme alanının 'Cebirsel ifadeler' alt öğrenme alanlarına ilişkin kazanımlara (1 defa), "Olasılık" öğrenme alanının 'Bir Olayın Olma Olasılığı' alt öğrenme alanına ilişkin kazanımlara (2 defa) yeteri kadar yer verilmediği görülmüştür. Yazar, "Sayılar ve İşlemler" öğrenme alanının 'Doğal Sayılarla İşlemler' alt öğrenme alanına ait kazanımlara daha çok yer verilmiştir (7 defa). Matematik öğretim programında "Sayılar ve İşlemler" öğrenme alanı bütün sınıflarda ilk ve en temel bir öğrenme alanı olması ve sayıların temelinde bu öğrenme alanının önemi göz önüne alınırsa '*Kral'ın Onlukları'* masal kitabının bu öğrenme alanları ile uyumluluk gösterdiği söylenebilir. Programdaki kazanımların bu masal kitabında geçen durumları karşıladığı söylenebilir.

Yazarın '*Açı Diyarının Büyük Şövalyesi'* adlı kitabında; "Ölçme" öğrenme alanının 'Açı ve Açı Ölçüsü' alt öğrenme alanına ait kazanımlara daha çok yer verdiği tespit edilmiştir (8 defa). Bunun yanı sıra "Geometri ve Ölçme" öğrenme alanının alt öğrenme alanlarına ilişkin kazanımlara 'Temel Geometrik Kavramlar' (2 defa), 'Açılar' (1 defa), 'Çember' (4 defa), 'Dönüşüm Geometrisi' (2 defa) yeteri kadar yer vermediği görülmüştür. Yazarın 'Açı ve Açı Ölçüsü' alt öğrenme alanına daha çok yer vermesi; bu alt öğrenme alanının diğer alt öğrenme alanlarının temeli niteliğinde olması şeklinde açıklanabilir. Dolayısıyla '*Açı Diyarının Büyük Şövalyesi'* adlı masal kitabının öğretim programlarıyla uyumlu olduğu düşünülebilir.

Yazarın '*Konideki büyük Kılıç'* adlı kitabında; "Geometri ve Ölçme" öğrenme alanının 'Geometrik Cisimler' alt öğrenme alanına ilişkin kazanımlara daha çok yer verdiği incelemeler sonucunda ortaya çıkmıştır (25 defa). Bunun yanı sıra "Ölçme" öğrenme alanının 'Uzunluk Ölçme' alt öğrenme alanına ilişkin kazanımlara yeteri kadar yer vermediği (1 defa) görülmüştür. Masal kitabında birçok geometrik cisim ile ilgili ölçüm yapıldığı anlatılmaktadır; ancak 'Uzunluk Ölçme' öğrenme alanı ile ilgili sadece bir kazanıma yer verildiği görülmektedir. İlkokul matematik programında 4.sınıf 'Uzunluk Ölçme' alt öğrenme alanı ile ilgili beş tane kazanım bulunmaktadır. Yazar bunlardan sadece bir tanesine yer vermiş, ortaokul matematik öğretim programı 5.sınıf 'Uzunluk Ölçme' alt öğrenme alanı ile ilgili kazanımlara yer vermemiştir. Buradan hareketle '*Konideki büyük Kılıç'* masal kitabında geçen kazanımların öğretim programıyla çok fazla uyumlu olmadığı ifade edilebilir. Programdaki kazanımların bu masal kitabında geçen durumları yeteri kadar karşılamadığı ifade edilebilir.

Yazarın '*Çetre Adası'* adlı kitabında; "Ölçme" öğrenme alanının 'Alan Ölçme' alt öğrenme alanına ilişkin kazanımlara daha çok yer verdiği belirlenmiştir (4 defa). Bunun yanı sıra "Geometrik Şekiller ve Çizimler'" (1defa), 'Uzunluk Ölçme' (2 defa), "Geometri ve Ölçme" Öğrenme alanının alt öğrenme alanına ilişkin kazanımlara 'Çember' (3 defa), 'Çember ve Daire' (1 defa) ise yeteri kadar yer verilmediği görülmüştür. Bu açıdan bakıldığında '*Çetre Adası'* adlı masal kitabının, öğretim programıyla yeteri kadar örtüşmediği görülmektedir. Programdaki kazanımların bu masal kitabında geçen durumları tam olarak karşılamadığı söylenebilir.

Yazarın son incelenen masal olan '*Viking Haritası'* adlı kitabında; "Cebir" öğrenme alanının 'Doğrusal Denklemler' alt öğrenme alanına ilişkin kazanımlara daha çok yer verdiği ortaya çıkmıştır (15 defa). Bunun yanı sıra "Geometri ve Ölçme" öğrenme alanının alt öğrenme alanına ilişkin kazanımlara 'Açılar' (2 defa), 'Doğru, Doğru Parçası ve Işın' (1 defa), "Sayılar ve İşlemler" öğrenme alanına 'Tam Sayılar' alt öğrenme alanına ilişkin kazanımlara (1 defa) yeteri kadar yer verilmediği görülmüştür. Bu bağlamda '*Viking Haritası'* adlı masal kitabı da programda yer alan bir öğrenme alanına sıklıkla yer vermiş ancak diğer öğrenme alanlarıyla yeteri kadar uyumluluk gösterememiştir.

Masalların matematik öğretim hedeflerini kazandırma amacında olduğunu düşünürsek zaman zaman pek çok matematik kavramlarına da (paralellik, doğru parçası, eğim ve yükseklik gibi) yer verildiğini, sembol ve birimlerin önemine de değinildiğini görmekteyiz.

Ayrıca masallarda kavramları anlatmaya yönelik benzetim ve örneklerle ilgili durumların dışında örnek ve benzetimlere de (kesirler konusunda verilen kek örneği, saatteki akrep ve yelkovanın belli saatlerde oluşturduğu açılar gibi) yer verilmiştir. Masallarda ortaya çıkan matematiksel durumlara gerçekmiş gibi yaklaşılması da öğrencilerin ders süresince ilgisini çekebilir ve eğlenerek öğrenmelerini sağlayabilir.

Öğrencilerin matematik endişesi ve korkusuna; matematik derslerindeki odaklanma eksikliğinin, dersi dinlememenin, önbilgilerdeki eksikliğin, matematik dersiyle baş etmedeki motivasyon ve öz güven yetersizliğinin ve matematiğin zor oluşunun sebep olduğu düşünülebilir. Dolayısıyla bu kaygı ve korkunun engellenmesine yardımcı olacak faktörlerden biri de masalların öğretim sürecinde yer almasıdır.

Çocukluğumuzda okumaktan zevk aldığımız masal ve hikâyelerin genellikle belli değerler kazandırma amacıyla yazıldığı bilinmektedir. Her ne kadar matematik konularına yönelik de olsa bu araştırmada incelen masallarda da bu tür öğelerin varlığı göze çarpmaktadır. Dolayısıyla masallarda birçok sosyal değerin tartışıldığı ortaya çıkmıştır. Bunları, ön yargılı olmama, sabırlı ve hoşgörülü olma, enerji tasarrufunun önemi, zorluklara karşı gayretli olma öne çıkan sosyal değerler olmuştur.

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RELATIONSHIP BETWEEN CONCEPTUAL AND PROCEDURAL LEARNING: THE CASE OF GENERAL MATHEMATICS COURSE

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ABSTRACT: In the current study, it was aimed to determine the relation between conceptual and procedural learning types in the course of General Mathematics among primary school pre-service mathematics teachers. The study group consisted of 97 freshmen studying at Primary School Mathematics Teacher Training Department. Case study method was used within the scope of descriptive approach. Pre-service teachers were asked questions measuring procedural and conceptual learning within the context of general mathematics course. At the end of the study, it was found that while there was no positive relation towards procedural learning $\rightarrow$ conceptual learning, there was positive relation towards conceptual knowledge $\rightarrow$ procedural learning.

Key words: Procedural Learning, Conceptual Learning, General Mathematics Course, Pre-service Mathematics Teachers.

İŞLEMSEL VE KAVRAMSAL ÖĞRENME ARASINDAKİ İLİŞKİ: GENEL MATEMATİK DERSİ ÖRNEĞİ

ÖZET: Bu çalışmada ilköğretim matematik öğretmen adaylarının Genel Matematik dersinde kavramsal - işlemsel öğrenme türleri arasındaki etkileşimin nasıl olduğunun belirlenmesi amaçlanmaktadır. Çalışmanın örneklemini İlköğretim Matematik Öğretmenliği programında öğrenim görmekte olan 97 birinci sınıf öğrencisi oluşturmaktadır. Araştırmada betimsel yaklaşım kapsamında örnek olay yöntemi kullanılmıştır. Çalışmada öğretmen adaylarına Genel Matematik dersi kapsamında işlemsel ve kavramsal öğrenmeyi ölçen sorular sorulmuştur. Çalışmanın sonucunda işlemsel öğrenme$\rightarrow$ kavramsal öğrenme yönünde pozitif bir ilişki yokken kavramsal öğrenme$\rightarrow$ işlemsel öğrenme yönünde pozitif bir ilişki olduğu ortaya konulmuştur.

Anahtar sözcükler: İşlemsel Öğrenme, Kavramsal Öğrenme, Genel Matematik Dersi, Öğretmen Adayı.

GİRİŞ

Matematik, birbirinden farklı konu, işlem ve kuralların oluşturduğu bir bilgi yığını değil, temel ilke ve kavramlara dayanan bir düşünme yöntemidir (Yıldırım, 2004). Bu nedenle matematik ezberlemekten çok anlamaya dayanmaktadır. Bunun doğal bir neticesi olarak da matematikte, kavramsal ve işlemsel olmak üzere iki tür bilgiden ve buna bağlı olarak matematiksel öğrenmenin işlemsel ve kavramsal olmak üzere iki türlü gerçekleştiğinden söz edilir (Groth & Bergner, 2006).

Hiebert ve Lefevre (1986), en genel anlamda işlemsel bilgiyi "nasıl yapıldığını bilme", kavramsal bilgiyi de "neden öyle olduğunu/yapıldığını bilme" olarak tanımlamaktadır. Daha ayrıntılı tanımlamak gerekirse, kavramsal bilgi, bir alanın ilke, kural ve tüm bilgi parçacıkları arasındaki karşılıklı ilişkilerin açık veya örtük bilgisi iken işlemsel bilgi, matematiksel soruları çözmek için kullanılan kural ve işlemler ile bilgiyi temsil etmek için kullanılan sembolleri içerir (Hiebert & LeFevre, 1986; Hiebert & Carpenter, 1992; Rittle-Johnson, Siegler & Alibali, 2001; Schneider & Stern, 2010).

Matematiksel bilgiyi her zaman işlemsel veya kavramsal bilgi olarak kesin çizgilerle birbirinden ayırmak güçtür. Zaten matematik öğrenmek için hem işlemsel hem de kavramsal bilgiye ihtiyaç vardır. Bu iki tip bilgi de birbirinden bağımsız olarak gelişmez (Van de Walle, 1994; Rittle-Johnson & Alibali, 1999). Kavramsal ve işlemsel öğrenme arasındaki ilişki geçmişten günümüze araştırmacılar tarafından çeşitli kademedeki öğrenciler için araştırılmış olmasına rağmen bir fikir birliği sağlanamamıştır. Araştırmacıların bir bölümü işlemsel öğrenmenin kavramsal öğrenmeyi etkilediği yani bireylerin ancak doğru prosedürleri öğrendikten sonra o prosedürlerin altında yatan kavramları öğrendiklerini belirtmektedir (Briars & Siegler, 1984; Frye, Braisby, Lowe, Maroudas & Nicholls, 1989). Fakat bu araştırmaların tersine bazı çalışmalarda da prosedür oluşumunun temelinde kavramsal öğrenmenin bulunduğu üzerinde durulmaktadır (Baki & Kartal, 2004; Cauley, 1988; Hiebert & Wearne, 1996; Rittle-Johnson & Alibali, 1999). Bazı araştırmacılar ise bu iki anlamanın çift yönlü olduğu (Rittle-Johnson, Siegler & Alibali, 2001) görüşünde iken bazıları da kavramsal ve işlemsel anlamanın ilişkili olmadığı (Resnick & Omanson, 1987) görüşündedir.

Üniversite öğrencilerinin matematik derslerindeki işlemsel ve kavramsal öğrenmeleri ile ilgili yapılan çalışmalar incelendiğinde Analiz dersinin ön plana çıktığı (örn. Engelbrecht, Harding & Potgieter, 2005; Porter & Masingila, 2000; Mahir, 2009) görülmektedir. Öğretmen adaylarıyla yapılan çalışmalar incelendiğinde de Lineer Cebir (İşleyen & Işık, 2005), Diferansiyel Denklemler (Arslan, 2010) gibi dersler ile belirli integral (Delice & Sevimli, 2010), istatistiksel alan bilgileri (ortalama, medyan, mod) (Groth & Bergner, 2006) gibi konularda işlemsel/kavramsal öğrenmenin araştırıldığı görülmektedir.

Çalışmanın Amacı

Eğitim Fakültelerinde okutulan Genel Matematik dersinin içeriğinde "Sayılar, İkinci Dereceden Denklem ve Eşitsizlikler, Doğrunun ve Çemberin Analitik İncelenmesi, Fonksiyon kavramı, Fonksiyonların Grafikleri, Tümevarım İlkesi, Karmaşık Sayılar" gibi konular mevcut olup bu içeriğin lise matematik dersi müfredatıyla örtüştüğü görülmektedir. Yapılan literatür taraması, Genel Matematik dersinde öğretmen adaylarının işlemsel/kavramsal öğrenmelerini sorgulayan bir çalışma bulunmadığını göstermektedir. Oysa öğretmen adaylarının ortaöğretimde gördükleri konuların daha geniş kapsamlı ele alınıp sonraki dönemlerde alacakları alan derslerine temel oluşturması açısından Genel Matematik dersinin önemli olduğu düşünülmektedir. Bu tespitten hareketle ilgili çalışmada öğretmen adaylarının Genel Matematik dersindeki işlemsel ve kavramsal öğrenmeleri arasındaki ilişkinin araştırılması amaçlanmaktadır.

YÖNTEM

Araştırma problemine cevap vermek amacıyla betimsel yaklaşım kapsamında örnek olay yöntemi kullanılmıştır. Çalışmanın örneklemini, bir devlet üniversitesinin İlköğretim Matematik Öğretmenliği programında Genel Matematik dersine devam öğretmen adayları oluşturmaktadır. İki ardışık yıl tekrarlanan araştırmaya, ilk yıl 47, ikinci yıl 50 olmak üzere toplam 97 öğretmen adayı dahil edilmiştir. Çalışmanın iki yıl üst üste yapılmasındaki amaç -uzman görüşleri doğrultusunda- örneklem sayısını arttırmak ve kapsamı genişletmektir (Özpınar & Arslan, 2012). Böylece sonuçların güvenirliğini arttırmak amaçlanmıştır. Her iki yılda da katılımcılara hem işlemsel hem de kavramsal sorular sorulmuştur. Soruların içeriği Genel Matematik dersinin farklı konularıyla ilişkili olup kapsam geçerliği sağlanmıştır.

İşlem ve Veri Toplama Araçları

Bu çalışmada öğretmen adaylarına matematik dersi kapsamında işlemsel ve kavramsal öğrenmeyi ölçen sorular sorulmuştur. Bir sorunun hangi öğrenme türünü (işlemsel veya kavramsal) ölçmeye yönelik olduğunu belirlemek için literatür incelemesi (Arslan, 2010; Baki & Kartal, 2004; Baki, 2008; Olkun & Toluk-Uçar, 2009; Schneider & Stern, 2010; Siegler & Alibali, 2001; Van de Walle, 1994) sonucu bir karakterizasyon ölçeği geliştirilmiştir.

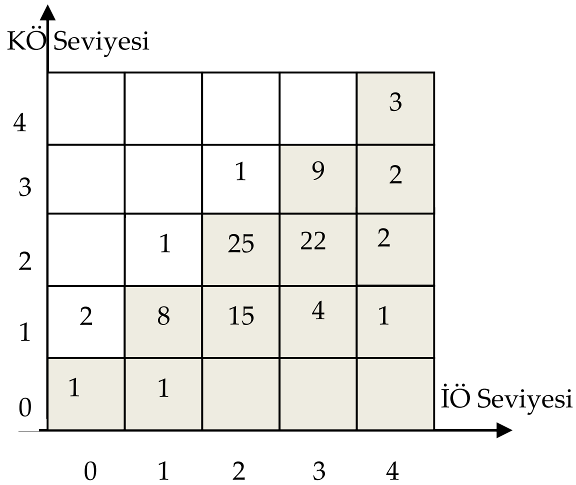
Veri Analizi

Öncelikle soruların cevap anahtarları hazırlanarak çözümün her bir aşaması için verilecek puan belirlenmiştir. Ardından öğrencilerin sorulara verdikleri cevaplar puanlanarak öğrencilerin her sorudan aldıkları puanlar ayrı ayrı hesaplanmıştır.

Öğrencilerin işlemsel öğrenmeyi ölçen sorular ile kavramsal öğrenmeyi ölçen sorular için 100 üzerinden iki ayrı notu hesaplandıktan sonra Arslan (2010) tarafından geliştirilen seviye aralıkları kullanılarak öğrencilerin seviyeleri tespit edilmiştir. Buna göre öğrenciler beş seviyeye ayrılmış olup seviyeler 20 puanlık aralıklardan oluşmaktadır: [0-20) puan aralığı 0. seviye, [20-40) puan aralığı 1. seviye, [40-60) puan aralığı 2. seviye, [60-80) puan aralığı 3. seviye ve [80-100] puan aralığı 4. seviye olarak belirlenmiştir. Son aşamada ise bu seviyeler çift yönlü olarak karşılaştırılarak işlemsel kavramsal öğrenme ilişkisine bakılmıştır. Burada anlatılan işlem her iki yıldan elde edilen veriler için ayrı ayrı yapılmıştır.

BULGULAR

Bulgular aşağıdaki grafikte özetlenmiştir. Aşağıda yer alan grafik işlemsel (İÖ) ve kavramsal öğrenme (KÖ) ile ilgili öğrenci seviyelerini özetlemektedir. Grafiklerde x ve y eksenleri üzerinde yer alan sayılar (0, 1, 2, 3, 4) seviyeleri, grafiğin içindeki sayılar da ilgili işlemsel ve kavramsal öğrenme seviyesindeki öğrenci sayısını göstermektedir. Öğrencilerin işlemsel ve kavramsal öğrenme türlerinden hangisinin öne çıktığının ve bu iki öğrenme türü arasındaki ilişkinin daha rahat görülmesi amacıyla bulgulara toplu halde göz atılmasının faydalı olacağı düşünülmektedir.



Şekil 1. İşlemsel ve Kavramsal Öğrenme Türleri Arasındaki İlişki

Şekil 1'de işlemsel seviyesi düşük olan öğrencilerin genel olarak kavramsal seviyelerinin de düşük olduğu görülmektedir. Verilen grafik göz önünde bulundurarak işlemsel öğrenmesi üst seviyede olan bir öğrencinin kavramsal seviyesinin üst düzeyde olmasının gerekmediği yani işlemsel öğrenmeyi gerçekleştiren bir öğrencinin her zaman kavramsal öğrenmeyi gerçekleştiremeyebileceği söylenebilir. Örneğin işlemsel seviyesi 4 olan bir öğrencinin kavramsal seviyesi 1, iki öğrencinin kavramsal seviyesinin 2 ve iki öğrencinin ise kavramsal seviyesinin 3 olduğu görülmektedir.

Diğer yandan, grafik incelendiğinde kavramsal öğrenmesi üst düzeyde olan bir öğrencinin işlemsel öğrenmesinin de üst düzeyde olduğu, kavramsal öğrenme seviyesi düşük öğrencilerin işlemsel öğrenme seviyesinin de genel olarak düşük olduğu görülmektedir. Bu durum göz önünde bulundurularak kavramsal öğrenmeyi gerçekleştiren bir öğrencinin işlemsel öğrenmeyi de gerçekleştireceği söylenebilir. Elde edilen bu bulgu literatürdeki bazı çalışmaların bulguları ile de örtüşmektedir (Arslan, 2010; Mahir, 2009; Rittle-Johnson, Siegler & Alibali, 2001).

Şekil 1 incelendiğinde öğretmen adaylarının işlemsel öğrenme seviyelerinin 2. ve 3. seviyede yoğunlaştığı görülmektedir. İşlemsel olarak 4. seviyede olan yalnızca 8 öğrenci bulunmaktadır. Diğer yandan Şekil 1 öğrencilerin kavramsal seviyelerinin 1. ve 2. seviyede yoğunlaştığını ortaya koymaktadır. Kavramsal seviyesi 3 olan 12, 4 olan ise 3 öğrenci bulunmaktadır. Öğrencilerin işlemsel öğrenme gerektiren sorulardaki performanslarının kavramsal öğrenme gerektiren sorularda sergilediklerine göre daha yüksek olduğu bulgusu ilgili literatürün bulguları ile de örtüşmektedir (Arslan, 2010; Baki & Kartal, 2004; Bekdemir, 2012; Bekdemir & Işık, 2007; İşleyen & Işık, 2005).

SONUÇ

Bu çalışmada Genel Matematik dersinde işlemsel öğrenme ile kavramsal öğrenme arasındaki ilişkinin araştırılması amaçlanmıştır. Çalışmada, işlemsel öğrenme $\rightarrow$ kavramsal öğrenme yönünde doğrusal bir ilişki ortaya çıkmazken kavramsal öğrenme $\rightarrow$ işlemsel öğrenme yönünde doğrusal bir ilişki olduğu sonucuna varılmıştır. Dolayısı ile kavramsal olarak başarılı olan öğrencilerin işlemsel olarak da başarılı, kavramsal olarak başarısız olan öğrencilerin ise işlemsel olarak da başarısız oldukları fakat bunun aksinin doğru olmadığı söylenebilir. Bu sonuç ise kavramsal öğrenmenin işlemsel öğrenmeyi desteklediğinin fakat bunun tersinin doğru olmadığının bir göstergesidir.

NOT

Bu çalışmanın ilk yıl toplanan veriler ile oluşturulan ilk hali Niğde Üniversitesi'nde düzenlenen X. UFBMEK'te sunulmuştur (Özpınar ve Arslan, 2012).

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DESIGN AND EVALUATION OF THE DYNAMIC MANIPULATIVE AND ACTIVITIES IN PROBABILITY EDUCATION

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ABSTRACT: Manipulative is defined as controllable materials. Manipulatives are especially used in the education to teach the notions to the students. It may materialize the abstract notions by visualization that students have difficulty in understanding. Therefore students can learn these notions more easily. It also both enables to enrich problem solving activities and renders the class more attractive and efficient and it helps students to develop their creative thinking (Moyer, 2002). Akkan and Çakıcıoğlu (2009) have stated in their study -in which virtual and physical manipulatives are compared with each other- that students find virtual manipulatives more practical. At the same study it has been concluded that virtual manipulatives are not used in the class frequently. However using the physical materials in probability teaching is both difficult and expensive and it may lead to misconception. Therefore virtual manipulative can be used in probability subjects (Van De Walle,2012). At the each step of the probability education (in basic notion teaching, definition of the relation between theoretical and experimental probability, dependent and independent event teaching) virtual manipulatives can be used. In this context, this study aims to design manipulatives that will be used at the teaching of dependent event notion and to design appropriate activities with prepared manipulatives that are related to basic notions and to evaluate efficiency of these tools. The qualitative research pattern will be used in the study. The manipulatives which will be used during the activity was developed by means of Unity 3d 5.0 version game engine. When the manipulative was being designed, it was benefited from the internet site of the American National Virtual Manipulative (unvl.com) Library. In addition, new activities were designed by benefitting from the activities that were developed by NCTM and MNE. These activities and manipulative are shown to the 5 teacher and the interviews with teacher are recorded. By this way the deficiencies and the point which are needed to correct will be determined.

Key words: mathematics education, probability teaching, virtual manipulatives.

OLASILIK EĞITIMINDE BAĞIMLI OLAY ILE ILGILI SANAL DINAMIK MANIPÜLATIF VE ETKINLIKLERIN TASARLANMASI

ÖZET: Manipülatif, kontrol edilebilir materyal olarak tanımlanmaktadır. Sanal manipülatifler genellikle öğrencilere, bir kavramın öğretiminde kullanılmaktadır. Özellikle öğrencilerin anlamalarında zorluk yaşadıkları soyut kavramları görselleştirerek somutlaştırmaktadır. Böylece kavramı öğrenmeleri daha kolay hale gelmektedir. Ayrıca problem çözme etkinliklerinin zenginleşmesine olanak sağladığı gibi dersi daha ilgi çekici ve etkili hale getirmekte ve öğrencilerin yaratıcı düşüncelerini geliştirmelerine yardımcı olmaktadır(Moyer,2002). Akkan ve Çakıcıoğlu (2009)' nun sanal ve fiziksel manipülatifleri karşılaştırdıkları çalışmada öğrencilerin sanal manipülatifleri daha kullanışlı bulduklarını belirtmişlerdir. Ayrıca aynı çalışmada manipülatiflerin sınıflarda fazla kullanılmadığı sonucuna ulaşılmıştır. Halbuki olasılık gibi konularda fiziksel materyali kullanmak çok zor, pahalı ve kavram yanılgısı oluşumuna neden olabilmektedir. Bundan dolayı olasılık konusunda sanal manipülatifler kullanılabilir(Van De Walle,2012). Olasılık öğretimin her basamağında (temel kavramların öğretiminde, teorik-deneysel olasılık arası ilişkinin belirlenmesinde, bağımlı ve bağımsız olay kavramının öğretiminde) sanal manipülatifler kullanılabilir. Bu bağlamda bu çalışmanın amacı olasılık konusu içerisinde bulunan bağımlı olay kavramını öğretiminde kullanılacak bir manipülatif ile daha önce temel kavramlar ile ilgili hazırladığımız manipülatife uygun etkinlikler tasarlamak ve geliştirilen bu araçların etkililiğini değerlendirmektir. Çalışmada nitel araştırma deseni kullanılmıştır. Etkinlik sırasında kullanılacak olan sanal manüpülatif Unity3d 5.0 sürüm oyun motoru yardımıyla geliştirilmiştir. Manipülatif tasarlanırken Amerikan Ulusal sanal Manipülatif (unvl.com) kütüphanesi internet sitesinden yararlanılmıştır. Ayrıca NCTM ve MEB tarafından geliştirilmiş etkinliklerden yararlanılarak yeni etkinlikler tasarlanmıştır. Daha sonra bu etkinlikler ve manipülatif 5 öğretmene gösterilerek, öğretmenlerle yapılacak görüşmeler ses kaydına alınmıştır. Bu şekilde eksiklikler ve düzeltilmesi gerekilen noktalar belirlenmiştir.

Anahtar sözcükler: matematik eğitimi, olasılık eğitimi, sanal manipülatif.

GİRİŞ

Manipülatif, genel olarak kontrol edilebilir materyal olarak tanımlanmaktadır. Hynes'e (1986) göre manipülatifler matematiksel kavramlarla ilişkili olan ve birkaç duyuyu harekete geçiren modeller olarak tanımlamıştır. Swan ve Marshal (2010) ise kişisel olarak kullanılabilen ve bilinçli ya da bilinçsiz olarak matematiksel düşünceyi geliştirebilen araçlar olarak tanımlamışlardır. Manipülatifleri sanal ve somut (fiziksel) olarak ikiye ayırabiliriz. Fiziksel manipülatiflerin eğitimde kullanımı Fröbel(1826) ve Montessory (1912) yapmış olduğu çalışmalar gibi çok eski tarihlere kadar gitmektedir. Bilgisayar ortamında tasarlanmış materyale ise sanal manüpülatif denilmektedir (Durmuş ve Karakırık, 2006 akt. Yaman ve Şahin,2013) ve özellikle son yıllarda bu tür manipülatifler önemi giderek anlaşılmada ve kullanımı artmaktadır. Literatürde sanal manipülatifler kendi içerisinde dinamik ve statik olmak üzere iki alt türe ayrılmıştır. Statik manipülatifler sadece okumak ya da gözlemlemek için tasarlanmış olup kullanımı oldukça kısıtlıdır. Dinamik manipülatifler ise kullanıcıların etkileşim haline girebildiği materyaller olarak tanımlanmaktadır (Spicer, 2000). Sanal dinamik manipülatifler, matematik eğitimine olumlu katkı sunacaktır.

Sanal dinamik manipülatifler genellikle öğrencilere, bir matematiksel kavramın öğretiminde kullanılmaktadır. Özellikle öğrencilerin anlamalarında zorluk yaşadıkları soyut kavramları görselleştirerek somutlaştırmaktadır böylece kavramı öğrenmeleri daha kolay hale gelmektedir. Problem çözme etkinliklerin zenginleşmesine olanak sağlamaktadır. Dersi daha ilgi çekici ve etkili hale getirmekte ve öğrencilerin yaratıcı düşüncelerini geliştirmelerine yardımcı olmaktadır(Moyer,2002). Manipülatifler matematikte çok sık kullanılmaktadır. Özellikle olasılık gibi fiziksel materyal kullanmak çok zor, pahalı ve kavram yanılgısı oluşumuna neden olabileceği durumlarda sanal manipülatifler kullanılabilir(Van De Walle,2012).

Bundan dolayı olasılık konusunun temel kavramların öğretimi için kullanılabilecek sanal dinamik manipülatiflerin tasarlanması çok önelidir. Ayrıca son dönemlerde eğitim için geliştirilen araçların kullanımının, etkililiğinin değerlendirilmesinde hatta tasarımında kullanıcılar da katılımcı olarak kullanıldığından (Bossen vd. 2010; Kafai 2003; Druin 1999; Scaife vd. 1997 akt. Hansan vd. 2016,) manipülatif tasarımında aşamasında öğretmen değerlendirmesini belirlemek önemlidir. Bu amaçla biz tasarladığımız manipülatifleri, etkinliklere yönelik öğretmen görüşlerini ve değerlendirmelerini belirledik. Bir sonraki adımda bu öğretmenlerin görüşlerini ve değerlendirmelerin göz önüne alarak manipülatiflerde değişikliğe gideceğiz.

YÖNTEM

Çalışmada nitel araştırma deseni kullanılmıştır. Etkinlik sırasında kullanılacak olan sanal manüpülatif Unity3d 5.0 sürüm oyun motoru yardımıyla geliştirilmiştir. Manipülatif tasarlanırken Amerikan Ulusal sanal Manipülatif (unvl.com) kütüphanesi internet sitesinden yararlanılmıştır. Nctm ve meb tarafından geliştirilmiş etkinlikler yararlanılarak yeni etkinlikler manipülatiflere uygun olarak tasarlanmıştır.

Tasarlanan bu etkinlikler ve manipülatifler öğretmenlere tanıtılmıştır. Öğretmenlerin manipülatifler hakkındaki görüşler belirlemek için yarı yapılandırılmış görüşme soruları hazırlanmış ve görüşmeler ses kayıt cihazı ile kaydedilmiştir. Daha sonra bu görüşmeler içerik analizine tabi tutularak temalar oluşturulmuştur. Görüşme soruları temel olarak iki sorudan oluşmuştur:

Manipülatif ve etkinliklerin eğitime katkısı var mı?
a)Kavramların öğretimine
b)Öğrencilerin motivasyonuna ve katılımına
Tasarım yönünden düzenleme yapılmalı mıdır?
Çalışmaya 5 öğretmen katılmıştır. Bu öğretmenlerin üçü bu mesleği 10 yıldan uzun diğer iki öğretmen beş yıldan az süredir bu mesleği yapmaktadır. Öğretmenler hakkındaki bilgiler aşağıdaki tabloda verilmiştir:

Tablo: 1 Öğretmen çalışma yılı

Öğretmen	Çalışma yılı
Öğretmen 1	5 yıllık
Öğretmen 2	3 yıllık
Öğretmen 3	10 yıllık
Öğretmen 4	12 yıllık
Öğretmen 5	14 yıllık

BULGULAR

Çalışmada öğretmenlerin tamamı manipülatifi olasılık ile ilgili kavramların öğretimde kullanılabilir mı? sorusuna olumlu yanıt vermiştir. Özellikle manipülatiflerin görselleştirme ve somutlaştırma özelliklerinden bahsetmişlerdir.

Öğretmen4: *«tabiki önce öğretmen anlatacak matematikte yüzme gibidir yüzmeyi öğrencilere göstermek yetmiyor tekrar yaşatmak lazım. Mutlaka katacaktır.»*
Öğretmen3: *«Muhakkak sağlar dersin görselleştirmesi açısından biliyorsunuz olasılık biraz soyut bir konu biraz daha somutlaştırmasını sağlayabilir»*

Öğretmenlerden ikisi manipülatiflerin özellikle teorik ve deneysel olasılık ile ilgili kavramların öğretiminde etkili olacağını belirtmiştir.

Öğretmen3: «*Bir de bu teorik ve deneysel olasılığı anlatıyoruz biz kendilerine teorik olasılık sabittir, deneysel olasılık ise deney sayısı arttıkça teorik olasılığa yaklaşır. Mesela bunu göstermek açısından bu iyi bir şey olmuş*»
Öğretmen5: «*özellikle ikinci etkinlikte teorik ve deneysel olasılık öğretimde zorluk yaşıyoruz. Bu materyaller kullanışlı olabilir.*»

Öğretmenin üçü sınıf içerisinde manipülatiflerin kullanımının öğrencilerin motivasyonlarının ve derse olan ilgisini artıracağını söylemiştir.

Öğretmen 4: «*Etkinlik olsun diye dediğiniz gibi yarışma düzenlenebilir. Öğrenciler arası motivasyonu artırır. Hatta ilk oynadığınızda 2. Ve 3. Defa daha oynayalım önerileri de gelir. Ama abartmamak lazım.»*
Öğretmen 5: «*Matematiğe ilgisi olmayan öğrenci dönüp bakabilir bence hatta bu durumda bile ilgisi olmayan öğrenci mutlaka dönüp bakar o yüzden güzel bir materyal.»*

Öğretmenlerinden ikisi manipülatiflerin kavram yanılgılarını engelleyebileceğini belirtmiştir.

Öğretmen 5: «*evet bu materyal çok güzel (ikinci manipülatiften bahsediyor) öğrenciler tarafından en çok zorlandıkları kısım bu zaten. 6 gelme olasılığını direk 6 (pay kısmına) yazabiliyorlar.»*

Öğretmenlerden ikisi ilk manipülatifte bulunan yüzdeliklerin gösterilen bölümün öğrencilerin anlamlandırmada zorluk yaşayacaklarını belirtmiştir. Çünkü öğrencilerin çok büyük bir kısmının yüzdelik konusunu ve özellikle yüzdeliklerin ondalık kısmını anlamlandıramayacağını belirtmişlerdir.

Öğretmen 3: «*Bu yüzdeler kafa karıştırabilir çünkü yüzdeler olasılığın içerisine hemen girdiği zaman sıkıntı yazabilir. Bir de burada yüzdeler tam net sayı çıkmayacak hep virgüllü çıkacak bundan sıkıntı yaşayabilir. Bunun yanına kesir gelebilir.»*
Öğretmen 5: «*İlk manipülatifte yüzdeler verilmiş ya bu kısım öğrencilerin kafasını karıştırır gibi geldi. Yüzdeyi hesaplarken sıkıntı yaşıyorlar genellikle. Mesela top seçiyorsunuz yan tarafta küsüratlı yüzdelikler çıkıyor bunlar bence kafa karıştırır bence yüzdelik ve küsüratlı olduğu için. Çünkü genelde virgüllü sayılarda çok takılıyorlar ya yani bu yüzdelik kısım değiştirilsin*»

Öğretmenlerin tamamı manipülatiflerin daha renkli olması gerektiğini ve öğretmenlerin dördü de animasyonlarla zenginleştirilmesi gerektiğini belirtmişlerdir.

Öğretmen 4: *«Burayı (arka plan) daha renklendirelim. İlgi çekici olsun. Mesela topu çektiğiniz zaman ne topu çektiğiniz belli olsun. Mesela gösterecek bak 5 geldi daha sonra bunun içerisine atacak. yoksa burada düğmeye basıyor burada 1 yazıyor 2 yazıyor öğrenci o şeyi göremez. Top çek denildiğinde burada bir top çıksın ve bize göstersin daha sonra top torbanın içine konulduğu belli olsun. Arkadan bir el çıksın çekiyor el gösteriyor burada 5 yazdı. Daha sonra topu içeri atıyor. Rastgele çekecek bir baktı 4 çıktı diğerinde baktı tekrar 4 çıktı diğerinde 0 çıktı yani topu görsün ve içeri atıldığını bilsin.»*
Öğretmen 3: *«Ekran sadeleştirilmeli ve görsellik artırılmalı bence sayılar büyütülebilir ve zar atmada zar sonucu görünür. 1 sayısı görünür ve yanda öyle yazar, ilk materyalde de topu çeker, öğrenci çekilen topu görür ve yana geçer. Ekranın rengi daha ilgi çekici olabilir. Koyu renk mesela daha açık renk olabilir. Yazıların boyutu bunu akıllı tahtada gösterebiliriz. Yazı tipi değiştirilse Comic sans ile yazılırsa daha iyi olur. Sadelik ve görsellik önemli çünkü öğrencilerin dikkati çok çabuk dağılabiliyor»*

Öğretmenlerden sadece bir tanesi sanal manipülatif yerine somut materyal kullanılmasını önermiştir.

Öğretmen1*: «İlk materyal güzelde dokunarak kullanacağımız bir materyal olsa daha güzel olmaz mı? Ekranda değil de top olsa kağıt olsa elle öğrencinin yaşadığı şeyi öğrenmesi daha fazladır. Çünkü kendi yaşıyor. İkinci materyal ise elektronik ortamda kullanılabilir çünkü bu konuda elle materyal yapmak daha zordur.»*

SONUÇ

Araştırmaya katılan öğretmenlerin genel olarak bilgisayar üzerinde tasarlanan materyallere karşı olumlu görüşlere sahip olduğu özellikle motivasyonu artıracağını belirtmişlerdir. Çağıtay ve arkadaşları (2001) yaptığı çalışmada benzer sonuçlara ulaşmıştır.

Öğretmenler, manipülatiflerin eğitimde kavramların gelişimine katkı sağlayacağını belirtmişlerdir. Bilgisayar destekli eğitimin öğrencilerin akademik başarıları artırdığı ve kavramsal öğrenmenin gerçekleştirdiği birçok çalışmada belirlenmiştir (Güven ve Sülün,2012, Yeniçeri, 2013). Öğretmenlerin manipülatif hakkındaki görüşlerinin belirlenmesi, manipülatifin birçok yönden gelişimine neden olmuştur. Özellikle biçimsel olarak verilen görüşler manipülatifi öğrencilerin gözünde daha değerli ve öğretici hale getirecektir.

ÖNERİLER

Buna benzer çalışmalar için vereceğimiz için vereceğimiz öneriler şunlardır:

1. Çalışma sırasında öğretmenler bağımlı olay ile ilgili bir materyalin hazırlanmasını önermiştir.
2. Bilgisayar ortamları için tasarlanacak materyaller için grafikerlerden yardım alınmalıdır.
3. Yeniçeri (2013) yapmış olduğu çalışmada Türkçe manipülatiflerin tasarlanmasının önemine vurgu yapmıştır.
4. Bu tür materyallerin niteliği ve niceliği artırılmalıdır.
5. Üretilen manipülatifler sınıf ortamında uygulanmalıdır

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FRACTIONAL LITERACY LEVEL OF STUDENT MATHEMATICS TEACHERS

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ABSTRACT: The purpose of this study is to determine the student mathematics teachers Fractional Literacy level. Survey method was used in this study. The sample of this study consists of 176 student mathematics teachers from Inonu University Faculty of Education, in Malatya, in 2016 spring semester. Data was collected by Fractional Literacy Test and personal information form developed by researcher. Findings show that, student teachers fractional literacy level is average. Based on this result, it can be recommended that, in teacher training process, lecturers should focus on activities that improve student teachers' fractional (mathematical) literacy.

Key words: mathematics literacy, fractional literacy, student teachers.

MATEMATİK ÖĞRETMEN ADAYLARININ KESİR SAYI OKURYAZARLIĞI DÜZEYLERİ

ÖZET: Bu çalışmanın amacı matematik öğretmen adaylarının kesir sayı okuryazarlığı düzeylerini tespit etmektir. Araştırmada tarama yöntemi kullanılmaktadır. Araştırmanın örneklemi 2014 bahar yarıyılında Malatya İnönü Üniversitesi Eğitim Fakültesi İlköğretim Matematik Öğretmenliği programında öğrenim gören 176 matematik öğretmeni adayından oluşmaktadır. Veriler araştırmacı tarafından hazırlanan "Kesir sayı Okuryazarlığı Ölçeği" ve kişisel bilgi formu aracılığıyla toplanmıştır. Bulgular, öğretmen adaylarının kesir sayı okuryazarlığının orta düzeyde olduğunu göstermektedir. Bu sonuca dayalı olarak, öğretim elemanlarının öğretmen adaylarındaki kesir sayı okur-yazarlığı gibi matematik okuryazarlığının alt dallarını geliştirici etkinliklere yönelmesi gerektiği söylenebilir.

Anahtar sözcükler: matematik okuryazarlığı, kesir sayılar, öğretmen adayları.

GİRİŞ

2005 yılında hazırlanıp 2013 yılında güncellenen ortaokul matematik öğretim programı eski programlara göre birçok farklılıklar içermektedir. Bu farklılıklar nedeniyle, matematik eğitiminde köklü bir değişime ihtiyaç vardır. Öğretmenlerin, sistemin uygulayıcıları olarak bu değişimin öncüleri arasında yer aldığı söylenebilir. Bu da öğretmenlerin hizmet içi eğitimlerinin yanı sıra öğretmen yetiştiren kurumların değişimi daha yakından takip etmesini gerektirmektedir.

Matematik eğitiminde reform için yazılagelen bütün önerilere rağmen, yapılan ihtiyaç analizi çalışmalarında genellikle yeni anlayışın eksikliği göze çarpmaktadır (MEB, 2008). 2005 yılında hazırlanan programdaki aksaklıkların giderilmesi için öğretmenlerin anahtar rolünde olduğunu varsayarsak, eğitim sistemimizdeki reformların önünün tıkalı olduğu görüntüsü karşımıza çıkar. Programla ilgili öğretmenlerden kaynaklanan sorunlar incelendiğinde öğretmenlerin bu programı uygulamada ve yetersiz olduğu görüşünün çok sık tekrarlandığı görülmektedir. Farklı çalışmalarda çıkan sonuçlara göre yetersizliğin en fazla değerlendirme boyutunda olduğu görülmektedir. Öğretmenlerin yetersiz oluşunu sebeplere dayalı açıklamaya çalışan bazı araştırmalarda özellikle kıdemli öğretmenlerin araç-gereçleri kullanmayı beceremediği ve dolayısıyla ders kitaplarına yöneldikleri; öğretmenlerin ders kitaplarını incelemeden konuları anlatıyor ve kendilerini derse adamıyor olmaları; ücretli öğretmenlik uygulaması; programın felsefesinin öğretmenlerce kavranamamış olması (Yapıcı, 2009) gibi sebeplerden dolayı programın uygulanmasında aksaklıklar ortaya çıkmaktadır. Bu aksaklıklar bir bütün olarak düşünüldüğünde baş edilmesi zor görünse de parçalara ayırmak suretiyle üstesinden gelinmeyecek sorunlar değildir. Öğretmenlerin süreçteki yetersizliği ile ilgili olumsuz görüş bildiren (Gözütok vd., 2005; Yazıcı, 2009) çalışmalara göre öğretmenlerin ve öğretmen adaylarının eğitimine ağırlık verilmesi gerekmektedir.

2005 yılındaki program değişikliğinin ardından, daha önce aranmayan bazı becerilerin de kazanımlar arasında kendine yer bulduğu görülmüştür. Bunlardan biri olan matematik okuryazarlığı, oldukça geniş bir kavramdır.

"Matematiksel okuryazarlık; bireyin düşünen, üreten ve eleştiren bir vatandaş olarak bugün ve gelecekte karşılaşacağı sorunların çözümünde matematiksel düşünme ve matematiksel karar verme süreçlerini kullanarak çevresindeki dünyada matematiğin oynadığı rolü anlama ve tanıma kapasitesidir" (OECD, 2000, s.10).

Matematik okuryazarlığı oldukça geniş bir kavram olup, alt boyutlara ayrılarak daha doğru değerlendirilebileceği varsayımına dayanılarak hazırlanan bu çalışmada, "kesir sayı okuryazarlığı" (KSOY) terimi kullanılmaktadır. Bu çalışmada kullanılan KSOY: verilen bir kesir sayı ifadesini ve kesir sayılarla yapılan dört işlemi görsel olarak ifade edebilme; görseli sunulan kesir sayıyı ve kesir sayılarla yapılan dört işlemi çıkarsayabilme; verilen bir kesir sayının veya kesir sayılarla yapılan dört işlemin kullanılmasını sağlayacak problem durumları oluşturabilme anlamında kullanılmıştır. Bu vesileyle çalışmada, öğretmen adaylarının bu yönlerini ölçmeyi amaçlayan sorulara yer verilmiştir.

Bu çalışmada, matematik öğretmen adaylarının KSOY düzeyleri ortaya konulmaya çalışılmış olup, Türk Eğitim Sistemi'ndeki program değişikliğinin ardından, öğretmenlerin hangi alanlarda eğitime ihtiyacı olduğunu göstermesi bakımından önem arz etmektedir. Matematik okuryazarlığının çalışıldığı çok sayıda çalışma olmakla birlikte matematiğin tamamının ele alınmasının ve ölçülmesinin zorluğu nedeniyle alt öğrenme alanlarına ayırmak gerekmektedir. Bu çalışma matematikteki alt öğrenme alanlarındaki okuryazarlığı inceleyen ilk çalışma olması nedeniyle önemlidir.

YÖNTEM

Bu bölümde araştırmanın problem cümlesi, modeli, evren-örneklemi ve veri toplama aracı hakkında bilgiler verilmektedir.

Problem Cümlesi

Matematik öğretmen adaylarının, kesir sayı okuryazarlığı düzeyleri nasıldır?

Araştırmanın Modeli

Bu araştırma, ilköğretim matematik öğretmen adaylarının KSOY düzeylerinin belirlenmesi amacıyla veri toplamaya yönelik "tarama modelinin kullanıldığı betimsel nitelikli bir çalışmadır. Betimsel çalışmalar olayların, objelerin, varlıkların, kurumların, grupların ve çeşitli alanların "ne" olduğunu betimlemeye, açıklamaya çalışan çalışmalardır. Betimleme araştırmaları, mevcut olayların geçmişteki olay ve koşullarla ilişkilerini dikkate alarak, durumlar arsındaki etkileşimi ortaya koymayı hedefler (Kaptan, 1998).

Evren-Örneklem

Araştırmanın evrenini 2015- 2016 yılı bahar yarıyılında İnönü Üniversitesi Eğitim Fakültesi İlköğretim Matematik Öğretmenliği programında öğrenimlerine devam eden matematik öğretmen adayları oluşturmaktadır. Çalışmada evren örnekleme yöntemi kullanılmış olup, programın 3. ve 4. sınıflarında öğrenim gören tüm öğretmen adaylarından veri toplanmıştır. Çalışmada yer almaya razı olan toplam 176 öğretmen adayından veriler toplanmıştır.

Veri Toplama Aracı

Araştırmanın verilerinin toplanması için toplam 8 maddeden ve demografik değişkenlerden oluşan, "KSOY Ölçeği" araştırmacı tarafından geliştirilmiştir. Denemelik formdaki maddelerin ölçeğe dâhil edilmesinde güçlük ve ayırt edicilik indeksleri temel alınmıştır. Ölçek oluşturulurken aşağıdaki adımlar takip edilmiştir.

Özel Öğretim Yöntemleri dersi kapsamında öğretmen adaylarına sunulan Sayılar öğrenme alanında yer alan Kesir Sayılar alt öğrenme alanındaki hedefler göz önüne alınarak açık uçlu sorulardan oluşan madde havuzu oluşturulmuştur.

Öğretmen adaylarının Kesir sayılar alt öğrenme alanı okuryazarlığı düzeylerini belirlemeye yönelik denemelik sorular oluşturulmuştur. Denemelik sorular İnönü Üniversitesi Eğitim Fakültesi Eğitim Bilimleri Bölümü Eğitim Programları ve Öğretim Bilim Dalı'nda görev yapan 2 ve İlköğretim Matematik Öğretmenliği Programında görev yapan 2 öğretim elemanı ve MEB'e bağlı okullarda çalışan 3 matematik öğretmeni tarafından incelenmiş, yapılan düzeltmelerin ardından 11 açık uçlu sorudan oluşan deneme formu oluşturulmuştur.

Deneme formundaki maddelerin anlaşılabilirliğinin belirlenmesi için, matematik öğretmenliği yapan 5 öğretmene uygulanmıştır. Öğretmenlerden anlamakta güçlük çektikleri soruları belirtmeleri istenmiş ve gerekli düzeltmeler yapılmıştır. Deneme formu 2015-2016 yılı güz yarıyılında 52 matematik öğretmenine uygulanmış uygulanmıştır. Uygulamanın ardından madde ve test analizleri yapılmıştır. Testteki tüm maddelerin güçlük ve ayırt edicilik indeksleri bulunmuştur. Deneme formunun madde analizi için verilen cevapların frekansları, yüzdeleri, maddelerin güçlük, ayırt edicilik değerleri ve bunların gerektirdiği yorumlar tablo 1'de verilmiştir.

Tablo 1. KSOY Ölçeği Madde Analizi Sonuçları

Deneme formu (OİBT)	Güçlük (P)	Güçlük Yorumu	Ayırt Edicilik (D)	Ayırt Edicilik Yorumu
1 (1)	0,750	Kolay	0,458	Çok iyi
2 (2)	0,429	Orta	0,729	Çok iyi
3 (3)	0,464	Orta	0,625	Çok iyi
4 (4)	0,321	Orta	0,208	Düzeltilmesi gerek
5 (5)	0,571	Orta	0,958	Çok iyi
6 (6)	0,286	Orta	0,396	Düzeltilmesi gerek
7 (7)	0,643	Orta	0,646	Çok iyi
8 (8)	0,286	Orta	0,563	Düzeltilmesi gerek
9 (yok)	0,143	Zor	0,208	Çok zayıf
10 (yok)	0,071	Zor	0,125	Çok zayıf
11 (yok)	0,107	Zor	0,250	Çok zayıf

Güçlük ($0.25<P<0.75$ orta güçlük) ve ayırt edicilik (0.40 çok yüksek) değerlerinin yorumlanmasında Tekin (1993: 249-252) tarafından belirlenen sınırlar esas alınmıştır.
Tekin (1993: 249) madde ayırt edicilik indeksine göre, maddeler hakkında yapılacak yorumların aşağıdaki gibi olması gerektiğini belirtmektedir:

0,40 veya daha yüksek:	Çok iyi bir madde,
0,30 - 0,39:	Geliştirilmesi gereken bir madde,
0,20 - 0,29:	Düzeltilmesi ve geliştirilmesi gereken bir madde,
0,19 veya daha düşük:	Çok zayıf bir madde (Testten çıkarılmalıdır).

Ayırtedicilik indeksleri çok zayıf olan 9, 10 ve 11 numaralı sorular testten çıkarılmıştır. Bu soruların çıkarılması ile testte kalan 8 madde arasında düzeltilmesi gereken 4, 6 ve 8 numaralı maddelerdeki kesir sayılar en sade hale getirilerek ve ek açıklama eklenerek daha anlaşılır hale getirilmiştir. Son durumda kalan 8 madde için yapılan analizlere ilişkin bulgular tablo 2'de verilmiştir.

Tablo 2. KSOY Ölçeği için Betimsel İstatistikler

	Genel	Alt Grup	Üst Grup
Soru Sayısı	8	8	8
Uygulanan Kişi Sayısı	52	14	14
En Yüksek Puanlı Öğrencinin Puanı	8 (%100)	3 (%21,4)	14 (%100)
En Düşük Puanlı Öğrencinin Puanı	0 (%0)	0 (%0)	5 (%35,7)
Ortalama	4 (%50,0)	1,5 (%18,8)	6,07 (%75,9)
Standart Sapma	1,921 (%24.0)	0,824 (%10,3)	0,961 (%12,0)
Çarpıklık z-değeri	-0,008	-0,725	0,660
Basıklık z-değeri	-1,206	-0,341	0,312
KR-20 Güvenirlik Katsayısı	.825	-	-
Madde Güçlük Ortalaması	.500	-	-
Madde Ayırt Edicilik Ortalaması	.563	-	-

Tablo 2'de görüldüğü gibi testte en yüksek puan alan öğrenci 8 puan alabilmiştir. Teste katılan öğrenciler ortalama 4 (%50) puan, alt gruptaki öğrenciler 1,5 (%18,8) puan, üst gruptaki öğrenciler ise 6,07 (%75,9) puan elde etmiştir. Testin geneli için çarpıklık z-değeri (Skewness/Std.Err.) -0,008; basıklık z-değeri (Kurtosis/Std.Err.) ise -1.206 olarak hesaplanmış olup, dağılımın normal dağılıma uygun olduğu diğer bir ifade ile verilerin homojen olduğu görülmektedir. Madde güçlük ortalaması 0.500 olan testin ayırt edicilik ortalaması 0.563'dir.

Hazırlanan test için hesaplanan KR20 güvenirlik katsayısı 0.772 olup, testin güvenirliğinin yeterli (Murphy & Davidshoper, 1988; Nunnally, 1978; Kaplan & Saccuzzo, 2001) olduğunu göstermektedir. KSOY ölçeği öğretmen adaylarının kesir sayı alt öğrenme alanı okuryazarlığının ortaya konulması amacıyla uygulanmıştır. KSOY'den alınan yüksek puan yüksek kesir sayı okuryazarlığını ifade etmektedir.

BULGULAR

Örneklemde yer alan öğretmen adaylarının kişisel bilgileri tablo 3'de görüldüğü gibidir.

Tablo 3. Öğretmen Adaylarının Demografik Değişkenlere göre Dağılımı

Değişkenler		N	%	Değişkenler		N	X
GANO	0-1,99	8	4,5	Öz-yeterlik İnancı	Belirtilmemiş	3	1,7
	2-2,49	47	26,7		0-44	33	18,8
	2,5-2,99	72	40,9		45-54	75	42,6
	3-3,49	46	26,1		55-69	7	4,0
	3,5-4	3	1,7		70-84	36	2,5
Öğretmenlik Tecrübesi	Yok	106	60,2		85-100	22	12,5
	MEB	9	5,1	Sınıf	3. sınıf	97	55,1
	Özel ders	32	18,2		4. sınıf	79	44,9
	Dershane	20	11,4	Cinsiyet	Erkek	65	36,9
	Özel Okul	9	5,1		Kadın	111	63,1
TOPLAM		176	100			176	100

Öğretmen adaylarının kişisel bilgileri incelendiğinde büyük çoğunluğunun kadın (%63,1) ve öğretmenlik tecrübesi olmadığı (%60,2) görülmektedir. Çalışmada toplanan veriler ışığında, araştırmanın problemine yönelik aşağıdaki bulgulara ulaşılmıştır.

Öğretmen Adaylarının KSOY Düzeyleri Nasıldır?

KSOY Ölçeği'ndeki 8 madde üzerinden yapılan değerlendirmeye ilişkin elde edilen ortalamalar ve standart sapmalar tablo 3'de verilmiştir.

Tablo 3. KSOY Ölçeği'ndeki Maddelere İlişkin Ortalama ve Standart Sapma Değerleri

	KAZANIMLAR	x*	Std. Sap.
1.	Kesirlerde toplama	,82	,029
2.	Kesirlerde çıkarma	,49	,038
3.	Kesirlerde çarpma	,67	,036
4.	Kesirlerde bölme	,58	,037
5.	Basit kesir gerektiren problem durumu oluşturma	,66	,036
6.	Bileşik kesir gerektiren problem durumu oluşturma	,20	,030
7.	Basit kesirlerin toplanmasını gerektiren problem durumu oluşturma	,61	,037
8.	Bileşik kesrin bölünmesini gerektiren problem durumu oluşturma	,26	,033
	Şekilleri Formülleştirme (İlk 4 soru)	,64	,022
	İşlemleri Yorumlama (Son 4 soru)	,43	,023
	Kesir Sayı Okuryazarlığı	0,537	0,018

*: elde edilen yüzde başarı yüzdesini göstermektedir.

Ölçekteki maddelerin ilk dördünün, verilen şekillerden yola çıkarak kesir sayılardaki dört işlemi sorguladığı, kalan dört soruda ise, verilen kesir sayının veya işlemin kullanılmasını gerektirecek problem durumlarının oluşturulmasının istendiği görülmektedir. Tablodaki ortalama ve standart sapma değerleri incelendiğinde, öğretmen adaylarının şekilden kesir sayıya gitme becerilerinin formülden somut veriye gitme becerisinden daha yüksek olduğu görülmüştür. Başka bir deyişler, öğretmen adayları verilen somut görsellerden formüle ulaşmada formülden somut veriye ulaşmaya göre daha yüksek başarı elde etmişlerdir. Öğretmen adaylarının ortalama puanlarının 0,537 olduğu görülmektedir. Ölçeğin ölçmeyi amaçladığı kesir sayı okuryazarlığı düzeyinin, bu veriye göre orta düzeyde olduğu görülmektedir. Elde edilen değerler incelendiğinde matematik öğretmen adaylarının yorumlama becerisinin matematiksel ifadeye dönüştürmeye göre daha düşük olduğunu göstermektedir.

Sorular teker teker ele alındığında özellikle şematik olarak verilen kesirlerde toplama işlemini ifade etme konusunda başarılı oldukları (%82); buna karşın bileşik kesir gerektiren sorularda ise oldukça düşük başarı (6.soruda %20, 8. soruda %26) görülmektedir.

SONUÇ

Öğretmen adaylarının kesir sayı okuryazarlığı düzeyini belirlenmeyi amaçlayan bu çalışmada, örneklemde yer alan öğretmen adaylarının orta düzeyde kesir sayı okuryazarı olduğu sonucuna ulaşılmıştır. Bu sonuç alanda yapılan birçok çalışmayla karşılaştırıldığında matematik öğretmenlerinin düzeyi konusunda uyuşum göstermemektedir. Alanda yapılan çalışmalarda matematik okuryazarlığının başarı testi yerine matematik okuryazarlığı özyeterlik ölçeği ile yoklanmış olması, düzeyin farklı çıkmasının sebebi olabilir. Zira özyeterlik, performansın göstergelerinden biri olmakla birlikte çoğu zaman yanıltıcı olabilmektedir (Kruger & Dunning, 1999).

Veriler incelendiğinde örneklemdeki öğretmen adaylarının şekilleri formülleştirme konusunda problem durumu oluşturmaya göre daha başarılı oldukları görülmektedir. Bu sonuç çoktan seçmeli sınavların öğretmen adayları üzerindeki etkisinin (Roediger & Marsh, 2005) bir yansıması olarak ele alınabilir. Çoktan seçmeli teste alışan öğrencilerin üretmek yerine hazırla yetinme eğilimi içinde olması bu sonucu beraberinde getirmiş olabilir.

ÖNERİLER

Matematik öğretmen adaylarının orta düzeyde olan kesir sayı okuryazarlığı düzeyi, öncelikle öğretim elemanları tarafından ele alınmalıdır. Öğretmen adaylarının kendi bilim alanı ile ilgili problem ortaya koymadaki başarısızlığının azaltılması için, öğretim programını merkezine alan ders saatleri artırılabilir. Diğer taraftan matematik okuryazarlığı dersi öğretim programına eklenerek, öğretmen adaylarının bu konuya daha fazla dikkat etmeleri sağlanabilir. Öğretim üyeleri öğretmen adaylarına problem üretme etkinlikleri yapabilir.

Araştırmacılar, öğretmen adaylarının matematik okuryazarlığını özyeterlik ölçümlerinden ziyade performans testleri aracılığıyla ölçerek, bu alandaki eksikliği doldurabilirler. Diğer taraftan matematik okuryazarlığı çalışılırken konuların ayrı ayrı ele alınması ilgili alanın resmini daha net göstereceği için araştırmacıların genel matematik okuryazarlığı yerine özel alanlara yönelmesi, bu çalışmaların verimini artırabilir. Ayrıca, nitel veya deneysel çalışmalar ile bu alanın zenginleştirilmesi de matematik okuryazarlığını artırıcı önlem olarak değerlendirilebilir.

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THE PERCEPTIONS OF SOCIAL SCIENCES TEACHERS ABOUT FATIH PROJECT

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ABSTRACT: With the inclusion of student-centered education concept in the education-learning process in our country, various visual, audio, audio-visual, and technology-assisted materials, which are different from each other, have been brought into use. These materials leaving positive influences on the attention, motivation, and success levels of students increased the necessity for the use of additional materials in education. In this study, the purpose is determining the perceptions of social sciences teachers on Fatih Project by focusing on the support for student development with the help of technologic materials in education in our country. The Qualitative Research Method has been used in this study, and the content and descriptive analysis techniques have been used in data analysis. When the findings of the study are analyzed, it has been determined that the social sciences teachers have positive and negative perceptions on Fatih Project.

Key Words: Social Sciences Teacher, Project, Perception.

SOSYAL BİLGİLER ÖĞRETMENLERİNİN FATİH PROJESİNE İLİŞKİN ALGILARI

ÖZET: Öğrenci merkezli eğitim anlayışının ülkemizde yaygın bir şekilde öğrenme-öğretme sürecinde merkeze alınmasıyla birlikte birbirinden farklı görsel, işitsel, hem görsel hem de işitsel ve teknoloji destekli materyaller kullanılmaya başlanmıştır. Bu materyallerin öğrencinin dikkat, güdülenme ve başarı düzeyi üzerinde olumlu etki bırakması, materyal kullanımının gerekliliğini eğitimde daha da arttırmıştır. Bu çalışmada da ülkemizde eğitimde teknolojik materyaller yardımıyla öğrencinin gelişimini her alanda desteklememeyi temele alıp uygulanmakta olan Fatih projesine ilişkin sosyal bilgiler öğretmenlerinin algılarını belirlemektir. Nitel araştırma yönteminin kullanıldığı bu çalışmada veri analizinde içerik ve betimsel analiz teknikleri kullanılmıştır. Çalışma bulguları irdelendiğinde sosyal bilgiler öğretmenlerinin fatih projesine yönelik birbirinden farklı olumlu ve olumsuz algılara sahip olduğu ortaya çıkmıştır.

Anahtar Sözcükler: Sosyal bilgiler öğretmeni, proje, algı

GİRİŞ

Dünyanın bir çok ülkesinde teknoloji entegrasyonu ile ilgili yapılan çalışmalar, teknoloji entegrasyonunun çok boyutlu, karmaşık, yavaş işleyen, zorlu ve dinamik bir süreç olduğunu, ayrıca teknolojilerin öğretmenler ve öğrenciler tarafından istenilen düzeyde kullanılmadığını göstermektedir (Harris, Mishra, Koehler, 2009; Hsu, 2010; Mishra, Koehler, 2006; Roblyer, 2006; Teo, 2009; Usluel ve Demiraslan, 2005; Yurdakul Kabakçı, 2011; Karal, Aktaş, Turgut, Gökoğlu, Aksoy ve Çakır, 2013). Eğitim dünyası açısından bakıldığında, bilgi ve iletişim teknolojilerinin (BİT) eğitime entegrasyonu sürecinde genel olarak karşılaşılan zorluklar; donanım, yazılım ve alt yapı eksikliği (Empirica, 2006; Korte, Husing, 2007; Pelgrum, 2001), öğretmenlerin yeterli bilgi ve beceriye sahip olmamaları, özgüven, teknik destek ve eğitim eksikliği, öğretmenlerin isteksizlikleri ve değişime karşı direnç göstermeleri (Becta, 2004; Lim, Khine, 2006; Karal, Aktaş, Turgut, Gökoğlu, Aksoy ve Çakır, 2013) olarak sayılabilir. Bu sorunların ortadan kaldırılması amacıyla bilgi ve iletişim teknolojilerinin (BİT) farkına varan başta gelişmiş ülkeler olmak üzere bir çok ülke, sınıfların teknolojik alt yapılarının geliştirilmesi ve eğitime entegrasyonu için çalışmaktadır. Ülkemizin eğitim politikaları bağlamında düşünüldüğünde, özellikle son on yıllık süreçte teknolojideki gelişime ayak uyduracak çeşitli politikaların zaman zaman işe koşulduğu fakat ülke geneline yaygınlaştırılan ulusal bir eğitimde teknoloji projesinin hayata geçirilemediği görülmektedir (Dursun, Kuzu, Kurt, Güllüpınar ve Gültekin, 2013). Bundan dolayı Milli Eğitim Bakanlığı bu sorunların ortadan kaldırılması ve öğrenme-öğretme sürecine etkili entegrasyonun sağlanmasında "Fırsatları Artırma ve Teknolojiyi İyileştirme Hareketi (FATİH)" projesini hayata geçirmiştir. Bu proje kapsamında; teknolojiyle zenginleştirilmiş öğretim ortamlarında, etkili öğretim stratejileriyle birlikte daha etkili öğretimin sunulması ve fırsat eşitliğinin sağlandığı, bireysel farklılıkların göz önünde bulundurulduğu eğitim ortamlarının oluşturulması amaçlanıp bu amaç çerçevesinde gerekli uygulamalar hala devam etmektedir (Bilici, 2011; Karal, Aktaş, Turgut, Gökoğlu, Aksoy ve Çakır, 2013). FATİH Projesi (Fırsatları Artırma ve Teknolojiyi İyileştirme Hareketi) gerek kapsam gerekse sağladığı teknolojik donanım açısından öncül örneklerinden farklılaşmaktadır. FATİH Projesi açılımından da çıkarılacağı gibi, tüm yurt genelinde yaşanan eğitimdeki kalite farklılaşmasını ortadan kaldırmak, teknolojiyi iyileştirmek ve tüm paydaşlar arasında fırsat eşitliği sağlamak adına işe koşulan bir projedir. Bilindiği gibi gerek internet teknolojilerinde yaşanan gelişmeler gerekse mobil teknolojilerin giderek yaygınlaşması bu teknolojilerin eğitsel yönünü de ön plana çıkarmıştır fakat bu teknolojilere sahip olma konusunda hali hazırda tüm öğrencilerin eşit şartlara sahip olduklarını söylemek güçtür. İlgili teknolojiler, erişim sağlayabilen öğrenciler için önemli yardımcılar olurken, bu olanaklardan yoksun öğrenciler için ise fırsat eşitsizliğini artıran teknolojilerdir (Alkan ve diğerleri, 2011).

Araştırmanın Amacı

Araştırmanın amacı, ülkemizde eğitimde teknolojik materyaller yardımıyla öğrencinin gelişimini her alanda desteklememeyi temele alıp uygulanmakta olan Fatih projesine ilişkin sosyal bilgiler öğretmenlerinin algılarını belirleyip genel amaç çerçevesinde çeşitli öneriler sunmaktır. Bu genel amaç çerçevesinde şu sorulara cevap aranmıştır:

- ✓ Fatih projesinin siz öğretmenlere yüklediği en önemli sorumluluklar nelerdir?
- ✓ Ülkemizde uygulanan Fatih projesini eğitime katkı açısından verimli buluyor musunuz, niçin?
- ✓ Fatih projesiyle birlikte öğrenme – öğretme sürecinde ne gibi değişiklikler oldu?
- ✓ Fatih projesinin uygulanma sürecinde karşılaşılan olumsuz durumlar sizce nelerdir?

YÖNTEM

Araştırma Modeli

Türkiye'de eğitimde teknolojik materyaller yardımıyla öğrencinin gelişimini her alanda desteklememeyi temele alıp uygulanmakta olan Fatih projesine ilişkin sosyal bilgiler öğretmenlerinin algılarını belirlemeye yönelik bu araştırma, nitel araştırma yaklaşımına dayalı yarı yapılandırılmış görüşme yöntemiyle gerçekleştirilmiştir. Bu araştırma da durum çalışması modeli kullanılmıştır. Durum çalışması modeli "güncel bir olgunun gerçek yaşam bağlamında, özellikle bağlam ve olguların sınırlarının kesin olarak belli olmadığı durumlarda görgül olarak araştırılması" şeklinde ifade edilmektedir.(Yin,1994: 13; Merriam, 1998: 27).

Çalışma Grubu

Araştırmada çalışma grubunu, Malatya ve Elazığ'da çeşitli okullarda görev yapan 30 sosyal bilgiler öğretmeni oluşturmaktadır. Araştırmacının, öğrencilere daha rahat ulaşmak, araştırmacıya araştırmanın güvenirliği açısından kolaylık sağladığından dolayı çalışma grubu üyeleri bu illerden seçilmiştir.

Veri Toplama Aracı

Araştırmanın kuramsal boyutu oluşturulduktan sonra sosyal bilgiler öğretmenlerinin Fatih projesine yönelik görüşlerini almak üzere yarı yapılandırılmış görüşme formu hazırlanmıştır. Görüşme formu hazırlanırken öncelikle sorulacak sorular belirlenmiştir. Sorular oluşturulurken kolay anlaşılabilecek sorular yazma, açık uçlu sorular sorma, odaklı sorular hazırlama, yönlendirmekten kaçınma, çok boyutlu sorular sormaktan kaçınma ve soruları mantıklı bir biçimde düzenleme gibi ilkelere (Yıldırım ve Şimşek, 2008) dikkat edilmiştir.

Araştırmada kullanılacak olan görüşme formu, Fırat Üniversitesi ve İnönü Üniversitesi Eğitim Fakültelerinde görev yapan alan uzmanlarına, içerik geçerliliğini sağlamak amacıyla görüşlerine sunulmuştur. Alan uzmanlarından gelen görüş ve öneriler doğrultusunda görüşme formuna son şekli verilmiştir. Görüşme formunda 4 soru yer almaktadır.

Verilerin Analizi

Görüşme formu ile ilgili çözümlemeler nitel boyutta gerçekleştirilmiştir. Kodlamalar araştırmacıların ortak görüşleri doğrultusunda oluşturulmuştur. Bu çerçevede, sosyal bilgiler öğretmenlerinin Fatih projesine yönelik görüşlerinden elde edilen veriler içerik ve betimsel analiz teknikleriyle belli temalar altında gruplanarak çözümlenmeye çalışılmıştır. Araştırmanın güvenirliğini sağlamak için, araştırmada ulaşılan uzman görüşüne başvurulmuştur. Araştırmacı ve uzmanlar tarafından öncelikle ana temalar ardından bunlara bağlı tema ve alt temalar oluşturulmuştur. Çözümlemeler sonucunda ortaya çıkan temalar aralarındaki bağları gösterir şekilde modellenmiş ve görselleştirilmiştir. Modelde yer alan ilişkileri gösteren temayı söyleyen kişi sayısı (frekansını) belirlenmiştir. Araştırmacıların ve uzmanın, temalarda yer alması gereken görüşlere ilişkin değerlendirmeleri karşılaştırılarak "*görüş birliği*" ve "*görüş ayrılığı*" sayıları tespit edilmiştir. Araştırmacı dışında iki uzmanla birlikte analizler yapılıp, Miles ve Huberman'ın (1994) formülüne göre araştırmacılar arasındaki uyum hesaplanmıştır. Bu hesaplama sonucunda, P =(83/83+1) x 100 = %92 olarak hesaplanmıştır.

BULGULAR

Bu bölümde, Elazığ ve Malatya'da çeşitli okullarda görev yapan sosyal bilgiler öğretmenlerinin Fatih projesine ilişkin görüşleri belirlenip ve bu görüşleri uygun temalara dönüştürüldükten sonra tablolar halinde sunulmuştur.

Fatih Projesinin Öğretmenlere Yüklediği Sorumluluklar Durumu

Araştırmada çalışma grubunu oluşturan sosyal bilgiler öğretmenleri "Fatih projesinin siz öğretmenlere yüklediği en önemli sorumluluklar nelerdir?" şeklindeki soruya yanıtlar verirken farklılaştıkları ortaya çıkmıştır. Çalışma grubunun verdiği yanıtlar içerik ve betimsel analize tabi tutularak tablo halinde sunulmuştur.

Tablo 1: Çalışma Grubu Üyelerinin Fatih Projesinin Öğretmenlere Yüklediği Sorumluluklara İlişkin Algıları

1.TEMA*: Fatih projesinin öğretmene yüklediği sorumluluklar*	
Alt Temalar	***f***
G.1. *Teknolojiyi iyi bilip kullanma*	*14*
G.2. *Sınıfta teorik ve pratik etkinlikleri birlikte yapma*	*7*
G.3*. Öğrenci merkezli kontrole önem verme*	*4*
G.4. *Dönütleri yerinde ve zamanında yapma*	*3*
G.5. *İyi bir gözlemci olma*	*2*

Tablo 1'de çalışma grubunu oluşturan sosyal bilgiler öğretmenlerinin verdiği cevaplar alt temalar şeklinde gruplandırılarak verilmiştir. Bu alt temaları oluşturan öğretmen görüşleri aşağıda örneklendirilmiştir.

> *"Fatih projesi biz öğretmenlere bir çok sorumluluk yüklemekle beraber aslında bir çok alanda eksikliğimizi görmemize yardımcı oldu diyebilirim. Çünkü ben 26 yıllık öğretmenim ben teknolojiyle hiç bu kadar etkileşim halinde olmadım. Bu proje sayesinde aldığımız eğitimler bize bu proje kapsamındaki teknolojik aletleri daha iyi kullanmamızı sağladı. Bundan dolayı bana göre en önemli sorumluluk öğretmenlerin bu proje kapsamında kullanılması gereken teknolojik araçları kullanmasını Bilmesidir."* **(G.1)**

Fatih Projesinin Eğitime Katkı Durumu

"Ülkemizde uygulanan Fatih projesini eğitime katkı açısından verimli buluyor musunuz, niçin?" şeklindeki soruya sosyal bilgiler öğretmenlerinin birbirinden farklı yanıtlar verdiği tablo 2'de görülmektedir.

Tablo 2: Çalışma Grubu Üyelerinin Fatih Projesinin Eğitimdeki Verimliliğine İlişkin Algıları

2.TEMA*: Fatih projesinin eğitimde kullanımının sonuçları*		
	Alt Temalar	***f***
Evet	*G.1.Öğrencinin dersi dinleme süresinin artması*	*10*
	G.2. Daha çok duyunun öğrenme sürecine katılımı	*7*
	G.3.Farklı yöntem ve tekniklerin bir arada kullanımı	*2*
	G.4.Öğrencide oluşan özgüven yüksekliği	*4*
Hayır	*G.5. Öğretmeni pasifleştirmesi*	*3*
	G.6.Öğrencide dikkat dağınıklığına sebep olması	*4*

Çalışma grubu üyelerinin "Ülkemizde uygulanan Fatih projesini eğitime katkı açısından verimli buluyor musunuz, niçin?" şeklindeki soruya araştırmada verdikleri yanıtların içerik ve betimsel analize tabi tutularak tablo 2'de verilmesine bağlı olarak öğretmenlerin görüşleri de şu şekilde örneklendirilmiştir:

> *"Şu hiç bir zaman unutmayalım ki hiç bir materyal öğretmenin yerini tutamaz. Soruya gelince ben bu projeyi gereksiz ve yersiz gören öğretmenlerden biriyim. Çünkü daha önceki sistemde öğretmen aktif dersini anlatan bir bileşen iken bu proje sayesinde sadece akıllı tahtada var olanı öğrenciye okuyan ya da aktaran bir birey haline gelmiştir. Ayrıca öğretmen yapması gereken etkinliklerin tamamını bir arada yapması bu projenin verimsizliğinin en önemli sebeplerinden biri olduğunu düşünüyorum."* **(G.5).**

Fatih Projesinin Öğrenme-Öğretme Sürecinde Oluşan Değişiklikler Durumu

Araştırmada elde edilen bulguların oluşmasında belirleyici role sahip olan ve çalışma grubunu oluşturan sosyal bilgiler öğretmenlerinin yarı yapılandırılmış görüşme formunda yer alan "Fatih projesiyle birlikte öğrenme – öğretme sürecinde ne gibi değişiklikler oldu?" şeklindeki soruya birbirinden farklı yanıtlar vermişlerdir. Öğretmenlerin verdiği yanıtlar tablo 3'de içerik ve betimsel analize tabi tutulara alt temalara ayrılmıştır.

Tablo 3: Çalışma Grubu Üyelerinin Fatih Projesinin Öğrenme Öğretme Sürecine İlişkin Algıları

***3.TEMA**: Öğrenme-öğretme sürecinde fatih projesi*	
Alt Temalar	***f***
***G.1.** Öğrencinin dikkat düzeyinin yükselmesi*	*9*
***G.2.** öğrencinin kavrama ve anlama seviyesinin artması*	*7*
***G.3**. Öğrencinin somutlaştırma düzeyinin azalması*	*6*
***G.4.** Öğretmenin hazırlıksız sınıfa gelmesi*	*3*
***G.5.** Öğrencinin daha çok sayıda duyuyla sürece katılması*	*5*

Çalışma grubunu oluşturan sosyal bilgiler öğretmenlerinin yarı yapılandırılmış görüşme formunda yer alan bu soruya verdiği yanıtlar yukarıdaki tabloda alt temalara ayrılarak verilmiştir. Öğretmen görüşlerinin benzerlik ve farklılığından oluşan bu alt temaları her biri örneklendirilebilir. Bu örneklerden biri aşağıda verilmiştir.

> *"Fatih projesi ile birlikte bu projenin uygulanabildiği okullarda" Öğrenme-öğretme sürecinde bir takım değişiklikler olmuştur ve olmaya da devam edecektir. Bu değişikliklerin başında öğrencinin soyut ve anlaşılmaz olan konun öğrenilmesinde karşılaştığı zorlukların ortadan kalkması durumunu sağlayan projede ki araçların öğrenciye sağladığı somutlaştırmaya dayalı öğrenmeye ihtiyaç duyulmamasıdır."* **(G.3)**

Fatih Projesinin Uygulanması sürecinde karşılaşılan Olumsuzluklar Durumu

Araştırmada görüşme formunda yer alan **"**Fatih projesinin uygulanma sürecinde karşılaşılan olumsuz durumlar sizce nelerdir" şeklindeki soruya çalışma grubu üyelerinin cevaplarda farklılaştıkları ortaya çıkmıştır. Çalışma grubu üyelerinin farklılaşması çalışmada birbirinden farklı temaların ortaya çıkmasını beraberinde getirmiştir. Ortaya çıkan bu farklı temalar tablo 4'de verilmiştir.

Tablo 4: Çalışma Grubu Üyelerinin Fatih Projesinin Uygulama Sürecinde Karşılaşılan Olumsuzluklara İlişkin Algıları

***4.TEMA**: Fatih projesinin uygulama sürecindeki olumsuzlukları*	
Alt Temalar	***f***
***G.1.** Teknik donanım eksikliği*	*9*
***G.2.** Öğretmeninin teknolojik bilgi ve kullanım eksikliği*	*11*
***G.3**. İçeriğin olduğu gibi aktarımı*	*5*
***G.4.** Öğrencinin oryantasyon problemi*	*3*
***G.5.** Öğrencinin sorumluluklarını yerine getirmemesi*	*2*

Çalışma grubu üyelerinin "Fatih projesinin uygulanma sürecinde karşılaşılan olumsuz durumlar sizce nelerdir" şeklindeki soruya araştırmada verdikleri yanıtların içerik ve betimsel analize tabi tutularak tablo 2'de verilmesine bağlı olarak öğretmenlerin görüşleri de şu şekilde örneklendirilmiştir:

> *"Fatih projesinin uygulanma sürecinde bir takım olumsuzların yaşanması çok da problem değildir, ancak bunlar giderildiği müddetçe bu böyledir. Eğer bu problemler giderilmezse ya da giderilemiyorsa o zaman sıkıntı büyük olur. Ben derste proje kapsamında akıllı tahta kullanarak ders anlatıyorum ve dersi anlatırken yaşadığım en büyük problem tahtayı kullanmayı tam anlamıyla bilmememdir. Belki biraz garip olacak ama bunun için kurs verdiler ama yine öğrenemedik."* **(G.1)**

SONUÇLAR

Elazığ ve Malatya'da çeşitli okullarda görev yapan sosyal bilgiler öğretmenlerinin Fatih projesine ilişkin görüşleri belirlenip ve bu görüşleri uygun temalara dönüştürülüp verildiği bu araştırmada elde edilen bir çok dikkat çekici sonucun olduğunu yukarıda verilen tablolarda görmekteyiz. Fatih projesinin tasarlanıp uygulanmasının birbirinden farklı bir çok amacı olmasına rağmen asıl amaç proje ile, öğrencilerin bilgi ve iletişim teknolojileri ile daha erken yaşta tanışması ve böylece topluluğun bilgi iletişim teknolojileri okuryazarlığının artması sağlanarak, bilgi iletişim teknolojilerinin toplumsal, sosyal ve ekonomik yaşamı etkilemesi planlanmaktadır. Böylelikle, ülkenin BIT, yazılım ve donanım üretiminin artırılması, elektronik ve bilgiye dayalı sanayinin geliştirilmesi, kısaca ekonomik ve sosyal büyümenin sağlanması hedeflenmesidir (Ekici ve Yılmaz, 2013). Ancak bu hedefin gerçekleştirme boyutunda bir çok sorunun ortaya çıkabileceğini yapılan bu araştırma ortaya koymuştur. Örneğin araştırmada elde edilen bir çok dikkat çekici sonuçtan biri, proje için okulların teknik donanım eksikliği ve öğretmenlerin teknolojik bilgi ve kullanım eksikliğine sahip olmalarıdır. Her iki eksikliğin olduğu bir ortamda siz öğrencilere bilgi ve teknolojilere dayalı bir eğitim vermekte zorlanmakla birlikte öğrencilere bu becerileri kazandırmakta da başarısız olmanız kaçınılmazdır. Çünkü işin gereklerinin yapılması için bir ortam ve işten anlayan bilgi ve beceri düzeyi gelişmiş bir aktarana sahip olmanız gerekiyor.

Çalışmada elde edilen bir diğer önemli sonuç, bu projenin kullanımının öğrenme öğretme sürecinde meydana getirdiği bir çok değişiklikten biri olan öğrencinin dikkat düzeyinin yükselmesidir. Öğrenciler için dikkat çekici unsurlar öğrenciye görelilik ilkesi doğrultusunda farklılık göstermektedir. Öğrenme öğretme sürecinde öğrencinin verimliliğini arttıran öğrenciyi sürdürülebilir bir şekilde etkinliklerle öğrenme sürecine dahil eden her türlü strateji, yöntem, teknik ve materyal öğrencinin dikkatini çekmektedir. Fatih projesi bu öğelerin tamamını içerisinde barındıran bir bir uygulama olduğundan öğrencinin dikkat düzeyi üzerinde etkili olabildiğini söyleyebiliriz.

ÖNERİLER

Yapılan çalışmada elde edilen sonuçlardan hareketle:

- ✓ Projenin uygulanması için uygulamanın yapıldığı bütün okullarda teknik ve donanım olarak eksiklikleri tamamlanıp giderilmelidir,
- ✓ Projenin uygulayıcıları olan öğretmenlere proje ile ilgili bütün yeterlilikler kazandırılmalıdır,
- ✓ Projenin ülke, bakanlık, veli, öğrenci ve öğretmen açısından bütün kazanımları eğitimin bileşenleri olan öğrenci, veli ve öğretmene anlamlı bir şekilde anlatılmalıdır,
- ✓ Teknolojinin sadece bir sohbet ve oyun aracı olmadığı bu proje için temel işlevinin öğrencinin bilgiyi algılma, kavrama, tekrar ederek anlamlı bir şekilde öğrenme olduğu öğrencilere ve velilere anlatılmalıdır.

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EXAMINATION OF THE PRIMARY TEACHER CANDIDATES' TECHNOLOGICAL PEDAGOGICAL CONTENT KNOWLEDGE (TPACK) COMPETENCIES AS TO DIFFERENT VARIABLES

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ABSTRACT: The aim of this study is examination of primary teacher candidates' technological pedagogical content knowledge (TPACK) competencies as to gender, high school type and overall academic average. 308 primary teacher candidates student in final year spring 2014-2015 at department of primary school teaching constitute the sample of the research. Survey method used for the study. Data was collected with the TPACK Scale adapted to Turkish by Sahin (2011). So as to analyze the data obtained, Independent samples t test and one way ANOVA was used. According to the research results while there was no difference between gender variable (t(306): -1,831, p>0,05), there were significant differences between high school type and overall academic average (F(4, 303)= 5,055 p<.05).

Key words: TPACK, Primary teacher candidates, Technology integration

SINIF ÖĞRETMENİ ADAYLARININ TEKNOLOJİK PEDAGOJİK ALAN BİLGİSİ (TPAB) YETERLİKLERİNİN ÇEŞİTLİ DEĞİŞKENLERE GÖRE İNCELENMESİ

ÖZET: Bu çalışmanın amacı sınıf öğretmenliği adaylarının, TPAB becerilerini cinsiyet, mezun oldukları lise türü ve genel akademik ortalama gibi demografik özelliklerine göre incelemektir. Çalışmaya 2014-2015 bahar döneminde sınıf öğretmenliği son sınıfında okuyan 308 öğretmen adayı katılmıştır. Veriler, Şahin (2011) tarafından Türkçeye uyarlanan TPAB ölçeği ile toplanmıştır. Verilerin analizi için Bağımsız t-testi ve Tek yönlü varyans (ANOVA) analizi kullanılmıştır. Çalışma sonuçlarına öğretmen adaylarının TPAB seviyeleri; cinsiyet değişkeni için istatiksel olarak anlamlı bir farklılık yok (t(306): -1,831, p>0,05) iken, mezun oldukları lise türüne ve akademik ortalamaya göre anlamlı fark söz konusudur (F(4, 303)= 5,055 p<.05).

Anahtar sözcükler: TPAB, Sınıf Öğretmeni Adayları, Teknoloji entegrasyonu

GİRİŞ

Bir ülkenin geleceğini inşaa eden mimarlar öğretmenlerdir. Öğretmenler genç nesillerin nitelikli ve günün şartlarına uygun donanıma sahip olarak yetişmesinde başrol oynarlar. Öğretmenlerin bu başrolü oynayabilmeleri için kendi yeterliliklerini tamamlaması gerekir. Günümüzde bu yeterlilik ise teknoloji bilgisi ve bu bilgi türü ile birlikte Teknolojik Pedagojik Alan Bilgisi(TPAB)dir.

Milli Eğitim Bakanlığı Öğretmen Yetiştirme ve Eğitimi Genel Müdürlüğünce hazırlanan öğretmenlik mesleği yeterlik alanlarında "Kişisel ve Mesleki Değerler" alanının üçüncü alt boyutundaki performans göstergesi "Bilgi ve iletişim teknolojileri ile ilgili yasal sorumlulukları bilir ve bunları öğrencilere kazandırır"(MEB, 2012).şeklinde düzenlenmiştir. Türk Eğitim Derneği tarafından gerçekleştirilen Öğretmenlik Mesleği Genel Yeterlikleri konulu araştırmada TPAB, öğretim programları ve konu alanı, programın ne şekil öğretileceği alanın diğer alanlarla ilişkisi, alandaki en son gelişmeler, alanın temel kavram, araç ve yapıları, öğretilecek içeriğin teknoloji ile bütünleştirilmesi hakkında bilgili olma" şeklinde tanımlanmıştır (TED, 2009). TPAB, öğretmen veya öğretmen adayının teknoloji, pedagoji ve alan bilgisinin bileşiminden oluşan ve alanlarıyla ilgili bir konuyu öğretmek için kullanabilecekleri teknolojiler ve öğretim yaklaşımları hakkındaki bilgisidir (Mishra ve Koehler, 2006).

TPAB kavramının bileşenleri olan alan, pedagoji ve teknoloji bilgisinin içeriği aşağıda Tablo 1 de verilmiştir.

Tablo 1. Alan Bilgisi, Pedagojik Bilgi ve Teknolojik Bilginin İçeriği

Alan Bilgisi	**Pedagojik Bilgi**	**Teknolojik Bilgi**
Öğretim Programı	Sınıf Yönetimi	Temel Kullanım
Temsil Sistemleri	Öğretim Strateji ve Yöntemleri	Standart Ayarlar
Öğrenci Zorlukları (Nelerdir?)	Öğrenci Zorlukları, Kavram Yanılgıları (Nasıl Giderilir?)	Teknik Sorunları Çözebilme
Ölçme ve Değerlendirme (Nedir?)	Ölçme ve Değerlendirme (Nasıl?)	

Bozkurt ve Cilavdaroğlu, (2011)

TPAB modeli, temelini oluşturan PAB modeli çerçevesinde ele alınarak bütünleştirici ve dönüştürücü olmak üzere iki şekilde teknoloji entegrasyonu öne sürmektedir. Pierson (1999, s.225), TPAB'ı en basit haliyle alan bilgisi, pedagojik bilgi ve teknolojik bilginin birleşimi veya teknoloji entegresyonu olarak açıklamıştır. Keating ve Evans (2001)'e göre TPAB, teknoloji kullanarak konu alan bilgisini en uygun şekilde sunma olanağı sağlamaktadır (Ay, 2015). Margerum-Lays ve Marks (2003)'ın teknolojinin pedagojik alan bilgisi şeklinde tanımladığı TPAB kavramı, eğitim teknolojisinin kullanıldığı öğretme-öğrenme durumlarından türetilmiş ve uygulanabilir bir bilgi olarak ifade edilmektedir. Araştırmacılara göre, bu bilgiye sahip olan öğretmen; belirli teknolojilerin öğretimde nasıl kullanılacağını, bu teknolojiler ile gerçekleştirilecek öğretim için gereken zamanı, öğrencilerin olası problemlerinin belirli teknolojilerle nasıl çözüleceğini, öğretim ve öğrenmenin teknolojik imkânlara göre nasıl düzenlenmesi gerektiğini bilmektedir. Teknolojiyi mantıklı bir şekilde kullanma kabiliyetine sahiptir ve öğrencisinin konu ile ilgili sahip olduğu kavramları öğrenmesinde teknolojinin etkisinin farkındadır (Ay, Karadağ ve Acat, 2015). TPAB ile ilgili yapılan çalışmalarda, öğretmen ve öğretmen adaylarının öğretim sürecinde teknolojinin eğitim içerikli kullanımı konusunda kendilerini yetersiz gördüklerinden (Bilgin, Tatar ve Ay, 2012) öğretmen eğitim programlarında TPAB' ları geliştirmeleri için neler yapılabileceği hakkında araştırmalara duyulan ihtiyaç belirtilmektedir (Ay, Karadağ ve Acat, 2016).

İçinde bulunduğumuz yüzyıl bilgi ve teknolojinin ön planda olduğu bir çağdır. Günümüzde ülkeler arasındaki önemli ihracat dallarından biriside teknoloji ve teknolojik araç gereçlerdir. Ülkelerin gelişmişlik düzeyleri eğitim sistemlerinin gelişmişlikleri ile doğru orantılı olduğu için eğitim sistemlerine ve yeni nesillere teknolojiyi entegre edebilenler her alanda bir adım önde olacaklardır. Bu yüzden devletler geleceklerinin inşası anlamında olmazsa olmaz gördükleri eğitim alanında teknolojiyi eğitim programlarının merkezine koydukları görülür (Karakuyu, 2015). Ayrıca başarılı bir eğitim öğretim için ve hedeflenen başarıya ulaşabilmek için öğretmen ve adaylarının mesleklerinde öncelikle teknolojinin eğitimdeki rolünü kabul etmeleri ve kullanabilme becerisine sahip olmaları gerekir. Çünkü karşılarında teknoloji ile iç içe olan öğrenci grubu vardır (Erdemir, Bakırcı ve Eyduran, 2009).

Araştırmanın Amacı

Araştırmada sınıf öğretmeni adaylarının TPAB seviyelerini cinsiyet, mezun olunan lise türü ve genel akademik ortalama gibi demografik özelliklere göre incelemek amaçlanmıştır.

YÖNTEM

Araştırmanın Modeli ve Çalışma Grubu

Araştırmada tarama yöntemi kullanılmıştır. Araştırmanın çalışma grubunu 2014-2015 yılı bahar döneminde eğitim fakültesi sınıf öğretmenliği son sınıfında öğrenim gören 308 sınıf öğretmeni adayı oluşturmaktadır.

Veri Toplama Araçları

Teknolojik Pedagojik Alan Bilgisi Ölçeği: Ölçeğin orijinali Schmidt ve diğ. (2009) tarafından geliştirilmiş olup, sınıf öğretmenlerinin TPAB'lerine yönelik yeterliliklerini belirlemek amacıyla Şahin (2011) tarafından Türkçeye uyarlanmıştır. Ölçek 47 madde ve "Kesinlikle Katılıyorum", "Katılıyorum", "Kararsızım", "Katılmıyorum" ve "Kesinlikle Katılmıyorum" şeklinde 5'li Likert yapıdan oluşmaktadır. Ölçekten alınabilecek puanlar 47-235 arasındadır.

Verilerin Analizi

Öğretmen adaylarına fotokopi yoluyla çoğaltılarak dağıtılan ölçeklerden toplanan veriler SPSS analiz programına girilmiştir. Sınıf öğretmeni adaylarının cinsiyet değişkeni için, bağımsız t testi, mezun oldukları lise türü ve genel akademik ortalamaları için ise tek yönlü varyans analizi (ANOVA) yapılmıştır.

BULGULAR

Tablo 1. Sınıf Öğretmeni Adaylarının Cinsiyetlerine Göre TPAB Seviyeleri

TPAB	X	SS	t	df	p
Erkek	160,96	28,05	-1,831	306	0,068
Kadın	166,94	27,47			

N=308; *p>0,05

Tablo 1 de görüldüğü gibi erkek öğretmen adaylarının aldıkları puanların ortalamaları 160,96 ve standart sapma değeri 28,05 iken, bayan öğretmen adaylarının aldıkları puanların ortalamaları 166,94 ve standart sapma değeri 27,47 dir. Bağımsız t-testi sonuçları sınıf öğretmeni adaylarının cinsiyet değişkenine göre TPAB ölçeğinden aldıkları puanların ortalamaları arasında istatiksel olarak anlamlı bir fark olmadığını göstermektedir (t(306): -1,831, p>0,05).

Tablo 2 Sınıf Öğretmeni Adaylarının Lise Türüne Göre TPAB Seviyeleri

TPAB	df	OK	F	P
Mezun Oldukları Lise				
Gruplar Arası	4	3711,5	5,055	0,001
Grup içi	303	734,2		
Toplam	307			

N:308 *P<0,05

Tablo 2 de verilen Tek yönlü varyans analiz (ANOVA) sonuçları, sınıf öğretmeni adaylarının mezun oldukları lise türü değişkenine göre TPAB ölçeğinden aldıkları puanların ortalamaları arasında istatiksel olarak anlamlı bir fark olduğunu göstermektedir (F(4, 303)= 5,055 p<0,05). Bu farklılığın hangi grubun lehine olduğunu anlamak için ise Post.Hoc analizi yapılmış sonuçlar tablo 3 de verilmiştir.

Tablo 3 Sınıf Öğretmeni Adaylarının Lise Türüne Göre Post-Hoc.Analiz Sonuçları

(I)	(J)	Mean Difference (I-J)	Std.Hata	p
Meslek	Normal	2,22	12,30	1,000
	Anadolu	5,49	12,34	1,000
	And.Öğretmen	2,81	13,19	1,000
	Fen	-65,0	19,78	0,011*
Normal	Anadolu	3,26	3,17	1,000
	And.Öğretmen	0,58	5,63	0,882
	Fen	-67,22	15,78	0,000*
Anadolu	And.Öğretmen	-2,67	5,71	1,000
	Fen	-70,64	15,81	0,000*
And.Öğretmen	Fen	-67,81	16,49	0,000*

Tablo 3 de ki post-hoc analiz sonuçlarına göre sınıf öğretmeni adaylarının TPAB ölçeğinden aldıkları puanların ortalamaları mezun olduğu lise türü fen lisesi olan grup lehine anlamlı bir fark vardır.

Tablo4 Sınıf Öğretmeni Adaylarının Genel Akademik Ort. Göre TPAB Seviyeleri

TPAB	df	OK	F	P
Genel Akademik Ort.				
Gruplar Arası	4	1780,5	2,349	0,048
Grup içi	303	757,9		
Toplam	307			

N:308 *P<0,05

Tablo 4 de verilen Tek yönlü varyans analiz (ANOVA) sonuçları, sınıf öğretmeni adaylarının genel akademik ortalama değişkenine göre TPAB ölçeğinden aldıkları puanların ortalamaları arasında istatiksel olarak anlamlı bir fark olduğunu göstermektedir (F(4, 303)= 2,349 p<0,05). Bu farklılığın hangi grubun lehine olduğunu anlamak için ise Post.Hoc analizi yapılmış ve sonuçlar tablo 5 de verilmiştir.

Tablo 5. Sınıf Öğretmeni Adaylarının Genel Akademik Ortalamalarına Göre Post-Hoc.Analiz Sonuçları

(I)	(J)	Mean Difference (I-J)	Std.Hata	p
1,99 ve altı	2,00 – 2,49	-7,06	6,25	1,000
	2,50 – 2,99	-3,17	4,17	0,071
	3,00 – 3,49	-9,71	3,67	0,027*
	3,50 – 4,00	-6,12	4,07	0,082
2,00 – 2,49	2,50 – 2,99	5,13	5,21	1,000
	3,00 – 3,49	-5,62	4,34	0,842
	3,50 – 4,00	-3,51	4,84	1,000
2,50 – 2,99	3,00 – 3,49	-7,76	3,04	1,000
	3,50 – 4,00	-5,64	4,72	0,762
3,00 – 3,49	3,50 – 4,00	2,56	4,58	1,000

Tablo 5 da ki post-hoc analiz sonuçlarına göre önlisans öğrencilerinin TPAB puanların ortalamaları arasında, genel akademik ortalaması 3,00 – 3,49 olan grup lehine anlamlı bir fark vardır.

SONUÇ

Öğretmen adaylarının mezun oldukları lise türü değişkenine göre TPAB ölçeğinden aldıkları puanların ortalamaları arasında fen lisesi mezunları lehine anlamlı bir farklılık bulunmuştur. Fen liselerinin sayısal ağırlıklı eğitim veren liseler olması bu grup lehine anlamlı bir farklılığın çıkmasının sebebi olabilir. Gündoğmuş (2013) yaptığı çalışmada öğretmen adaylarının liseden mezun oldukları puan türüne göre sayısal puan türünden mezun olan öğretmen adaylarının teknolojik bilgilerinde anlamlı bir farklılık bulmuş fakat TPAB'lerinde anlamlı bir farklılık bulamamıştır.

Çalışmamızda ortaya çıkan bir diğer sonuçta sınıf öğretmeni adaylarının genel akademik ortalamalarında ortalaması 3,00 – 3,49 arasında çıkan grup lehine anlamlı bir farklılık olmasıdır. Akademik ortalaması daha yüksek olan öğretmen adaylarının hem öğretmenlik mesleğini hem de mesleğin gereklerinden olan TPAB'ni daha fazla içselleştirdiklerini söyleyebiliriz.

Analiz sonuçlarına göre ortaya çıkan bir diğer sonuç sınıf öğretmeni adaylarının TPAB'lerinin cinsiyetlerine göre anlamlı bir farklılığın olmamasıdır. Literatürdeki bazı araştırmalarda çıkan sonuçlarda çalışmamızdaki bu sonucu doğrular niteliktedir (Şimşek, Demir, Çağçeci ve Kınay, 2013; Mutluoğlu, 2012; Gömleksiz ve Fidan, 2013; Çuhadar, Bülbül ve Ilgaz, 2013; Gündoğmuş, 2013; Sancar-Tokmak, Yavuz-Konokman ve Yanpar-Yelken, 2013).

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MIDDLE SCHOOL STUDENTS' USE OF REPRESENTATIONS FOR PROPER FRACTIONS

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ABSTRACT: Fractions are one of the challenging topics for middle school students in mathematics. One reason behind this difficulty might be related to representations. Fractions can be represented through various forms. Area models and number line models are often used by students to represent fractions. The purpose of this study was to investigate how middle school students represented proper fractions using these two models. Data were collected through a written instrument which was administered to 34 6th grade students. The instrument included 4 tasks. While two of the tasks required students to find the part of a whole, the other two tasks asked students to find the whole using the given parts on area and number line model. The data showed that while the majority of students were able to represent the proper fraction on the given area model, very few of them were able to locate fractions on a number line.

Key words: fractions, representations, area model, number line.

ORTAOKUL ÖĞRENCİLERİNİN BASİT KESİRLER İÇİN TEMSİLLERİ KULLANIMI

ÖZET: Kesirler ortaokul öğrencilerinin güçlük yaşadıkları konulardan bir tanesidir, Bu güçlüğün altında yatan nedenlerden biri de temsiller ilgili olabilir. Kesirler çeşitli şekillerde temsil edilebilir. Alan ve sayı doğrusu temsilleri, öğrencilerin sıklıkla kullandıkları temsillerdir. Bu çalışmanın amacı ortaokul öğrencilerinin bu iki modeli kullanarak basit kesirleri nasıl temsil ettiklerini incelemektir. Veriler 34 adet 6. sınıf öğrencisine uygulanan yazılı dokümanlar aracılığıyla toplanmıştır. Dokümanda 4 adet soru bulunmaktadır. Soruların iki tanesi alan ve sayı doğrusu temsilleri ile bir bütünün parçalarını bulmaya yönelik iken, diğer ikisi yine bu modeller üzerinde verilen parçaları kullanarak bütünü bulmaya yöneliktir. Elde edilen bulgular öğrencilerin çoğunluğunun alan temsilini kullanarak basit kesri gösterebildiğini; buna karşın sayı doğrusu temsilinde ise çok az bir kısmının başarılı olduğunu göstermiştir.

Anahtar sözcükler: kesirler, temsiller, alan modeli, sayı doğrusu.

GİRİŞ

Kesirler konusu 1. sınıftan itibaren 7. sınıfta yer alan rasyonel sayılar sisteminin inşasına kadar, okul programının bütün kademelerinin kazanımlarında yer alan (MEB, 2013; MEB, 2016) matematiğin önemli konularından bir tanesidir. İlkokul birinci sınıfta bütün, yarım, çeyrek gibi somut kavramların öğretimi ile başlayan bu süreç, birim kesir kavramı, kesirlerin büyüklüklerinin karşılaştırılması, kesirlerle işlemler gibi daha soyut konularla devam etmektedir. Kesirler, öğretim kademelerinin ilerleyen yıllarında ondalık gösterimler, yüzdelik gösterimler, oran kavramı, rasyonel sayı sistemleri gibi birçok konunun temelini oluşturmaktadır.

Yapılan bir çok çalışma öğrencilerin kesirler konusunda çeşitli zorluklar yaşadıklarını ortaya koymaktadır (örn Behr vd., 1983; Hodgen vd., 2010; Işık vd. 2012; Kieran, 1980; Tabak vd. 2010; Wachsmuth & Post, 1985; Yanik, Helding & Flores, 2008). Bu zorlukların bir nedeni kesirlerin farklı temsilleri ile ilgili olabilir (Yanik, Helding & Flores, 2008). Kesirler çeşitli temsillerle (alan modeli, çubuk modeli, sayı doğrusu gibi) gösterilebilmektedir. Literatür (Alacacı, 2010; Watanebe, 2002; Yanik, Helding & Flores, 2008) incelendiğinde alan ve sayı doğrusu modellerinin en sık kullanılan temsillerden biri olduğu görülmektedir. Bu temsiller soyut bir kavram olan kesir kavramının somutlaştırılmasında öğrencilere yardımcı olan araçlardır. Buna karşın, öğrencilerin temsilleri zihinlerinde canlandırmaları her zaman kolay olmamaktadır. Literatür incelendiğinde öğrencilerin bazı temsilleri diğer temsillere göre daha rahat kullanabildikleri gözlemlenirken, özellikle sayı doğrusu gibi temsilleri (bkz. Yanik, Helding & Flores, 2008) öğrencilerin tam olarak kavrayamadıkları görülmektedir. Bu çalışmanın amacı, ortaokul öğrencilerin sıklıkla kullanılan bu iki temsili basit kesirleri göstermede ne ölçüde kullanabildiklerini incelemektir.

YÖNTEM

Ortam ve Katılımcılar

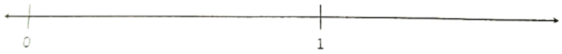
Bu çalışma 2014-2015 eğitim-öğretim yılının ikinci döneminde Eskişehir il merkezinde, bir devlet okulunun 6. sınıfında bulunan 34 öğrenci ile yürütülmüştür. Bu çalışmada 6. sınıf öğrencileri ile çalışılmasının sebebi, bu öğrencilerin kesir kazanımlarının çoğunu derslerinde görmüş olmalarıdır.

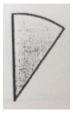
Veri Toplama ve Analiz

Bu çalışmada veriler, öğrencilere dağıtılan yazılı dokümanlar aracılığıyla toplanmıştır. Bu dokümanlarda öğrencilere 4 adet soru yöneltilmiştir. Aşağıda bu 4 soruya yer verilmiştir:

Soru 1) Eğer şekildeki kare  bir bütünse, bu bütünün $\frac{3}{4}$ 'lük kısmını çizim yaparak gösteriniz

Soru 2) Aşağıdaki sayı doğrusu üzerinde $\frac{5}{6}$ kesrini gösteriniz



Soru 3) Şekildeki  dilim bir bütünün $\frac{1}{5}$'ini gösteriyorsa bu bütünü çizerek gösteriniz. (Tam daire olmak zorunda değildir.)

Soru 4) "1" sayısını verilen sayı doğrusunda gösteriniz.

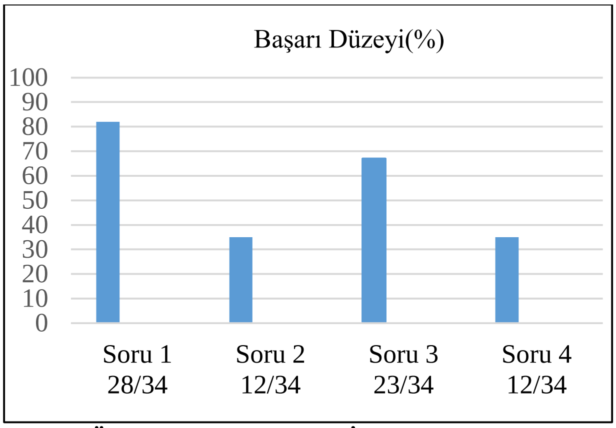
Toplanan veriler analiz edilirken öncelikle her bir soruya ilişkin yüzde-frekans değerleri ortaya çıkarılmıştır. Daha sonra ise sorulara verilen cevapların her biri incelenerek ortaya çıkan yanılgıları anlamlı kategorilere ayırmaya çalışılmıştır. Kategorilere ayrılan cevapların frekans değerleri verilerek yanılgıların sıklığı ortaya çıkarılmaya çalışılmıştır. Katılımcıların bazılarının verdikleri cevaplar belirlenen anlamlı kategorilerden herhangi birine yerleştirilemediğinden sınıflandırma dışı bırakılmıştır.

BULGULAR

Bu bölümde, öğrencilere yöneltilen sorulara ilişkin elde edilen bulgulara yer verilmiştir. Bulgularda öncelikle öğrencilerin bu 4 soruya ilişkin başarılarının ne düzeyde olduğu yüzde-frekans değerleri verilerek paylaşılmıştır (bkz. Şekil 1). Sonrasında ise her bir soruya ilişkin ortaya çıkan bulgular öğrenci cevaplarından elde edilen doğrudan alıntılara yer verilerek paylaşılmıştır.

Öğrencilerin Başarı Düzeylerine İlişkin Bulgular

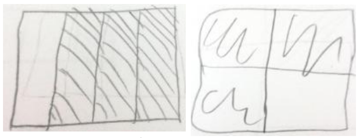
Bu çalışmada öğrencilere kesir temsillerine ilişkin 4 adet soru yöneltilmiştir. Bu soruların ilk ikisi alan ve sayı doğrusu temsillerini kullanarak verilen bir basit kesri göstermeyi, diğer iki soru ise yine alan ve sayı doğrusu temsillerini kullanarak verilen bir basit kesrin bütününü bulmaya yönelik sorulardır. 34 öğrencinin 4 soruya ilişkin cevaplar incelendiğinde birinci soruyu 28, ikinci soruyu 12, üçüncü soruyu 23 ve dördüncü soruyu ise 12 öğrencinin doğru bir şekilde cevaplayabildikleri görülmektedir (Şekil 1).



Şekil 1. Öğrencilerin Sorulara İlişkin Başarı Düzeyleri

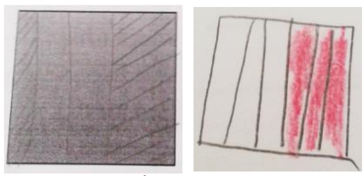
Birinci Soruya İlişkin Bulgular

Birinci soruya ilişkin cevaplar incelendiğinde 28 öğrencinin soruyu doğru bir şekilde cevaplayabildiği görülmektedir. Doğru kabul edilen cevaplarda öğrencilerden bütünü 4 eşit parçaya bölerek 3 tanesini işaretlemesi beklenmektedir. Şekil 2'de öğrencilerin vermiş oldukları doğru cevaplara ilişkin örneklere yer verilmiştir.



Şekil 2. Birinci Soruya İlişkin Doğru Cevap Örnekleri

Geriye kalan öğrencilerin 4 tanesi soruyu yanıtsız bırakırken, diğer ikisi Şekil 3'de yer alan cevapları vermişlerdir.

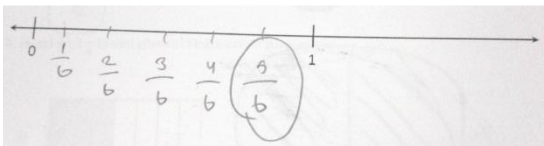


Şekil 3. Birinci Soruya İlişkin Yanlış Cevap Örnekleri

Bu cevaplarda birinci öğrencinin bir bütünü eş parçalara bölmediği, 3 parça yerine 2 parçayı işaretlediği görülmektedir. İkinci öğrencinin ise bütünü 4 eş parçaya bölmek yerine 6 parçaya böldüğü ve 3 parçasını işaretlediği görülmektedir.

İkinci Soruya İlişkin Bulgular

İkinci soruya ilişkin cevaplar incelendiğinde, 12 öğrencinin soruyu doğru bir şekilde cevaplayabildiği görülmektedir. Doğru kabul edilen cevaplarda öğrencilerin 0 - 1 aralığını 6 eş parçaya bölerek $\frac{5}{6}$' in konumunu doğru bir şekilde bulabilmesi beklenmektedir. Şekil 4'te doğru kabul edilen bir cevap örneğine yer verilmiştir.



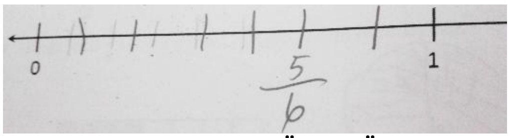
Şekil 4. İkinci Soruya İlişkin Doğru Cevap Örneği

Geriye kalan öğrencilerden 2 tanesi soruyu yanıtsız bırakırken, diğer 20 öğrenci sorunun çözümünde çeşitli yanılgılara düşmüşlerdir. Bu yanılgılar analiz edildiğinde 3 farklı kategori ortaya çıkmıştır (Tablo 1). Bu kategorilerin dışında kalan öğrenciler (n=3) için herhangi bir sınıflama yapılamamıştır.

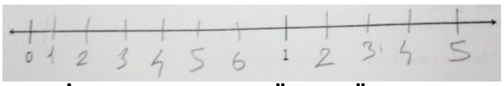
Tablo 1. İkinci Soruya İlişkin Yanlış Cevap Kategorileri

Kategori	f
1. 0-1 aralığını verilen kesir kapsamında doğru bir şekilde parçalara ayıramama	7
2. Kesrin pay ve paydasını iki ayrı doğal sayı olarak ele alma	5
3. Pay ve paydayı ters yazma	5

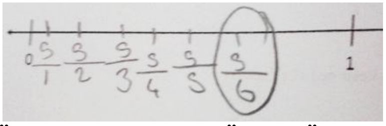
Aşağıda bu kategorilere ilişkin örnek öğrenci cevaplarına yer verilmiştir:



Şekil 5. Birinci Kategoriye Örnek Öğrenci Cevabı



Şekil 6. İkinci Kategoriye Örnek Öğrenci Cevabı



Şekil 7. Üçüncü Kategoriye Örnek Öğrenci Cevabı

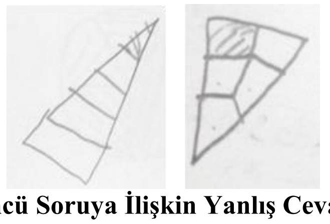
Şekil 7'de görüldüğü gibi öğrencilerin bazıları kesrin pay ve paydasını ters yazmakla kalmayıp aynı zamanda birinci kategoride yer alan 0-1 aralığını doğru bir şekilde eş parçalara ayıramama hatasını yapmışlardır. Bu durumda birinci kategori hatasını yapan öğrencilerin sayısının artacağını söylemek mümkündür.

Üçüncü Soruya İlişkin Bulgular

Üçüncü soruya ilişkin cevaplar incelendiğinde 23 öğrencinin soruyu doğru bir şekilde cevaplayabildiği görülmektedir. Doğru kabul edilen cevaplarda öğrencilerin $\frac{1}{5}$ olarak kabul edilen 5 daire dilimini birleştirerek bir bütünü elde etmesi beklenmektedir. Soruda açıklandığı üzere öğrencilerin tam daire elde etmeleri şart değildir. Şekil 8'de doğru kabul edilen bir cevap örneğine yer verilmiştir.

Şekil 8. Üçüncü Soruya İlişkin Doğru Cevap Örneği

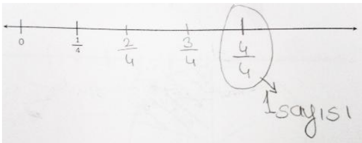
Geriye kalan 11 öğrencinin cevabı incelendiğinde öğrencilerin çoğunlukla daire dilimlerini birleştirerek bir bütünü elde etmek yerine, $\frac{1}{5}$'lik daire dilimini parçalara bölmeye çalıştıkları görülmektedir. Diğer bir ifade ile öğrenciler parçadan bütüne ulaşmak yerine verilen parçanın diğer bir parçasını bulma arayışına girdikleri görülmüştür. Ancak, bu süreçte öğrencilerin daire dilimini eş parçalara ayıramadıkları da gözlenmiştir. Şekil 9'da öğrencilerin vermiş oldukları yanlış cevaplara ilişkin örneklere yer verilmiştir.



Şekil 9. Üçüncü Soruya İlişkin Yanlış Cevap Örnekleri

Dördüncü Soruya İlişkin Bulgular

Dördüncü soruya ilişkin cevaplar incelendiğinde 12 öğrencinin soruyu doğru bir şekilde cevaplayabildiği görülmektedir. Doğru kabul edilen cevaplarda öğrencilerin 0 - $\frac{1}{4}$ aralığını bir birim olarak ele alarak bu aralığı toplam dört defa tekrarlayarak 1 tamsayısını (bütünü) elde etmeleri beklenmektedir. Şekil 10'da doğru kabul edilen bir cevap örneğine yer verilmiştir.



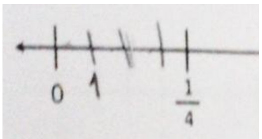
Şekil 10. Dördüncü Soruya İlişkin Doğru Cevap Örneği

Geriye kalan öğrencilerden 2 tanesi soruyu cevapsız bırakırken, diğer 20 öğrenci sorunun çözümünde çeşitli yanılgılara düşmüşlerdir. Bu yanılgılar analiz edildiğinde anlamlı 3 farklı kategori ortaya çıkmıştır (Tablo 2). Bu kategorilerin dışında kalan öğrenciler (n=5) için sınıflama yapılamamıştır.

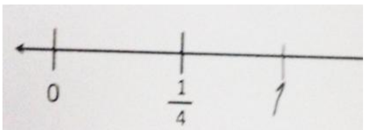
Tablo 2. Dördüncü Soruya İlişkin Yanlış Cevap Kategorileri

Kategori	f
1. Parçanın parçasını bulmak	5
2. Verilen birimi tekrarlamadan herhangi bir nokta belirleme	3
3. Pay ve paydayı yorumlayamama- paydayı arttırarak ilerleme	7

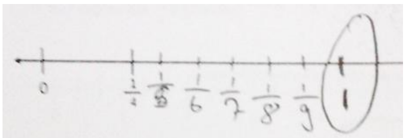
Aşağıda bu kategorilere ilişkin örnek öğrenci cevaplarına yer verilmiştir:



Şekil 11. Birinci Kategoriye Örnek Öğrenci Cevabı



Şekil 12. İkinci Kategoriye Örnek Öğrenci Cevabı



Şekil 13. Üçüncü Kategoriye Örnek Öğrenci Cevabı

SONUÇ

Bu çalışmada 34 tane 6. Sınıf öğrencisine kesir temsillerine ilişkin 4 adet soru yöneltilmiştir. Bu 4 sorunun ilk ikisi alan ve sayı doğrusu modellerini kullanarak verilen bir bütünün ya da aralığın belirli bir parçasını bulmaya, diğer iki soru ise yine alan ve sayı doğrusu modellerini kullanarak verilen bir parçadan yola çıkarak bütünü bulmaya yönelik sorulardır. Elde edilen bulgular incelendiğinde, öğrencilerin alan modeline ilişkin temsillerde bütünün parçasını gösterme görevlerinde sayı doğrusuna ilişkin temsillere oranla çok daha başarılı oldukları görülmektedir. Benzer durum parçadan bütüne ulaşmada da gözlemlenmiştir.

Alan modeline ilişkin temsillerde, öğrenciler bir bütünün belli bir parçasını bulmada, parçadan yola çıkarak bütünü bulmaya oranla daha başarılı oldukları görülmektedir. Bu durum öğrencilerin, verilen bir parçanın bütününü bulmaya yönelik sorulara çok fazla aşina olmadıkları şeklinde yorumlanabilir. Nitekim 3. soruya verilen yanlış cevaplarda öğrencilerin kendilerine verilen kesir parçasının bütününü bulmaya değil, parçanın parçasını bulmaya çalıştıkları görülmektedir (örn. Şekil 9). Ayrıca 4. soruya ilişkin cevaplar incelendiğinde, sayı doğrusu temsillerinde de benzer bir durumun söz konusu olduğu görülebilir (örn. Şekil 11). Bu sorulara ilişkin cevaplarda ortaya çıkan bir diğer önemli husus öğrencilerin eş parçalara ayırmada yaşadıkları sorunlardır (bkz. Şekil 9 ve Şekil 12).

Sayı doğrusuna ilişkin sorularda bütünün (0-1 aralığı) belli bir parçasını bulabilen öğrencilerin neredeyse tamamının parçadan yola çıkarak bütünü elde edebildikleri görülmektedir. Cevaplar incelendiğinde öğrencilerin sayı doğrusuna özgü bazı yanılgılarının olduğu ortaya çıkmaktadır. Bunlardan birincisi kesirlerde pay ve paydayı yorumlayamamalarıdır. Kesirleri sayı doğrusuna yerleştirirken paydanın 0-1 aralığının kaç eşit parçaya ayrıldığını gösterme, payın ise eşit parçalardan ne kadar tekrarlandığını gösterme (örn. $\frac{1}{5}$, $2(\frac{1}{5})$, $3(\frac{1}{5})$) gibi bir fonksiyonu vardır. Bu tekrarlama öğrenciler tarafından tam olarak anlamlandırılmadığı zaman Şekil 13 örneğinde olduğu gibi farklı yanılgılar ortaya çıkabilmektedir. İkinci soruda 5, dördüncü soruda 7 öğrencinin bu yanılgıya düştüğü göz önünde bulundurulursa, bu durumun yaygın karşılaşılan bir kavram yanılgısı olduğu söylenebilir. İkinci bir yanılgı, öğrencilerin kesrin pay ve paydasını ayrı birer doğal sayı gibi ele alarak sayı doğrusuna yerleştirmeleri ile ilgilidir. İkinci soruya verilen cevaplarda 5 öğrencinin (örn, Şekil 6) bu yanılgıya düştüğü görülmektedir. Üçüncü bir yanılgı ise öğrencilerin sayı doğrusu üzerinde aralık saymak yerine nokta saymalarından kaynaklanmaktadır. Bu durum da öğrencilerin (Şekil 5 örneğinde olduğu gibi) iki tamsayı aralığını daha fazla birime bölmelerine neden olmaktadır.

ÖNERİLER

Bu çalışmada ortaya çıkan sonuçlar ortaokul öğrencilerinin sayı doğrusu temsilinde, alan temsiline oranla daha fazla zorlandıklarını ortaya koymaktadır. Sayı doğrusu sayıların sürekliliğini göstermek için elverişli bir temsil olması nedeniyle öğrencilere rasyonel sayı sisteminin kavratılması için önemli bir araçtır. Ancak, öğrencilerin erken yaşlardan itibaren kesirleri daha çok alan temsili ile öğrenmeleri, onların sayı doğru temsiline yeterli ölçüde odaklanmamalarına neden olmuş olabilir. Bu nedenle, okullarda kesirlerin bütün temsillerine ilişkin çalışmalara yeterince yer verilmelidir. Çalışmanın bulguları ayrıca, sıklıkla kullanılan alan modelinde, öğrencilerin parçadan bütüne ulaşmada zorlandıklarını göstermektedir. Bu nedenle derslerde bütünün parçasına odaklanan örneklerin yanında parçadan bütüne ulaşmayı gerektiren örneklerin de ele alınması gereklidir.

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VIEWS OF SCIENCE TEACHER CANDIDATES ON TEACHING A LESSON IN LABORATORY AND EXAMINATION OF THE EXPERIMENTS WHICH THEY IMPROVE

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ABSTRACT: It is an indisputable fact that laboratory lessons are very important in science education. Having qualified lessons may be effective for younger generation to gain different perspectives. There are so many factors in teaching a qualified laboratory lesson such as material used, equipment, place and experiments to be conducted. The experiments to be conducted are one of the most important elements of a good quality of a laboratory lesson. Selection and implementation of an efficient experiment or experiments, are very important to have a qualified laboratory lesson. In accordance with this importance, the science educators studying in faculties need to have certain abilities in terms of laboratory competency and experiment editing skills. Based on this expectation, the aim of this study is to identify the suggestions, regarding the operation of laboratory lessons, of teacher candidates who study at science teaching department in 2nd grade and to examine the experiments that have been created by these teacher candidates. This study has been conducted with 80 2nd grade students who study in science teaching department of a university in Black Sea region of Turkey. Two open-ended questions have been asked to the teacher candidates in the study as an obtainment tool. The data which were obtained in open-ended questions have been evaluated with content analysis. According to Büyüköztürk et al. (2008), content analysis is defined to be a renewable technique in which some words of a text are summarized with smaller content categories by means of coding. In consequence of the results that have been obtained in the study, interpretations have been made and suggestions have been offered with the purpose of enlightening other researchers.

Key words: laboratory, science education, experiment, teacher candidate

FEN ÖĞRETMEN ADAYLARININ, LABORATUVAR DERSİ İŞLENİŞİNE YÖNELİK GÖRÜŞLERİ VE GELİŞTİRDİKLERİ DENEYLERİN İNCELENMESİ

ÖZET: Laboratuvar derslerinin fen eğitimi bakımından yeri tartışmasız bir önem arz etmektedir. Laboratuvar derslerinin nitelikli geçmesi yeni yetişen neslin de farklı bakış açıları kazanmalarında etkili olabilecektir. Nitelikli laboratuvar dersinin işlenişin de ise; kullanılan malzeme, ekipman, mekan ve yapılacak deneyler… gibi bir çok etken bulunmaktadır. İyi bir laboratuvar dersinin olmazsa olmaz elemanlarının belki de en önemlilerinden biri, uygulanacak olan deneylerdir. Etkin bir deneyin ya da deneylerin seçilmesi ve uygulanması nitelikli bir laboratuvar dersinin gerçekleşmesinde oldukça önemlidir. Bu önem doğrultusunda fakültelerde yetişen fen eğitimcilerinin laboratuvar yetkinliği ve deney kurgulama becerileri açısından iyi bir noktada olması gerekmektedir. Bu beklentiden yola çıkarak araştırmanın amacını; fen bilgisi öğretmenliği programı 2.sınıfında okumakta olan öğretmen adaylarının, laboratuvar derslerinin işleyişine yönelik önerilerini belirlemek ve kendi geliştirdikleri deneylerin incelenmesi oluşturmaktadır. Bu çalışma Türkiye'nin Karadeniz bölgesindeki bir üniversitenin fen bilgisi öğretmenliği anabilim dalında okumakta olan 80 2. Sınıf öğrencisi ile yürütülmüştür. Çalışmada veri elde etme araçları olarak fen bilgisi öğretmen adaylarına iki adet açık uçlu soru sorulmuştur. Açık uçlu sorulardan elde edilen veriler içerik analizi ile değerlendirilmiştir. Büyüköztürk ve diğerlerine (2008) göre içerik analizi, kodlamalarla bir metnin bazı sözcüklerinin daha küçük içerik kategorileri ile özetlendiği yinelenebilir bir teknik olarak belirtilmektedir. Çalışmadan elde edilen sonuçlar neticesinde yorumlamalar yapılmış ve diğer araştırmacılara ışık tutması amacı ile öneriler sunulmuştur.

Anahtar sözcükler: laboratuvar, fen eğitimi, deney, öğretmen adayı

GİRİŞ

Yapılandırmacılık öğretmeye değil, insanın nasıl öğrendiği üzerine temellenmiş bir kuramdır. İnsanın nasıl öğrendiği, bilgiyi nasıl oluşturduğu ortaya konabilirse ona uygun bir öğrenme ortamı oluşturulabilmektedir (Duban, 2008). 1960'lı yıllarda Amerika eğitim programındaki reform ile öğretmenler, bilgi sunucu olmaktan çıkıp, öğrencilere soru soran ve onlara rehberlik eden kişiler olmaya yönlendirilmiştir (Çelik, Şenocak, Bayrakçeken, Taşkesenligil ve Doymuş, 2005). Günümüzde de özellikle fen ve matematik eğitiminde bu modelin önemi vurgulanmaktadır (Çelik, Şenocak, Bayrakçeken, Taşkesenligil ve Doymuş, 2005). Yaparak yaşayarak öğrenme felsefesini içeren yapılandırmacı yaklaşım özellikle fen eğitimde oldukça önem arz etmektedir.

Bu yaklaşımda buluş yoluyla öğrenmede olduğu gibi öğretmen yine yol gösteren, öğrenci araştıran; öğretmen öğrencilere kaynak eser ya da kişiler öneren, bunlardan yararlanma yollarını gösteren, öğrenciler de istenen bilgiye ulaşan kişiler olarak tanımlanmaktadır (Arıcı, 2006). Yapılandırmacı öğrenme ortamlarında sorgulayıcı-araştırma yaklaşımı sıklıkla kullanılmakta; böylece sorgulayıcı-araştırma etkinlikleri ile eleştirel olarak sorgulamaları teşvik edilmektedir. Sorgulayıcı araştırma, bu özellikleriyle öğrenci merkezli ve bilgi yapılandırmasını destekleyen bir yaklaşımdır (Köseoğlu ve Tümay, 2013). Bu yaklaşım hipotez test etme deney türüne karşılık da gelmektedir. Bu noktada öncelikle öğrenci bir hipotez kurar, bu hipotezi ile ilgili deney planlar, araç-gereçleri temin eder, deney düzeneğini oluşturur, deneyi yapar, verileri, gözlemleri kaydeder, verilerden sonuçlar çıkarır ve yorum yapar; elde ettiği verilerle hipotezini kabul ya da reddeder, duruma göre yeni deneyler planlar ve gerekliyse hipotezini değiştirir. Böylece bilinen bilimsel gerçeklere yeni bilgi ve yaklaşımlar ilave edebilir (Karamustafaoğlu ve Yaman, 2006).

Araştırma sorgulamaya dayalı öğretim, bilişsel faaliyetler, farklı etkinlik kullanımı ve sınıf içi tartışma türleri gibi öğretim uygulamalarının çeşitliliği açısından değiştirilerek gerçekleştirilebilmektedir (McNeill, Pimentel ve Strauss, 2013). Fen eğitimcilerinin büyük bölümü laboratuvarların (ve uygulamalı etkinliklerin) fen öğrenimi ve öğretimindeki önemini tartışmasız biçimde kabul etmektedir. Fenin doğası nedeni ile araştırma, sorgulama, yorumlama gibi birçok üst düzey becerinin kazandırılabileceği, geliştirilebileceği, uygulamalı etkinlik ve deneylerin yapılabileceği tek ortam, laboratuvarlar olarak görülmektedir. Nitekim fen derslerinin tamamıyla laboratuvarda gerçekleştirilmesi veya sınıfların laboratuvar gibi düzenlenmesi gerektiği belirtilmektedir (Bahar, Aydın, Polat ve Bertiz, 2008).

Özellikle açık uçlu laboratuvar deneyimleri öğrencilere genel yanlış kavramları sezgileri ile eleştirme ve yaratıcı çözümler aramalarına imkan tanımaktadır (MacLean, 2003). Laboratuvar uygulamalarının geliştirdiği becerilerden bazıları; problem çözme, yaratıcı düşünme, grup halinde çalışma, koordinasyon ve mantıksal düşünme olarak sayılabilmektedir (Sarıbıyık, Altunçekiç ve Yaman, 2004). Bu sebeple araştırma-sorgulamaya dayalı öğrenmenin fen öğrenimi ve özellikle laboratuvar uygulamalarında oldukça önem arz ettiği düşünülmektedir.

Bu noktadan hareketle araştırmanın amacını; fen bilgisi öğretmenliği programı 2.sınıfında okumakta olan öğretmen adaylarının, laboratuvar derslerinin işleyişine yönelik önerilerini belirlemek ve kendi geliştirdikleri deneylerin incelenmesi oluşturmaktadır.

YÖNTEM

Bu çalışma Türkiye'nin Karadeniz bölgesindeki bir üniversitenin fen bilgisi öğretmenliği anabilim dalında okumakta olan 80 2. Sınıf öğrencisi ile yürütülmüştür. Çalışmada veri elde etme araçları olarak fen bilgisi öğretmen adaylarına iki adet açık uçlu soru sorulmuştur. Veri elde etme aracı olarak kullanılan bu açık uçlu sorular için uzmanlar tarafından görüş alınmıştır. Açık uçlu sorulardan elde edilen veriler içerik analizi ile değerlendirilmiştir. Büyüköztürk ve diğerlerine (2008) göre içerik analizi, kodlamalarla bir metnin bazı sözcüklerinin daha küçük kategoriler ile özetlendiği yinelenebilir bir teknik olarak belirtilmektedir.

BULGULAR

Bu çalışmada öğretmen adaylarının, laboratuvar derslerinin işleyişine yönelik önerilerin ve kendi geliştirdikleri deneylerin incelenmesinden elde edilen veriler tablolar halinde sunularak yorumlanmıştır.

Tablo1. Öğretmen Adaylarının, Laboratuvar Derslerinin İşleyişine Yönelik Önerileri

Temalar	f
Tüm laboratuvar malzemeleri tanıtılmalı	35
Laboratuvar kuralları öğretilmeli	22
Laboratuvar eğlenceli işlenmeli	13
Laboratuvara hazırlıklı gelinmesi gerektiğini anlatır	13
Deneyden önce hazırbulunuşluğa bakmalı	10
Malzeme ve laboratuvar temizliğine dikkat etmeli	9
Maliyeti az/ bulunabilen deney malzemeleri kullanmalı	8

Önce soru sormalı/bilgi vermeli	7
Önce soru sormalı/bilgi vermeli	7
Öğrencilerin dokunmalarına izin vermeli	6
Laboratuvarı iyi bilen birinden yardım almalı	6
Önce teorik bilgi vermeli, sonra uygulamayı göstermeli, öğrenciye yaptırmalı	6
Önce laboratuvarda eksik var mı kontrol etmeli	6
Birşeyler kırıldığında/zarar gördüğünde kızmamalı	5
Deneylerde kullanılan malzemeyi bilmeli	4
Önlük giyilmesini söylemeli	4
Malzemeleri kullanırken kızmamalı	4
Seviyeye uygun deneyler seçmeli	4
Günlük yaşamla ilgi deneyler olmalı	4
Eşyaları dikkatli kullanmaları gerektiği konusunda uyarmalı	4
Bazı deneyleri öğrencilerin yapmalarını ister	4
Grup çalışması yaptırmalı	4
Deneylerle ilgili bilgi toplamalı	3
Tehlikeli olan deneyleri kendisi yapmalı	3
Konuya hakim olmalı	3
Malzeme eksikliği varsa tamamlamalı	2
Kendi de konuya çalışmalı	2
Büyük kısmını öğrenciye yaptırmalı	2
Bilgi vermeli	2
Ciddiyeti ve disiplini ön planda tutmalı	2
Zararlı maddeleri öğrenciye öğretmeli	2
Önceden hazırlanmalı	2
Önce kendisi yapmalı, sonra öğrencilere yaptırmalı	2
Konuları düzenlenmeli	2
Rapor istemeli	2
Derste işlediği teorik konuları laboratuvarda desteklemeli	2
Diğer	103

Tablo1'de de görüldüğü üzere öğretmen adayları tarafından en çok "Tüm laboratuvar malzemeleri tanıtılmalı; Laboratuvar kuralları öğretilmeli; Laboratuvar eğlenceli işlenmeli; Laboratuvara hazırlıklı gelinmesi gerektiğini anlatmalı; Deneyden önce hazırbulunuşluğa bakmalı" temalarının ifade edildiği görülmektedir.

Tablo2. Öğretmen Adaylarının Geliştirdikleri DeneyTiplerinin İncelenmesinden Elde Edilen Veriler

Deney tipi	f
Temelde sorgulayıcı deney oluşturma	50
Klasik deney oluşturma	26
Yaratıcı düşünce ile deney oluşturma	12

Tablo2'de görüldüğü üzere öğretmen adaylarının kurguladıkları deneylerde en çok "sorgulayıcı ve klasik deney" oluşturdukları görülmektedir.

Tablo3. Öğretmen Adaylarının Geliştirdikleri Deneylerin Yapılışından Elde Edilen Veriler

Deney yapılışı	f
Öğretmen yapar	46
Öğretmen-öğrenci	31
Öğretmen rehber öğrenci yapar	7
Öğrenci yapar	4

Tablo3'de görüldüğü gibi öğretmen adaylarının deneyleri, daha çok "öğretmen ve öğretmen-öğrenci" kurgusuyla oluşturdukları görülmektedir.

Tablo4. Öğretmen Adaylarının Geliştirdikleri Deneylerin Alan Olarak İncelenmesinden Elde Edilen Veriler

fizik	kimya	biyoloji	disiplinlerarası
20	10	59	1

Tablo4'de görüldüğü üzere, fen öğretmen adayları en çok biyoloji alanında; en az disiplinlerarası alanda deney kurgulamışlardır.

Tablo5. Öğretmen Adaylarının, Geliştirdikleri Deneylerin Konu Olarak İncelenmesinden Elde Edilen Veriler

Konu başlıkları	f
Kan grubu	27
Renk oluşturma (yansıma)	7
Asidik-bazik	4
Kırılma	4
Bitki-hayvan hücresi	4
Hayvan hücresi	4
Bitki hücresi	3
Mitoz-mayoz	3
Gölge	2
Yaprak	2
Harf	2
Diğer	24

Tablo5'de görüldüğü üzere fen öğretmen adaylarının en çok kan grupları konusunda deney kurguladıkları belirlenmiştir.

SONUÇ

Fen eğitiminin olmazsa olmaz yöntemlerinden olan laboratuvar uygulamalarının önemi yadsınamaz. Bu laboratuvar etkinliklerinin etkin olabilmesi ise içeriğinin nasıl yapılandırıldığına dayanmakta ve öğrencilerin farklı bakış açılarının gelişmesi hedeflenerek yaratıcı etkinlikler barındırması gerekmektedir. Wingate'e (2011) göre; bilim insanlarının deneylerini nasıl oluşturduklarını ve bilim yaptıklarını, kalıcı olarak algılamak için eğitimde modeller ve hipotezlerle yaratıcı ve sezgisel düşünmeye odaklanılması gerektiği düşünülmektedir. Koray, Köksal, Özdemir ve Presley'e (2007) göre, etkili fen eğitiminin en önemli araçlarından biri olan laboratuvar yönteminde, yaratıcı ve eleştirel düşünmenin kullanılması, bu yöntemin fen öğrenimine olan katkısını kat kat arttırmaktadır. Bu nedenle öğretmen adaylarının bir laboratuvar dersini etkin kılabilmek adına neler düşündüklerini ortaya koymanın oldukça önem arz ettiği düşünülmektedir. Yapılan çalışmada öğretmen adaylarının, bir laboratuvar dersinin nasıl işleneceğine dair sorulan açık uçlu soruya en çok "Tüm laboratuvar malzemeleri tanıtılmalı; Laboratuvar kuralları öğretilmeli; Laboratuvar eğlenceli işlenmeli; Laboratuvara hazırlıklı gelinmesi gerektiğini anlatmalı; Deneyden önce hazırbulunuşluğa bakmalı" temaları ile yanıt verdikleri görülmektedir. Bu noktada öğretmen adaylarının laboratuvar derslerinin etkin uygulanmasına yönelik önerilerden ziyade bir takım kurallara daha çok değindikleri tespit edilmiştir. Bu noktada öğretmen adaylarının sorgulayıcı ya da yaratıcı laboratuvar yapılandırması ile ilgili fikir ifade etmedikleri görülmektedir. Koray, Köksal, Özdemir ve Presley'in (2007) gerçekleştirmiş oldukları araştırmada; yaratıcı ve eleştirel düşünme temelli fen laboratuvarı uygulamalarının sınıf öğretmeni adaylarının bilimsel süreç becerilerinde etkili olduğu belirlenirken; Ketpichainarong, Panijpan ve Ruenwongsa da (2010), sorgulama temelli laboratuvar uygulamasının eleştirel düşünme ve bilimsel süreç becerilerinde önemli olduğu ortaya konmuştur. Yapılan çalışmada öğretmen adaylarının geliştirdikleri deneyler incelendiğinde en çok "temelde sorgulayıcı ve klasik deney" oluşturdukları görülmesine karşın; deneyler ayrıntılı incelendiğinde daha çok "öğretmen ve öğretmen-öğrenci" kurgusuyla deneylerin oluşturulduğu belirlenmiştir.

Söz konusu bu çalışmanın sonucu, sorgulayıcı deney oluşturma ile ilgili olarak öğretmen adaylarının düşünce yapısında olumlu bir durum oluşmasına karşın; uygulama aşamasının çok gerçekleşemediğini gösterir nitelikte bulunmuştur. Ayrıca bu deneyler incelendiğinde öğretmen adaylarında deney konusu ve içeriği açısından disiplinlerarası bakışın da çok oluşamadığı tespit edilmiştir. Halbuki sorgulayıcı bakış açısını yakalamada olaylara disiplinlerarası bakmanın oldukça önemli olduğu düşünülmektedir. Nitekim Bozkurt (2012) araştırmaya dayalı öğrenme yönteminin sınıf öğretmenliği adaylarının; Duru, Demir, Önen ve Benzer (2011) ise, sorgulamaya dayalı laboratuvar uygulamalarının fen bilgisi öğretmen adaylarının bilimsel süreçleri becerilerinde olumlu etki gösterdiğini ortaya koymuştur. Yine Demir'in (2014) yapmış olduğu araştırmaya göre araştırma sorgulamaya dayalı laboratuvar uygulamalarının, öğretmen adaylarının bilimsel yaratıcılık becerileri üzerinde etkili olduğu belirlenmiştir. Sorgulayıcı öğrenmeyi laboratuvara yansıtma, bireyde disiplinlerarası bakış açısını etkin kılarken; olaylara farklı açılardan bakabilen, yorumlayabilen, sorgulayabilen bireyler yetiştirilebilmeyi de sağlayabilecektir.

ÖNERİLER

Bu çalışmadan yola çıkarak öğretmen adaylarının nitelikli ve sorgulayıcı laboratuvar ortamları ile sık sık deneyim yaşamaları gerektiği düşünülmektedir. Sorgulayıcı laboratuvar ortamları ile bireylerin bakış açılarının genişletilmesi, olaylara farklı bakabilmeyi hedeflemesi ve yeni bilgiler üretme konusunda heveslendirilmesi oldukça önemlidir. Bu noktada sorgulayıcı laboratuvar ortamlarının öğretmen adaylarına özellikle fakültelerde yaşatılması gerektiği düşünülmektedir.

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MICROSCOPE USAGE INFORMATION: SAMPLE OF SCIENCE TEACHER CANDIDATES

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ABSTRACT: A qualified laboratory lesson is of great importance in science education. In a qualified laboratory lesson there are so many essential elements such as material, tool and place. One of the most important elements of a qualified laboratory lesson is the equipment used, and usage information and ability of this equipment. Microscope which is frequently used in science education is one of such tools. Microscope usage information is very important for a science educator. Therefore, a teacher who acquired this information and usage ability will be effective in encouraging students to use the microscope correctly, to have interest in science and even to do research in this field. In parallel with this importance, it is thought that the science educators who study in faculties need to have a good ability of microscope usage information. Based on this expectation, the aim of this study is to identify the ability of microscope usage information of the candidate students who study at science teaching department in 2nd grade. This study has been conducted with 80 2nd grade students who study in science teaching department of a university in Black Sea region of Turkey. Microscope usage information scale which was improved by Benzer and Demir in 2014 has been used as obtainment tool in the study. Microscope usage information scale is composed of tripple likert type 20 articles and two open-ended questions. The data which were obtained from likert type articles have been evaluated with frequency calculation whereas the data which were obtained from open-ended questions have been evaluated with content analysis. According to Büyüköztürk et al. (2008), content analysis is defined as a systematic technique where certain words of a text are summarized with smaller content categories through coding. Based on the results that were obtained in the study, interpretations have been made and suggestions have been offered in order to enlighten other researchers.

Key words: microscope usage information, teacher candidate, science education

MİKROSKOP KULLANIM BİLGİSİ: FEN BİLGİSİ ÖĞRETMEN ADAYLARI ÖRNEĞİ

ÖZET: Fen eğitiminde nitelikli bir laboratuvar dersi oldukça önem taşımaktadır. Nitelikli bir laboratuvar dersinde ise, olmazsa olmaz malzeme, araç, mekan… gibi bir çok eleman söz konusudur. İyi bir laboratuvar dersinin elemanlarının belki de en önemlilerinden biri, kullanılan ekipman ve bu ekipmanı kullanım bilgisi ve becerisidir. Fen eğitiminde sıklıkla kullanılan mikroskop da bu araçlardan biridir. Mikroskop kullanım bilgisi bir fen eğitimcisi için oldukça önem arz etmektedir. Dolayısıyla bu bilgiyi iyi edinmiş ve kullanabilme yetisinde olan öğretmen, çocukların da mikroskobu doğru kullanabilmesinde, fen alanına olan ilgisinde ve hatta araştırma yapmasında oldukça etkili olacaktır. Bu önem doğrultusunda fakültelerde yetişen fen eğitimcilerinin mikroskop kullanım bilgilerinin iyi bir yetkinlikte olması gerektiği düşünülmektedir. Bu beklentiden yola çıkarak araştırmanın amacını; fen bilgisi öğretmenliği programı 2.sınıfında okumakta olan öğretmen adaylarının, mikroskop kullanım bilgisini belirlemek oluşturmaktadır. Bu çalışma Türkiye'nin Karadeniz bölgesindeki bir üniversitenin fen bilgisi öğretmenliği anabilim dalında okumakta olan 80 2. Sınıf öğrencisi ile yürütülmüştür. Çalışmada veri elde etme aracı olarak Benzer ve Demir tarafından 2014 yılında geliştirilen mikroskop kullanım bilgisi ölçeği kullanılmıştır. Mikroskop kullanım bilgisi ölçeği, üçlü likert tipi 23 maddeden ve iki adet açık uçlu sorudan oluşmaktadır. Likert tipi maddelerden elde edilen veriler frekans hesabı ile, açık uçlu sorulardan elde edilen veriler ise içerik analizi ile değerlendirilmiştir. Büyüköztürk ve diğerlerine (2008) göre içerik analizi, kodlamalarla bir metnin bazı sözcüklerinin daha küçük içerik kategorileri ile özetlendiği sistematik bir teknik olarak belirtilmektedir. Çalışmadan elde edilen sonuçlar doğrultusunda yorumlamaya gidilmiş ve diğer araştırmacılara farklı çalışmalar yapılabilmesi adına öneriler sunulmuştur.

Anahtar kelimeler: mikroskop kullanım bilgisi, öğretmen adayı, fen eğitim

GİRİŞ

Laboratuvar fen eğitiminde yeri tartışmasız bir önem derecesine sahiptir. Fen eğitimindeki mevcut yöntemler içerisinde en etkili olanlardan biri laboratuvar yöntemidir (Hofstein, Kipnis ve Kind, 2008; İlhan, Sadi, Yıldırım ve Bulut, 2009; Demirbaş ve Pektaş, 2010; Dahar ve Faize, 2011). Laboratuvar uygulamaları basit veya karmaşık, günlük hayattan veya çok çeşitli materyallerin birlikte kullanılmasını gerektirmektedir (Güler ve Çobanoğlu, 1997). Laboratuvar çalışmaları; bilimsel düşünmeyi, bilime ve bilimsel uygulamalara yönelik olumlu tutum geliştirmeyi, bilimsel süreç becerileri kazandırmayı, soyut fen konularını yaparak yaşayarak daha iyi öğrenmeye olanak tanımaktadır (Harman, 2012). Laboratuvar materyalleri, öğrencilerin bilim insanı gibi çalışarak bilimsel bilgiyi yapılandırmasını ve bilim alışkanlığı kazanmalarına neden olmaktadır (Jewitt, Kress, Ogborn ve Tsatsarelıs, 2001). Bu anlamda laboratuvar, bilimin mutfağı olarak tanımlanabilmektedir.

Flick ve Bell (2000) yapmış oldukları araştırmada öğretmenlerin bilim ve teknolojiyi kullanmaları adına mikroskop kullanılmasının önemini ortaya koymuşlardır. Öğrencilerin biyoloji alanında kavramları öğrenmelerini kolaylaştıran en önemli araçların başında "Mikroskop" gelmektedir (Ekici, 2016). Mikroskop "Çıplak gözle görülemeyecek kadar küçük canlı ve cansız nesnelerin incelenmesini sağlayan mercek sistemlerinden oluşan optik bir araç" olarak ifade edilebilmektedir (Özata ve Türe, 1999; Dökme, Doğan ve Yılmaz, 2010; MEB, 2011). Böylece soyut olan ve gözle görülemeyen nesnelerin görünür hale dönüştürülebilmesinde önem taşımaktadır. İlköğretim okullarının birçoğunda var olan mikroskop (Akpınar ve Turan, 2002; Demir, Böyük ve Koç, 2011) diğer teknolojik araçlar gibi eğitimde kullanıldığında anlamayı kolaylaştıran bir materyaldir (Yavuz ve Coşkun, 2008). Bu nedenle gerek öğretmen ve gerekse öğretmen adaylarının mikroskop kullanımında yeterli nitelikte olması gerektiği düşünülmektedir. Nitekim Ural Keleş, Er Nas ve Çepni'nin (2009) yaptıkları çalışmada da öğretmen adaylarının mikroskopta görüntü oluşturma aşamasında kavram yanılgılarına sahip oldukları görülmüştür. Bu bağlamda öğretmen adaylarının mikroskop ile daha çok ve kaliteli vakit geçirmelerinin gerektiği düşünülmektedir. Nitekim Yeşilyurt (2004) yaptığı çalışmada öğretmen adaylarının mikroskopla daha az uğraştıklarında anlama zorluğu yaşadıklarını ortaya koymaktadır. Demir'in (2015) yapmış olduğu araştırmadan elde edilen sonuçların neticesinde ise, fen öğretmen adaylarının mikroskop kullanım bilgilerinin genel olarak orta düzeyde ve yetersiz olduğu belirlenmiştir.

Tüm bu çalışmalardan da yola çıkarak, öğretmen adaylarının mikroskop kullanımı konusunda yeterli düzeyde olup olmadıklarını ya da durumlarının ne olduğunu saptamanın önemli ve gerekli olduğu düşünülmektedir. Dolayısıyla bu çalışmanın amacını; fen bilgisi öğretmenliği programı 2.sınıfında okumakta olan öğretmen adaylarının, mikroskop kullanım bilgisini belirlemek oluşturmaktadır

YÖNTEM

Bu çalışmada, fen bilgisi öğretmenliği anabilim dalında öğrenim görmekte olan öğretmen adaylarının mikroskop kullanım bilgilerinin bir ölçme aracı ve açık uçlu sorularla betimlenmesi amaçlandığından, tarama modeli kullanılmıştır. Tarama modelindeki çalışmalar; yaşayanların ve yaşananların ne olduğunun betimlenip açıklanarak ortaya konulması olarak ele alınabilmektedir (Sönmez ve Alacapınar, 2011).
Bu çalışma Türkiye'nin Karadeniz bölgesindeki bir üniversitenin fen bilgisi öğretmenliği anabilim dalında okumakta olan 80 2. Sınıf öğrencisi ile yürütülmüştür. Çalışmada veri elde etme aracı olarak Benzer ve Demir tarafından 2014 yılında geliştirilen mikroskop kullanım bilgisi ölçeği kullanılmıştır. Mikroskop kullanım bilgisi ölçeği, üçlü likert tipi 23 maddeden ve iki adet açık uçlu sorudan oluşmaktadır. Likert tipi maddelerden elde edilen veriler frekans hesabı ile, açık uçlu sorulardan elde edilen veriler ise içerik analizi ile değerlendirilmiştir. Büyüköztürk ve diğerlerine (2008) göre içerik analizi, kodlamalarla bir metnin bazı sözcüklerinin daha küçük içerik kategorileri ile özetlendiği sistematik bir teknik olarak tanımlanabilmektedir.

BULGULAR

Bu çalışmada mikroskop kullanım bilgisi ölçeğinden elde edilen veriler tablolar halinde sunularak yorumlanmıştır.

Tablo1.Ölçek Maddelerinden Elde Edilen Yüzdelikler

Ölçeğe ilişkin bazı maddeler	evet	hayır	bilmiyorum
1-Makrovida görüntüyü netleştirmeye yarar.	45	53,8	1,3
2-Mikroskopta inceleme yapmak için önce tabla yukarı kaldırılır, sonra preparat yerleştirilir.	10,0	87,5	2,5
3-Yapılacak çalışmaya göre diyafram açılıp kapanabilir.	65,0	22,5	12,5
4-Materyalin uzun eksenine dikey olan düzlemden alınan kesit enine kesittir.	87,5	10,0	2,5
5-Enine, boyuna ve yüzeysel olmak üzere genel olarak üç tip kesit alınır.	95,0	5,0	0,0
7-Mikroskopta inceleme yaparken, çizim için 4'lük objektif görüntüsü kullanılır.	25,0	67,5	7,5
8- 4'lük objektifte makrovida ile oynanmaması gerekir.	18,8	73,8	7,5
10-Lam ve lamel ikilisine preparat denir.	21,3	76,3	2,5
11-Mikroskopta inceleme yapmak için objektif kontrol edilir, preparat	88,8	7,5	3,8

yerleştirilir ve sonra tabla yukarı kaldırılır.			
12-Mikroskoptaki görüntü olduğu gibi çizilmeli ve sonra bilgilerle doğrulanmalıdır.	95,0	5,0	0,0
13-Mikroskoptaki görüntü kitaplardaki gibi ayrıntılı çizilmelidir.	43,8	43,8	12,5
14-Mikroskop sağlık sektöründe kullanılır.	86,3	10,0	3,8
15-40'lık objektifte makrovidayla oynamanın bir sakıncası yoktur.	20,0	70,0	10,0
17-Diyafram mikroskop tablasının üzerinde bulunur.	21,3	72,5	6,3
19-Mikroskop büyütmesi, "objektif x oküler" olarak yazılır.	85,0	5,0	10,0
20-İnceleme ortamı alınan kesiti daha iyi görebilmek için damlatılan çözeltidir.	50,0	35,0	15,0
22-Mikroskop kriminal suçlarda kullanılır.	78,8	2,5	18,8
23-Mikroskopta inceleme yapmak için objektif kontrol edilmeden, preparat yerleştirilir ve sonra tabla yukarı kaldırılır.	11,3	85,0	3,8

Tablo1 incelendiğinde öğretmen adaylarının birçok madde için olumlu yanıtlar verdiği belirlenirken; özellikle "Makrovida görüntüyü netleştirmeye yarar; Mikroskoptaki görüntü kitaplardaki gibi ayrıntılı çizilmelidir" maddelerinde çelişkide kalındığı görülmektedir.

Tablo2. Mikroskopta Herhangi Bir Bitkisel Dokuyu İncelemek Adına Gerekli Tüm Aşamalara İlişkin Temalar

Temalar	evet	hayır
Doğru sıralama	43,8	56,2
Tam inceleme	3,8	96,2
Doğru preparat oluşturma	71,3	28,7

Tablo2'de de görüldüğü üzere öğretmen adaylarının mikroskopta herhangi bir bitkisel dokuyu incelemek adına gerekli tüm aşamaları yazmalarından elde edilen ifadeler temalaştırıldığında, doğru sıralama temasının ağırlıklı olarak yapılabildiği ancak hemen hemen eşit bir dağılım görüldüğü; tam inceleme temasının yüksek oranda yapılamadığı; doğru preparat oluşturma temasının ise yüksek oranda gerçekleştirilebildiği görülmüştür.

Tablo3. Öğretmen Adaylarından Elde Edilen Diğer İfadeler

İfadeler	f
Taşırken altından tutulmalı, sürüklenmemeli	6
İşlem bitince 4x10 objektife alınmalı	4
Öncelikle 4'lük objektifte bulunur.	3
Diğer objektiflerde makrovida ellenmeden netleştirme yapılır.	3
İnceleme bitince preparat alınır ve mikroskop kapatılır.	3
Mikrovida netleştirir.	2
İşlem bitince tabla indirilmelidir.	2
İşlem bitince temizlenip toparlanmalı	2
Preparatın kırılmamasına dikkat edilmeli	2
Diğer	26

Tablo3'de de görüldüğü üzere öğretmen adayları en çok "Taşırken altından tutulmalı, sürüklenmemeli; İşlem bitince 4x10 objektife alınmalı; Öncelikle 4'lük objektifte bulunmalı; Diğer objektiflerde makrovida ellenmeden netleştirme yapılmalı; İnceleme bitince preparat alınmalı ve mikroskop kapatılmalı" ifadelerinin verildiği görülmüştür.

SONUÇ

Doğrudan öğretim; deney tasarlama, mikroskop kullanarak öğrenme ve ölçümler yapma… gibi bir dizi etkinlik boyunca öğrencilere rehberlik yaparak öğretmenin, bilgiyi oluşturması olarak tanımlanabilmektedir (Schroeder, Scott, Tolson, Huang ve Lee, 2007). Nitekim yapılandırmacı öğrenme, öğrencinin etkin kılınması ile gerçekleştirilen yaparak yaşayarak öğrenme felsefesidir. Bu alanda beklenen amaçların gerçekleştirilmesi; laboratuvar ve ders araç-gereçlerinin en iyi şekilde kullanılması ile mümkün olmaktadır (Köseoğlu ve Soran, 2006). Keskin, Özbek, Ulaş ve Müdok'un (2015) yapmış oldukları çalışma sonuçları değerlendirildiğinde günümüzün teknolojik yenilikleri ile büyüyen öğrencilerin dijital mikroskop kullanımını daha çok tercih ettikleri ve bu görüntüler ile daha rahat çalıştıkları anlaşılmaktadır. Mikroskop kullanımı deneyim gerektiren bir süreç içermektedir. Uzel ve arkadaşlarının (2011) yaptıkları çalışmada, fen bilgisi öğretmen adaylarının mikroskobun bölümlerinden en çok oküler, tabla, makrovida ve mikrovidayı doğru bildikleri; kondansatör vidası ve kondansatörü ise yanlış bildikleri belirlenmiştir. Yapılan bu çalışmada ise, öğretmen adaylarının birçok madde için ölçeğe olumlu yanıtlar verdiği belirlenirken; özellikle "Makrovida görüntüyü netleştirmeye yarar; Mikroskoptaki görüntü kitaplardaki gibi ayrıntılı çizilmelidir" maddelerinde çelişkide kaldığı tespit edilmiştir. Mikroskopta görüntünün incelenmesi ile ilgili olarak Uzel ve arkadaşlarının (2011) yaptıkları çalışmada ise, fen bilgisi öğretmen adaylarının kesit almada zorluk çektikleri görülmektedir. Yapılan bu çalışmada ise, öğretmen adaylarının mikroskopta herhangi bir bitkisel dokuyu incelemek adına gerekli tüm aşamaları yazmalarından elde edilen ifadeler temalaştırıldığında, doğru sıralama temasının ağırlıklı olarak yapılabildiği; tam inceleme temasının yüksek oranda yapılamadığı; doğru preparat oluşturma temasının ise yüksek oranda gerçekleştirilebildiği belirlenmiştir. Bu anlamda öğretmen adaylarının preparat oluşturmada problem yaşamadıkları, ancak tam bir inceleme gerçekleştiremedikleri görülmektedir. Yine bu çalışmada görüldüğü üzere öğretmen adaylarının en çok "Taşırken altından tutulmalı, sürüklenmemeli; İşlem bitince 4x10 objektife alınmalı; Öncelikle 4'lük objektifte bulunmalı; Diğer objektiflerde makrovida ellenmeden netleştirme yapılmalı; İnceleme bitince preparat alınmalı ve mikroskop kapatılmalı" ilave ifadelerini verdikleri görülmüştür. Bir başka çalışmada Benzer ve Demir'in (2014) mikroskopta görüntü bulma ve inceleme teması ile ilgili kodları incelediğinde; görüntünün bulunması ve netleştirilmesi kodlarında, en yüksek doğru cevap oranı 3. sınıflarda bulunurken, 2 ve 4. sınıfların doğru cevap oranlarının birbirine yakın olduğu, 1. sınıfların ise bu konu ile ilgili hiç bilgilerinin olmadığı saptanmıştır. Bu noktada Taşdelen ve Güven (2012) de yapmış oldukları araştırmada öğretmen adaylarının deneysel uygulamalara daha çok yer verilmesini ve gözlemlerin bizzat mikroskop kullanılarak yapılmasını istediklerini tespit etmişlerdir.

Dikmenli, Türkmen ve Çardak'ın (2002) çalışmasında, üniversite fen bilimleri öğrencilerinin biyoloji laboratuvarlarında mikroskop çalışmaları ile ilgili alternatif kavramları belirlenirken; Ekici'nin (2016) yapmış olduğu araştırmada da biyoloji öğretmen adaylarının mikroskopla ilgili oldukça zengin, anlamlı ve farklı bakış açılarıyla ifade ettikleri metaforları ve açıklamaları tespit edilmiştir. Fen eğitiminde mikroskop kullanımının olmazsa olmaz bir yeri olduğu kabul edilmektedir. Bu sebeptendir ki, gerek mikroskop teknik bilgisinin ve gerekse mikroskop kullanım bilgisinin bir fen eğitimcisinde yeterli düzeyde olması gerektiği düşünülmektedir. Böylece öğrencilerinin doğayı laboratuvara taşımada ve bilinmeyen görünmeyen bazı yapıları, organizmaları, nesneleri keşfetmelerini sağlamada fen eğitimcilerinin etkin olacağı düşünülmektedir (Demir, 2015). Ketelhut, Nelson, Clarke ve Dede (2010) de sanal mikroskoplarla bile, öğrencilerin bir deneyi etkin olarak gerçekleştirme hissini yaşayabileceğini ve bir bilim insanı gibi hissedebileceğini ifade etmektedirler. Mikroskop konusunda yanlış anlamaların neler olduğunun tespiti, biyoloji ve biyoloji laboratuvar çalışmalarının bu yanılgıları yok edecek veya azaltacak şekilde düzenlenmesi, öğrencilerin başarılarını artırmada son derece önem kazanmaktadır (Yeşilyurt, 2004). Bu sebeptendir ki; öğretmen adaylarının mikroskop kullanım becerilerinin geliştirilebilmesi adına oldukça zengin deneyim ortamları yaşatılması gerektiği düşünülmektedir.

ÖNERİLER

Yapılan bu çalışmadan yola çıkarak, lisans seviyesindeki programlarda özellikle biyoloji içerikli konuların mümkün olduğu kadar mikroskop kullanılarak ve uygulamalı olarak yürütülmesi gerektiği düşünülmektedir. Yine bu programlarda öğrenim gören öğretmen adaylarının mümkün olduğunca fazla örnek uygulamaları yaşamaları ve deneyim içerisinde bulunmaları oldukça önemlidir. Özellikle fen bilgisi öğretmen adaylarının, ileride mesleklerini nitelikli olarak yürütebilmeleri ve mikroskobun ilkokul ve ortaokul öğrencileri için etkin bir şekilde kullanımının sağlanabilmesi adına bu program öğrencilerinin mikroskop kullanımı konusunda bilgi ve becerilere sahip olması gerekmektedir.

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OBJECTIVES OF PHYSICS TEACHER CANDIDATES TO DESIGN 3D MATERIAL AND PROBLEMS THEY ENCOUNTERED IN THE PROCESS

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ABSTRACT: The aim of this study was to determine objectives of physics teacher candidates to design 3D material, problems they encountered in the process and their views about contribution of their materials to subject and course process. The working group of the study was 15 physics teacher candidates that received instructional technology and material design course. Aim oriented interview form that contains three questions was developed. Semi-structured interviews were conducted with teacher candidates. The obtained data were presented on the basis of qualitative data analysis. It was determined that physics teacher candidates prepared their 3D materials mostly to eliminate misconception about the subject and to make the subject more understandable. In this process, the problems that physics teacher candidates mostly stated were to provide necessaries to serve the purpose and construction of material.

Key words: 3D material, physics teacher candidate, material design

FİZİK ÖĞRETMEN ADAYLARININ ÜÇ BOYUTLU MATERYAL TASARIMI AMAÇLARI VE SÜREÇTE KARŞILAŞTIKLARI PROBLEMLER

ÖZET: Bu çalışmanın amacı fizik öğretmen adaylarının üç boyutlu materyal tasarlama amaçlarını, süreçte karşılaştıkları problemleri, hazırladıkları materyallerin ilgili konuya ve ders sürecine nasıl katkı sağladığına yönelik görüşlerini belirlemektir. Araştırmanın çalışma grubunu öğretim teknolojileri ve materyal tasarımı dersini almış olan gönüllü 15 fizik öğretmen adayı oluşturmaktadır. Veri toplama aracı olarak araştırmanın amacı doğrultusunda üç sorudan oluşan bir görüşme formu hazırlanmıştır. Öğretmen adayları ile yarı yapılandırılmış mülakat gerçekleştirilmiştir. Elde edilen veriler nitel veri analizlerinden içerik analiz yaklaşımı esas alınarak sunulmuştur. Fizik öğretmen adaylarının en fazla konu ile ilgili kavram yanılgılarını gidermek ve konuyu daha anlaşılır kılmak amaçlı üç boyutlu materyal hazırladıkları belirlenmiştir. Bu süreçte fizik öğretmen adaylarının en fazla dile getirdikleri problemler amaca hizmet edecek malzemeleri temin etme ve materyalin yapım aşaması olmuştur.

Anahtar sözcükler: Üç boyutlu materyal, fizik öğretmen adayı, materyal tasarımı

GİRİŞ

Öğrenme-öğretme sürecinde hedeflenen davranışlara ulaşabilmek için uygun öğrenme ortamlarının oluşturulması önem taşımaktadır. Birçok araştırmacı (Acer, 2011; Akkoyunlu, 2002; Aydın, 2011; Karataş ve Yapıcı, 2006; Uyangör ve Ece, 2010; Yaşar, 2004) ders sürecinde öğretim materyali kullanımının öğrencilerin öğrenmesinde olumlu etkilerinin olduğunu belirtmiştir. Derste öğretim materyali kullanımı öğrencilerin algılamalarını ve öğrenmelerini kolaylaştırmakta, unutmayı azaltmakta ve hatırlamayı sağlamaktadır. Ayrıca ulaşılamayan, sınıfa taşınması güç olan olay, olgu ve varlıkları sınıfa taşımaktadır (Yaşar, 2004). Ateş ve diğ. (2010) öğrenme-öğretme sürecinde öğrencilerin gereksinimini karşılayacak hazır materyallerin seçilmesi ve kullanılması gerektiğini, bu sağlanamadığında var olan materyallerin daha uygun hale getirilip kullanılması gerektiğini, bu da olanaklı değilse öğretmenin kendisinin materyal geliştirebileceğini belirtmektedirler.

Öğretim teknolojileri ve materyal tasarımı öğretmen yetiştirme programlarında zorunlu dersler arasında yer almaktadır. Bu ders geleceğin öğretmen adaylarının, öğrenme sürecini etkili kılmak için kullanabilecekleri öğretim materyalleri tasarlamalarında gerekli olan ilkeleri öğrenmelerine ve bu doğrultuda materyal geliştirebilmelerine olanak vermektedir. Bu nedenle bu ders kapsamında öğretmen adaylarının materyal hazırlama süreçlerine yönelik görüşleri önem arz etmektedir.

Bu araştırmanın amacı fizik öğretmen adaylarının üç boyutlu materyal tasarlama amaçlarını, süreçte karşılaştıkları problemleri, hazırladıkları materyallerin ilgili konuya ve ders sürecine nasıl katkı sağladığına yönelik görüşlerini belirlemektir.

YÖNTEM

Bu araştırma öğretmen adayları ile gerçekleştirilen yarı yapılandırılmış mülakattan elde edilen veriler ile nitel bir boyut taşımaktadır.

Katılımcılar

Araştırmanın katılımcılarını öğretim teknolojileri ve materyal tasarımı dersini almış olan gönüllü 15 fizik öğretmen adayı oluşturmaktadır.

Veri Toplama Aracı

Veri toplama aracı olarak araştırmanın amacı doğrultusunda üç sorudan oluşan bir görüşme formu hazırlanmıştır. Öğretmen adayları ile yarı yapılandırılmış mülakat gerçekleştirilmiştir. Mülakatta öğretmen adaylarına materyallerini hangi amaç ile geliştirdikleri, materyallerini hazırlama sürecinde karşılaştıkları problemler, hazırladıkları materyallerin konuya ve ders sürecine nasıl bir katkı sağladığı sorulmuştur.

Verilerin Analizi

Elde edilen veriler nitel veri analizlerinden içerik analiz yaklaşımı esas alınarak sunulmuştur. İçerik analizinde temel amaç, toplanan verileri açıklayabilecek kavramlara ve ilişkilere ulaşmaktır (Yıldırım ve Şimşek 2006: 227).

BULGULAR

Bu bölümde öğretmen adaylarının mülakatta vermiş oldukları cevaplardan oluşturulan kodlamalara yer verilmiştir.

Tablo 1. Materyallerin hangi amaç ile geliştirildiğine yönelik kodlamalar

Kodlamalar	Frekans
Bilgi eksikliğini gidermek (Ö1)	**1**
Kavram yanılgısını gidermek (Ö1, Ö3, Ö4, Ö5, Ö8, Ö10, Ö11, Ö14)	**8**
Konuyu daha anlaşılır kılmak (Ö2, Ö5, Ö6, Ö7, Ö12, Ö13, Ö14, Ö15)	**8**
İçeriği somutlaştırmak (Ö3, Ö9, Ö10)	**3**
Üç boyutlu hayal etme zorluğu (Ö3, Ö11)	**2**

Fizik öğretmen adaylarının kendi oluşturdukları materyalleri hangi amaç ile geliştirdiklerine ilişkin kodlamaların yer aldığı Tablo 1 incelendiğinde; öğretmen adaylarının en fazla konu ile ilgili kavram yanılgılarını gidermek ve konuyu daha anlaşılır kılmak amaçlı üç boyutlu materyal hazırladıkları görülmektedir.

Tablo 2. Materyali hazırlama sürecinde karşılaşılan problemlere yönelik kodlamalar

Kodlamalar	Frekans
Amaca hizmet edebilecek malzemeleri temin etme (Ö1,Ö2,Ö3,Ö5,Ö6,Ö7,Ö8,Ö9,Ö12,Ö13,Ö14)	**11**
Yapım aşaması (Ö1, Ö3, Ö5, Ö6, Ö7, Ö10, Ö11, Ö12, Ö13, Ö15)	**10**
Ne yapılacağı konusunda kararsızlık (Ö4, Ö8)	**2**
Nasıl yapılacağı (Ö4)	**1**
Zamanın kısıtlı olması (Ö7, Ö8)	**2**
Düzeneğin çalışmaması (Ö9)	**1**

Fizik öğretmen adaylarının materyallerini hazırlama sürecinde karşılaştıkları problemleri gösteren Tablo 2 incelendiğinde; öğretmen adaylarının en fazla dile getirdikleri problemler amaca hizmet edecek malzemeleri temin etme ve materyalin yapım aşamasıdır. En az karşılaştıkları problemler ise materyali nasıl yapacakları konusunda zorlanma ve oluşturdukları düzeneklerin çalışmamasıdır.

Tablo 3. Materyalin konuya ve ders sürecine nasıl bir katkı sağladığına yönelik görüşlere ait kodlamalar

Kodlamalar	Frekans
Soyut kavramları somutlaştırma (Ö1, Ö9, Ö11)	3
Derse ilgi çekme (Ö1, Ö2, Ö3, Ö4, Ö15)	5
Konuyu anlaşılır kılma (Ö2, Ö3, Ö4, Ö6, Ö7, Ö8, Ö10, Ö12, Ö13, Ö14, Ö15)	11
Akılda kalıcılığı sağlama (Ö3, Ö8, Ö14)	3
Kavram yanılgısını giderme (Ö5, Ö6, Ö10)	3
Görsellik (Ö11, Ö12, Ö15)	3

Fizik öğretmen adayları hazırladıkları materyallerinin ilgili konuya ve ders sürecine sağladığı katkı hususunda en fazla konuyu anlaşılır kılmayı ifade etmişlerdir. Bu görüşü derse ilgi çekme katkısı takip etmektedir.

SONUÇ

Bu araştırma fizik öğretmen adaylarının üç boyutlu materyal tasarlama amaçlarını, süreçte karşılaştıkları problemleri, hazırladıkları materyallerin ilgili konuya ve ders sürecine nasıl katkı sağladığına yönelik görüşlerini belirlemek amacıyla yapılmıştır. Elde edilen bulgular incelendiğinde; fizik öğretmen adaylarının üç boyutlu materyallerini en fazla konu ile ilgili kavram yanılgılarını gidermek ve konuyu daha anlaşılır kılmak amacı ile tasarladıkları belirlenmiştir. Aynı zamanda öğretmen adaylarının üç boyutlu materyal tasarlamada; bilgi eksikliğini gidermek, içeriği somutlaştırmak ve üç boyutlu hayal etme zorluğunu ortadan kaldırmak amaçları da bulunmaktadır.

Fizik öğretmen adayları üç boyutlu materyal tasarlama sürecinde en çok karşılaştıkları problemlerin amaca hizmet edecek malzemeleri temin etmenin zor olduğunu ve materyalin yapım aşamasında problemlerle karşılaştıklarını belirtmişlerdir. Öğretmen adaylarının materyal tasarlama sürecinde karşılaştıkları problemler arasında hangi materyali nasıl yapacakları, zamanın kısıtlı olması ve geliştirdikleri düzeneğin çalışmaması da bulunmaktadır. Özer ve Tunca (2014)'nın öğretmen adaylarının materyal hazırlama ve kullanmaya yönelik görüşlerini belirledikleri çalışmanın sonuçları bu araştırma ile benzerlik gösterip öğretmen adayları materyallerini hazırlama aşamasında malzemeye ulaşma, malzemeyi biçimlendirme, zaman yönetimi konularında problem yaşadıklarını ifade etmişlerdir.

Öğretmen adayları hazırladıkları materyallerin en çok konuyu anlaşılır kılmada ve derse ilgi çekmede fayda sağladığını dile getirmişlerdir. Buna ek olarak materyallerin soyut kavramları somut hale getirme, akılda kalıcılığı sağlama, kavram yanılgısını giderme ve görsellik katkıları belirtilmiştir. Özer ve Tunca (2014)'nın çalışmasında da öğretmen adaylarının büyük çoğunluğu öğretim materyali hazırlama ve kullanmayı; dikkati çekme, kalıcı öğrenmeler sağlama, öğrencileri derse güdüleme ve öğrenmeyi kolaylaştırma açılarından önemli gördüklerini belirtmişlerdir. Geleceğin öğretmeni olacak olan fizik öğretmen adaylarının öğretim materyallerinin konuya ve ders sürecine yönelik olumlu yöndeki bu görüşleri öğrenme sürecini etkili kılmak adına önem arz etmektedir.

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EXAMINATION OF PRESERVICE TEACHERS' ATTITUDES TOWARDS SUSTAINABLE ENVIRONMENT IN TERMS OF VARIOUS VARIABLES

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ABSTRACT: Sustainability defines as living generations' fulfilling their improvement without endangering next generations' opportunities to meet their vital needs. Accordingly, the concept of sustainability can be expressed as a development process going on. In this sense, both teaching of sustainability conceptually and developing of positive attitudes towards this issue have become an important matter of educational research. In this process, individuals aimed to develop cognitive, affective and psychomotor acquisitions towards natural, social and cultural environment. According to related literature, it was echoed that supporting the teachers and preservice teachers' development of awareness in this regard are very important. In this study, it was aimed to compare attitudes of preservice teachers studying in different programs and at different grades towards sustainable environment in terms of various variables (program, grade and gender). Totally, 330 preservice teachers studying in three different teacher education programs (Science, Social Studies and Primary School Teacher Education) in a state university in the south-eastern region of Turkey were involved in this study. At the end of the study, the preservice teachers' average points towards sustainable environment were calculated in terms of their gender, programs they are studying in, and finally, in terms of their grades. To test the significance of the differences among average scores, it was carried out suitable parametric test procedures. As a result, a significant difference was found (p>. 05) among the attitudes of preservice teachers towards sustainable environment in terms of gender. However, it was not found a significant difference regarding grades. As for the programs in which the participants studying, social studies teacher candidates were determined to have the lowest average scores of sustainable environmental attitudes compared to preservice primary school teachers and preservice science teachers. And these difference found as statistically significant. These differences among the groups in terms of attitude for sustainable environment were discussed by comparing with other studies related to the issue and various suggestions were made.

Key words: sustainable environment, sustainable development, attitude, preservice teachers

ÖĞRETMEN ADAYLARININ SÜRDÜRÜLEBİLİR ÇEVREYE YÖNELİK TUTUMLARININ ÇEŞİTLİ DEĞİŞKENLER AÇISINDAN İNCELENMESİ

ÖZET: Sürdürülebilirlik, yaşayan kuşağın, gelecek kuşakların gereksinimlerini sağlama olanaklarını zorlamadan, kendi gelişmelerini gerçekleştirebilmeleri şeklinde tanımlanmıştır. Dolayısıyla, sürdürülebilirlik kavramı, gelecek zaman diliminde de devam eden bir gelişme süreci olarak ifade edilebilir. Bu sebeple önce sürdürülebilir kalkınma ardından da sürdürülebilir çevre kavramı ortaya çıkmıştır. **Bu bağlamda sürdürülebilirliğin hem kavramsal olarak öğretiminin yapılması ve hem de bu konuya ilişkin olumlu tutumların geliştirilmesi, eğitim araştırmalarının önemli bir konusu haline gelmiştir. Bu süreçte bireylerde doğal, yakın, sosyal ve kültürel çevreye yönelik bilişsel duyuşsal ve psiko-motor kazanımların geliştirilmesi hedeflenmektedir. Bunun için ise öncelikle öğretmenlerde ve öğretmen adaylarında, söz konusu gelişimleri desteklemenin gerekliliği ortaya çıkmaktadır. Bu çalışmada, eğitim fakültesinin farklı programlarında ve sınıf düzeylerinde öğrenim görmekte olan öğretmen adaylarının sürdürülebilir çevreye ilişkin tutumlarının çeşitli değişkenler (program, sınıf düzeyi ve cinsiyet) açısından karşılaştırılması amaçlanmıştır.** Çalışma, Türkiye'nin Güneydoğu Bölgesinde yer alan bir devlet üniversitesinin eğitim fakültesinde, üç farklı programda (Fen Bilgisi Öğretmenliği, Sosyal Bilgiler Öğretmenliği ve Sınıf Öğretmenliği) öğrenim görmekte olan toplam 330 öğretmen adayı ile yürütülmüştür. Veriler, "Sürdürülebilir Çevre Eğitimi Kapsamında Tutum Ölçeği" ölçme aracı kullanılarak toplanmıştır. Verilerin analizinde uygun betimsel ve kestirimsel analiz teknikleri uygulanmıştır. Çalışma sonucunda, öğretmen adaylarının sürdürülebilir çevreye ilişkin tutum puan ortalamaları, cinsiyetleri öğrenim gördükleri programlar ve son olarak sınıf düzeyleri açısından ele alınmıştır. Betimsel analizler sonucu belirlenen ortalamalar arasındaki bu farkların anlamlılığını test etmek için ise bağımsız gruplar t testi (sınıf düzeyi ve cinsiyet değişkenleri için) ve tek yönlü varyans analizi (program değişkeni için) yöntemleri kullanılmıştır. Cinsiyet ve sınıf düzeyi değişkenleri için yapılan bağımsız gruplar t-testi sonuçlarına göre, öğretmen adaylarının sürdürülebilir çevre tutumları arasında cinsiyet değişkeni açısından anlamlı fark bulunmuş ($p<.05$), ancak sınıf düzeyi açısından anlamlı fark bulunmamıştır ($p>.05$). Bölüm bazında yapılan analiz sonucunda ise, sosyal bilgiler öğretmenliği ile sınıf ve fen bilgisi öğretmenliği arasında anlamlı farkların olduğu bulgusuna ulaşılmıştır ($p<.05$). Sürdürülebilir çevre tutumu açısından gruplar arasında ortaya çıkan farklar, konuyla ilgili diğer çalışmalarla karşılaştırılarak tartışılmış ve çeşitli önerilerde bulunulmuştur.

Anahtar sözcükler: sürdürülebilir çevre, sürdürülebilir kalkınma, tutum, öğretmen adayları

GİRİŞ

İnsanoğlu, özellikle sanayi devriminden itibaren, üzerinde yaşadığımız mavi kürenin kaynaklarını uzun süre bilinçsizce tüketme yoluna gitmiştir. Ancak, geleceğe yönelik sosyal, ekonomik, politik ve çevresel etkileri pek dikkate alınmadan yürütülen bu tüketim çılgınlığı ve buna dayalı endüstrileşme, diğer alanlarda olduğu gibi çevreyle ilgili alarm zillerinin çalmasına da neden olmuştur. Nihayet, 80'li yıllardan itibaren, doğal kaynakların daha sağlıklı ve verimli kullanımına ilişkin toplumsal bilincin gelişmeye başlamasına paralel olarak, sürdürülebilirliği esas alan çevreci politikaların üretilmesi ihtiyacı kendini iyiden iyiye hissettirmeye başlamıştır. Sürdürülebilirlik, yaşayan kuşağın, gelecek kuşakların gereksinimlerini sağlama olanaklarını zorlamadan, kendi gelişmelerini gerçekleştirebilmeleri şeklinde tanımlanmıştır. Dolayısıyla, sürdürülebilirlik kavramı, gelecek zaman diliminde de devam eden bir gelişme süreci olarak ifade edilebilir. Bu sebeple önce sürdürülebilir kalkınma ardından da sürdürülebilir çevre kavramı ortaya çıkmıştır. Bu bağlamda sürdürülebilirliğin hem kavramsal olarak öğretiminin yapılması ve hem de bu konuya ilişkin olumlu tutumların geliştirilmesi, eğitim araştırmalarının önemli bir konusu haline gelmiştir. Bu süreçte bireylerde doğal, yakın, sosyal ve kültürel çevreye yönelik bilişsel duyuşsal ve psiko-motor kazanımların geliştirilmesi hedeflenmektedir. Bunun için ise öncelikle öğretmenlerde ve öğretmen adaylarında, söz konusu gelişimleri desteklemenin gerekliliği ortaya çıkmaktadır.

Sürdürülebilirlik, dünyadaki çevre dengesi ile ekonomik büyümeyi aynı anda ele alan, gelecek nesillerin ihtiyaçlarını göz ardı etmeden ve tehlikeye sokmadan, doğal kaynakların verimli kullanımını sağlayan ve kaliteli bir çevre için kalkınmaya önem veren bir kavramdır (Babaoğul, 2015). Sürdürülebilirlik çevrenin kalkınma ile ele alındığını vurgulamaktadır (Afacan ve Demirci-Güler, 2011). Bu aşamada çevre eğitiminin önemi artmış bulunmaktadır (Tanrıverdi, 2009).

Sürdürülebilir kalkınma, insan ile doğa arasında denge kurarak gelecek kuşakları tehlikeye atmadan onlarında ihtiyaçlarının karşılanması koşuluyla, doğal kaynakların verimli kullanımını vurgulayan hem bugünün hem de geleceğin kalkınmasını amaç edinen bir programlamadır (Afacan ve Demirci-Güler, 2011). Sürdürülebilirlik, geçmişten bugüne birçok siyasal sistemin içinde yer alan bir kavram olmuştur (Summers, Corney ve Childs, 2004). İnsanoğlunun hem bugün hem de geleceğini göz önüne alarak kaynak kullanımını temel alan sürdürülebilirlik (WCED, 1987) ilk kez 1972 yılında İsveç'te Birleşmiş Milletler İnsan Çevresi Komisyonunda sonra 1976 yılında Kanada'da Birleşmiş Milletler Habitat I Konferansında, 1987 yılında ortak geleceğimiz Bruntland raporunda ve 1992 yılında Brezilya'da BM çevre ve kalkınma komisyonunda (UNCED) yer bulmuş, 2003 yılında da dünya bankası 2003 yılı faaliyet raporunda yer almıştır.

Yukarıda özetlendiği üzere sürdürülebilirlik birçok uluslararası toplantılarda ele alınmış ve daha iyi bir gelecek için adımlar atılmıştır ve atılmaktadır. Ancak bu aşamada sürdürülebilir kalkınmanın sadece ekonomi odaklı yapılmaması, bu süreçte doğal çevrenin de dikkate alınması gerektiği vurgulanmaktadır (Demirci-**Güler, 2013).** Bu nedenle sürdürülebilir kalkınma ardından da sürdürülebilir çevre kavramı ortaya çıkmıştır (Tanrıverdi, 2009). Bu dönemlerde UNESCO da bir program değişikliği yaparak Uluslararası Çevre Eğitimi Programını, Sürdürülebilir Gelecek için Eğitim Programıyla değiştirmiştir (UNESCO, 1997).

Çevresel sorunlarının, insan kaynaklı olduğu görülmekte ve bu nedenle insana dayalı çözümler bulunmaya çalışılmaktadır. Bu çözümlerin ilk sırasında insanların çevre ile ilgili eğitimi ön plana alınmalıdır. Çevre eğitimi; çevre ile ilgili bilinçli, duyarlı, bireyi geliştirmeyi amaç edinen, kişilere toplumda görevler yükleyen ve bir ömür devam edecek bir yaklaşımdır (Moseley, 2000). Bu aşamada ayrıca insanlar belli başlı tutumlar geliştirmelidir. Çevre tutumu ise, insanların bulundukları doğaya karşı olumlu ya da olumsuz bir algısının olması olarak, ifade edilebilir (Pelstring, 1997). Bireylerin çevre ile ilgili tutumlarını birbirinden farklı olabilir. Bunun nedenleri ise kişinin gelir düzeyi, eğitim durumu, yaşam tecrübeleri, yaşadığı toplumun gelenek ve görenekleridir. (Özgen, 2012). Son yıllarda üniversitelerde sürdürülebilirlik kavramına değinilmiş ve bu kavram, sürdürülebilir gelecek ve çevre şeklinde bazı dallarda ele alınmıştır. Bazı üniversiteler 1990 yılında, sürdürülebilir gelecek ile ilgili çalışmalara katkı sağlamak maksadıyla düzenlenmiş olan "*Talloires Declaration*" 'a imza atmışlardır (Wright, 2002). Tüm bunlara rağmen, öğretim programlarında çevre eğitimine yapılan vurgunun yetersiz olduğu savunulmaktadır (Tanrıverdi, 2009). Bu nedenle, sürdürülebilir bir gelecek için, eğitim sistemimizde sürdürülebilirlik kavramını iyice benimsetmeye ve aktif hale getirmeye çalışmalıyız; bu sebeple yükseköğretimde çevre ve sürdürülebilir kalkınma eğitimi verilmelidir (Teksöz, vd. 2010).

Yükseköğretimde Fen Bilgisi, Sınıf, Biyoloji, Sosyal Bilgiler Öğretmenliği ve Çevre Mühendisliği bölümleri gibi bazı bölümler haricinde çevre eğitimi dersi alan bölümler çok bulunmamaktadır. Bu durum ise üniversite öğrencilerinin çevre ile ilgili tutumlarının gelişememesine neden olmuştur (Sadık ve Çanak, 2010). Yükseköğretimde öğrenim gören tüm öğrencilere bu dersin, kendilerinin de aktif katılımı sağlanarak verilmesi önerilmiştir (Şahin, vd. 2004).

Çalışmanın Amacı

Bu çalışmanın amacı; öğretmen adaylarının sürdürülebilir çevreye yönelik tutumlarını belirlemek ve bu tutumlarını; öğrenim gördükleri program, sınıf düzeyi ve cinsiyet değişkenleri açısından karşılaştırmaktır. Bu amaç doğrultusunda bazı sorulara cevap aranmıştır.

1. Öğretmen adaylarının sürdürülebilir çevre tutumları arasında;
    1a. Cinsiyetleri açısından anlamlı bir fark var mıdır?
    1b. Sınıf düzeyleri açısından anlamlı bir fark var mıdır?
    1c. Öğrenim gördükleri programlar açısından anlamlı bir fark var mıdır?
2. Her bir programın kendi içinde cinsiyet ve sınıf düzeyi değişkenleri açısından sürdürülebilir çevre tutumları arasında anlamlı bir fark var mıdır?

YÖNTEM

Araştırma Deseni

Araştırmada ilişkisel tarama modeli kullanılmıştır. Bu model Karasar (2005, ss. 5) tarafından "Çok sayıda elemandan oluşan bir evrende, evren hakkında genel bir yargıya varmak amacı ile evrenin tümü ya da ondan alınacak bir grup örnek ya da örneklem üzerinde yapılan tarama düzenlemeleri" olarak tanımlanmaktadır. Tarama tipi araştırmalarda cinsiyet, yaş, gelir düzeyi, öğrenim durumu, sınıf, gibi bazı özellikler belirlenmek amacıyla yapılır (Can, 2016). Veriler üzerinde mod, medyan, aritmetik ortalama gibi istatistiksel işlemler yapılmaktadır.

Çalışma Grubu

Araştırmanın örneklemini, 2015-2016 eğitim öğretim yılında Türkiye'nin güneydoğusunda yer alan bir devlet üniversitesinin eğitim fakültesi 2. ve 3. sınıflarında öğrenim görmekte olan toplam 330 öğretmen adayı oluşturmaktadır. Katılımcıların 113'ü fen bilgisi öğretmenliği, 129'u sınıf öğretmenliği ve 88'i sosyal bilgiler öğretmenliği programındandır. Diğer taraftan, öğretmen adaylarının 234'ü kız, 96'sı erkektir. Araştırmaya katılan fen bilgisi öğretmenliği bölümü öğretmen adayları III. ve IV. yarıyılda 6 AKTS'lik "*Genel Biyoloji I ve II*", VI. yarıyılda ise 3 AKTS'lik "*Çevre Bilimi*" dersi almışlardır. Sınıf öğretmenliği öğretmen adayları I. yarıyılda 5 AKTS'lik "*Genel Biyoloji*" ve III. yarıyılda 3 AKTS'lik "*Çevre Eğitimi*" dersi almışlardır. Sosyal bilgisi öğretmenliği bölümü öğretmen adayları ise 5. yarıyılda 3 AKTS'lik "*Çevre Bilimi*" dersi almışlardır.

Veri Toplama Aracı

Afacan ve Demirci-Güler (2011) tarafından geliştirilen "Sürdürülebilir Çevre Eğitimi Kapsamında Tutum Ölçeği" ölçme aracı olarak kullanılmıştır. Bu çalışmada, ölçeğin Cronbach Alpha iç tutarlılık katsayısı 0.89 olarak bulunmuştur.

Veri Analizi

Araştırmada cinsiyet ve bölüm açısından kız ve erkek öğretmen adayları arasında sürdürülebilir çevre tutumu açısından bir fark olup olmadığını saptamak için bağımsız gruplar t testi (sınıf düzeyi ve cinsiyet değişkenleri için) ve tek yönlü varyans analizi (program değişkeni için) yöntemleri kullanılmıştır.

BULGULAR

Problem 1: Öğretmen adaylarının sürdürülebilir çevre tutumları arasında cinsiyetleri açısından anlamlı bir fark var mıdır?

Tablo 1. Fen Bilgisi, Sınıf ve Sosyal Bilgiler Öğretmen Adaylarının Cinsiyet Değişkenine İlişkin Bağımsız Gruplar t-Testi Sonuçları

Cinsiyet	N	$\bar{X}$	S	sd	t	p
Kız	234	4,13	,40	328	2,91	,004
Erkek	96	3,92	,65			

Öğretmen adaylarının sürdürülebilir çevre tutumları arasında cinsiyet açısından anlamlı bir fark olup olmadığını ortaya koymak için yapılan ilişkisiz örneklemler için t testi sonucuna göre kızlar lehine anlamlı bir fark olduğu bulunmuştur [$t_{(328)} = 2{,}91$, $p<0.05$ (p=0,004)].

Problem 2: Öğretmen adaylarının sürdürülebilir çevre tutumları arasında sınıf düzeyleri açısından anlamlı bir fark var mıdır?

Tablo 2. Fen Bilgisi, Sınıf ve Sosyal Bilgiler Öğretmen Adaylarının Sınıf Düzeyi Değişkenine İlişkin Bağımsız Gruplar t-Testi Sonuçları

Sınıf Düzeyi	N	$\bar{X}$	S	sd	t	p
2. Sınıf	148	4.06	,48	328	0,055	,95
3.Sınıf	182	4.07	,50			

Öğretmen adaylarının sürdürülebilir çevre tutumları arasında sınıf düzeyi değişkeni açısından anlamlı bir fark olup olmadığını ortaya koymak için yapılan ilişkisiz örneklemler için t testi sonucuna göre ise gruplar arasında anlamlı bir fark olduğu bulunmamıştır [$t_{(328)} = 0.055$, $p>0.05$ (p=0,95)].

Problem 3: Öğretmen adaylarının sürdürülebilir çevre tutumları arasında öğrenim gördükleri programlar açısından anlamlı bir fark var mıdır?

Tablo 3. Fen Bilgisi, Sınıf ve Sosyal Bilgiler Öğretmen Adaylarının Bölüm Değişkenine İlişkin Tek Yönlü Varyans Analizi ve LSD Sonuçları

Varyansın Kaynağı	Kareler Toplamı	sd	Kareler Ortalaması	F	p	Anlamlı Fark
Gruplar arası	5,699	2	2,849	12,283	,00	Sınıf-Sosyal/Fen-Sosyal
Gruplar içi	75,85	327	,232			
Toplam	81,55	329				

Üç farklı bölümde okuyan toplam 330 öğretmen adayının, sürdürülebilir çevre tutumları arasında program bazında anlamlı bir fark olup olmadığını sınamak için, öğrenim gördükleri program değişkeni ile sürdürülebilir çevre tutumu ortalamaları ilişkisiz örneklemler için tek yönlü varyans analizi ile karşılaştırılmıştır. Buna göre, sınıf öğretmenliği öğretmen adaylarının ortalaması 4.19, fen bilgisi öğretmen adaylarının ortalaması 4.08 ve sosyal bilgiler öğretmen adaylarının ortalaması ise 3.86 olarak bulunmuştur. Fen bilgisi ve sınıf öğretmenliği öğretmen adaylarının sürdürülebilir çevre tutum ortalamaları, sosyal bilgiler öğretmen adaylarına göre anlamlı düzeyde daha yüksek bulunmuştur. Sınıf ve fen bilgisi öğretmen adaylarının puanları arasında ise istatistiksel olarak anlamlı bir fark bulunmamıştır.

Problem 4: Her bir programın kendi içinde cinsiyet ve sınıf düzeyi değişkenleri açısından sürdürülebilir çevre tutumları arasında anlamlı bir fark var mıdır?

Farklı bölüm değişkeninin, kız ve erkek öğrencilerin başarıları üzerindeki etkisini belirlemek için yapılan analiz sonucuna göre; fen bilgisi ve sınıf öğretmen adaylarının cinsiyet değişkeni açısından ortak etkisi incelendiğinde anlamlı fark bulunmamıştır ($\bar{X}_{fen\text{-}kız}=4{,}10$, $\bar{X}_{fen\text{-}erkek}=3{,}95$, $\bar{X}_{sınıf\text{-}kız}=4{,}18$, $\bar{X}_{sınıf\text{-}erkek}=4{,}22$). Sosyal bilgiler öğretmen adaylarının cinsiyet değişkeni açısından ortak etkisi incelendiğinde ise anlamlı fark bulunmuş [p=0,002 ($p<0{,}05$)] ve bu farkın kızlar lehine olduğu görülmüştür ($\bar{X}_{kız} = 4.05$, $\bar{X}_{erkek} = 3.68$).

Tablo 4. Fen Bilgisi, Sınıf ve Sosyal Bilgiler Öğretmen Adaylarının Sınıf Düzeyi Değişkenine İlişkin Ayrı Ayrı Eşleştirilmiş Gruplar T-Testi Sonuçları

Program	Sınıf Düzeyi	N	X	ss	t	sd	p
SINIF ÖĞRETMENLİĞİ	2. sınıf	54	4,2233	,31681	,659	127	,511
	3. sınıf	75	4,1791	,41354			
FEN BİLGİSİ ÖĞRETMENLİĞİ	2. sınıf	55	4,0355	,57915	-,917	111	,361
	3. sınıf	58	4,1247	,45014			
SOSYAL BİLGİLER ÖĞRETMENLİĞİ	2. sınıf	39	3,8997	,49352	,464	86	,644
	3. sınıf	49	3,8431	,62261			

Farklı bölüm değişkeninin, sınıf düzeyi açısından başarıları üzerindeki etkisini belirlemek için yapılan analiz sonucuna göre; fen bilgisi, sınıf ve sosyal bilgiler öğretmen adaylarının sınıf düzeyi değişkeni açısından ortak etkisine bakıldığında anlamlı fark bulunmamıştır ($\overline{X}_{fen\text{-}2}$=4,03 , $\overline{X}_{fen\text{-}3}$=4,12 , $\overline{X}_{sınıf\text{-}2}$=4,22 , $\overline{X}_{sınıf\text{-}3}$=4,17).

Tablo 5. Fen Bilgisi, Sınıf ve Sosyal Bilgiler Öğretmen Adaylarının Cinsiyet Değişkenine İlişkin Ayrı Ayrı Eşleştirilmiş Gruplar T-Testi Sonuçları

Program	Cinsiyet	N	X	ss	t	sd	p
SINIF ÖĞRETMENLİĞİ	Kadın	97	4,1870	,332679	-0,461	40,94	,647
	Erkek	32	4,2297	,487512			
FEN BİLGİSİ ÖĞRETMENLİĞİ	Kadın	94	4,1063	,459560	0,843	20,87	,409
	Erkek	19	3,9574	,741446			
SOSYAL BİLGİLER ÖĞRETMENLİĞİ	Kadın	43	4,0593	,391307	3,294	72,92	,002
	Erkek	45	3,6856	,647181			

SONUÇ

İnsanoğlu var olduğu günden itibaren yaşamını devam ettirebilmek için bulunduğu çevrenin kaynaklarından yaralanıyordu. İnsanlar zamanla kullandığı kaynakların azalmasından dolayı üretim ve ticarete yöneldi. Artan nüfusun etkisiyle sanayi devrimi ve ham madde ihtiyacı doğdu. İnsanoğlu doğaya daha fazla yönelmeye başladı. Günümüzde ise bu durumda herhangi bir azalma olmadı aksine artış yaşandı ve doğa alarma vermeye başladı. Yaşanan bu süreç yarınlarımızı tehdit eder hale geldi. İnsanoğlu kendi elleriyle ekosistemi tahrip etmiş, küresel ısınmaya yol açmış ve iklim değişiklikleri gibi çevresel sorunların oluşmasına neden oldu. Birleşmiş milletler raporları ve bu konuyla ilgili yapılan diğer çalışmalar bu problemleri göz önüne sermektedir. İnsanoğlunun hem bugün hem de geleceğini göz önüne alarak kaynak kullanımını temel alan sürdürülebilirlik (WCED, 1987) ilk kez 1972 yılında İsveç'te Birleşmiş Milletler İnsan Çevresi Komisyonunda sonra 1976 yılında Kanada'da Birleşmiş Milletler Habitat I Konferansında, 1987 yılında Ortak geleceğimiz Bruntland raporunda ve 1992 yılında Brezilya'da BM çevre ve kalkınma komisyonunda (UNCED) yer bulmuş, 2003 yılında da dünya bankası 2003 yılı faaliyet raporunda yer almıştır.

Yaşanan bu kadar olumsuzluk sonucunda öncelikle toplumun tüm bireylerine çevre eğitimi verilmeli ve insanlarda çevreye yönelik olumlu tutumlar geliştirmesi sağlanmalıdır. Bu eğitim öncelikle çevre eğitimi veya ekoloji gibi dersler almış üniversite öğrencilerinden başlanmalıdır. Thomas ve Nicita (2002) da, yükseköğretimde sürdürülebilir kalkınma konulu çalışmalarında çevre okuryazarlığının belirlenmesi amacı ile araştırmalar yapılması gerektiğini ve bu yolla üniversitelerdeki çevre ve sürdürülebilir kalkınma eğitiminin etkinliğinin belirlenmesi gerektiğini vurgulamışlardır. Bu nedenle araştırmadaki katılımcılar, ilköğretimde sınıf, fen bilgisi ve sosyal bilgiler öğretmeni olarak görev alabilecek adaylardan oluşturulmuştur.

Öğretmen adaylarının çevre yönelik daha bilinçli olması, çevre sorunlara karşı olumsuz düşüncelere sahip olup olmadığı, çevreye yönelik gönüllü davranışlara sahip olup olmaması, çevre eğitiminde tutumlu, duyarlı ve tasarruflu olup olmaması konusunda farklı tutumlara sahip oldukları görülmüştür. 330 öğretmen adayı arasında cinsiyet değişkeni açısından kızlar lehine anlamlı fark vardır. Yapılan çalışma kızların erkeklere göre daha çevreci bireyler olduğunu göstermektedir. Bayan öğretmen adaylarının duyarlılık seviyelerinin de yüksek olduğunu ortaya koymaktadır. Bu sebeple sürdürülebilir çevre oluşturabilmek için en başta elimizdeki kaynakları korumak; sürdürülebilir üretimi ve tüketimi amaç edinmemiz gerekmektedir. Cinsiyetin ekoloji ve çevre bilgileri ile çevreye yönelik tutumlara etkisi inceleyen Eroğlu Doğan, (2013)'a göre tutumun kızlar lehine olduğu belirlenmiştir. Teksöz vd. (2010)'ın yaptığı çalışmada da bayan öğretmen adaylarının çevre problemlerine daha fazla ilgi gösterdikleri görülmüştür. Aynı zamanda Özgen (2012)'de öğrencilerin çevre sorunlarına yönelik tutumlarına yönelik yaptığı araştırmasında kız öğrencilerin daha duyarlı olduğunu tespit etmiştir. Demirci-Güler, (2013)'in yaptığı çalışmada da akamdemik personeller arasında bayanların yüksek düzeyde olumlu tutum gösterdikleri görülmüştür. Çalışmalarda ki ortak sonuçlara bakıldığında genelde çevreye yönelik tutumun kızlar lehine olduğu , bunun da kızlara yüklenen toplumsal cinsiyet rolleri ile ilgili olabildiği düşünülmektir (Eroğlu Doğan, 2013). Kız çocuklarının erkek çocuklara oranla yetişme tarzları birbirinden farklılık göstermektedir. Kızların küçük yaştan itibaren genelde evde annelerine temizlik konusunda yardım etmeleri onların ileriki hayatlarında da çevre temizliği konusunda daha duyarlı hale gelmelerini sağlayabileceği düşünülmektedir. Bayan ve erkek arasında böyle bir farklılık oluşmasına rağmen üniversite de eğitim yapılırken asla bu göz önüne alınmamalı ve eşit düzeyde bilgi verilip, bütün bireylerin çevre eğitimi konusunda duyarlı vatandaşlar olarak yetişmesi sağlanmalıdır. Bu eğitimler de sürdürülebilir çevreye yönelik tutumu arttırarak bizlere daha iyi bir gelecek hazırlar.

Sınıf düzeyi değişkeni açısından, farklı programlarda öğrenim gören aday öğretmenlerin sürdürülebilir çevreye yönelik tutumlarına olan etkisini araştırmak amacıyla yapılan analiz sonuçları, sınıf düzeyleri arasında sürdürülebilir çevreye yönelik tutumlar açısından istatistiksel olarak anlamlı bir farklılık olmadığını göstermiştir. Yapılan ilişkisiz örneklemler için t testinde, sınıfların test puan ortalaması yine de yüksek çıkmıştır. Bu da 2 ve 3. sınıfların dönem olarak birbirlerine yakın olmasının sürdürülebilir çevre tutumlarında çok fark yaratmayacağını göstermektedir. Ancak sınıf düzeyleri birbirine daha uzak dönemler arasında karşılaştırma yapılırsa bazı anlamlı farklılıklar ortaya çıkabilir. Gürbüz, Çakmak ve Derman (2013)'nın yaptığı çalışmada 1 ve 5. sınıf öğretmen adaylarının sürdürülebilir çevre eğitimine yönelik gönüllülük alt boyutunda 5. sınıflar lehine anlamlı fark olduğu bulunmuş ve bunun da birinci sınıflara oranla daha bilinçli olmalarından kaynaklandığı görülmüştür.

Bölüm değişkeni açısından öğretmen adaylarının sürdürülebilir çevre tutumları karşılaştırıldığında fen bilgisi ve sınıf öğretmenliği öğretmen adaylarının sürdürülebilir çevre tutum ortalamaları, sosyal bilgiler öğretmen adaylarına göre anlamlı düzeyde daha yüksek bulunmuştur. Sınıf ve fen bilgisi öğretmen adaylarının puanları arasında istatistiksel olarak anlamlı fark bulunmamıştır. Sosyal Bilgiler Öğretmenliği programında öğrenim gören öğretmen adayları ikinci sınıfta “Türkiye Fiziki Coğrafyası”, üçüncü sınıfta “Türkiye Beşeri ve Ekonomik Coğrafyası” konusu yer alırken Fen Bilgisi Öğretmenliği programında ikinci sınıfta “Genel Biyoloji”, üçüncü sınıfta hava kirliliği, asit yağmurları, sera etkisi gibi günümüz çevre konularını içeren “Kimyada Özel Konular” ve “Çevre Bilimi” ile ilgili ders almaktadır. Buna karşın Sınıf Öğretmenliği programında birinci sınıfta “Genel Biyoloji”, ikinci sınıfta “Çevre Eğitimi” dersinde çevre konuları yer almaktadırlar. Her üç bölümünde yeterli sayıda ders almasına karşın sosyal bilgiler öğretmen adaylarının fen ve sınıf öğretmen adaylarına göre tutum ortalamalarının daha düşük olduğu görülmektedir. Bu da fen ve sınıf öğretmenliği derslerinin çevre konularıyla daha ilişkili olduğunu bize göstermektedir. Sosyal bilgiler öğretmenliğinin ders yoğunluğu tarih bilgisi üzerine olduğu için çevre konularında biraz daha düşük tutumlara sahip oldukları söylenebilir. Farklı programlarda öğrenim gören öğretmen adaylarının en başta ailelerine ardından kendi yetiştirecekleri öğrencilerine ve çevrelerine, sürdürülebilir çevreye yönelik olumlu tutumlar kazandırmalarında önemli roller ve görevler düşecektir (Eroğlu Doğan, 2013). Alkış (2008)'e göre sürdürülebilir kalkınma eğitiminin tüm eğitim kademelerinde disiplinler arası bir şekilde ele alınması son derece önem taşımaktadır [Aktaran: Kaya & Tomal (2011)].

ÖNERİLER

Sürdürülebilir çevreye yönelik tutumu arttırabilmek için; yükseköğretimde çevreye yönelik verilen derslerin arttırılması gerekmektedir. Sadece teorik bilgi vermek yerine, yaparak yaşayarak öğretim modeli kullanılmalı ve çevre eğitimi işlevsel hale getirilmeli, uygulama kısmı oluşturulmalı ve merak düzeylerini artırıcı etkinliklere yer verilmelidir. Öğretmen adayları çevre ile ilgili bilinçlendirilmelidir. Çevreye yönelik tutumu artırmak için doğal alanlara geziler ve yürüyüşler düzenlenmeli ve öğretmen adaylarının bu etkinliklere düzenli olarak katılmaları teşvik edilmelidir. Öğretmen adayları ile görüşme ve mülakat üzerine kurulu bir çalışma yapılabilir. Son dönemlerin en gözde konularında olan "Okul dışı öğrenme" kapsamında sürdürülebilir çevre eğitimi, doğada verilmelidir. Verilen eğitimler ve uygulamalar sadece yükseköğretim bazında kalmamalı ve öncelikle geleceğimizi emanet edeceğimiz çocuklardan başlamalıdır. Bu sebeple ilköğretim bazında uygulama içerikli etkinliklerle sürdürülebilir çevre bilinci aşılanabilir. İlköğretimden itibaren müfredatta daha çok çevre üzerinde durulabilir. Eğitim kurumlarının sürdürülebilir kalkınma felsefesini programlarına yansıtması, öğrencilerde küçük yaştan itibaren bu bilincin oluşmasında katkı sağlamakla beraber, çözüm yollarının üretilmesinde ve uygulanmasında da büyük bir bilinç oluşturur (Yapıcı, 2003). Öğretmen adaylarının çoklu zekâ türlerine göre ayrılıp özellikle doğa zekâsına sahip olanlar belirlenebilir ve çeşitli etkinlikler yapılabilir. Çünkü doğa zekâsına sahip olanlar doğa olaylarına çok meraklıdır, bitki yetiştirmeyi çok sever ve çevreye karşı duyarlıdır.

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DETERMINATION OF THE DIFFERENCES BETWEEN PRESERVICE TEACHERS' AND PEDAGOGICAL FORMATION STUDENTS' SELF EFFICACY AND PERSPECTIVES TO TEACHING PROFESSION

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ABSTRACT: The purpose of this study is to find self efficacy and teaching profession perspectives of preservice teachers' and pedagogical formation students' based on various variables. In this study it was examined that whether preservice teachers' and students' from different disciplines efficacy change in terms of their disciplines. In addition, it was also searched whether their perspective on teaching show any changes in terms of their disciplines.

The data was collected from two different universities in spring semester of 2015-2016 academic year in Turkey. Preservice teachers in four year teacher prepation programme and students graduated from different disciplines and attended in one year pedagogical formation programmes in educational faculty were attended in this study.

Data related to self efficacy was collected through Teachers' Sense of Efficacy Scale developed by Çapa, Çakıroğlu and Sarıkaya (2005). Data related to teaching profession of preservice teachers and students from different disciplines was collected by openended questions. While open ended questions were analysed by using qualitative analysis method including content analysis, responses gathered from the scale was analysed by using quantitative analysis. Statistically analysis of the data including descriptive statistics and t test for independent groups was carried out by means of SPSS 17.00 program.

The findings show that preservice teachers and formation students' self-efficacy beliefs changed only one subdimension of the scale. Also participants teaching professions are paralel to each other but in some professions it changes.

Keywords: Teaching profession, self efficacy, preservice teachers, pedagogical formation students

ÖĞRETMEN ADAYLARININ VE PEDAGOJİK FORMASYON ÖĞRENCİLERİNİN ÖZYETERLİKLERİ VE ÖĞRETMENLİK MESLEĞİ İLE İLGİLİ GÖRÜŞLERİNİN BELİRLENMESİ

ÖZET: Bu çalışmanın amacı öğretmen adaylarıyla pedagojik formasyon öğrencilerinin özyeterlikleri ve öğretmenlik mesleğine ilişkin görüşlerini çeşitli değişkenler bakımından incelemektir. Çalışmada farklı disiplinlerden gelen öğretmen adaylarının özyeterliklerinin ve öğretmenliğe ilişkin görüşlerinin bu disiplinler doğrultusunda değişiklik gösterip göstermediği araştırılmıştır. Araştırma verileri 2015-16 akademik yıl güz döneminde iki farklı üniversitede toplanmıştır. Araştırmaya farklı disiplinlerden eğitim fakültesi 4. Sınıf öğrencileri ve formasyon öğrencileri katılmıştır.

Araştırmada veri toplamak amacıyla Çapa, Çakıroğlu ve Sarıkaya (2005) tarafından uyarlanmış olan "Öğretmen Özyeterlik Ölçeği" kullanılmıştır. Ayrıca Eğitim Fakültesi son sınıf öğretmen adayları ve pedagojik formasyon öğrencilerinin öğretmenlik mesleğine yönelik görüşlerini belirlemek üzere açık uçlu sorular sorulmuştur. Açık uçlu soruların analizinde nitel veri analizi tekniklerinden içerik analizinden yararlanılmıştır. Nicel verilerin analizinde SPSS17 analiz programı kullanılmıştır.

Araştırma sonucunda son sınıf öğretmen adaylarının özyeterliklerinin formasyon öğrencilerine göre ölçeğin sadece bir alt boyutunda farklılaştığı ve öğretmenlik mesleğine ilişkin görüşlerinin de genel olarak birbirine paralel olduğu ancak bazı mesleki boyutlarda farklılar olduğu tespit edilmiştir.

Anahtar sözcükler: Öğretmenliğe ilişkin görüşler, özyeterlik, öğretmen adayı, pedagojik formasyon öğrencileri,

GİRİŞ

Öğretmenlik mesleği, toplumumuzu şekillendirecek olan bilgi, beceri, tutum ve değerlerin gelecek nesillere kazandırılması açısından önemlidir. Bu bağlamda, eğitim ve öğretim yolu ile gelecek nesillerin yetişmesinde rol alarak ülkenin kalkınmasında, nitelikli insan gücünün yetişmesinde, kültür ve değerlerin kuşaklar arasında aktarılmasında (Eskicumalı, 2004) önemli bir göreve sahip olan öğretmenlerin, sorumluluklarının farkında olarak öğretmenlik mesleğini tercih etmeleri önemlidir.

Eğitim kalitesini belirleyen en önemli etkenlerden birisi, öğrenme ortamının kalitesini de belirleyen öğretmen kalitesidir (Hattie, 2000; Marzano, 2003). Araştırmacılar öğretmen kalitesinin sağlanması için gerekli bilgiler konusunda görüş birliğindedir. Bunlar; alan bilgisi, pedagojik bilgi, pedagojik içerik bilgisi olarak belirlenmiştir (Schulman, 1987; van Driel, Verloop, de Vos, 1998). Öğretmen kalitesini belirlemek için farklı ülkelerde yapılan bir çalışmada ise öğretmen kalitesinin farklı yeterlilikler ile ilişkilendirildiği ve etkili öğretim, okul içinde ve dışında birlikte çalışma, yansıma ve kişisel gelişim olmak üzere genel olarak üç özelliğin vurgulandığı tespit edilmiştir (Snoek ve diğ., 2009)

Öğretmen kalitesini belirlemek için sıkça kullanılan ifadelerden birisi "iyi bir öğretmen" dir. İyi bir öğretmen olma özellikleri eğitim reformlarında ele alınan önemli konular arasında her zaman yerini almıştır. Bu ifadenin içeriği ile ilgili uluslararası düzeyde genel bir görüş birliğine varılamamış olsa da (Waldrip, Fisher, 2005) iyi bir öğretmenin sahip olması gereken niteliklerin belirlenmesi ile ilgili yapılan çalışmalarda sahip olunması gereken özellikler şu şekilde belirlenmiştir (Manchanda, 2010; Orlando, 2003; Parkay, Stanford, Vaillaniant, Stephens & Harris, 2012)

Öğrencilere saygı duyma-Öğrencilerle ilgilenme	Profesyonel organizasyon
Öğrenmeyi sevme	Etik kurallar
Alanda uzmanlık-Bilgi	Özerklik-Otonomi
Öğrencilerle iletişim kurma becerileri	Sürekli eğitim
Sorumluluk	Topluma hizmet
	Prestij-Statu

Araştırmacılar belirtilen özelliklerin öğrencilerin derse dahil edilmesi için önemli olduğunu vurgulamaktadırlar (Manchanda 2010). Belirlenen bu özellikler genel olarak akademik, etik ve sistemik olmak üzere üç boyut altında toplanmıştır (Maskit, 2013). Akademik boyutta uzmanlık eğitimi temel gerekliliktir. Bu da öğretmen olunması için alınması gereken eğitimi ve öğretmenlik sürecinde devam eden eğitimi kapsar. Program bilgisini, sınıf yönetimini, öğretim materyalleri bilgisini ve öğrenci özelliklerini anlama bu boyuta dahil olan konular arasında sayılmaktadır (Parkay ve diğ., 2012). Son dönemlerde yapılan araştırmalar küresel konuları (yoksulluk, çevre gibi) içeren küresel bilginin de bu niteliklere eklenebileceğini göstermektedir (Holden & Hicks, 2007). Etik boyut, öğretmen sorumluluğudur. Öğrencilerin öğrenmesinden, bilgi ve beceri ve akademik başarının artırılmasından sorumlu olmayı kapsar (Sahlberg, 2007). Organizasyonel boyut, öğretmenlerin içerikle ilgili konu seçiminde, programda ve tercih edilen konularda karar vermede özerkliği ifade eder (Maskit, 2016).
Öğretmenin kişiliği ile ilgili özellikler de iyi bir öğretmenin sahip olması gereken özellikler arasında sayılmaktadır (Benekas, 2016; Leblanc, 1998). Buna göre;

Etkili bir dinleyici olan ve soruları yanıtlayan
Arkadaşça bir yaklaşıma sahip olan
Esprili
Öğrencilerin öğrenmesini benimseyen
Tutkulu
Alçakgönüllü
İlham veren
Enerjik
Sevecen

özelliklerine sahip olan öğretmenler eğlenceli, keyifli öğretmenleri işaret etmektedir (Leblanc, 1998).

Öğretmenlerin kişisel özellikleri öğretmeye olan davranışlarını, tutumlarını da etkilemektedir. Bandura'ya göre (1986) kişinin kendi yeteneklerine olan inancı ve gösterdiği çaba, ne yaptığının ve nasıl davrandığının iyi bir belirleyicisidir. Kişinin özyeterliği, davranışının belirleyicisi olarak vurgulanabilir. Bir başka ifade ile bir kişinin özyeterliği bir işte gösterdiği performansını etkileyebilir (Brandon, 2000). Özyeterlik, istenilen sonuca ulaşmak için bir eylemi başarılı bir şekilde sürdürebilme yeteneğine olan inançtır (Bandura, 1986). Tschannen-Moran, ve arkadaşları (1998) ise öğretmen yeterliğini, öğretim yeterliğine olan algı ve öğretim içeriği ile ilgili inanç olarak ele almışlardır.

Özyeterliğin en fazla odaklandığı konulardan birisi de öğretimdir (Brandon, 2000). Öğretimde özyeterlik, öğretmenlerin, öğrencilerinin performanslarını etkileme kapasitelerine olan inançlarıdır ve bu inancın öğrencilerin performansları üzerine güçlü bir olumlu etkisi vardır (Tschannen-Moran, Hoy, Hoy, 1998; Greenwood ve diğ., 1990). Öğretmen yeterliği, bir dersi planlama ve belirli bir konunun öğretimini başarılı bir şekilde tamamlama yeteneğine olan inanç ya da öğretme yeteneği ve bu konuda kendilerine olan güven olarak da ifade edilmektedir (Carleton ve diğ., 2008; Tschannen-Moran, ve diğ., 1998).

Yüksek özyeterlik düzeyine sahip olan öğretmenler öğrenci başarısını ve motivasyonunu kontrol edebileceklerine inanırlar, öğretimi anlamlı ve faydalı bulurlar, öğrenci başarısız olduğunda kendilerini değerlendirirler, hedefler belirler ve onlara ulaşmak için stratejiler oluştururlar, yeni öğretim yöntem ve tekniklerini kullanmaya daha isteklidirler. Bununla birlikte, kendilerine ve öğrencilerine karşı olumlu tutuma sahiptirler, daha az tükenmişlik eğilimi gösterirler (Ashton, 1984, Brandon, 2000; Brouwers ve Tomic, 2000; Guskey, 1988)

Ülkemizde öğretmenlerin niteliği ve kalitesi MEB tarafından oluşturulan Öğretmenlik Mesleği Genel Kriterleri'ne göre belirlenmektedir. Bu bağlamda 6 yeterlik, 31 alt yeterlik ve 233 performans göstergesi oluşturulmuştur. Yeterlik alanları şu şekilde belirlenmiştir (MEB, 2006):

A.Kişisel ve Mesleki Değerler- Kişisel Gelişim
B.Öğrenciyi Tanıma
C.Öğrenme ve Öğretme Süreci
D.Öğrenmeyi, Gelişimi İzleme ve Değerlendirme
E.Okul-Aile-Toplum İlişkileri
F.Program ve İçerik Bilgisi

Mesleki yeterliklerin geliştirme ve uygulama sürecinde öğretmenlik mesleğinin yükseltilmesi amaçlanmakta, belirlenen yeterliklerin bilinmesinin yanı sıra, hizmet öncesi ve hizmet içi eğitim programlarıyla bu yeterliklerin öğretmen adaylarına ve öğretmenlere kazandırılmasına çalışılmaktadır. Ayrıca MEB ve üniversiteler arasında gerçekleştirilen işbirliği ile öğretmen yeterlikleri sorgulanmakta ve geliştirilmesine yönelik çalışmalar yapılmaktadır. Bu çalışmalardan birisi 2006-2007 yılında öğretmen yetiştirme programlarına yönelik olarak gerçekleştirilmiştir. Buna göre, alanlara göre farklılaşacak şekilde programların %50'si alan bilgisi, %30'u öğretmenlik meslek bilgisi ve becerileri (eğitim bilimleri, alan öğretim yöntemleri ve öğretim yöntem ve teknikleri), %20'si genel kültür derslerinden oluşmuştur. Bu boyutlara ek olarak uygulama boyutu da dahil edilmiştir (www.yok.gov.tr).

Ülkemizde öğretmen eğitimi üniversitelerde yürütülmekte, öğretmen yetiştirme programları tüm Eğitim Fakülteleri için benzer şekilde hazırlanmakla birlikte %25 esneklik sağlanmaktadır. Öğretmen yetiştirme programları üç aşamadan oluşmaktadır. İlk aşama programa dahil olan adayların belirli bir süre içinde ve belirli bir program çerçevesinde yetiştirilmeleridir. İkinci aşama, programı bitiren adayların görevlendirilmek üzere seçilmeleri, son aşama ise görevdeki öğretmenlerin hizmet içi eğitime alınmalarıdır (YÖK, 2007).

Eğitim fakültelerinde öğretmen yetiştirme amaçlı uygulanan bir diğer program Pedagojik Formasyon Programı'dır. Bu programın açılması ile ilgili öğretmen istihdamı-öğretmen yetiştirme ya da programın uygulanması gibi tartışmalar yaşansa da program, çeşitli alanlardaki öğretmen ihtiyacını karşılamak üzere düzenlenmektedir. Pedagojik Formasyon Eğitimi Sertifika Programı yükseköğretim programlarına devam eden lisans programı öğrencilerini ve mezunlarını kapsamakta olup, eğitim süresi en az iki yarıyıl olarak belirlenmiştir. Programın amacı, belirlenen öğrenci grubuna öğretmenlik mesleğine yönelik becerilerin kazandırılmasıdır. Bu programda, öğretmenlik meslek bilgisi derslerinin yanı sıra alan eğitimi ve öğretimine (Özel öğretim yöntemleri, Öğretim teknolojileri ve materyal geliştirme, öğretmenlik uygulaması) özgü dersler verilmektedir.

Öğretmenlik mesleğinin önemi ve sahip olunması gereken nitelikler göz önünde bulundurulduğunda, eğitim fakültelerinde öğrenim gören öğretmen adaylarının ve öğretmen olmak amacıyla formasyon programına katılan öğrencilerin öğretmenlik mesleğine bakış açılarının ve özyeterliklerinin tespit edilmesinin önemi ortaya çıkmaktadır.

YÖNTEM

Araştırmaya 2015-2016 eğitim öğretim yılında iki üniversitenin Eğitim Fakültesi'nde gerçekleştirilmiştir. Çalışmaya Eğitim Fakültesi'nde dört yıl süresince öğrenim gören son sınıf öğretmen adayları ve farklı fakültelerin farklı bölümlerinden mezun olmuş ve Eğitim Fakültesi'nde pedagojik formasyon programında öğrenim gören 215 öğrenci katılmıştır.

Araştırmada veri toplamak amacı ile Çapa, Çakıroğlu ve Sarıkaya (2005) tarafından Tschannen-Moran ve Wool folk Hoy(2001)'dan uyarlanmış olan "Öğretmen Özyeterlik Ölçeği" kullanılmıştır. Ayrıca Eğitim Fakültesi son sınıf öğretmen adayları ve pedagojik formasyon öğrencilerinin öğretmenlik mesleğine yönelik görüşlerini belirlemek üzere açık uçlu sorular sorulmuştur. Açık uçlu soruların analizinde nitel veri analizi tekniklerinden içerik analizinden yararlanılmıştır. İçerik analizinde uygulanırken literatürde yer alan çalışmalarda elde edilmiş olan temalar dikkate alınmış, uygun olmayan kodlar için yeni temalar oluşturulmuştur.

Ölçek uygulamasından elde edilen verilerin analizi için nicel veri analizinden yararlanılmıştır. Bu amaçla SPSS 17 istatistik programı kullanılmıştır. Öğretmen özyeterlik ölçeğinden elde edilen Cronbach alpha değerleri Tablo 1'de verilmiştir.

Tablo.1. Öğretmen Özyeterlik Ölçeği Cronbach Alpha Değerleri

Ölçekler	Cronbach α
Özyeterlik	,93
Öğrenci Katılımı	,83
Öğretim Stratejisi	,85
Sınıf Yönetimi	,82

BULGULAR

Tablo 2. Özyeterlik Puanları Dağılımın Normalliğini Denetlemek Amacı ile Yapılan Bir Örneklem Kolmogorov-Smirnov Testi Sonuçları

Değerler		Özyeterlik Ölçeği	Öğrenci Katılımı	Öğretim Stratejisi	Sınıf Yönetimi
N		215	215	215	215
Normal Parametreler	$\bar{x}$	94,82	31,47	31,84	31,50
	ss	11,78	4,16	4,31	4,25
Kolmogorov-Smirnov Z		1,53	1,72	1,62	1,80
p		,01*	,00*	,01*	,00*

Özyeterlik ölçeği ve alt boyutlarından elde edilen puanların normal dağılım gösterip göstermediğini belirlemek amacı ile yapılan tek örneklem Kolmogorov-Smirnov testi sonucunda ölçeğin tamamından ve alt boyutlarından elde edilen verilerin dağılımlarının normal dağılımdan farklılığı anlamlı bulunmuştur.

Tablo 3. Özyeterlik Ölçeği Puanlarının Program Değişkenine Göre Farklılaşıp Farklılaşmadığını Belirlemek Üzere Yapılan Mann Whitney-U Testi Sonuçları

Puan	Gruplar	N	$\bar{x}_{sira}$	$\sum_{sira}$	U	z	p
Özyeterlik	Öğretmen adayları	73	115,62	8440	4627	-1,28	,19
	Formasyon	142	104,08	14780			
	Toplam	215					
Öğrenci Katılımı	Öğretmen adayları	73	120,22	8776	4291	-2,07	,03*
	Formasyon	142	101,72	14444			
	Toplam	215					
Öğretim Stratejisi	Öğretmen adayları	73	111,87	8166	4900	-,65	,51
	Formasyon	142	106,01	15053,5			
	Toplam	215					
Sınıf Yönetimi	Öğretmen adayları	73	110,84	8091,5	4975	-,48	,62
	Formasyon	142	106,54	15128,5			
	Toplam	215					

Öğrencilerin Özyeterlik ölçeği ve alt boyutlarından almış oldukları puanların program değişkenine göre anlamlı bir şekilde farklılaşıp farklılaşmadığını belirlemek üzere yapılan non parametrik Mann Whitney-U testi sonucunda öğrenci katılımı alt boyutunda gruplar arasında lisans öğrencileri lehine istatistiksel açıdan p<,05 düzeyinde anlamlı bir farklılık saptanmıştır (p:,03).

Tablo 4. Öğretmenlik Mesleğini Seçme Nedeni

	Gerekçe	Öğretmen adayları	Formasyon
Özgeci gerekçeler (Altruistic)	Ülkeye hizmet etme isteği	1	-
	Topluma faydalı olma isteği	6	12*
	İnsanlara hizmet etme isteği	7	4
	Kutsal bir meslek olması	3	8
	Toplam	**17**	**24**
İçsel gerekçeler (intrinsic)	Mesleği sevmek ve ilgi duymak	31	36
	İnsanları-çocukları sevmek	24	9
	Kişisel özelliklerin etkisi	9	17
	Cinsiyet etkisi	5	-
	Duygusal etkenler	5	26
	Sosyalleşme	2	-
	Yaşam boyu eğitim-bireysel gelişime katkı	-	8
	Toplam	**76**	**88**
Dışsal nedenler (extrinsic)	Çevrenin etkisi	10	-
	Bölüm puanının etkisi	4	-
	Bölüme istemeyerek gelme	9	-
	Toplam	**23**	**-**
Çıkarcı gerekçeler	Zaman etkisi	2	12
	Ekonomik etkisi	3	2
	Çalışma koşulları etkisi	1	29
	İş bulma kolaylığı	-	3
	Toplam	**6**	**59**

Tablo 4'de araştırmaya katılan katılımcıların öğretmenlik mesleğini seçme nedenleri verilmiştir. Tabloya (4) göre her iki grup katılımcıların öğretmenlik mesleğini seçme nedenleri en fazla içsel gerekçelerde yer aldığı görülmektedir. İçsel gerekçeler içinde her iki grup katılımcıları da mesleği sevmeyi ve ilgi duymayı gerekçe en fazla sıklıkta belirtmişlerdir. İçsel gerekçeler içinde, öğretmen adayları, insanları sevmeyi, formasyon grubu da duygusal etkenleri ikincil gerekçe olarak ifade etmiştir. Katılımcılar tarafından ikinci olarak en fazla değinilen gerekçe lisans grubunda dışsal gerekçeler iken, formasyon grubunda çıkarcı gerekçeler olarak tespit edilmiştir. Özgeci gerekçeler her iki grup tarafından üçüncü olarak vurgulanmıştır.

Tablo 5. İyi Öğretmenin Sahip Olması Gereken Özellikler

	Özellikler	Öğretmen adayları	Formasyon
Alan Bilgisi	Bilgili	**15**	**57**
Öğrenme-Öğretme Süreci	Davranış yönetimi	10	12
	Zaman yönetimi	2	-
	Sınıf yönetimi	4	7
	Dersi planlama-Öğretme süreci-Öğretimi çeşitlendirme	17	34
	Toplam	**48**	**110**
Kişisel ve Mesleki Gelişim	Öğrencilerle iletişim kurma	11	35
	Öğrencilere değer verme, anlama, saygı gösterme	30	39
	Kişisel gelişimi sağlama	45	122
	Mesleki gelişmeleri izleme ve katkı sağlama	3	-
	Toplam	**89**	**196**
Öğrenciyi Tanıma	Öğrenciye rehberlik etmek, değer verme	**14**	**42**
Kişisel Özellikler		**80**	**112**
Diğer		**4**	**-**

Araştırmaya katılan lisans ve formasyon grubundan elde edilen iyi öğretmenin niteliklerine ilişkin yanıtlar Alan Bilgisi, Öğrenme-Öğretme Süreci, Kişisel ve Mesleki Gelişim, Öğrenciyi Tanıma, kişisel özellikler olmak üzere 5 temada toplanmıştır. Bu temalara Milli Eğitim Bakanlığının öğretmen yeterliklerine ilişkin belirttiği ana noktalardan hareketle oluşturulmuştur. Tabloya göre her iki grupta da frekansı en yüksek olan özellikler kişisel ve mesleki gelişim ile ilgilidir. Kişisel ve mesleki gelişim boyutunda her iki gruptaki katılımcılar sıklıkla kişisel gelişim sağlama özelliğini belirtmişlerdir. Kişisel özellikler Öğretmen adayları ve formasyon grubu öğrencilerinin ikinci, öğrenme-öğretme süreci üçüncü, alan bilgisi de son olarak sıklıkla vurguladıkları özellikler olmuştur.

Tablo 6. Öğretmenlik Mesleğinde Fark Yaratma

		Öğretmen adayları	Formasyon
Evet		**4**	**14**
Kodlanamayan		**1**	
Öğrenme-Öğretme Süreci	Dersi planlama-Öğretimi çeşitlendirme	21	30
	Öğrenme ortamını düzenleme	8	9
	Materyal hazırlama	1	-
	Sınıf yönetimi	2	2
	Davranış yönetimi	7	-
	Başarı sağlamak	4	-
	Okulu ve dersleri, bilimi sevdirme	4	-
	Ödüllendirme	1	-
	Toplam	**48**	**41**
Öğrencilere Olan İnanç	Öğrencilere değer verme, anlama, saygı gösterme	12	34
	Öğrencilerin öğrenebileceğine, başaracağına inanma	5	-
	Kişisel gelişimi sağlama	5	21
	Toplam	**22**	**55**
Öğrenciyi Tanıma	Öğrenciye rehberlik etmek	3	-
	Öğrencilere kazandırılacak beceriler ve özellikler	21	31
	Toplam	**24**	**31**
Öğretmenin Kişisel Özellikleri		**20**	**46**

Tablo 6'da katılımcıların öğretmen olduklarında öğrenciler üzerinde farklılık yaratıp yaratmayacakları ile ilgili görüşleri yer almaktadır. Tabloya göre öğretmen adayları en fazla öğrenme-öğretme süreci ile, formasyon grubu öğrencileri ise en fazla öğrencilerine olan inan konusunda farklılık yaratacaklarını belirtmişlerdir. İkinci olarak lisans grubu öğrencileri öğrenciyi tanıma, formasyon grubu öğrencileri ise kişisel özellikleri konusunda farklılık yaratacaklardır. Öğrencilere olan inanç lisans grubunun, öğrenme-öğretme süreci de formasyon grubunun üçüncü olarak vurguladıkları özelliklerdir. Öğretmenin kişisel özellikleri öğretmen adalarının, öğrenciyi tanıma da formasyon grubunun dördüncü olarak vurguladıkları özelliklerdir. Öğretmen adaylarından 4, formasyon grubundan 14 farklılık yaratabileceği özelliği belirtmeyerek sadece evet yanıtını vermişlerdir.

TARTIŞMA

Araştırmacılar, öğretmen özyeterlik düzeyleri yüksek olan öğretmenlerin öğretmeye daha fazla olumlu tutuma sahip olduklarını vurgulamaktadır (Carleton ve diğ., 2008; Guskey, 1988). Bu araştırmadan elde edilen sonuçlar öğretmen adaylarının öğretmen özyeterlik düzeylerinin formasyon öğrencilerinin özyeterliklerinden yüksek olduğunu ancak aralarında istatistiksel açıdan anlamlı farklılık olmadığını göstermektedir. Bezer şekilde, öğretmen adaylarının öğretim stratejileri ve sınıf yönetimi konularında sahip oldukları özyeterlikleri formasyon öğrencilerinin sahip olduğu düzeyden yüksek olmakla birlikte gruplar arasında anlamlı farklılık tespit edilmemiştir. Buna karşılık, öğrenci katılımına yönelik özyeterlik açısından öğretmen adaylarının lehine anlamlı farklılık olduğu belirlenmiştir. Bu sonuca göre, öğretmen adaylarının, öğrenciyi derse dahil etme, motive etme, başarılı olacakları konusunda destekleme gibi konularda özyeterlik düzeylerinin yüksek olduğu anlaşılmaktadır. Araştırmaya katılan öğretmen adaylarının birinci açık uçlu sorulara verdikleri yanıtlara incelendiğinde literatürle eşleşen kodlara ulaşıldığı görülmüştür. Buna göre, öğretmen adaylarının ve formasyon öğrencilerinin öğretmenlik mesleğini seçme nedenleri incelendiğinde, katılımcıların öğretmenlik mesleğini tercih etme nedenlerini özgeci, içsel, dışsal ve çıkarcı gerekçelere dayandırdıkları görülmektedir. Bu nedenler arasında her iki grup tarafından da en sık vurgulanan neden "içsel gerekçeler" olmuştur. Ortaöğretim öğretmen adaylarının öğretmenliği tercih etme nedenlerinin incelendiği bir araştırmada katılımcıların içsel ve dışsal nedenlerden ötürü öğretmen olmayı tercih ettikleri belirlenmiştir. İçsel nedenler arasında öğretmeyi sevme, alanı sevme, dışsal nedenler arasında ise Kimya ve Matematik öğretmenini sevme gibi nedenleri belirlenmiş, bunların yanı sıra meslek tatmini, topluma katkısı ve sınav sisteminden kaynaklanan zorunluluk belirlenmiştir (Boz ve Boz, 2008). Mevcut çalışmada ise içsel gerekçeler altında, öğretmen adayları “mesleği sevmek” ve insanları sevmek” nedenlerini en fazla sıklıkta belirtirken, formasyon öğrencileri, “mesleği sevmek”, “duygusal etkenler” ve “kişisel özellikler” etkisini sıklıkla vurgulamışlardır. Bu durumda, formasyon grubundaki öğrencilerin iş yaşamlarında da insanlarla yakın iletişime dayalı çalışmaları nedeniyle öğretmenlik mesleğini seçme nedenlerine ilişkin içsel gerekçelerinde kişisel özelliklerinin öğretmenliğe uygun olduğu ve insanlarla çalışma konusunda sorun yaşamayacaklarını düşünmekte oldukları sonucu çıkarılabilir.

Formasyon grubu öğrencilerin “duygusal etkenler”e dayalı nedenleri altında ise öğretmenlik mesleğinin çocukluk hayalleri olması da göze çarpmaktadır. Bu durum lisans öğrencilerine ilişkin gerekçelerde daha az sıklıkla karşımıza çıkmaktadır.

“Çıkarcı gerekçe” formasyon grubu öğrencileri tarafından, “dışsal gerekçeler” ise öğretmen adayları tarafından öğretmenlik mesleğini seçme nedeni olarak ikinci sırada vurgulanmıştır. Formasyon gurubunun çıkarcı gerekçe ile öğretmenlik mesleğini seçmelerinin nedenleri arasında göze çarpan nokta, çalışma saatlerindeki belirginlik ve çalışma koşullarının sağlık sektörüne göre daha rahat olmasıdır. Mesleğin iş garantisi sağlaması öğretmenlik mesleğinin tercih nedenler arasındadır (Eskicumalı, 2002; Gürbüz ve Sülün, 2004). Fen Bilgisi Öğretmenliği programında öğrenim gören öğretmen adaylarının katıldığı bir çalışmada katılımcıların çıkarcı ve içsel nedenlerden dolayı bu mesleği tercih ettikleri bulunmuştur. Katılımcıların, geleceğe yönelik güvence sağlaması gibi mesleğin sağlayacağı faydaları göz önünde bulundurarak tercih anlaşılmaktadır (Candaş, Bebek, 2015). Yapılan çalışmalar çıkarcı ve dışsal nedenlerin aksine, özveriye dayalı ve içsel nedenlerle öğretmenlik mesleğini tercih edenlerin yaptıkları işte daha istekli olduklarını ve mesleği daha uzun süre sürdürdüklerini göstermektedir (Wang, Fwu, 2001). Bu nedenle öğretmenlerin daha çok içsel ve özveriye dayalı nedenlerle mesleği tercih etmeleri mesleğe karşı olumlu yaklaşabilmeleri için önemlidir (Boz ve Boz, 2008).

Formasyon grubu öğrencileri “dışsal gerekçeler” grubuna girecek herhangi bir neden belirtmemiştir. Öğretmen adayları ise çevrelerinde öğretmenlik mesleğini yapanların etkisiyle ya da istemeyerek bölümü tercih ettiklerini belirtmişlerdir. Bu bulgu yapılan çalışmalarla da paralellik göstermektedir. Bireyin öğretmen bir akrabasının olması, çevrenin etkisi ve üniversite sınavında tercih sırası olması dışsal gerekçeler olarak nitelendirilmiştir (Kılcan, Keçe, Çepni, Kılınç, 2014; Özbek, 2007).

“Özgeci gerekçeler” de her iki katılımcı grubu tarafından üçüncü sırada vurgulanmıştır. Her iki öğrenci grubu da topluma faydalı olma ve insanlara hizmet etme, kutsal bir meslek olması gerekçeleri ile öğretmenlik mesleğini tercih ettiklerini belirtmişlerdir. Yapılan çalışmalarda da toplumun gelişmesine ve refahına katkı sağlama isteği bu mesleği tercih etme nedenleri arasında sayılmaktadır. Bu durum öğrencilerin toplumun gelişmesine yönelik gösterdikleri hassasiyet olarak ifade edilmiştir (Kılcan ve diğ., 2014). Araştırmaya katılan öğretmen adaylarının yanıtları incelendiğinde lisans ve formasyon öğrencileri arasında bazı noktalarda görüş farklılıkları olduğu görülmüştür. Bunun nedenleri arasında formasyon gurubu öğrencilerinin tamamına yakınının çalışıyor olması ve özelde de sağlık sektöründe çalışıyor olmasına bağlanabilir.

Araştırmaya katılan öğretmen adayları ve formasyon grubu öğrencilerinin yanıtları doğrultusunda, “iyi bir öğretmenin sahip olması gereken özellikler” arasında kişisel ve mesleki gelişim, kişisel özellikler ve öğrenme-öğretme süreci temaları konusuna daha fazla odaklandıkları görülmektedir. Kişisel ve mesleki gelişimi sağlama teması araştırmaya katılan lisans grubu öğrencileri tarafından en fazla sıklıkla kod belirtilen temalardandır. Kişisel ve mesleki gelişimi sağlamada “kişisel gelişim” ve “öğrenciye değer verme, anlama, saygı duyma” önemli özellikler olarak belirtilmiştir. Bu tema altında öğretmenlerin öğrencilerine karşı hoşgörülü, anlayışlı olmaları, onları anlama, saygı duyma, onlarla iletişim kurabilmeleri gibi özellikler belirtilmiştir. Kişisel gelişimi sağlamada ise öğretmenlerin donanımlı, yenilikçi, yaratıcı, girişken, teknolojiyi kullanma becerisi gibi niteliklere sahip olması gerektiği belirtilmiştir.

Kişisel özellikler teması altında öğretmen adayları, bir öğretmenin sahip olması gereken kişilik özelliklerinden bahsetmişlerdir. Bu tema içerisinde en fazla oranda bir öğretmenin duyarlı, sabırlı, özgüvenli, ahlaklı olması ve insanları-çocukları seven, insani değerleri yüksek bir kişi olması belirtilmiştir. Formasyon öğrencileri ile öğretmen adaylarının fikirleri en fazla oranda sabır konusunda farklılık göstermektedir. Formasyon öğrencilerinin çoğunluğu öğretmenlerin sabırlı olması gerektiği konusunda görüş bildirmiştir.

Araştırmaya katılan formasyon grubu öğrencileri için iyi öğretmenin sahip olması gereken nitelikler içerisinde alan bilgisi, öğretmen adaylarına göre daha önemli bir nokta olarak görülmektedir. Bunun nedeni formasyon gurubunun çoğunluğunun sağlıkçı olmasından kaynaklanabilmektedir. Çünkü sağlıkçı olan bu gurup yeni sağlıkçıların yetiştirilmesi konusunda çalışacaklardır ve bu nedenle alan bilgisi onlar için özellikle önem taşımaktadır. Bazı öğretmen adayları yanıtları içerisinde bundan özellikle bahsetmiş ve staja gelen hemşire adayları ile olan deneyimlerinden de yola çıkarak alana ilişkin bilgilerinin önemini belirtmişlerdir.

Öğrenme-öğretme sürecine ilişkin olarak, öğretmen adayları çağdaş görüşler çerçevesinde görüşler belirtmişler ve özellikle yöntem tekniklerin kullanılması konusunun öneminden bahsetmişlerdir. Bu sonuç öğretmen adaylarının öğretim stratejilerine yönelik özyeterliklerinin formasyon öğrencilerinden yüksek olması sonucu ile de desteklenmektedir. Öğretmen adaylarının görüşleri sınıf yönetimi konusunda farklılaşmaktadır. Formasyon öğrencileri yaşları fark etmeksizin sınıf yönetimi konusunda otoriter tutum sergilenmesi gerektiğini söylemişlerdir. Bu durum genel olarak çağdaş öğretim konusunda fikir beyan etmeleri ile çelişmektedir, Öğrencilere rehberlik edebilmeye yönelik olarak da öğretmen adayları öğrencileri tanımaya yönelik fikir beyan etmişlerdir.

İyi bir öğretmenin hangi özelliklere sahip olmasına yönelik elde edilen sonuçlar, yapılan çalışmaların sonuçları ile de paralellik göstermektedir. İyi bir öğretmeni tanımlamak amacı ile yapılan çalışmalardan birisinde çeşitli fakülteleri öğretim üyeleri dahil olmuş ve iyi bir öğretmeni tanımlayan on altı özellik tespit edilmiştir. Belirlenen özellikler arasında en sık vurgulanan özellik "öğretmeye ve alana olan tutku" olmuştur. "Öğrencilerin ilgisini çekme ve öğrenen olma" ise en sık vurgulanan ikincil özellikler olarak ifade edilmiştir. Aynı çalışmada "iyi öğretmen kimdir" sorusuna yönelik katılımcıların çoğunun (%63) kişisel özellikleri yansıtan yanıtlar verirken, çok azının da pedagojik becerilerle ilgili (organizasyon, pedagojik beceriler, bilgili olma, öğrenen olma) yanıtlar verdiği tespit edilmiştir (Benekas, 2016).

Araştırmaya katılan öğretmen adayları büyük çoğunluğu öğretmen olduklarında öğrencileri üzerinde farklılık yaratabileceklerini düşünmektedirler. Bu farklılığı nasıl yaratabileceklerine ilişkin görüşleri istendiğinde ise öğrenme öğretme süreci, öğrenciyi tanıma, öğretmenin kişisel özellikleri, kişisel ve mesleki gelişim olmak üzere 4 tema altında birbirlerine yakın görüş bildirmişlerdir. Formasyon öğrencilerinin fark yaratacaklarını düşündükleri konular, iyi bir öğretmenin sahip olması gereken özellikle yönelik görüşleri ile paraleldir. Öğretmen adaylarının görüşlerinde ise en çok vurguladıkları konular sıralama olarak farklılaşmaktadır. Araştırmaya katılan öğretmen adayları en fazla oranda öğrenme-öğretme süreçleri ile farklılık yaratabileceklerini belirtmişlerdir. Bu noktada farklılığı öğretimin çeşitlendirilmesi ve öğrenme ortamının öğrencilere göre düzenlenmesi ile yaratabileceklerini düşünmüşlerdir. Bunlarla birlikte sınıf yönetimi, ödüllendirme ve ders-okul-bilimi sevdirerek de farklılık yaratabileceklerdir. Formasyon öğrencileri ise daha çok kişisel ve mesleki gelişimi sağlama ve kişisel özellikler gibi konularda bir öğretmen olarak fark yaratacakları görüşündedirler. Kişisel gelişimi sağlamada öğrencileri anlama, onlara saygı duyma, değer verme, kişisel özelliklerde de sevilen, yardımsever, sempatik, sabırlı vb. gibi özelliklere sahip olarak öğretmen olduklarında farklılık yaratabileceklerini düşünmektedirler. Öğretmen adayları öğretme-öğrenme sürecinde fark yaratabilecekleri görüşünde oldukları halde, öğretim stratejilerine yönelik özyeterliklerinin formasyon grubu öğrencilerinden farklı olmadığı tespit edilmiştir. Öğretmen adayları öğrencilerin olumlu yönde desteklenmesi, yüreklendirilmesi, kişisel gelişimlerinin desteklenmesi, onlara değer verilmesi gibi öğrenciyi tanıma noktasında da farklılık yaratabileceklerini düşünmüşlerdir. Öğrencilere olan bu olumlu inanç onların desteklenerek başarmalarını sağlayacaktır. Ayrıca öğrencilerin çeşitli beceriler ve kişisel özellikler ile donanımlı olarak yetiştirilmeleri de farklılık yaratabilmelerine olanak sağlayabilecektir. Örneğin onların eleştirel düşünme, sorgulama becerilerini geliştirmek, bilinçli, sorumluluk sahibi, hoşgörülü, mutlu bireyler olmalarını desteklemek de farklılık yaratabilmelerine imkan sağlayacaktır. Bunlarla birlikte lisans öğrencileri ideal öğretmen tipine uyan kişisel özellikleriyle de öğrencilerde farklılık yaratabileceklerini düşünmektedirler. Sempatik, sabırlı, sevilen-sayılan, öğrencilerini seven, araştırmacı öğretmen olarak öğrencileri etkileyebileceklerini düşünmüşlerdir.

Öğretmen adayları iyi bir öğretmenin nitelikleri için belirttikleri bazı özellikleri bu soruda da beyan etmişlerdir. Örneğin kişisel özellikler ve öğrenme-öğretme sürecine ilişkin ortak kodlara bu sorularda rastlanmaktadır. Bu durum öğrencilerin görüşlerini destekler nitelikte olduğunu göstermektedir. Açık uçlu sorulara verilen yanıtlar incelendiğinde genel olarak lisans ve formasyon öğrencilerinin ortak fikirleri olduğu görülürken bazı noktalarda formasyon öğrencilerinin hemen hepsinin çalışması ve sağlık çalışanı olması nedeniyle bazı kodların sıklıklarında farklılıklar olduğu da görülmüştür. Bu durum daha çok mesleği seçme nedenlerinde, iyi bir öğretmenin nitelikleri içerisinde kişilik özelliği olarak sabırlı olması noktasında ve öğrencilerde farklılık yaratabilmede öğrencilere değer verme, anlama, saygı gösterme boyutunda göze çarpmaktadır.

Araştırmadan elde edilen sonuçlar doğrultusunda her iki gruptaki katılımcıların da çoğunun içsel gerekçelerle öğretmenlik mesleğini seçmeleri, kişisel ve mesleki gelişimi ön planda tutmaları, öğretmenlik mesleğini önemsediklerinin ve daha istekli gerçekleştireceklerinin göstergesi olarak düşünülebilir. Ancak öğretmen adaylarının dışsal gerekçeler, formasyon öğrencilerinin önemli bir bölümünün çıkarcı gerekçeler ile mesleği tercih etmeleri, öğretmenlik mesleğini gönüllü olarak yapmak istemediklerini göstermektedir. Bu durum ülkemizde öğretmen yetiştirme sorunları arasında ele alınması gereken önemli problemlerden birisi olarak görülebilir.

Katılımcıların, iyi bir öğretmenin sahip olması gereken özellikler arasında kişisel özellikleri de vurgulamaları, meslek-kişilik ilişkisini dikkate aldıklarını göstermektedir. Öğretmen adaylarının, formasyon öğrencilerine göre, öğrenme-öğretme sürecinde fark yaratacaklarına inanmaları ve bu konudaki özyeterliklerinin de daha yüksek düzeyde olması, aldıkları eğitim ile ilişkilendirilebilir.

Sonuç olarak, ülkemizde bireylerin öğretmen olma nedenleri, öğretmenliğe yönelik özyeterlikleri ve öğretmen yetiştirme programlarının olumlu ve olumsuz niteliğinin yetişen öğretmen kalitemizi de etkilemektedir. Bu sonuçlar doğrultusunda, öğretmen özyeterliklerinin öğretme yetiştirme programlarında dikkate alınması, meslek seçiminde öğrencilere öğretmenlik mesleğinin önemi ve niteliğinin anlatılması, özellikle pedagojik formasyon programlarında mesleğin özelliklerini içeren ve öğretim derslerine önem verilmesi önerilmektedir.

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EVALUATION OF TEACHING PRACTICE COURSE TEACHERS ACCORDING TO OPINIONS OF MATH TEACHER CANDIDATES

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ABSTRACT: Student teacher learns to whom, why and where to teach theoretically through teaching profession knowledge lessons. And the skill to use the theoretical knowledge is learned through School Experience and Teaching Practice lessons in Turkey. In gaining these skills, the personal and professional characteristics of the practice teacher at the school where the student teacher had his internship are of importance. This research aims to determine the ideas of the student teachers who are studying elementary school maths teaching about the personal and professional characteristics of the Teaching Practice lesson teachers. In line with this aim, the ideas of the student teachers were determined with regard to how they evaluated the practice teachers who are in charge of teaching practice lesson. The study group of the research consists of the senior year students who are studying at Elementary School Maths Teaching at Ahmet Keleşoğlu Faculty of Education at Necmettin Erbakan University. The data was collected with an unstructured question in which the student teachers were asked to evaluate the practice teachers in personal and professional terms. The data was evaluated by making content analysis.

Key words: math teacher candidate, practice course teachers, teaching practice course.

MATEMATİK ÖĞRETMEN ADAYLARININ GÖRÜŞLERİNE GÖRE ÖĞRETMENLİK UYGULAMASI DERSİ ÖĞRETMENLERİNİN DEĞERLENDİRİLMESİ

ÖZET: Öğretmen adayı kime, niçin, nerede ve nasıl öğreteceğini teorik olarak öğretmenlik meslek bilgisi dersleri ile öğrenmektedir. Teorik bilgilerini kullanma becerisini de Türkiye'de Okul Deneyimi ve Öğretmenlik Uygulaması dersleri ile öğrenmektedir. Bu becerileri kazanmasında staj yaptığı okuldaki uygulama öğretmeninin kişisel ve mesleki özellikleri önemlidir. Bu araştırmada ilköğretim matematik öğretmenliğinde öğrenim gören öğretmen adaylarının öğretmenlik uygulaması dersi öğretmenlerinin kişisel ve mesleki özelliklerine ilişkin görüşlerinin belirlenmesi amaçlanmaktadır. Bu amaç doğrultusunda öğretmen adaylarının öğretmenlik uygulaması dersinden sorumlu uygulama öğretmenlerini nasıl değerlendirdiklerine ilişkin görüşleri saptanmıştır. Araştırmanın çalışma grubunu Necmettin Erbakan Üniversitesi Ahmet Keleşoğlu Eğitim Fakültesi İlköğretim Matematik Öğretmenliğinde öğrenim gören son sınıf öğrencileri oluşturmaktadır. Veriler öğretmen adaylarının, uygulama öğretmenlerini kişisel ve mesleki açıdan değerlendirmeleri istenen yapılandırılmamış bir soru ile toplanmıştır. Veriler, içerik analizi yapılarak değerlendirilmiştir.

Anahtar sözcükler: matematik öğretmen adayı, uygulama öğretmeni, öğretmenlik uygulaması.

GİRİŞ

Eğitim faaliyetlerini yürütmekle görevli öğretmenlerin hizmet öncesinde iyi yetişmiş olmaları gerekmektedir. İyi bir öğretmen yetiştirme, teorik eğitimin yanı sıra uygulama faaliyetleri ile mümkün olabilir.

Öğretmen adayları sınıf ortamında ihtiyaç duydukları bilgi ve becerileri ancak deneyimle öğrenilebilirler. Çağdaş öğretmen yetiştirme modellerinde uygulama çalışmalarının önemi vurgulanarak, uygulamaya daha fazla yer verilmektedir (Çelikkaya, 2011).

Öğretmen adayına öğretmenlik becerilerini kazandırmak amacıyla eğitim fakültelerinin programlarında teorik dersler yanında Öğretmenlik Uygulaması dersi de bulunmaktadır. 8. dönemdeki öğretmenlik uygulaması, 2 saat teorik ve 6 saat okulda uygulamadan oluşmaktadır. Öğretmenlik uygulaması, öğretmen adayının daha önce edinmiş olduğu bilgi ve becerileri okul ortamında uygulamaya koyup geliştirmesi ve mesleğinin gerektirdiği yeterlilikleri kazanması için planlanmış bir derstir (YÖK, 2016).

Öğretmenlik uygulamasında okuldaki uygulama öğretmeninin mesleki ve kişisel özellikleri önemlidir. Etkili bir uygulama öğretmeni: öğrencilerini dinler, onlarla iletişim kurar, onları anlar ve öğretmen adaylarının gelişmesine yardımcı olur. Uygulama öğretmenlerinin genç ama tecrübeli öğretmenler olması, alan bilgisinin yanı sıra öğretim bilgisinin iyi düzeyde olması, açık fikirli, iletişim kanallarını açık tutabilen ve öğrenci ve öğretmen adayları ile tartışabilen öğretmenler olması gerektiği vurgulanmıştır (Boreen, 2009; Akt: Kırksekiz, Uysal, İşbulan, Akgün, Kıyıcı ve Horzum, 2015).

AMAÇ

Bu araştırmada ilköğretim matematik öğretmenliğinde öğrenim gören öğretmen adaylarının öğretmenlik uygulaması dersi öğretmenlerinin kişisel ve mesleki özelliklerine ilişkin görüşlerinin belirlenmesi amaçlanmaktadır.

YÖNTEM

Matematik öğretmen adaylarının öğretmenlik uygulaması dersi öğretmenlerinin kişisel ve mesleki özelliklerine ilişkin görüşlerinin belirlenmesine yönelik bu araştırma nitel yöntemle yürütülmüştür.

Çalışma Grubu

Araştırmanın çalışma grubunu NEÜ Ahmet Keleşoğlu Eğitim Fakültesi İlköğretim Matematik Öğretmenliği programında öğrenim gören 40 son sınıf öğrencisi oluşturmaktadır. Katılımcıların 33'ü kadın, 7'si erkektir. Katılımcılar en az 3, en fazla 28 kez olmak üzere ortalama 10 kez uygulama öğretmeni ile görüşmüşlerdir.

Verilerin Toplanması ve Analizi

Veriler, açık uçlu anket yoluyla toplanmıştır. Katılımcılara, "Öğretmenlik uygulaması için gittiğiniz okuldaki uygulama öğretmeninizi, sizinle ve öğrencilerle kişisel ve mesleki ilişkileri, size olumlu ve olumsuz etkileri açılarından kısaca değerlendirebilir misiniz?" sorusu sorularak, uygulama öğretmenlerini kişisel ve mesleki açıdan değerlendirmeleri istenmiştir.

Veriler, içerik analizi yapılarak değerlendirilmiştir. Kodlanan veriler, benzerlikleri dikkate alınarak temalarda bütünleştirilmiştir.

BULGULAR

Katılımcıların verdikleri cevaplar analiz edilerek 80 kod çıkarılmıştır. Kodlar benzer özellikleri itibariyle öğrencilerle ilişkiler, mesleki özellikler, kişisel özellikler ve uygulama öğrencileri ile ilişki ve uygulama öğrencilerine etkisi temalarına ayrılmıştır. Her temanın altında alt temalar da oluşturulmuştur. Temalar ve özellikleri aşağıda açıklanmıştır.

1. Öğrencilerle İlişkiler

24 kod bu tema altında bütünleştirilmiştir. Kodlardan 15 tanesinin uygulama öğretmeninin öğrencileriyle olumlu ilişki kurduğuna, 5 tanesinin olumsuz ilişki kurduğuna, 4 tanesinin olumlu ilişki ile birlikte olumsuz ilişkilerine işaret ettiği görülmektedir.

Olumlu

Bu temada bütünleştirilen görüşlere göre, uygulama öğretmenleri; öğrencileri ile çok iyi iletişim kurmakta, öğrenciler arasında ayrım yapmamakta, öğrencilerine ismiyle hitap etmekte, bütün öğrencileriyle ilgilenmeye çalışmaktadır. Bir öğrenci bu durumu, "Beni etkileyen en önemli nokta, öğrenciler arasında ayrım yapmaması ve her öğrenciye adıyla hitap etmesi" şeklinde ifade etmiştir.

Olumsuz

Bu temada bütünleştirilen görüşlere göre, uygulama öğretmenleri öğrenciler arasında ayrım yaparak, öğrencilere kırıcı davranarak, azarlayarak hatta fiziksel şiddet uygulayarak öğrencilerin öğrenme isteklerini azaltabilmekte, özgüvenlerine zarar verebilmektedir. Bu durumu bir katılımcı, "Öğrenciler arasında ayrımcılık yapmakta, erkeklere karşı daha soğuk, şiddete meyilli, kızlara daha ılımlı tavır sergiliyor" şeklinde ifade etmiştir.

Hem Olumlu-Hem Olumsuz

Bu temada bütünleştirilen görüşlere göre, uygulama öğrencileri uygulama öğretmenlerinin öğrencileriyle ilişkilerini genel olarak olumlu bulurken bazı davranışlarını da olumsuz olarak değerlendirmektedirler. Bir katılımcı bu durumu "Öğrencilerine karşı bazen kırıcı olsa da ılımlı ve olumluydu, teneffüslerde öğrencilerle ilgiliydi" şeklinde ifade etmiştir. Bir başka katılımcı da "Öğrencilerin hepsine söz vermeye çalışıyor. Bunun yanında birkaç öğrenciyi azarladığını gördüm ve bir kez dövdü. Bu olumsuz bir olaydı, kırıcı sözler sarf edebiliyor" şeklinde ifade etmiştir.

2. Mesleki Özellikleri

16 kod bu tema altında bütünleştirilmiştir. Kodlardan 11 tanesinin uygulama öğretmeninin mesleğinde başarılı, kendini yetiştirmeye çalıştığına, 4 tanesinin klasik, yenilikçi olmayan, soğuk duruşuna vurgu yaptığı görülmektedir.

Yenilikçi

Bu temada bütünleştirilen görüşlere göre, uygulama öğretmenleri mesleğinde başarılı ve daha başarılı olmak için çabalamaktadırlar. Bir katılımcı bu durumu, "Mesleğinde gayet iyi ve daha iyisi için çabalamaktadır" şeklinde ifade etmiştir. Bir başka katılımcı da "Konu anlatımlarında bizden farklı stratejiler kullanmamızı isteyerek, kendisi de bu konularda bilgilenmek istedi" diye ifade etmiştir.

Geleneksel

Bu temada bütünleştirilen görüşlere göre, uygulama öğretmeni, öğretmen merkezli ders işlemekte, matematik öğretimine ilişkin yeni yöntem ve teknikleri kullanmamaktadır. Bir katılımcı bu durumu, "Ders anlatım tarzı çok eski, klasik ezbere dayalı anlatım tarzı beni üzdü" diyerek ifade etmiştir.

3. Kişisel Özellikler ve Uygulama Öğrencileri İle İlişki

Bu tema altındaki 25 koddan 14 tanesinin, uygulama öğretmeninin uygulama öğrencilerine karşı olumlu davrandığı, 1 tanesinin ise olumsuz özellikleriyle öne çıktığı görülmektedir. 10 kod da uygulama öğretmeninin kişisel özellikleriyle ilgili olup tümü olumlu alt teması içine yerleştirilmiştir.

Olumlu

Bu temada bütünleştirilen kodlara göre, uygulama öğretmenleri uygulama öğrencilerine, saygılı, sıcak, içten, yardımsever davranışlar sergilemektedirler. Uygulama öğrencileri, danışman öğretmenlerinin, insanlara karşı olumlu tutum içinde olmalarından ve kişilik özelliklerinden memnundurlar. Bir katılımcı bu durumu "Bana karşı, saygılı ve sıcak davranıyor. Bir isteğim olduğunda yardım etmeye çalışıyor, beni geri çevirmiyor" şeklinde ifade etmiştir.

Olumsuz

Bu temada bütünleştirilen kodlara göre, uygulama öğretmeni uygulama öğrencileri ile ilgilenmemekte, öğrenciye yeterli zaman ayırmamakta, dönüt vermemektedir. Bir öğrenci bu durumu, "Bizimle pek ilgilenmedi, bizimle sadece konu anlatacağımız zaman konuştu" şeklinde ifade etmiştir.

4. Uygulama Öğrencilerine Etkisi

Bu tema altındaki 15 koddan 11 tanesinde uygulama öğretmeninin uygulama öğrencisine olumlu etkisinin olduğu, 1 tanesinde olumsuz etkisinin olduğu, 3 tanesinde hem olumlu hem de olumsuz etkisinin olduğu görülmüştür.

Olumlu

Bu temada bütünleştirilen görüşlere göre, uygulama öğretmenleri uygulama öğrencilerine öğretmenlik mesleğini tanıtmış; örnek uygulamalar, davranışlar göstererek, onlara öğretmen olarak özellikle öğretmen-öğrenci iletişimi, sınıf yönetimi konularında kullanabilecekleri davranışları göstermişlerdir. Bir öğrenci bu durumu, "Bana etkisi daha çok olumlu yönde oldu, öğrencilerle nasıl güzel iletişim kurabileceğimi, dersimi nasıl işlersem verimli olabileceğimi, konu anlatım tarzımın nasıl olacağı konusunda etkili oldu." şekilde ifade etmiştir.

Olumsuz

Bu temada bütünleştirilen görüşlere göre, danışman öğretmenin uygulama öğrencisine olumsuz etkisi olmuştur. Bir öğrenci bu durumu, "Çok sert bir öğretmendi, bazen iş arkadaşlarına da sesini yükseltebiliyordu. Genelde öğrencileri azarlayarak disiplin altında tutmaya çalışıyordu. Beni olumsuz etkiledi" şeklinde ifade etmiştir.

Hem olumlu-Hem Olumsuz

Bu temada bütünleştirilen görüşlere göre, uygulama öğrencileri uygulama öğretmeninden genel olarak memnun olmalarına, kendilerini olumlu etkilediğini ifade etmelerine rağmen, öğretmenin bazı davranışlarından da rahatsız olduklarını dile getirmişlerdir. Bir öğrenci bu durumu "Gerek ders anlatımı, gerek sınıf yönetimi olsun son derece takdir ettiğim bir öğretmendi. Erkek öğrencilerin sınıfındaki dersini dinleyene kadar, onlara kaba davranıyor, hakaret içerikli konuşuyor. Bu yönünü beğenmiyor, hiç tasvip etmiyorum" şeklinde ifade etmiştir.

TARTIŞMA VE SONUÇ

1. Uygulama öğrencileri, uygulama öğretmenlerinin; öğrencileri ile çok iyi iletişim kurduklarını, ifade etmişlerdir. Saracaloğlu, Yılmaz, Çöğmen ve Şahin'in (2011) yaptıkları bir araştırmada da öğretmen adayları; uygulama öğretmeni sayesinde öğrencilerle nasıl sağlıklı iletişim kurulabileceğini öğrendiklerini ifade etmişlerdir. Ancak katılımcılar, uygulama öğretmenlerinden öğrencileriyle olumsuz ilişki kuranların da olduğunu ifade etmişlerdir. Demircan (2007)'ın yaptığı bir araştırmada da öğretmen adayları, uygulama öğretmenlerinin, uygulama öğrencilerini derse katabilecek; okul yaşantısına ısındırabilecek; uygulamayı istekli sürdürmelerini sağlayabilecek her hangi bir çaba göstermedikleri ve uygulamayı isteksizce sürdürdüklerini ifade etmişlerdir.

2. Katılımcılar, uygulama öğretmenlerinin mesleğinde başarılı ve daha başarılı olmak için çabaladıklarını ifade etmişlerdir. Saracaloğlu vd.'nin (2011), yaptıkları bir araştırmada da öğretmen adayları; alan bilgisi açısından uygulama öğretmenini yeterli gördüklerini ve yine uygulama öğretmeninin ders araç-gereçlerini etkin biçimde kullandıklarını ifade etmişlerdir. Ancak uygulama öğrencileri, geleneksel tipte uygulama öğretmenlerinin de bulunduğunu ifade etmişlerdir. Bu bulgu öğretmenlerden kendilerini yenileme ve geliştirme yönünde çaba göstermeyenlerinde olduğu düşüncesini ortaya çıkarmaktadır.

3. Uygulama öğrencileri uygulama öğretmeninin kendileriyle, olumlu ilişki kurduğunu ve öğretmenin kişilik özelliklerinden memnun olduklarını ifade etmişlerdir. Kale'nin (2011) yaptığı bir araştırmada da uygulama öğretmenlerinin uygulama öğrencilerine hakaret sayılabilecek bir söz ya da davranışlarının olmadığı görülmüştür. Ancak katılımcılar, uygulama öğrencileri ile ilgilenmeyen, olumsuz özellikler gösteren uygulama öğretmenlerinin de olduğunu belirtmişlerdir. Çelikkaya'nın (2011) yaptığı bir araştırmada da öğretmen adayları; ders işledikten sonra uygulama öğretmeniyle 10 dakikalık teneffüste ayaküstü bir iki dakika görüşebildiklerini bunun da hiç yeterli olmadığını ifade etmişlerdir.

4. Uygulama öğrencileri, uygulama öğretmeninin uygulama öğrencisine olumlu etkisinin olduğunu ifade etmişlerdir. Şişman ve Acat'ın (2003) yaptığı bir çalışmada da; öğretmen adaylarının, öğretmenliğin sosyal statüsüne, öğretmenliğin etik değerlerine ve kendi yeterliliklerine ilişkin algıları uygulama çalışmalarıyla olumlu yönde değişmiştir. Ancak katılımcılardan, uygulama öğretmenin, uygulama öğrencisine olumsuz etkisi olduğunu ifade edenlerde olmuştur. Kuzu ve Dursun'un (2006) yaptıkları bir çalışmada da, uygulamalar süresince gerek uygulama öğretmeninden gerekse de uygulama öğretim elemanından kaynaklanabilecek çeşitli sorunların öğretmen adayını olumsuz yönde etkileyebildiği görülmüştür (Akt: Becit, Kurt, ve Kabakçı, 2009).

ÖNERİLER

Uygulama öğretmenlerinin belirlenmesinde mesleğinde başarılı, insan ilişkileri ve mesleki yönden kedini geliştirmiş olmasına dikkat edilmelidir.

Uygulama öğretmenleri için uygulama öncesinde, uygulamada dikkat edilmesi gereken hususlar vb. konularda bir seminer programı hazırlanmalıdır.

Uygulama öğretmeni, uygulamadan sorumlu öğretim elemanı ve uygulama öğrencisi zaman zaman bir araya gelerek uygulamada karşılaşılan sorunları değerlendirmeli ve uygulamanın daha fazla etkili olması için yapılması gerekenleri belirlemelidir.

Farklı branşlarda benzer araştırmaların yapılarak araştırma sonuçlarına dayalı öğretmenlik uygulama ilke ve standartlarının belirlenmesi, öğretmenlik uygulamasının daha etkili olmasına ve dolayısıyla öğretmenlerin hizmet öncesinde iyi yetişmiş olmalarına yarar sağlayacaktır.

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DETERMINING THE VIEWPOINTS OF MATHS TEACHERS ON ROTATING CLASS SYSTEM (ORDU PROVINCE CASE)

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ABSTRACT: In the Mathematics curriculum which has been used since 2013 in Turkey, instead of transferring the knowledge, the teachers should include guiding activities for students during the classes. In order to carry out these activities in a proper way, it is necessary to create educational environment where students can understand these activities. In the studies carried out, a big majority of maths teachers support the idea that maths classes should be carried out in specially designed classrooms for maths. The purpose of this study is to identify the opinions of secondary school maths teachers on rotating class system. To do that, the "Teacher Questionnaire on Rotating Class System" developed by Ersöz was revised and administered to maths teachers.

The sample group of the study was maths teachers working at 10 official secondary schools of the Ministry of National Education at Ordu province during 2014-2015 academic year. All the maths teachers working at the aforementioned secondary schools were accessed and the questionnaire was administered on a total number of 41 maths teachers. And since the data in this study didn't have a normal distribution, nonparametric tests were used in the analyses. The analyses were conducted using SPSS 16.0 package programme. Whether there was a significant difference in teachers' opinions on rotating class system based on gender, seniority in the profession and whether they worked on a school where this system was used was analysed.

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Key words: rotating class system, education, maths

MATEMATİK ÖĞRETMENLERİNİN BRANŞ DERSLİK SİSTEMİNE BAKIŞ AÇILARININ BELİRLENMESİ (ORDU ÖRNEĞİ)

ÖZET: Ülkemizde 2013 yılından itibaren uygulanmakta olan Matematik öğretim programına göre öğretmenler derslerinde bilgiyi aktarmak yerine yol gösterici etkinliklere yer vermek durumundalar. Bu etkinliklerin sağlıklı bir şekilde uygulanabilmesi için bireylerin anlamalarını sağlayacak eğitim ortamlarının oluşturulması önemlidir. Yapılan çalışmalarda, matematik öğretmenlerinin büyük çoğunluğu, matematik derslerinin özel olarak düzenlenmiş dersliklerde yapılması görüşünü desteklemektedir. Bu çalışma ile amaçlanan, eğitim ortamı açısından ortaokul matematik öğretmenlerinin branş derslik sistemine ilişkin görüşlerinin belirlenmesidir. Bu bağlamda matematik öğretmenlerine Ersöz tarafından geliştirilen "Branş Derslik Sistemi Öğretmen Anketi" revize edilerek uygulanmıştır.

Araştırmanın örneklemini, 2014-2015 eğitim ve öğretim yılında Ordu İl merkezinde bulunan ve Milli Eğitim Bakanlığına bağlı 10 resmi ortaokulda görev yapan matematik öğretmenleri oluşturmaktadır. Bu okullarda görev yapan matematik öğretmenlerinin tamamına ulaşılarak toplam 41 öğretmene anket uygulanmıştır. Bu çalışmada veriler normal dağılım göstermediğinden analizlerde nonparametrik testler kullanılmıştır. Veriler SPSS16.0 paket programı ile analiz edilmiştir. Öğretmenlerin, branş derslik sistemine ilişkin görüşleri arasında anlamlı bir

fark olup olmadığı cinsiyet, mesleki kıdem ve daha önce bu sistemi uygulayan bir okulda çalışma durumlarına göre yoklanmıştır.

Araştırmanın sonucunda matematik öğretmenleri, okulda kendilerine ait bir matematik dersliği istediğini ve bu dersliklerin kendilerini motive edeceğini belirtmiştir. Ayrıca öğretmenler, matematik dersliğinde işlenecek dersler ile öğrencilerin derse ilgisinin artacağını, araç gereçlerin sınıflara taşınmasından kaynaklanan yıpranmaların azalacağını ve derslerinin daha verimli geçeceğini düşünmektedirler.

Anahtar sözcükler: branş derslik sistemi, eğitim, matematik

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DEVELOPMENT OF A VALID AND RELIABLE ACHIEVEMENT TEST IN THE UNIT OF FORCE AND MOVEMENT

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ABSTRACT: This study aimed to develop a valid and reliable measurement instrument in relation to subject of "Force and Movement" in order to measure student unit achievement in a seventh grade science course. In the scope of this study, an achievement test in the Force and Movement unit of seventh grade science course was developed in order to assess students' achievement in relation to this subject. The validity and reliability research of the test was ensured. The test included questions prepared originally in accordance with the Science and Technology course curriculum. Prior to develop the final version of the test, the test was presented to expert and in-service science teachers' opinion and then, a pilot study was conducted with 25 eighth grade students. The eighth grade students had studied the subject in the previous academic year. At this stage, incomprehensible and illegible test phrases, pictures, shapes and graphics were identified and required revisions were applied. After all, the revisions were made and test was finalized, it was implemented to 270 eight grade students in order to compute the validity and reliability coefficients of the test. In this study, the sampling is determined to be as Typical Sampling within the aimful sampling unit of non-random sampling method. The sample of the study includes 270 eight grade students that were studying in secondary schools located in three districts of Ankara in the first period of 2014-2015 academic years. The two of the schools included in the sampling were in Keçiören district and one was selected from Sincan district and one was selected from Çankaya district. The number of students participated in the test are 35 from School A, 95 from School B, 70 from School C and 70 from School D. The unit of Force and Movement includes the sub-topics of "Force and Movement, Simple Machines, Work, Energy and Power. This unit includes a total of 31 objectives. In this test, 62 multiple choice items were prepared in accordance with each objective. Each test item has equal points. In the test development process, first, the unit objectives were determined. The researchers cared about develop the test basing on the unit objectives. Additionally, the question banks on this unit, different science textbooks, questions asked in Secondary School Student Selection National Examination, Placement Test, PISA and TIMMS were examined before a total of 62 questions were prepared. The questions were originally prepared by the researchers. In order to provide the content validity, the test questions were reviewed by three science and technology teachers having at least a master degree and at least five years of professional experience. The unclear, uncompleted and improper question parts in terms of the content and student grade level were revised in accordance with the teacher feedbacks. After that, the test questions were examined by considering its content and format by an instructor in the Master of Science in Science Education Department. Finally, a specialist in the area of measurement and assessment reviewed the questions and resulting feedbacks developed the final version of the test. The experts' opinions on the finalized test are as following. The test represents the entire unit subjects. The language of the test is clear and the font size of the written texts, images, and shapes are eligible for the seventh grade students. The questions are appropriate to assess the determined objectives and two class hours are required to implement the test. The final comments of the in-service teachers and experts were applied to the test and the resulting number of questions was determined to be as 62. The test comprises multiple choice questions having four alternatives. The alternatives were constructed based upon to distracter answers. Accordingly, items with a discrimination value smaller than 0.20 is extracted from the test. It is identified in the analysis that, even though the item has discrimination value larger than 0.20, it was left blank by many students. In this case, required revisions to the question were applied in accordance with the expert opinions. The following are the samples to extracted and developed questions, respectively. The achievement test was implemented to eighth grade students who had studied the unit in the previous academic year. The Cronbach alpha reliability coefficient of the achievement test was found to be 0.804. Item analysis was conducted using the ITEMAN item analysis program. Based on to item analysis results, the item difficulty index was found to be 0,309 and the discrimination index as 0,367. The results revealed that the achievement test is a valid and reliable measurement tool. This achievement test can be used by researchers in scientific studies and it is recommended that science teachers should use it in their science course.

Key Words: Achievement test, force and movement, reliability, validity

Note: This study was compiled from a part of the doctoral dissertation of Şahin İDİN under supervision of Assoc. Prof. Cemil AYDOGDU. The research data was presented at ICEMST 2016.

DETERMINATION OF SCIENCE STUDENT TEACHERS' VIEWS RELATED TO COMPUTER SUPPORTED INSTRUCTION

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ABSTRACT: The aim of the science and technology course is to ensure students to learn by doing. Students getting this course in a early age raises some problems like embody some abstract concepts, inability to observe some of the highlights. Computers are the one of the educational tools used in solving these problems in science teaching. Computers play an important role to concretize abstract concepts at a level student can understand, provision of animations in mind, doing the experiments which are difficult to observe in school environment, to repeat the experiments take time. Frequency of use of technology, science teachers, is closely related to be aware of technology and its benefits. How much knowledge they have acquired during his university years when they become teachers they will be more likely to use it. Therefore, to determine science student teachers knowledge and ideas on computer supported teaching and use of computer in science teaching, is expected to arrange training to eliminate misunderstandings and negative thoughts on using them.

The aim of this study was to investigate science and technology student teachers views about computer supported teaching and its contribution to science and technology courses. The study was carried out with eighty two student teachers in Fatih Faculty of Education at Karadeniz Technical University in Trabzon. Data obtained from a questionnaire composed of two open-ended questions was analyzed by using content analysis. Student teacher views are coded and in order to reflect prospective teachers opinions direct quotations were used. It has seen that prospective teachers defined computer supported materials as execution tool for courses, providing for effective teaching that appeals to the senses, supporting tool for teaching, a technique that facilitates education, a tool to prevent loss of time, teaching material. Prospective teachers views about contribution of computer to science and technology are to provide permanent learning, secure experiment doing tool, presentation tool, a method used to ensure effective teaching, a tool provides visuality and student participation, used to embody abstract concepts, used to increase students interest to courses, facilitates learning, draw attention.

Key words: science student teacher, computer supported teaching

FEN BİLGİSİ ÖĞRETMEN ADAYLARININ BİLGİSAYAR DESTEKLİ ÖĞRETİM İLE İLGİLİ GÖRÜŞLERİNİN BELİRLENMESİ

ÖZET: Fen ve teknoloji dersi kapsamında amaç öğrencilerin yaparak yaşayarak öğrenmelerinin sağlanmasıdır. Öğrencilerin küçük yaşlarda bu dersi alıyor olmaları bazı soyut kavramları somutlaştırma, bazı olayları gözlemleme imkanı bulamamaları gibi sorunları beraberinde getirmektedir. Fen öğretiminde bu sorunları çözmede kullanılan eğitim araçlarından biri de bilgisayarlardır. Fen öğretiminde, soyut kavramların öğrencinin anlayabileceği seviyede somutlaştırılması, zihninde canlandırmasının sağlanması, tehlikeli, gözlemlenmesi zor deneylerin sınıf ortamında öğrencilere izlettirilmesi, yapılması zor ve zaman gerektiren deneylerin tekrarlanması noktasında bilgisayarlar önemli rol oynamaktadır. Fen bilgisi öğretmenlerinin teknolojiyi kullanma sıklıkları, teknolojiden ve faydalarından haberdar olmaları ile yakından ilişkilidir. Üniversite yıllarında ne kadar çok bilgi edinirlerse öğretmen olduklarında sahip oldukları bu bilgileri de kullanma olasılıkları artacaktır. Bu nedenle bu çalışmayla fen bilgisi öğretmen adaylarının bilgisayar destekli öğretim ve bilgisayarın fen eğitiminde kullanımına ilişkin bilgi düzeylerinin ve düşüncelerinin belirlenmesinin sahip oldukları yanlış anlamaları ve olumsuz düşünceleri giderilmesi yönünde eğitimi düzenleme imkanı sağlayacağı düşünülmektedir.

Bu çalışmanın amacı, fen bilgisi öğretmen adaylarının bilgisayar destekli öğretim ve fen ve teknoloji dersine sağlayacağı katkılar ile ilgili görüşlerini araştırmaktır. Çalışma bir eğitim fakültesinin 3. sınıfında öğrenim gören 82 fen bilgisi öğretmen adayı yürütülmüştür. İki açık uçlu sorudan oluşan bir anket ile elde edilen veriler içerik analizi ile çözümlenmiştir. İçerik analizinden elde edilen verilerinden matrisler oluşturulmuştur. Öğretmen adayı görüşleri kodlanmış ve kodlardan temalar oluşturulmuştur. Temaların öğretmen adayları tarafından tekrarlanma sıklığına göre frekansları hesaplanmıştır.

Öğretmen adaylarının görüşleri incelendiğinde birçoğunun bilgisayar destekli öğretimi bilgisayarlı öğretim olarak tanımladıkları görülmektedir. Demircioğlu ve Geban (1996) tarafından yapılan çalışmada da bilgisayar destekli öğretimi "Bilgisayarların öğrenme ve öğretme ile ilgili bütün faaliyetlerde kullanılması" olarak tanımlamışlardır. Öğretmen adaylarının bilgisayarda yer alan power point, animasyon, vb. bilgisayar

programlarını ve birçok bilgisayar yazılımını derste sıklıkla kullandıkları için bilgisayar destekli öğretimi bununla ilişkilendirdikleri görülmektedir. Bu anlamda fen bilgisi derslerinde kullanılan bilgisayar yazılımlarının sorulan sorulara aynı anda cevap bulabilecekleri şekilde geri bildirimli, öğrencinin kontrol edebileceği, anlamadığı bir konuyu tekrar ve her istediğinde izleyebileceği şekilde görsellerle desteklenerek hazırlanması gerekmektedir (Demircioğlu ve Geban, 1996). Öğretmen adaylarının bilgisayar destekli öğretimle birlikte hazırlanan materyallerin göze ve kulağa hitap etmesi ile kalıcı öğrenmenin sağlandığını ifade ettikleri görülmektedir. Arslan, (2003)'ün yürüttüğü çalışmasında yer alan “Bilgisayarlar bütün duyu organlarına hitap etmediğinden yeterli bir biçimde işitsel yaşantı sağlayamamaktadır” şeklindeki anket maddesinin öğretmenler tarafından kabul edilmediği, bilgisayar destekli materyallerin hem göze hem de kulağa hitap eder nitelikte olduğunu belirttikleri görülmektedir. BDÖ'nün fen derslerinde kullanılması ile birlikte soyut olan fen kavramlarının somutlaştırılabildiği, sınıf ortamında yapılması, tekrarlanması zor olan deneylerin bilgisayar simülasyonları, animasyonları ile öğrenciye sunulmasına imkan sağladığı, öğrenciler için kalıcı öğrenme ortamı, görsel materyal zenginliği sunduğu, sınıf ortamına getirilemeyen bazı malzemelerin bilgisayar ortamından öğrencilere gösterilerek bilgi sahibi olmalarının sağlandığı, öğrencilerin derse ilgillerini çekmede etkili olduğu, öğrencilere tekrar yapma imkanı sunduğu, bireysel, kendi hızlarında çalışma imkanı sunduğu, ders anlatımlarının eğlenceli hale getirildiği, öğrenmenin kolaylaştırıldığı, zaman kaybının önlendiği, sunu aracı olarak sınıf ortamında kullanıldığı öğretmen adayları tarafından belirtilmiştir. Fen bilgisi öğretmen adayların büyük bir çoğunluğu BDÖ'nün fen ve teknoloji dersine fayda sağlayacağı görüşünü savunmuştur (Akpınar, Aktamış, Ergin, 2005). Bu sonuç yapılan diğer çalışmalar ile desteklenmektedir. Örneğin, Demircioğlu & Geban (1996) yapmış oldukları çalışmada geliştirdikleri geri bildirimli bilgisayar yazılımı sayesinde öğrencilerin anlamadıkları kavramlar ve anlatılan dersi tekrar incelenmesine fırsat tanındığı için kalıcı öğrenmenin gerçekleştirildiğini ifade etmişlerdir. Güven ve Sülün (2012)'nin yaptıkları çalışmada ise öğretmenlerin derslerde gerekli gördükleri yerlerde bilgisayarı destek aracı olarak kullanarak soyut kavramların somutlaştırılmasını sağladıkları, konu işledikten sonra çeşitli bilgisayar programları aracılığıyla uygulamalar yapmalarının öğrencilerin algılamalarını, bilgilerin kalıcılığını artırdığı bunun sonucu olarak da akademik anlamda başarılı olmalarında etkili olduğunu belirtmişlerdir. Ayrıca Karamustafaoğlu, Aydın ve Özmen (2005)'in yaptıkları çalışmada da benzer şekilde BDÖ uygulamalarında bilgisayar destekli yazılımlardan yararlanmanın soyut kavramlarla ilgili simülasyonların ve animasyonların kullanılmasının, anlamakta güçlük çekilen kavramları daha kolay yapılandırmaya olanak sağladığını belirtmişlerdir. Yapılan çalışmalarda fen bilgisi derslerinde sınıf ortamında zaman açısından, maddi açıdan ve güvenlik açısından yapılması zor olan deneylerin simülasyonlar sayesinde yapılarak öğrencilere izlettirilmesinin öğrenci açısından bir avantaj olduğu belirtilmektedir (Tekdal, 2002; Çelik, 2007; Genç, 2013). Benzer şekilde Daşdemir, Uzoğlu ve Cengiz, (2012) yaptıkları çalışmalarında animasyon destekli öğretim ile birlikte öğrencilerin akademik başarılarının, öğrendikleri bilgilerin kalıcılığının ve bilimsel süreç becerilerinin arttığını belirtmiştir. Akpınar, Aktamış ve Ergin (2005) ise yaptıkları çalışmada eğitim teknolojisinin fen bilgisi derslerinde kullanılmasının derse ilgiyi artırma, araştırma imkanlarını genişletme, öğrenmeye destek sağlama ve bu sayede başarıyı artırmada etkisi olduğu sonucuna varmışlardır. Yenice, Sümer, Oktaylar ve Erbil, (2003) yaptıkları çalışmada da kullanılan bilgisayar yazılımlarının uygulama yapma, problem çözme, tekrar ve yanlışları görebilme, geri dönme gibi işlemlerin öğrencilerin öğrenme düzeyini olumlu yönde etkilediği yönünde görüş belirttikleri görülmektedir. Bununla birlikte öğretmen adaylarının bazılarının bilgisayarın fen derslerinde sürekli kullanılmasının öğrencilerin doğa ile etkileşimine engel olduğunu, deneylerin ilk elden yapılması yerine bilgisayar ortamından izlettirilmesinin öğrenciye katkı sağlamadığını, kalabalık sınıflarda öğrenci dikkatinin çabuk dağılması sebebiyle BDÖ'nün uygulanmasında zorluklar yaşandığını ifade ettikleri görülmektedir.

Bilgi teknolojileri ile ilgili öğrenci tutumlarının öğretmen tutumlarından etkilendiği göz önüne alındığında öğretmen adaylarının bilgisayarların fen derslerinde kullanımı ile ilgili olumlu tutum geliştirilmeleri sağlanmalıdır. Öğretmen adaylarına fizik, kimya ve biyoloji derslerinde bilgisayarın farklı kullanım alanları ile ilgili örnek uygulamalar sunulmalı ve teknolojinin eğitim alanında kullanımı ile ilgili öğretmen adaylarının farkındalıkları artırılmalıdır. Bilgisayar dersinin fen bilimleri dersi ile ilişkisi kurulmalıdır ve öğretmen adaylarının bilgisayarı bir sunum aracı olarak kullanmalarından ziyade bir öğretim aracı olarak kullanmalarına teşvik edilmeleri sağlanmalıdır. Öğretmen adaylarına kullanımı kolay, kullanıcı dostu arayüzleri ve ihtiyaca uygun geniş ürün yelpazesi ile eğitim sürecine alternatif bir boyut getiren Web 2.0 teknolojileri anlatılarak bu teknolojiler ile bilgisayar destekli fen öğretimine yönelik materyaller geliştirmeleri sağlanabilir.

Anahtar sözcükler: fen bilgisi öğretmen adayı, bilgisayar destekli öğretim

MIDDLE SCHOOL STUDENTS' MODELING EXPERIENCES: A PAPER PLANE CONTEST PROBLEM

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ABSTRACT: Given the goals of mathematics education, it has become critical for students to understand and explain mathematical concepts and concept systems, test hypotheses, analyze and explain relationships as well as learn how to reconstruct. Today, it is not enough to only memorize the mathematical processes and then apply it to similar problem situations. To prepare students for their future beyond the school, it is required that students are able to gain experience on complex problem situations that help them to develop mathematical thinking and constructing new mathematical concepts. Mathematical model and modeling approach can be used for the solution of complex problems that represent real-life situations in which students have actively participated. Therefore, the purpose of this study is to examine 7th grade students' modeling processes while working on the *Paper Plane Contest Problem* and identified difficulties they confronted in the process.

This qualitative research was conducted during the 2015-2016 academic year, in a middle school in a large city along the Black Sea Region of Turkey. Participants were 7th grade students in a state school. Three students among them were selected as a focus group using criterion sampling technique. They then were given the *Paper Plane Contest Problem* and asked to work on this problem. They were video-taped while they were working on the problem. Mathematical thoughts and written responses of the seventh-grade students were analyzed using Blum and Ferri's modeling cycle. They explained the four phases of the modeling cycle as follows: At the *understanding the task* phase, in order to understand a problem that has been taken out of the context of daily life, the student performs tasks such as reading, imagining, drawing and reading tables that have been designed to bring simplification to the problem at hand. In *establishing models,* students create the data needed, find and recognize the relationship and rules, become aware of the patterns and form a hypothesis. In the *using mathematics* step, the students are expected to determine the appropriate mathematical concepts, perform the suitable mathematical operations and thus reach a mathematical solution at the end of these operations. The cycle ends with the students' checking the accuracy of what they have done, verifying the validity of the model by comparing the result with real life and reporting the solution, all of which make up the *explaining the results* phase, the last in the cycle. The order above is not a linear order (understanding the problem, setting up the model, mathematizing, explaining the result) but is the order of the thinking processes of the students in the study as they analyze the data.

In general, the results showed that students (a) had difficulties to understand the problem, (b) developed different strategies for required situations, and (c) selected winner for Best Overall while taking into account of each measurement. In addition, although students faced difficulties to make mathematical operations, they were able to work together in group to overcome this problem. In particular, while students in groups had difficulties to understand the *Paper Plane Contest Problem*, they separately developed different strategies for required situations. They also took into account of all variables and reached a solution in order to select winner for best overall. In addition, even though students had challenges to make mathematical calculations on the developed strategies, they overcame these challenges to discuss and work together. At the very beginning of modeling process, they misınterpreted the given data and had trouble to make sense of the variables presented in the problem. At the process of the establishing model, students selected and used appropriate parameters, worked on the different assumptions and successfully identified teams by using given data. Students then identified a new criterion (velocity) and made required calculations while taking into together account of the variables of *distance travelled in a straight path* and *time in the air* at the data table. However, they did not make any assumptions on the *scratches* in the given table and did not make any calculations on them. In the using mathematics step, students showed some difficulties to make mathematical calculations because of learning deficiency. But, they checked their solutions and corrected them when they reached different results and made new assumptions when they failed. As a result, these students interpreted mathematical and scientific knowledge presented in the data table; read data table; analyzed and represented the data, and made assumptions on them. They also worked in a group; wrote a report at the end; shared their results with each other.

Keywords: Paper Plane Contest Problem, Middle School Students, Mathematical Modeling, Model Eliciting Activity

INTRODUCTION AND ASSESSMENT OF A FORMATIVE ASSESSMENT STRATEGY APPLIED IN MIDDLE SCHOOL SCIENCE CLASSES: ANNOTATED STUDENT DRAWINGS

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«If a picture is worth a thousand words, perhaps drawing and
visualizing can help science students enhance their learning potential»
(National Science Teachers Association [NSTA], 2006, p.20)

ABSTRACT: Formative assessment is a teaching method that helps to determine the prior knowledge of students, schedule the course plan accordingly, give it the final shape based on the feedback received from students, and encourage conceptual learning. The aim of this study is to introduce the "annotated student drawings" as one of the common formative assessment strategies used in science courses in middle schools and to evaluate the practices. The study was conducted during the classes of two science teachers who are doing their master's degree. In total, 48 students participated in the study from 5^{th} (20) and 6^{th} (28) grades. For data collection tools, annotated student drawings on the concepts of "pollination" and "water cycle" before and after the intervention and the science teachers' feedback about the strategy were used. The pre and post-interventional annotated drawings of the middle school students were compared. On both concepts, it was several alternative conceptions from the students' pre-interventional annotated drawings that were recovered on the post-interventional drawings. The findings indicated that the annotated student drawings are fairly effective formative assessment strategies in uncovering the prior knowledge and alternative conceptions of students in class. After the intervention, the students' second drawings gave detailed information on how the students' level of understandings improved. Formative assessment techniques are suggested to be used by science teachers instead of traditional assessments in order to: 1) Getting info about their students' initial understanding; 2) Reshaping their classroom instruction according to the feedback they get from their students; and 3) Always revising their interventional methods until the students got the main idea during the teaching period.

Key Words: Science Education, formative assessment strategies, conceptual understanding

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INVESTIGATING PHYSICS TEACHERS' CLASSROOM PRACTICES OF PHYSICS CURRICULUM

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ABSTRACT: The general aim of the current physics curriculum is to develop scientifically literate students and therefore encourage them to solve the cases or problems they faced using their scientific knowledge. Bearing teachers' roles in achieving these goals of the curriculum in mind, this study aims to determine physics teachers problems throughout the application of the existing curriculum. The participants of this case study are four physics teachers working in Anatolian High Schools. The participating physics teachers' actual practices were observed and video-recorded throughout four weeks. The video-recorded data consisting of 32-lesson hours were analyzed by using Nvivo9 software. Considering the pre-determined themes within the scope of this study, such as introductory activities, didactical structure of the lessons, teacher-student communication, student-centered approaches, assessment and evaluation, and classroom management, general state of current teachers' practices was analyzed and the basic problems encountered were determined. Findings revealed that the participating teachers had some issues in particular aspects of performing within the framework of the current curriculum, such as creating scientific debates, providing short repetitions or summaries towards the end of lesson, providing examples from daily life, linking topics or concepts, directing students to reach knowledge and using assessment-evaluation activities.

Key words: physics curriculum, self assessment

Öğretim programlarının yürütülmesinde ve başarılı olmasında büyük rol oynayan öğretmenlerin programlara karşı tutum, inanış ve görüşleri birçok araştırmaya konu olmuştur. Eğitim öğretimin paydaşları olarak düşünülen öğretmen-program-öğrenci üçlüsünün ortak hedefi nitelikli toplumu oluşturan bireyleri yetiştirmek olarak tanımlanabilmektedir. Nitelikli bireyler yetiştirme konusunda önemli bir yeri olan öğretim programlar ile o programların uygulayıcısı olan öğretmenlerin uyumu programların başarısını destekleyen en önemli etkenler arasında ilk sırada yer almaktadır. Bu durumla ilişkili olarak Karacaoğlu ve Acar (2010) öğretmenler yeni programlar vasıtasıyla kendi öğretim uygulamalarını değiştiremiyor veya uygulamada zorluk yaşıyorlarsa bu durumun programın yetersizliği olarak nitelendirilebileceğini ifade etmişlerdir. Bu bakış açısına göre birçok araştırmada da (Gömleksiz, 2005; Bümen, 2006; Gökleksiz, 2007; Aksu, 2008; Türkmen, 2010 ; Çiftçi ve Tatar, 2015; Uyar, 2016) belirtildiği gibi güncel gelişmelere paralel olarak kendi bilgisinden sorumlu, araştıran, sorgulayan bireylerin eğitimi için tek başına programların değiştirilmesi yeterli olmamaktadır. Buna göre radikal program değişiklikleri öğretmenlerin tutum, inanış ve uygulamaları ile bağdaşmazsa basit "teorik" değişimler olarak kalmakta ve sınıf içi uygulamalarda yer bulamamaktadır. Bilindiği gibi eğitim alanında reform olarak nitelendirilen bu değişim, geleneksel yaklaşımları sınıf dışına iterek yapılandırmacı öğrenme kuramını ön plana çıkaran çağdaş yaklaşımların uygulanması esasına dayanmaktaydı. Çağımızın gereklilikleri ile beslenen ve eğitim alanında öncü ülkelerde geniş uygulama alanı bulan bu yaklaşıma dayanan öğretim programları, haklı bazı gerekçeler nedeniyle ülkemizde istenilen nitelikte uygulanamamıştır. Değişime karşı gösterilen direnç, nasıl öğretilirse öyle öğretilir durumu, deneyimsizlik, hakimiyet kaygısı ve gerekli malzeme ve ortam eksikliği vb. bu konuya odaklanan çalışmaların (örn. Çepni ve Çil, 2009; Taşçı, 2011) ortaya koyduğu, programların uygulanmasını olumsuz yönde etkileyen, ortak nedenler arasında yer almaktadır.

Yukarıda yer alan nedenlerin önemli bir bölümünün öğretmenlerin bilgi, deneyim ve tecrübeleri ile ilgili olması öğretmenlerin programların başarı veya başarısızlığı üzerindeki etkilerini bir kez daha açık bir şekilde ortaya koymaktadır.

Bu durum, dikkate alınarak 2013 yılında revize edilen fizik dersi öğretim programlarının sınıf içi uygulamalarının analiz edilmesi ve öğretmen pratiklerin analizi için kullanılabilecek bir ölçeğin geliştirilmesi hedeflenmiştir. Bu amaçla çalışma kapsamında Trabzon ili ve çeşitli ilçelerindeki Anadolu liselerinin fizik derslerini yürüten toplam 4 öğretmenle çalışılmıştır ve katılımcı öğretmenlerin dersleri 4 hafta süresince toplam her öğretmen için sekiz saatlik ders gözlemleri gerçekleştirilmiş ve bu derslerin video kaydı alınmıştır. Bu çalışma kapsamında video kaydı alınan ders gözlemlerinin betimsel analizi sonucunda ders gözlem formu olarak da kullanılabilecek "Ders Değerlendirme Formu" geliştirilmiştir.
Öğretmenlerin mevcut durumlarını belirlemek için ilk gözlemlerden elde edilen kayıtlar önce transkript yapılmış ve bu transkriptlerin betimsel analizi sonucunda, bu çalışma kapsamında, ders gözlem formu olarak da kullanılabilecek "Ders Değerlendirme Formu (DDF)" geliştirilmiştir. Verilerin analizi DDF'de yer alan temalar altında Nvivo9 paket programı kullanılarak analiz edilmiştir. DDF 6 tema (Derse giriş faaliyetleri,Dersin didaktiksel analizi, Öğretmen-öğrenci iletişim analizi, Öğrenci merkezli yaklaşımlar, Ölçme-değerlendirme yaklaşımları, Sınıf yönetimi) ve 47 koddan oluşmaktadır. Bu bağlamda, ilk olarak, Nvivo'da ham veriler, temalar altındaki kodlara göre analiz edilmiş daha sonra bu kodlamadan öğretmenlere ait veri tablolar ve grafikler oluşturulup öğretmenlerin sınıf içi pratikleri belirlenmiştir.

Ders video kayıtlarının DDF ölçeği eşliğindeki analizi A teması[12] için katılımcı öğretmenlerin tamamının "*A2: Ön bilgileri yoklama-hatırlatma", A3: Dikkatin çekilmesi, A4: Güdüleme* ve *A5: Hedeften haberdar etme"* faaliyetlerinde bir takım eksikliklerinin olduğu saptanmıştır. B-Teması olan Dersin Didaktiksel Analizine[13] göre öğretmenlerin sınıf içi pratikleri incelendiğinde, FÖ2 ve FÖ4 kodlu öğretmenlerin *"B3: öğretimsel açıklamaların yapılması"* faaliyetini çok fazla yaptıkları ve öğretmen merkezli bir yaklaşım sergiledikleri görülmüştür. Diğer taraftan B teması altında ortak olarak *B1*,B2, *B4, B5, B11, B12, B13, B14ve B15*kodlu uygulamaların tüm öğretmenlerde eksik olduğu saptanmıştır.

Öğretmen-Öğrenci İletişimi[14] (C Teması) açısından katılımcıların pratikleri incelendiğinde *C5: Beden dilini kullanma; C6: Ses tonunu etkili bir biçimde kullanma* faaliyetlerinde bir takım eksikliklerin olduğu belirlenirken öğretmenlerin bu başlık altında yer alan diğer faaliyetler için nitelikli uygulamalar yaptıkları tespit edilmiştir. mevcut öğretim programının en önemli esaslarından olan Öğrenci Merkezli Yaklaşımlar[15] (D Teması) açısından ders kayıtları analiz edildiğinde ortak olarak öğretmenlerin eksik olduğu faaliyetlerin; *D2, D4, D7, D8, D9, D10* olduğu belirlenmiştir.

Eğitim öğretim faaliyetlerinin en önemli bileşenlerinden olan Ölçme Değerlendirme Yaklaşımlarına[16] (E teması) göre öğretmen pratiklerinin analizi, bu tema altında yer alan faaliyetlerin önemli bir bölümünde eksikliklerin olduğunu ve bunların eğitim sisteminde süre gelen bazı nedenlerden dolayı nitelikli bir şekilde gerçekleştirilemediklerini göstermektedir (örn. *Materyal ve gereç kullanma (Teknolojiden faydalanma); Performansa dayalı ölçme-değerlendirme araçlarını kullanma, Değerlendirme çalışmalarına (Sınav, portfolyo, sunu, proje ödevi...) dönüt verme, Ders içi performans ödevi verme)*. Son olarak F temasını[17] ait kodların uygulamasında öğretmenlerin ortak olarak *"F-1:Sınıf içi etkili hareketler"* konusunda eksik oldukları saptanmıştır.

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[12] A1: Selamlama, sınıfa giriş; A2: Ön bilgileri yoklama-hatırlatma; A3: Dikkatin çekilmesi (örnek verme, soru sorma, karikatür vs.); A4: Güdüleme; A5: Hedeften haberdar etme

[13] B1: Bilimsel tartışmaların yapılması; B2: Öğrencilerin ders içerisinde etkili şekilde not tutmalarını teşvik etme; B4: Kasıtlı bilimsel tartışma ortamı hazırlama; B5: Dersin ana temalarını toparlayıcı açıklamalarda bulunma; B11: Ders sonu kısa tekrarlar; B12: Konu veya kavramları ilişkilendirme; B13: Ders sonu öğrenmeleri yoklama; B14: Günlük hayattan örnekler; B15: Bir sonraki dersin içeriğinden haberdar etme)

[14] C1; Karşılaşılan problem ve güçlüklere müdahale etme (Sınıf hâkimiyetini sağlama), C2; Gerginlik ve zıtlığın olduğu durumları kontrol altına alma, C3; Normlar, kurallar ve düzenlemeleri uygulama(Ahlaki davranışlar), C4; Öğrencilere isimleriyle hitap etme; C5; Beden dilini kullanma, C6; Ses tonunu etkili bir biçimde kullanma, C7; Sınıfta rahat bir öğrenme ve iletişim ortamı oluşturma)

[15] D-1: Konu anlatım sırasında düşündürücü kısa soru yapma (Alt düzeyde zihinsel aktivite, D-2: Öğrenciyi bilgiye ulaşma sürecinde zihinsel olarak aktif tutma, D-3: Öğrenciyi fiziksel olarak aktif tutma, D-4: Öğrenciyi bilgiye (yeni bilgiye) ulaştırma sürecini yaşatabilme, D-5: Öğrencinin cevaplarını, açıklamalarını dinleme ve dönütler verme, D-6: Öğrencinin yanlış yaptığında düzeltmesini sağlama ve yanlışının üzerine gitme, D-7: Öğrenciler arasında işbirliğinin olması, D-8: Bireysel aktivitelerin yapılması, D-9: Öğrenciye bilgiye ulaşma sürecinde rehber olma ve D-10: Öğrenci ihtiyacına göre esnek zaman planlaması yapma)

[16] E-1: Materyal ve gereç kullanma (Teknolojiden faydalanma), E-2: Geleneksel ölçme-değerlendirme araçlarının kullanma, E-3: Performansa dayalı ölçme-değ. araçlarını kullanma, E-4: Değerlendirme çalışmalarına (Sınav, portfolyo, sunu, proje ödevi...) dönüt verme, E-5: Ders içi performans ödevi verme ve E-6: Ders içi performans notu verme

[17] F-1: Sınıf içi etkili hareketler, F-2: İstenmeyen davranışı görmezden gelme ve F-3: Dışsal motivasyonu sağlama

Elde edilen bulgular, gözlenen öğretmenlerin etkili öğretimin gereklilikleri arasında yer alan sınıf içi faaliyetlerim uygulanmasında önemli eksikliklerinin olduğunu göstermektedir. Bir öğretim programının başarıya ulaşması öncelikle programın uygulayıcıları olan öğretmenlerin yeterlikleri ile ilgilidir. Bu konuda yapılan çalışmalar (Toptaş, 2006; Bulut, 2007; Özmantar vd. 2009), öğretmenlerin programlarda reform olarak nitelendirilen değişimi içselleştiremedikleri ve bu nedenle de uygulayamadıkları sonucunu ortaya koymuştur. Bu çalışma kapsamında kullanılan DDF'de yer A, B, C ve D Temalarının 2013 Fizik dersi öğretim programının çatısını oluşturan "temel beceriler ile öğrenme kuram ve yaklaşımları" ile ilişkili olduğu görülmektedir. Karakuyu (2008) yapmış olduğu çalışmada öğretmenlerin öğrencileri nasıl aktif hale getirmesi gerektiğine ilişkin gerekli tekniklere sahip olmadıklarına ve öğretmenlerin fizik dersini anlatmada günlük hayattan örnekler verme konusunda eksikliklerinin olduğuna vurgu yapmaktadır. Aynı şekilde bu çalışmada da özellikle öğrenci merkezli yaklaşımla ilişkili olarak "*D-2 öğrencilerin zihinsel olarak aktif tutma"* ve dersin didaktiksel analizi ile ilgili olarak "*B-15 günlük hayattan örnek verme* "konularında katılımcı öğretmenlerin sınıf içi faaliyetlerinin yeterli olmadığı tespit edilmiştir. Ölçme-değerlendirme ile ilgili sınıf içi faaliyetlerin analizi, katılımcı öğretmenlerin ölçme değerlendirme çalışmalarından faydalanmadıklarını ve buna bağlı olarak dönüt verme mekanizmasını nitelikli şekilde kullanmadıkları sonucunu ortaya koymuştur. Ölçme-değerlendirme açısından bakıldığında programın uygulanmasında Karacaoğlu ve Acar (2010) da programın ölçme-değerlendirme açısından uygulamada eksiklikleri olduğunu tespit etmiş ve bunu ders süresinin yeterli olmamasına bağlamışlardır.

Elde edilen sonuçlar, öğretmenlerin mevcut öğretim programlarını uygulama sürecinde desteklenmesi gerektiğini ortaya koymaktadır. Bu bağlamda belirli zamanlarda MEB tarafından tasarlanan ve uygulanan Hizmet İçi Eğitim Seminerleri ile ilgili akademik çalışmalar (Çelikten, Şanal ve Yeni, 2005; Öztürk ve Sancak, 2007) bu seminerlerin yetersizliğine işaret ederken bu çalışma kapsamında öğretmenlerin sürekli eğitiminin akademik başarıya, kariyer gelişimine ve kişisel gelişime olumlu katkılar sağladığı farklı araştırmacılar tarafından kabul edilen mentorluk uygulamaları (Kuzu vd. 2012) ile desteklenmesi önerilmektedir.

NOT

Bu çalışma TUBITAK 214K043 kodlu proje kapsamında gerçekleştirilmiştir.

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RELATIONSHIP OF MIDDLE SCHOOL STUDENT STEM INTEREST TO CAREER INTENT

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ABSTRACT: Understanding middle school students' perceptions regarding STEM dispositions, and the role attitudes play in establishing STEM career aspirations, is imperative to preparing the STEM workforce of the future. Data were gathered from more than 800 middle school students participating in a hands-on, real world application curriculum to examine the relationship of the students' interest in STEM and their intentions to pursue a career in a STEM field. Among the middle school students who completed surveys for the MSOSW project, 46.6% expressed a desire to pursue a career in STEM at the time of the post test. Regarding alignment of positive interest in STEM with intent to purse a STEM career, middle school students who have stated that they plan to pursue a career in STEM, also show higher dispositions toward STEM and STEM career measures. Gender differences were also examined, resulting in the finding that middle school males generally have greater intent to pursue a career in STEM, and also show more positive interest in STEM areas. However, females appear to more positively react to the project activities presented in this study than males, so over the course of a project year females tend to "catch up." This is true regarding assessed STEM interest as well as stated intent to pursue a career in STEM. These findings provide additional contributions to the growing base of knowledge about the importance of middle school aspirations for STEM careers.

Keywords: STEM interest, career intent, gender, climate change

MOTIVATED STRATEGIES FOR LEARNING IN SCIENCE, ENGINEERING AND MATHEMATICS COURSES

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ABSTRACT: This study presents college students' motivational orientations for courses from Science, Technology, Engineering and Mathematics (STEM). A self-report instrument including *Motivated Strategies for Learning Questionnaire* (Pintrich, Smith, Garcia, & McKeachie, 1991) was used in four courses of an international metropolitan university to investigate university students' motivation. This presentation discusses the students' motivational orientations by using six factors of motivation including control beliefs, intrinsic goal orientation, extrinsic goal orientation, self-efficacy, task value, test anxiety.

Motivated Strategies for Learning Questionnaire (MSLQ) was developed by Pintrich and De Groot (1990), revised by Pintrich and others (1991) and adapted to Turkish by Karadeniz and others (2008). Although MSLQ includes two parts, first part is to assess motivational orientations and second part is to asses learning strategies. This study is used only the first part, the motivation scale of MSLQ. The motivation scale includes six subscales (intrinsic goal orientation, extrinsic goal orientation, task value, control of learning beliefs, self-efficacy, and test anxiety) to assess students' motivational belief (Pintrich & DeGroot, 1990; Pintrich et al., 1991).

The subjects of the research consisted of 346 students from a metropolitan international university. Confirmatory Factor Analysis (CFA) was used in order to ensure whether the original factor structure of the motivation scale (MS) is valid for the current sample as well. According to goodness of fit (GOF) statistics for a model with 6 factors set in the scale, the results showed excessive latent correlation between two factors Intrinsic Goal Orientation and Task Value. Therefore, it was decided to combine these two factors, and thus, five-factorial model was accepted in this study. The internal consistency computed in terms of Cronbach's alpha and are presented in Table 1.

Table 1. Measures of Motivation Scale

Factors	Reliability (Cronbach-alpha)
Intrinsic Goal Orientation & Task Value	.87
Control Beliefs	.60
Extrinsic Goal Orientation	.71
Self-Efficacy	.92
Test Anxiety	.81

The combined subscales of Intrinsic Goal Orientation and Task Value (α=.87) represents perceived importance of class work (e.g., 'It is important for me to learn what is being taught in this class'), preference for challenge and mastery goals (e.g., 'I prefer class work that is challenging so I can learn new things'), and viewing course content and class materials as personally useful, interesting, and worth learning (e.g., 'I think I will be able to use what I learn in this course in other courses') (Pintrich & DeGroot, 1990; Pintrich et al., 1991).

The Control of Learning Beliefs subscale (α=.60) represents students' beliefs and efforts to learn in order to be able to have control over their level of achievement (e.g., 'If I study in appropriate ways, then I will be able to learn the material in this course') (Pintrich & DeGroot, 1990; Pintrich et al., 1991).

The Extrinsic Goal Orientation subscale (α=.71) assesses the degree to which a student participates in the academic task in to obtain good grades or rewards (e.g., 'Getting good grade in this class is the most satisfying thing for me right now') (Pintrich & DeGroot, 1990; Pintrich et al., 1991).

The Self-Efficacy subscale (α=.92) represents confidence in performance of class work (e.g., 'I'm certain I can master the skill being taught in this class') (Pintrich & DeGroot, 1990; Pintrich et al., 1991).

Test Anxiety subscale (α=.81) represents students' concerns and cognitive interference on tests (e.g., 'When I take a test I think about how poorly I am doing compared with other students') (Pintrich & DeGroot, 1990; Pintrich et al., 1991). Higher scores on this scale reflected greater test anxiety.

The current study showed that the construct of four subscales (Control Beliefs, Extrinsic Goal Orientation, Self-Efficacy, and Test Anxiety) functioned well with university students in STEM courses, while the combined two subscales (Intrinsic Goal Orientation and Task Value) was considered that they measured the same feature by differently its original form as in the MSLQ.

Keywords: motivational orientations, university students, STEM, MSLQ.

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PROPERTIES OF EDUCATIONAL GAMES FOR MATHEMATICS: IOS APPLICATIONS FOR ARITHMETIC OPERATONS

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Games are stated as whether goal-oriented or not, performed regular or irregular, in which children take part in willingly and delightfully, which is a basic for physical, cognitive, language, emotional and social development, a part of a real life and the most effective learning process (Dönmez, 1992). Games are an activity which effects the character of children totally in a broad sense (Gürün, 1984).

In several studies in which the effects of educational games to the learning process, the findings that the games positively affect the success and attitude towards lessons (Taşlı, 2003; Yıldıran, 2004; Tural, 2005; Songur, 2006; Yurt, 2007; Yağmur, 2013); the students actively participate in the lessons when the subjects are learned via educational games and activities (Stupiansky, Stupiansky and Nicholas, 1999; Geer (1992); learning with games help students develop new skills in their knowledge and comprehension levels (Monroe and Nelson, 2003); and the learnings supported by games are more permanent (Altunay, 2004) have been figured out (cited by Duran and Kaplan, 2014).

As a result of recently performed studies; it is observed that by mathematical games and game assisted teaching, the attitude and success level towards mathematics is increasing day by day (Aksoy, 2010; Clark & Ernst, 2009; Kablan, 2010). Accordingly, especially in digital platforms, as in many disciplines, many games are recently being developed also in Mathematics and the children are enabled to play. However, considering that these games are not only fun aimed and they have educational aspects, these kinds of games should have some specific characteristics.

The method of the study has been determined as document research. Document research is called to obtain data by analysing written documents including information on facts and events about the research subject in the scope of research. A great deal of information about the research area can be obtained by document research without needing interview or observation. Documents such as the reports, books, archive files, video and voice recordings and photographs about the research subject should be analysed systematically by controlling the originality (Yıldırım and Şimşek, 2008).

Study Group: The games, performed by IOS applications which include four mathematical operations used in Mathematic education, form the study group. 25 IOS applications in http://www.edshelf.com platform and in App Store have been selected for this study. .

Data Collecting Tool: For evaluating the chosen applications for the study in educative aim, some criteria have been developed and opinions have been taken from five experts in the area. Obtained criteria are as follows:

1. The level of the classroom and the questions
2. Chronometry in the games
3. Question types in the games
4. Clues in the games
5. True or False notifications at the end of the games

In none of the 25 games researched in the scope of the study, a class level selection takes place at the beginning in the game. In most of the games, speed is important for the players because time is measured. In the games, multiple choice and open ended questions are used. In very few of the games clues are given to lead the students to the correct answers or to provide to correct the wrong answers. In very few of the games players learn the correct answer when they make a mistake.

As a result of the performed research, it could be uttered that, generally, in the design of the educational games, "educative" dimension has not been taken into consideration. Accordingly, to the studies to be performed hereafter it would be recommended that criteria having importance in the design of educational games should be determined and appropriate designs should be developed according to those criteria.

STUDENT VIEWS WITH REGARD TO THE WEB-BASED PROBLEM SOLVING METHOD

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ABSTRACT: The purpose of this study is to determine the views of 2nd year students at a university who received the Programming course designed in accordance with the Web-based Problem Solving Method about the said method (WBPSM). The views of 11 students selected from among the 29 students who had taken the course on a voluntary basis were elicited concerning WBPSM. In this study, in which the qualitative research method was used, the semi-structured interview technique was used as the data collection instrument. The interview form, which consisted of 12 open-ended questions, was administered to the 11 students, who had taken the course. As a result of the analysis of the data obtained from the students, it was seen that the students had stated that WBPSM supported individual learning, raised interest in the course, ensured non-spatial learning, increased their self-confidence in learning on their own, gained them problem solving ability, enabled them to assume responsibility in learning, encouraged them investigate, saved time and that it was applicable for other courses, too.

Key words: Web-based learning, Problem solving, Qualitative research.

THE EFFECTS OF KINDS AND NUMBERS OF TECHNOLOGY EDUCATION ON TEACHERS' PERCEPTIONS OF TECHNOLOGIC-PEDAGOGIC KNOWLEDGE, ACCESS TO TECHNOLOGY TOOLS AND SUPPORT OF USE OF TECHNOLOGY TOOLS

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ABSTRACT: In this study, investigate in service technological educational with and without teachers to different variables(Perceptions of Technological Pedagogical Knowledge, Perception Towards the Use of Technology and Perceptions Towards Technological Instruments to Access) whether significant differences between perceptions.

Research questions is formed technological-pedagogical knowledge perceptions, perceptions regarding the use of technology and teachers receive support on the use of technology and encountered barriers with related according to teachers taken different technological education (Fatih Project Technology Education, General Technology Education and Their Self-study) whether significant differences between perceptions of teachers and according to number of teachers taken different technological education [taken 1,2 or 3 training (Fatih Project Technology Education, General Technology Education and Their Self-study)] technological-pedagogical knowledge perceptions, perceptions regarding the use of technology and teachers receive support on the use of technology and encountered barriers with related whether significant differences between perceptions of teachers.

Working group is formed (297) branch teachers who in service technological educational with and without teachers 2014-2015 academic year of working in middle schools and high schools in Konya. In this study, data were collected through questionnaires and survey, "personal information" and "Questionnaire" is made up of parts.

Personal information is formed gender, age, graduation, length of service, branch, types of schools made the task, the use of technology level, access status to the technology needed in schools, the case of teacher training about technological information. The part of survey is formed 4Likert-type(Absolutely I agree, I agree, I disagree, strongly disagree) 40 questions which using teachers' perceptions of technology, pedagogical beliefs, technological beliefs, teachers receive among support on the use of technology and encountered barriers to determine how a relationship.

Alpha reliability coefficient was calculated for each a scale on item of scale and on the overall survey scores is made the Shapiro-Wilk normality tests. None of the scale total score was normally distributed($p<.05$). This conclusion is based on non-parametric Kruskal-Wallis test was used in order to determine whether significant differences in intra-group to answer of two research questions and Mann-Whitney U test was used to compare pairs subgroups (types of technology training and technology training received numbers).

Research results have been shown to have effects on different perceptions (technological-pedagogical knowledge perceptions, perceptions regarding the use of technology and perception of teachers received support on the use of technology and encountered barriers) about technology, technology-in service training of teachers making both negatively and positively.

Key words: Technology education, in-service training, technological pedagogical perception, use of technology, integration

ÖĞRETMENLERİN ALDIKLARI FARKLI TEKNOLOJİ EĞİTİMLERİNİN VE BU EĞİTİMLERİN SAYILARININ ÖĞRETMENLERİN TEKNOLOJİK PEDAGOJİK BİLGİ ALGILARINA, TEKNOLOJİK ARAÇLARIN ERİŞİMİNE YÖNELİK ALGILARINA VE TEKNOLOJİK ARAÇLARIN KULLANIMINA YÖNELİK DESTEK ALGILARINA ETKİSİ

ÖZET: Bu çalışmada, hizmet içi teknoloji eğitimi alan ve almayan öğretmenlerin farklı değişkenlere[Teknolojik Pedagojik Bilgi Algıları (TPBA), Teknoloji Kullanımına Yönelik Algıları (TKYA) ve Teknolojik Araçların Erişimine Yönelik Algıları (TAEYA)] göre algıları arasında anlamlı farklılık olup olmadığı araştırılmıştır. Araştırma soruları, öğretmenlerin aldıkları farklı teknoloji eğitimine göre (Fatih Projesi Teknoloji Eğitimi, Genel Teknoloji Eğitimi ve Kendi Kendine Çalışma) teknolojik-pedagojik bilgi algıları, teknoloji kullanımına yönelik algıları ve teknoloji kullanımına ilişkin aldıkları destekler ve karşılaştıkları engeller ile alakalı algıları arasında anlamlı farkın olup olmadığı ve öğretmenlerin aldıkları farklı teknoloji eğitimi sayısına göre [1, 2 veya 3 tane eğitim alan) Teknoloji Eğitimi, Genel Teknoloji Eğitimi ve Kendi Kendine Çalışma] teknolojik-pedagojik bilgi algıları, teknoloji kullanımına yönelik algıları ve teknoloji kullanımına ilişkin aldıkları destekler ve karşılaştıkları engeller ile alakalı algıları arasında anlamlı farkın olup olmadığı ile alakalı sorulardan oluşmuştur.

Çalışma grubu FATİH Projesi kapsamında hizmet içi eğitim alan ve almayan 2014–2015 Eğitim-Öğretim yılında Konya'da orta okullarda ve liselerde görev yapan (297) branş öğretmenlerinden oluşmuştur. Bu araştırmada veriler anket yoluyla toplanmış ve anket, "Kişisel bilgiler" ve "Anket" kısımlarından oluşmuştur. Kişisel bilgiler kısmı; cinsiyet, yaş, mezuniyet, hizmet süresi, branş, görev yapılan okul türü, teknoloji kullanım seviyesi, okuldaki ihtiyaç duyulan teknolojiye erişim durumu, teknolojik bilgi konusundaki öğretmenlerin eğitim durumundan oluşmakta, anket kısmı ise öğretmenlerin teknoloji kullanma algıları, pedagojik inançları, teknolojik inançları, teknolojiyi kullanmada aldıkları destekler ve teknolojiyi kullanmada karşılaştıkları engeller arasında nasıl bir ilişki olduğunu belirlemeye yönelik 4'lü likert tipi(kesinlikle katılıyorum, katılıyorum, katılmıyorum, kesinlikle katılmıyorum) kırk tane sorudan oluşmaktadır.

Ölçek maddeleri üzerinden her bir ölçeğin alfa güvenirlik katsayısı hesaplanmış ve toplam anket puanları üzerinde de Shapiro-Wilk normallik testleri yapılmıştır. Ölçeklerin toplam puanlarının hiç birisi normal dağılmamıştır ($p<.05$). Bu sonuca göre iki araştırma sorusunun cevabı için grup içi farkların anlamlı olup olmadığını belirlemek amacı ile parametrik olmayan Kruskal-Wallis testi ve alt grupları (teknoloji eğitimi çeşitleri ve alınan teknoloji eğitimi sayıları) ikişerli karşılaştırmak için Mann-Whitney U testi kullanılmıştır.

Araştırma sonucunda hizmet içi teknoloji eğitimlerinin yapılmasının öğretmenlerin teknoloji konusundaki farklı algıları (Teknolojik Pedagojik Bilgi Algısı, teknoloji kullanımına yönelik algıları ve teknoloji kullanımına ilişkin aldıkları destekler ve karşılaştıkları engeller ile alakalı algıları) üzerinde hem olumlu hem de olumsuz yönde etkilere sahip olduğu görülmüştür.

Anahtar Sözcükler: Teknoloji eğitimi, hizmet içi eğitim, teknolojik pedagojik algı, teknoloji kullanımı, entegrasyon

INVESTIGATION OF OPINIONS OF PRE-SERVICE TEACHERS REGARDING ONLINE CASE STUDY LIBRARY (fatih2023.net)

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ÖZET: Bu araştırmanın amacı, öğretmenlerin Fırsatları Artırma ve Teknolojiyi İyileştirme Hareketi (FATİH) Projesi uygulamalarını kullanma durumlarının öğretmen adayları tarafından gözlemlenmesi ile oluşturulan etkileşimli-çevrimiçi bir örnek olay kütüphanesine yönelik öğretmen adaylarının görüşlerinin incelenmesidir. Bu amaç doğrultusunda, oluşturulan örnek olay kütüphanesi Coğrafya Öğretmenliği bölümündeki öğretmen adaylarının öğretmenlik uygulaması dersinde kullanılmıştır. Daha sonra, örnek olay kütüphanesinin eğitsel olarak işlevselliğine yönelik öğretmen adaylarının görüşlerine başvurulmuştur. 11 öğretmen adayının katıldığı araştırmada veri toplama aracı olarak yarı-yapılandırılmış görüşme formu kullanılmıştır. Elde edilen veriler NVivo 10 programı yardımı ile nitel araştırma yöntemlerinden betimsel analiz ile incelenmiştir. Elde edilen verilerin analizine göre araştırma bulguları beş tema altında toplanmıştır. İlgili temalar şu şekildedir: öğretmen adayı olarak sağladığı fayda, öğretmenlikte akıllı tahtaları kullanma, öğretmenlikteki pedagojik yaklaşım, örnek olayların öğretmenlikte sağlayacağı fayda, teknolojiyi kullanan öğretmenin dikkat çekmesi. Çevrimiçi kütüphanede yer alan örnek olayların incelenmesi öğretmen adaylarında *"ben olsam bu durumda ne yapardım düşüncesi", "gelecekteki sınıf-içi problemlere yönelik farkındalık", "teknik bir sorunu gidermede yetersiz hissetme", "öğretimde kullanılan yazılım farkındalığı"* oluşmasını sağlamıştır. Öğretmen adaylarının göre empati ve farkındalık düzeylerine katkı sağlayan çevrimiçi etkileşimli web sayfası öğretmen eğitiminde kullanılabilir.

Anahtar Kelimeler: FATİH Projesi, Örnek Olay, Veri Kütüphanesi, Öğretmen Eğitimi

ÇEVRİMİÇİ ÖRNEK OLAY KÜTÜPHANESİNE (fatih2023.net) İLİŞKİN ÖĞRETMEN ADAYLARININ GÖRÜŞLERİNİN İNCELENMESİ

ABSTRACT: The purpose of this study is to examine pre-service teachers' opinions regarding an interactive online case study library which contains in-service teachers' use of technologies provided by the Movement of Enhancing Opportunities and Improving Technology (FATIH) Project. For this purpose, the case study library designed was utilized in teaching practice classes of pre- service teachers who study at the department of geography education. Afterwards, pre-service teachers have been asked about the educational functionality of the library. A semi-structured interview form was used to collect the data in the study in which 11 pre-service teachers participated in. The obtained data were analyzed by descriptive analysis of qualitative research methods using NVivo 10. According to the analysis of the data obtained, research findings are grouped under five themes. Related themes are as follows: benefits as a candidate, using interactive whiteboards in teaching, pedagogical approaches in teaching, benefits of the case studies in teaching, and drawing attention of a teacher who uses technology effectively. Pre-service teachers' examination of the case studies in the online library has contributed them in these subjects: *"thinking of what I would do in this situation", "awareness for future in-class problem", "feeling incapable of solving a technical problem" and "software awareness used in education."* According to the pre-service teachers, online interactive web site that increases the level of empathy and awareness can be used in teacher education.

Keywords: FATIH Project, Case based library, Teacher education

NOT: Bu çalışma, Türkiye Bilimsel ve Teknolojik Araştırma Kurumu (TÜBİTAK) tarafından desteklenen 113K302 numaralı "FATİH Projesi Uygulamalarının Teknolojik-Pedagojik-Alan Bilgisi (TPAB) Çerçevesinde Gözlemlenmesi ve Çevrimiçi Örnek Olay Kütüphanesi Oluşturulması" başlıklı proje kapsamında hazırlanmıştır. Yazarlar, bu çalışmaya desteğinden dolayı TÜBİTAK'a teşekkür eder. Bu çalışma, ilk yazarın proje kapsamında yapılan doktora tezinden üretilmiştir.

GİRİŞ

2010 yılı Kasım ayında kamuoyuna duyurulmuş olan FATİH Projesi ile e-dönüşüm kapsamında üretilen ve bilgi toplumu olma sürecindeki faaliyetleri tanımlayan Bilgi Toplumu Stratejisi Belgesi, Kalkınma Planları, MEB Stratejik Planı ve Bilişim Teknolojileri (BT) Politika Raporunda yer alan hedefler doğrultusunda 2015 yılı itibariyle dersliklere BT araçları sağlanarak, BT destekli öğretimin gerçekleştirilmesi amaçlanmıştır (MEB, 2015). FATİH Projesinin uygulandığı okullardan mezun olan bireylerin bilgi ve teknolojiyi gündelik ve iş yaşamlarında etkin kullanmaları ile ülkemizin bilgi toplumuna dönüşümü hedeflenmektedir. Bilgi ve iletişim teknolojileri eğitim sürecinin temel araçlarından birisi olduğundan öğrenci, öğretmen ve eğiticiler tarafından bu teknolojilerin etkin kullanımı amaçlanmaktadır (Bilici & ark., 2011). FATİH Projesinde, eğitim ve öğretimde fırsat eşitliğini sağlamak ve okullarımızdaki teknolojiyi iyileştirmek amacıyla BT araçlarından öğrenme-öğretme sürecinde daha fazla duyu organına hitap edecek şekilde; tüm okul kademelerindeki 570.000 dersliğe etkileşimli tahta ve internet altyapısı sağlanacaktır. Proje kapsamında, öğrencilere ve MEB bünyesinde çalışan bütün öğretmenlere tablet bilgisayarlar verilecektir. BT den etkin bir şekilde yararlanılması için öğretmenlere hizmet içi eğitimde verilecek olan FATİH Projesinde, öğretim programları BT destekli öğretime uyum için e-içerikler oluşturulacaktır. Bu kapsamda, eğitimde FATİH Projesinin beş temel bileşeni bulunmaktadır (MEB, 2015).

- Donanım ve Yazılım Altyapısının Sağlanması
- Eğitsel e-İçeriğin Sağlanması ve Yönetilmesi
- Öğretim Programlarında Etkin BT Kullanımı
- Öğretmenlerin Hizmet-içi Eğitimi
- Bilinçli, Güvenli, Yönetilebilir ve Ölçülebilir BT Kullanımının Sağlanması

Çevrimiçi Örnek Olay Kütüphaneleri

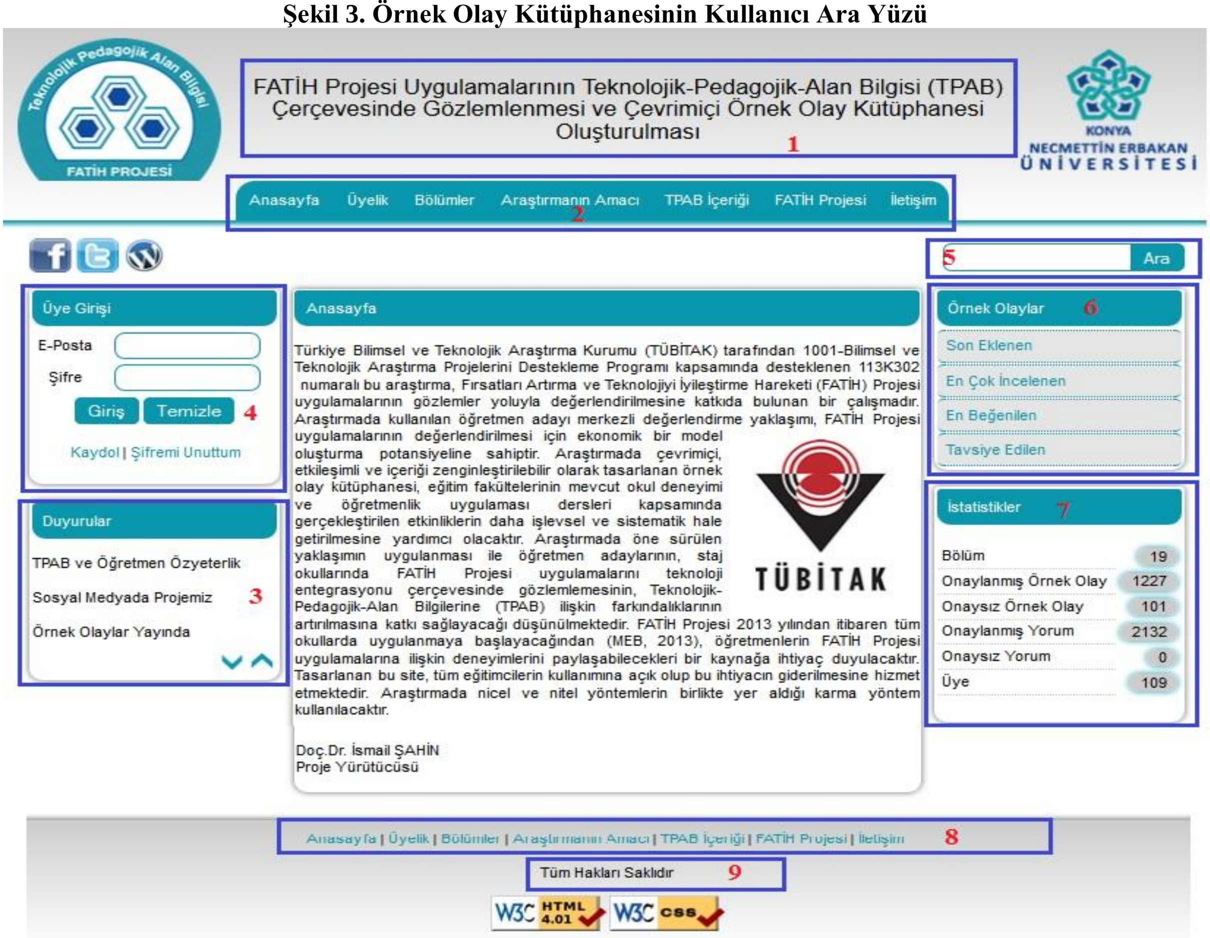
Örnek olay yöntemi, hem bir öğretim yöntemi (Güçlüol, 1985; Küçükahmet, 2001) hem de bir araştırma modeli (Karasar, 2005; Nisbet & Watt, 1984; Yıldırım & Şimşek, 1999) olarak kullanılmaktadır. Araştırma modeli olarak örnek olay yöntemi, güncel bir olguyu kendi gerçek yaşam çerçevesi içinde çalışan, olgu ve içinde bulunduğu içerik arasındaki sınırların kesin hatlarıyla belirgin olmadığı ve birden fazla kanıt veya veri kaynağının mevcut olduğu durumlarda kullanılan, görgül bir araştırma yöntemi olarak tanımlanabilir (Yıldırım & Şimşek, 1999). İlk olarak 1910 yılında Harvard Üniversitesi Hukuk Fakültesinde bir öğretim yöntemi olarak kullanılan örnek olaylar, ilerleyen zamanlarda tıp eğitimi, ekonomi ve diğer sosyal bilimler alanlarında da giderek yaygınlaşmıştır (Kimbal, 2006). Gerçek yaşam deneyimleri ile öğrencileri yüz yüze getirerek öğretim ortamında kuram ve uygulama arasındaki boşluğun doldurulmasına yardımcı olan bir yöntem olarak belirtilen (Stensmo, 1999) örnek olay yönteminin öğretmen eğitiminde kullanılması üzerine ilk çalışmalar Shulman (1988) tarafından yapılmıştır. Shulman eğitim fakültesinde çalışan birçok akademisyenin yaşadıkları okul tecrübelerinden bölümler ve örnekler sunan örnek olaylarla çalıştıklarını belirtmiştir. İlgili alanyazın incelendiğinde örnek olay kütüphaneleri, kullanıcıların gerçek durumlara ait örnek olaylara ilişkin hikâyelere ulaşabilecekleri çevrim içi ortamlar olarak tanımlanabilir (Hughes, Packard, & Pearson, 2000; Kurz, Llama, & Savenye, 2008; Şahin & ark., 2010). Örnek olay kütüphanesinin çevrim içi olması web 2.0 teknolojileri ile etkinliklerin kalitesini yükseltmekte ve öğrenenlerin herhangi bir mekana bağımlı kalmaksızın içeriği derinlemesine analiz edip tartışmalarına olanak sağlamaktadır. Çevrimiçi ortamlardaki örnek olay kütüphanelerinde, örnek olayda geçen problemlerle ilgili olarak öğrenci, uzman veya öğretmenlerin bakış açılarını anında görebilir. Buna ek olarak, öğretmen öğrenciye eş zamanlı olarak geribildirim verebilir. Üstelik metin, video, animasyon ve hikaye gibi öğretimsel multimedya bileşenleri, örnek olaydaki kavram ve ilkelerle ilgili zengin bir anlayışı kazanmalarına yardım edebilir (Uluyol, 2011). Alanyazın incelendiğinde örnek olay yönteminin teknoloji entegrasyonu kapsamında da kullanıldığı görülmektedir. Yapılan bir çalışmada, Geleceğin Öğretmenlerini Teknoloji Kullanmaya Hazırlama Programı (Preparing Tomorrow's Teachers to use Technology-PT^3) kapsamında teknolojinin öğretime entegrasyonu konusunda özellikle kuram ve sınıf uygulamaları arasındaki boşluğu gidermek amacıyla çoklu ortam destekli örnek olayların önemine değinilmiştir. İlgili çalışmada örnek olay, öğretim yönteminin yazılı biçimden video ve çoklu ortam biçimine geçiş sürecini ele alarak, çoklu ortam destekli örnek olayların öğretmen adaylarının teknoloji entegrasyon bilgisini geliştirdiği sonucuna ulaşılmıştır (Monroe-Baillargeon, 2002).

FATİH Projesi Uygulamalarına Yönelik Örnek Olay Kütüphanesi

Prof.Dr.İsmail ŞAHİN'in yürütücülüğünü yaptığı 113K302 numaralı TÜBİTAK projesi kapsamında bir örnek olay kütüphanesi oluşturulmuştur. Bu kütüphane, web-tabanlı olarak geliştirilmiş olup "Örnek Olaylar", "Araştırmanın Amacı", "TPAB İçeriği", "FATİH Projesi", "İletişim" gibi menüleri içermiştir. Web sitesinin geliştirilmesinde, ADDIE Tasarım Modeli'nden yararlanılmıştır. Bu web sitesinde, öğretmen veya öğretmen adayları (okul türü, konu alanı, sınıf düzeyi, okul yerleşim bölgesi veya kullanıcı tanımlı anahtar kelimeler gibi) farklı değişken veya kritere göre örnek olay sorgulaması yapılabilir. Ayrıca, listelenen sonuçlar, örnek olay başlığı, eklenme tarihi, kullanıcı derecelendirmesi, görüntülenme sayısı gibi ölçütlere göre sıralanabilir. Bu sistemin web tabanlı olması; yeni verilerin eklenmesi, güncellenmesi ve bu verilere her zaman ulaşılabilir olması açısından önemlidir. Bu sitede yer alan örnek olaylara kullanıcılar yorum yazıp ve bunları puanlayabilir. Web sayfasının tasarım amacı; projenin amacı doğrultusunda ve kapsamı çerçevesinde, eğitimciler için etkileşimli, zenginleştirilebilir, örnek olay tabanlı ve çevrimiçi eğitsel bir kaynak sunmaktır. Bu amaç doğrultusunda web sitesi ile ilgili aşağıdaki işlemler gerçekleştirilmiştir:

- Araştırmanın amaçları ve kazanımlarından site kullanıcıları haberdar edilmiştir.
- Örnek olay ve TPAB hakkında bilgilendirme yapılarak proje kapsamı açıklanmıştır.
- Kullanıcıların üyelik sistemi ile gözlemlerini dijital olarak da göndermesi sağlanmıştır.
- Kullanıcılara, gönderdikleri gözlemleri gözden geçirme ve düzenleme imkânı sunulmuştur.
- Site yöneticisi tarafından, gözlemlerin bir kontrol paneli aracılığıyla görüntülenmesi sağlanıp, yönetim paneli aracılığıyla gözlemlerin uygun etiket ve açıklamalarla örnek olay formatına dönüştürülerek örnek olay kütüphanesinde yayınlanmıştır.
- Kullanıcılara, yayınlanan örnek olayları oylama ve bunlara yorum bildirme imkânı sunulmuştur.
- Site yöneticilerinin yapılan yorumları kontrol paneli aracılığıyla gözden geçirmeleri ve onay verme/silme/düzenleme işlemlerine olanak sağlanmıştır.
- Örnek olaylar için hızlı (anahtar kelime ile) ve gelişmiş arama (içerik, yazar, etiket, alan, yerleşim, vb. seçimli) özellikleri sunulmuştur.
- Kullanıcılara, örnek olayların arama sonuçlarının, belirli kriterlere (Başlık, Oylama Puanı, Okunma Sayısı, Eklenme Tarihi, vb.) göre artan/azalan olarak sıralatmasına imkân sağlanmıştır.
- Kullanıcıları geri bildirim sürecine dâhil etmek için örnek olaylar altına "Hata Bildirme" linki ve formu yerleştirilmiştir.
- Web sitesi kullanıcılarının site ve araştırma hakkında görüş ve önerilerini almak için "İletişim" menüsü altında bir iletişim formu sunulmuştur.

Şekil 3. Örnek Olay Kütüphanesinin Kullanıcı Ara Yüzü



YÖNTEM

Bu araştırmanın amacı, öğretmenlerin FATİH Projesi uygulamalarını kullanma durumlarının öğretmen adayları tarafından gözlemlenmesi ile oluşturulan etkileşimli-çevrimiçi bir örnek olay kütüphanesine yönelik öğretmen adaylarının görüşlerinin incelenmesidir. Bu amaç doğrultusunda, oluşturulan örnek olay kütüphanesi Coğrafya Öğretmenliği bölümündeki öğretmen adaylarının öğretmenlik uygulaması dersinde kullanılmıştır. Daha sonra, örnek olay kütüphanesinin eğitsel olarak işlevselliğine yönelik öğretmen adaylarının görüşlerine başvurulmuştur. Bu kapsamda elde edilen veriler nitel araştırma yöntemi prensiplerine göre analiz edilmiştir.

Araştırma Süreci ve Katılımcılar

Araştırmanın katılımcılarını Necmettin Erbakan Üniversitesi Coğrafya Öğretmenliği son sınıfta öğrenim gören öğretmen adaylarından oluşmuştur. Öğretmen adayları örnek olay kütüphanesini 2013-2014 eğitim-öğretim yılı bahar döneminde öğretmenlik uygulaması dersi kapsamında kullanmışlardır. Öğretmen adaylarından örnek olayları inceleyip yorumlamalarına ek olarak sitede bulunan gözlem formunu okullarda anlattıkları dersle ilgili kendileri için doldurmaları istenmiştir. Araştırmanın katılımcılarını uygulama sürecinde çalışmalara katılımda gösterdikleri istek ve yazdıkları yorumlar dikkate alınarak çok istekli olanlardan 4, orta düzeyde istekli olanlardan 4 ve isteği düşük olanlardan da 3 kişi olmak üzere 11 kişilik grup oluşturmaktadır. 11 öğretmen adayının 5'i erkek 6'sı kızdır.

Veri Toplama Aracı

Araştırma kapsamındaki veriler öğretmen adaylarından yarı-yapılandırılmış görüşme formları kullanılarak toplanmıştır. Görüşme formu, öğretmen adaylarının oluşturulan çevrimiçi örnek olay kütüphanesinin içeriği hakkındaki düşüncelerini daha detaylı bir şekilde elde edebilmek için oluşturulmuştur. Görüşme formu, araştırmacı tarafından detaylı literatür incelemesi yapılarak hazırlanmıştır. Hazırlanan formda eğitsel işlevsellik bölümü ile ilgili 5 açık uçlu soru yer almaktadır. Bu sorular şu şekildedir:

- Bir öğretmen adayı olarak web sitesinde yer alan örnek olayları incelemenizin size faydalı olduğunu düşünüyor musunuz?
- Öğretmenliğe başladığınızda incelediğiniz örnek olayların sizlere nasıl yol göstereceğini düşünüyorsunuz?
- Web sitesindeki örnek olayları inceledikten sonra öğretmenlikte kullanacağınız pedagojik yaklaşımın değiştiğini düşünüyor musunuz?
- Derslerinde teknolojiyi etkin bir şekilde kullanan öğretmen ilginizi çekti mi? Staj öğretmeninin kullandığı bu yöntemi öğretmenliğe başladığınızda kullanmayı sizde düşündünüz mü? Neler söylemek istersiniz?
- Web sitesindeki örnek olayları inceledikten sonra öğretmenliğe başladığınızda FATİH Projesi teknolojilerini derslerinizde kullanma konusunda neler düşünüyorsunuz?

Verilerin Analizi

Yarı yapılandırılmış görüşme formlarından elde edilen veriler, betimsel analiz ile incelenmiş olup ve verilerin kodlanmasında NVivo 10 programı kullanılmıştır. Betimsel analizde amaç, görüşmeler sonucunda elde edilen bulguları düzenlenmiş ve yorumlanmış bir biçimde sunmaktır. Görüşülen bireylerin görüşlerini çarpıcı bir biçimde yansıtmak amacıyla doğrudan alıntılara sık sık yer verilmektedir. Betimsel analiz dört aşamadan oluşmaktadır(Yıldırım & Şimşek, 2011):

1. Betimsel analiz için bir çerçeve oluşturma,
2. Tematik çerçeveye göre verilerin işlenmesi,
3. Bulguların tanımlanması,
4. Bulguların yorumlanması

Bu amaçla görüşme formlarından elde edilen veriler örnek olay kütüphanesinin eğitsel işlevselliği ile ilgili daha önceden belirlenen temalar altında kodlanarak analiz edilmiştir. Ortaya çıkan bulguları çarpıcı bir şekilde yansıtmak amacıyla doğrudan alıntılara yer verilmiştir. Veri analizinde her bir öğretmen adayına analizi ve bulguları yorumlamayı kolaylaştırmak amaçlı bir kod atanmıştır.

BULGULAR

Görüşme formundaki ilgili sorular için elde edilen verilerden ulaşılan tema ve alt temalar Tablo 1'de verilmiştir.

Tablo 1. Örnek Olay Kütüphanesinin Eğitsel İşlevsellik Durumu

Temalar	*Alt Tema*	*f*	*%*
Öğretmen Adayı Olarak Sağladığı Fayda	Ben Olsam Bu Durumda Ne yapardım Düşüncesi	4	10.26
	Gelecekteki sınıf-içi problemlere yönelik farkındalık	3	7.70
	Nasıl Bir Öğretmen Olunacağına Dair Planlar	2	5.13
	Staj Okulunda Uygulama	2	5.13
Öğretmenlikte Akıllı Tahtaları Kullanma	Hizmet-içi Eğitime İhtiyaç Öngörüsü	1	2.56
	Kullanım Konusunda Öz-Güven	1	2.56
	Teknik Bir Sorunu Gidermede Yetersiz Hissetme	1	2.56
Öğretmenlikteki Pedagojik Yaklaşım	Derslerin Nasıl İşlenmesi Gerektiği Konusunda Farkındalık	3	7.70
	İletişim Şeklinin Nasıl Olması Gerektiği	5	12.82
	Yapılandırmacı Yaklaşımı Benimseyen Öğretmenin Dikkat Çekmesi	1	2.56
Örnek Olayların Öğretmenlikte Sağlayacağı Fayda	Gelecekte Karşılaşılacak Probleme Çözüm Üretme	3	7.70
	Materyalleri İşlevsel Kullanma Farkındalığı	2	5.13
	Yapılan Hataları Tekrarlamama	5	
Teknolojiyi Kullanan Öğretmenin Dikkat Çekmesi	Dersi Planlama Yöntemini Örnek Alma ve Uygulama	3	7.70
	Kullanılan Yazılım Farkındalığı	1	2.56
	Teknolojik Araç Çeşitliliği	2	5.13
Toplam		**39**	**100**

Örnek olay kütüphanesinin eğitsel işlevsellik durumu Tablo-4.19 ve Şekil-4.14 gösterilmiştir. Verilerin analizinden ulaşılan temalara ilişkin örnekler aşağıdadır:

"…Bana gerçekten faydalı oldu mesela oradaki örnek olayı okuyup kendim buradan ne çıkarıyorum yani bu konu hakkında ben olsam ne yapardım şeklinde düşünmemi sağladı.." [12Ady_COG_E]- (Öğretmen Adayı Olarak Sağladığı Fayda/Ben Olsam Bu Durumda Ne yapardım Düşüncesi)

"…ilerde göreve başladığımız zaman aynı problemlerle karşılaştığımda belki onlara yardımcı olabilir bu örnek olaylar..." [23Ady_COG_K]-(Öğretmen Adayı Olarak Sağladığı Fayda/Ben Olsam Bu Durumda Ne yapardım Düşüncesi)

*"…faydalı olduğunu düşünebilirim ya tecrübesizliğime az da olsa katkısı olabilir ve kesinlikle okudukça ben okudukça böyle olmam diyor insan…"[*20Ady_COG_E]-(Öğretmen Adayı Olarak Sağladığı Fayda/Nasıl Bir Öğretmen Olunacağına Dair Planlar)

"…uygulama okulunda ders anlatırken okuduğum ee örnek olaydaki öğretmenin ders anlatış şeklindeki gibi konuyu anlattım..." [31Ady_COG_K]-(Öğretmen Adayı Olarak Sağladığı Fayda/Staj Okulunda Uygulama)

"…ya akıllı tahta konusunda biraz hani uygulamaya dönük bir şey sadece örnek olaylarla okuyarak değil de eee bunun bir eğitimini ya da en azından bir hizmet içi eğitim ya da bir şekilde onda eğitimi almalıyız diye düşünüyorum..." [35Ady_COG_E]-(Öğretmenlikte Akıllı Tahtaları Kullanma/Hizmet-içi Eğitime İhtiyaç Öngörüsü)

"…aynen sıkıntı yaşayacağımı düşünmüyorum. Kesinlikle yani teknolojiden zaten birebir içinde olduğum için yaşayacağımı düşünmüyorum…"[6Ady_COG_K]-(Öğretmenlikte Akıllı Tahtaları Kullanma/Kullanım Konusunda Öz-Güven)

"… kullanabilirim ama bir arıza çıktığı zaman özellikle coğrafya öğretmeni olduğum için daha sonra bir problemle karşı nasıl davranmam gerektiğinle ilgili o konuda bazı çekincemelerim var açıkçası.." [11Ady_COG_K]-(Öğretmenlikte Akıllı Tahtaları Kullanma/Teknik Bir Sorunu Gidermede Yetersiz Hissetme)

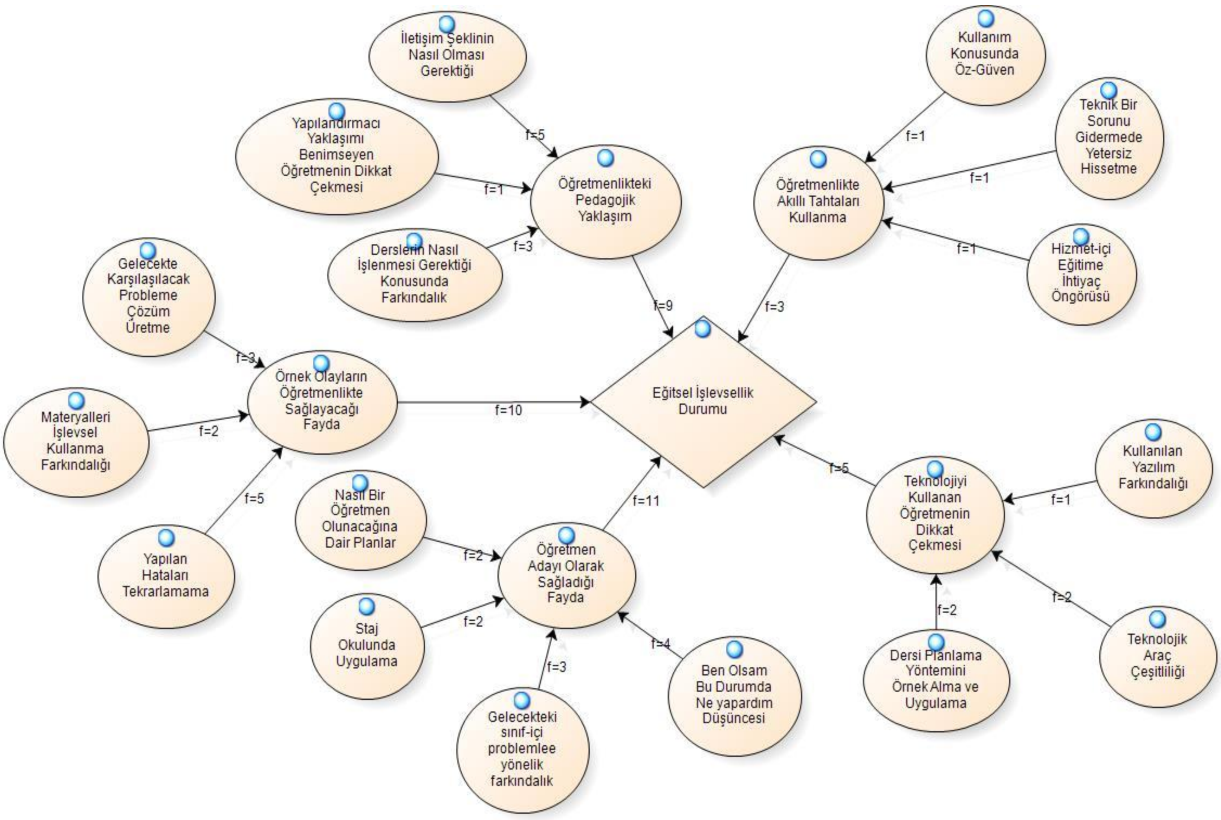
*"…hani zaten ilk yıllarımda büyük ihtimalle yine bakabileceğim bir site olur nasıl bir yöntem kullanabilirim ya da böyle yapan ne olmuş diye özellikle de yorumlarda da öyle hani faydası olur benim için…"[*21Ady_COG_E]-(Öğretmenlikteki Pedagojik Yaklaşım/Derslerin Nasıl İşlenmesi Gerektiği Konusunda Farkındalık)

"… ıı mesela yani bazı öğretmenlerin ıı öğrencilere hitabı, iletişimi çok kuvvetli değil ben ben onu yapmam diye düşünüyorum…."[23Ady_COG_K]- (Öğretmenlikteki Pedagojik Yaklaşım/İletişim Şeklinin Nasıl Olması Gerektiği)

"…bazı örnek olaylarda mesela öğretmen gerçekten dersini yapılandırmacı anlayışa göre çok güzel yapılandırmış çok güzel işlemiş örnek olaylar gördük…"[15Ady_COG_K]-(Öğretmenlikteki Pedagojik Yaklaşım/Yapılandırmacı Yaklaşımı Benimseyen Öğretmenin Dikkat Çekmesi)

"…örnek olayları incelediğimiz zaman bize faydası oldu söyle oldu yani sonuçta biz mezun olduktan sonra bu mesleğe başladığımız zaman bu mesleği yapan kişilerin nasıl yaptığı hakkında gayet iyi bir şekilde bilgimiz oldu kimisi gayet iyi bir şekilde yapıyordu kimisi ya kimi öğretmende yani hiç bir birçok problemle uğraştığını ve bunları çözerken neler yaşadığını gördük…" [15Ady_COG_K]-(Örnek Olayların Öğretmenlikte Sağlayacağı Fayda/Gelecekte Karşılaşılacak Probleme Çözüm Üretme)
*"…evet dediğim gibi hani kullandığı teknik veya araçlar nasıl kullandığı arasındaki hani orasındaki ilgiler biraz daha ilgimi çekti. Hani ona göre kafamda bir şeyler canlandı hani bi fırsat bulursam geliştirmeyi veya aynı şekilde uygulamayı düşünüyorum hani bazı örnek olaylarda oldu bu…"[*17Ady_COG_K]- (Örnek Olayların Öğretmenlikte Sağlayacağı Fayda/Materyalleri İşlevsel Kullanma Farkındalığı)
"…hayatımda yer buldu. Hıhı sağladı. Yorumlara bakarak hani belki öğretmenin dersi işleyişi benim için doğru değil ama hani genel bir yargı yani yanlışı ben bunu yorumlardan öğrenebilirim yorumlar daha hani…"[24Ady_COG_E]- (Örnek Olayların Öğretmenlikte Sağlayacağı Fayda/Materyalleri İşlevsel Kullanma Farkındalığı)
"…evet hatta şu an oldu bile diyebilirim çünkü gerçekten hani bizim aldığımız pedagojik bir eğitime göre çok ters ya da hiç uygun olmayan öğretmenlerde var gayet güzel uygulayan öğretmenler de var hem kendime örnek alıyorum hem arkadaşlarımın yorumlarına bakarak da ne yapılması gerektiğini öğrenebiliyorsunuz…"[30Ady_COG_E]-(Teknolojiyi Kullanan Öğretmenin Dikkat Çekmesi/Dersi Planlama Yöntemini Örnek Alma ve Uygulama)
"…en basitinden bu bizim okullarda mesela öğretmenin kendi bilgisayarından yani sınıfın içindeki tüm öğrencilerinin bilgisayarına ulaşabilmesi adına belli programlar var ben mesela bunun çok faydalı olduğunu düşünüyorum. Öğretmenin laboratuvarda sürekli dolaşması dersi mi anlatacak laboratuvarda mı dolaşacak bunlar çok sıkıntı yaratır o yüzden kendi bilgisayarından hepsinin neler yaptığını adım adım takip edebiliyor örneğin böyle bir programı bende kullanmak isterim öğretmen olduğumda..." [3Ady_COG_K]-(Teknolojiyi Kullanan Öğretmenin Dikkat Çekmesi/Kullanılan Yazılım Farkındalığı)
"…teknolojiyi etkin kullananlar dikkatimi çekti ama şöyle dikkatimi çekti hani derste zaten teknolojiyi kullanmamız gerekiyor ama teknolojiyi hani etkin kullananları gördüğümüz zaman demek ki okulun imkânları yeterliymiş hani okulun imkanlarına yönelik bir yorum yapabildik. Bende öğretmen olduğum zaman kullanmak isterim tabi ki.." [19Ady_COG_K]- (Teknolojiyi Kullanan Öğretmenin Dikkat Çekmesi/Teknolojik Araç Çeşitliliği)

Şekil 1. Örnek Olay Kütüphanesinin Eğitsel İşlevsellik Durumu



SONUÇ

Bu araştırma, öğretmenlerin FATİH Projesi uygulamalarını kullanma durumlarının öğretmen adayları tarafından gözlemlenmesi ile oluşturulan etkileşimli-çevrimiçi bir örnek olay kütüphanesine yönelik öğretmen adaylarının görüşlerinin incelenmesi ile yapılmıştır. Bu amaç doğrultusunda, oluşturulan örnek olay kütüphanesi Coğrafya Öğretmenliği bölümündeki öğretmen adaylarının öğretmenlik uygulaması dersinde kullanılmıştır. Daha sonra, örnek olay kütüphanesinin eğitsel olarak işlevselliğine yönelik öğretmen adaylarının görüşlerine başvurulmuştur. Çevrimiçi kütüphanede yer alan örnek olayların incelenmesi öğretmen adaylarında "ben olsam bu durumda ne yapardım düşüncesi", "gelecekteki sınıf-içi problemlere yönelik farkındalık", "teknik bir sorunu gidermede yetersiz hissetme", "öğretimde kullanılan yazılım farkındalığı" oluşmasını sağlamıştır. Öğretmen adaylarının göre empati ve farkındalık düzeylerine katkı sağlayan çevrimiçi etkileşimli web sayfası öğretmen eğitiminde kullanılabilir.

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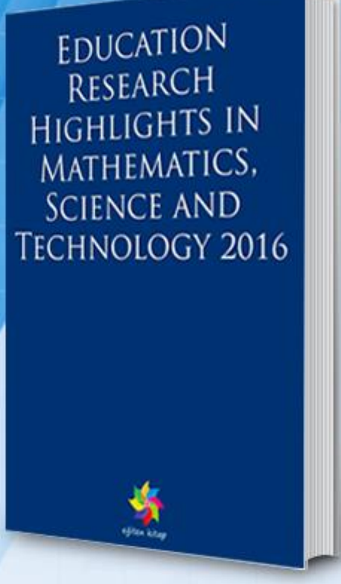

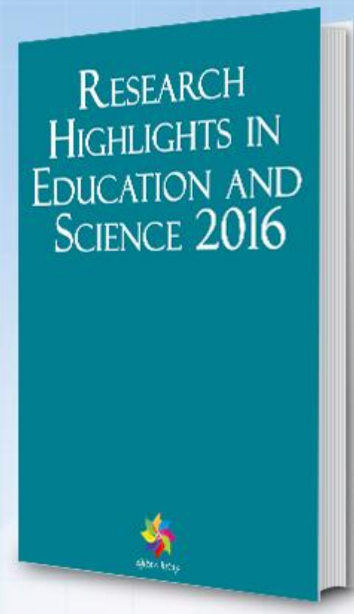

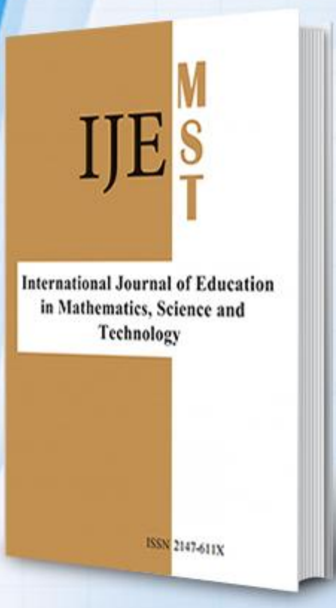

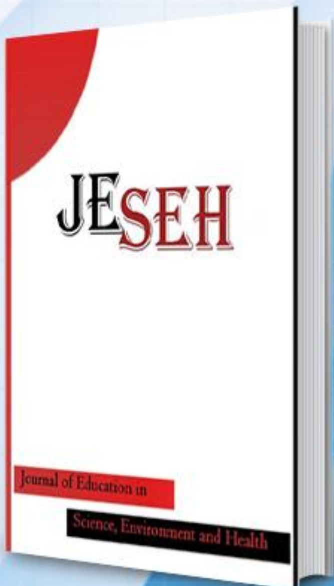

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