International Conference on Education in Mathematics, Science & Technology

PROCEEDING BOOK

Editors
Mack Shelley
Mustafa Pehlivan
Mustafa Tevfik Hebebci

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International Conference on Education in Mathematics, Science & Technology

ICEMST 2017

May, 18-21, 2017
Ephesus-Kuşadası
TURKEY

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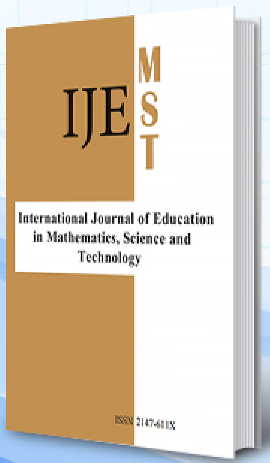

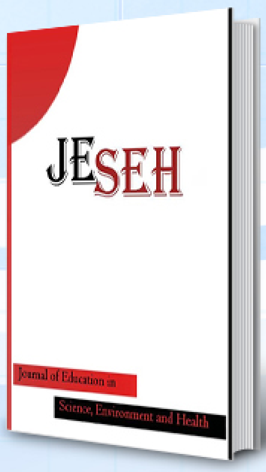

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This book was typeset in 10/12 pt. Times New Roman, Italic, Bold and Bold Italic.

International Conference on Education in Mathematics, Science and Technology (ICEMST) Published by ISRES Publishing, International Society for Research in Education and Science (ISRES).

Includes bibliographical references and index.

ISBN: 978-605-66950-5-6
Date of Issue: October 01, 2017

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ISRES Publishing

The Eurasia Proceedings of
Educational & Social Sciences (EPESS)
ISSN: 2587-1730

The Eurasia Proceedings of Educational & Social Sciences (EPESS), 2017

Volume 6, Pages 1-8

ICEMST 2017: International Conference on Education in Mathematics, Science & Technology

TEACHING MATHEMATICS USING LECTURE CAPTURE TECHNOLOGY

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Abstract: Technology in higher education is dramatically changing and continuously giving a challenging time for educators and institutions to provide the same level of innovative contents, environment and interaction to a digital native generation which is well powered with technology. It has been well observed and recognized that video lectures technology can have positive impacts on student learning and satisfaction however research on Mathematics intensive subjects have yet to be fully explored. This exploratory evaluation seeks to examine students' experiences and perception on receiving lectures via a digital lecture technology, and to assess using statistical tools the benefits of those video lectures on student performance in a mathematics intensive subject for freshman students at the American University of Sharjah, UAE. The concept of introducing rich text format lecture capture technology in Mathematics subjects (Math for Business and Calculus 2) was rigorously analyzed on a total sample of more than 300 students over multiple semesters. Both control groups without using any form of technology and experimental groups with using the proposed technology were compared in terms of student acceptance and academic performance improvements. Both qualitative and quantitative analyses were used and the results are very promising. Students saw the added benefits and found the technology very useful.

Keywords**:** Video lectures, lecture capturing, teaching and learning technology, innovative learning technology, student performance, mathematics teaching.

Introduction

In recent years, there have been a number of noticeable advancements in lecture delivery including the use of lecture capture technologies, wireless voting systems, digital tablets in classrooms, mobile applications, augmented reality tools, and virtual reality among others. Lecture Capture technology includes the recording of the classrooms or special event activities by using a combination of dedicated software and hardware. Recordings are stored digitally and available electronically for students or participants to learn, view and observe at a time convenient to them. Lecture capturing has been there for a while dating back to 1960s where it was used to record only audio lectures in UK. In 1980, Australian Universities started capturing lectures at a mass scale and in the 21st contrary Lecture Capture technology comes under a "should-have" category among most academic institutions. Many institutions around the globe are currently using or adopting the technology and a lot of research has already been in place on the same topic. Many studies discussed evident benefits of video lectures on the student's learning experience in several contexts however different subjects at different academic levels pose several challenges in preparing and delivering such video lectures and result in different student acceptance and satisfaction. Many universities have introduced a range of technological services to support students due to their changing nature in higher education. Students prefer flexibility options, diversity in delivery, and the opportunity to spare extra time before and after classes. Although many benefits have been recognized for lecture capture technology but still many lecturer and faculty argue that it could not be the replacement of the face-to-face learning depending on the subject being delivered and can only be used as an extra material to help students but not the replacement as in classroom there are many activities in which student are not able to participate if they don't attend the class. To analyze some of the existing limitations of lecture capture, this study focuses on the applicability of video lectures in a technical mathematics subject that covers a number complex concepts which students have found difficult and its effects on student performance.
To evaluate the effectiveness of our proposed approach, the video lecture technology was adopted with a total of 136 university students enrolled in two major mathematics subjects: s for Business (Math 101) and Calculus 2

- Selection and peer-review under responsibility of the Organizing Committee of the conference
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(Math 104) in fall 2016 and spring 2017 respectively. Math 101 covers coordinate systems and graphs, matrices, linear systems and applications, elementary linear programming, set theory, counting techniques, permutations and combinations, probability, and mathematics of finance. The subject emphasizes mathematical techniques and applications. Math 104 covers techniques of integration, hyperbolic functions, improper integrals, arc length, surface area, infinite series, power series, convergence tests, parameterized curves, polar coordinates, integration in polar coordinates and complex numbers.

Four sections of the same subjects taught from 2013-2016 by the same instructor covering the same material with comparable exam difficulty levels were used as a control group. Average GPAs of the students enrolled in the both the control and experimental groups are usually similar over previous semesters eliminating any possibility of bias. Mobile devices were adopted to enhance learners' experience, provide immediate access to information online, and provide enhanced hands-on learning. The empirical results demonstrate that the experimental condition, 5E mobile inquiry learning, had a positive impact on participants' learning motivation and scientific inquiry abilities. The rest of this paper is organized as follows. In Section 2, we provide a comprehensive review of related research work lecture capture technologies research in education. In Section 3, we provide our research methodology and approach. We present and analyze the results in Section 4 and conclude this paper in Section 5.

Related Work

Lecture capture technology has been used during the last decade extensively and there have been numerous research output analyzing both its implications on student attendance and its positive effects on student performance. Accessing video lectures after attending the lectures has been a norm for both normal students and also distance learners who do not attend the lectures physically as researched by the authors in (Woo, K. et al., 2008). In general, students find video lectures very helpful as it gives them better time management beyond the normal classroom especially for students who might have other off campus responsibilities as discussed in a number of research papers (Soong et. al, 2006; Williams et. al, 2007; Gosper et. al, 2008). Handicapped students or students with learning disabilities tend to find video lectures way more useful compared to normal students since it allows them to go over the lectures during their free time in private settings over and over (Williams, 2006). Also, students who are non-native English speakers find video lectures very helpful and useful especially if it can be combined with captions or tagged with keywords (Williams et. al, 2007; Leadbeater et al., 2013). Research on when students usually access the video lectures showed that they usually view lecture recordings more actively at the early stages of the academic year or semester and their involvement typically decreases linearly as we progress during the semester (Phillips, R. et al., 2011). Also, students usually see the added benefits of the video lectures just before major assessments or exams to supplement their written notes or teacher notes. Regarding the effects of video lectures on student performance or learning experience, there have been contradictory research results. For example, the authors in (Von Konsky et. al, 2009) discuss the positive usage of video lectures by top students to combine them with regular class material while (Phillips, R. et al., 2011) argue that there is a positive correlation between recurrent usage of video lectures and student motivation and performance. They also pointed out that the decrease in student attendance on campus since they have video lectures has minimal effect on their performance. On the other hand, there are a number of research work that do not see the added benefits for video lectures but on the contrary claim that they might even have negative effects on student learning including the works in (Leadbeater, W. et al., 2013). Overall, most studies agree that recorded lectures has little to no effect on student attendance (Holbrook et. al, 2009). On the other hand, the negative effects of video lectures and lecture capture technology in general were highlighted in (Gorissen et. al, 2012). The reasons discussed included normal deteriorations in attendance over an interval, the development of students' skills and reliance on technology and not being able to attend due to physical or mental disabilities. Regarding the percentage of students who would opt to use video lectures if they were available, there have been a number of research work that confirm that most students at different academic levels would chose video lectures over normal lectures notes in their course of studies (Inglis et. al, 2011). For example, both the authors in (Gorissen et. al, 2012) and (Soong et. al, 2006) collected results from surveys of more than 1000 students across several European universities and found that over 90% reported accessing video lecture recordings outside of campus and found them to be useful. Also, the authors in (Soong et. al, 2006) also found that video lectures did not discourage students to attend lectures and on the contrary encouraged them to attend and video lectures has a positive effect on student performance. There are majority of work conducted on different academic levels for different subjects and positive correlation between video lectures and academic performance was noted (Williams et. al, 2007). For example, (Gosper et. al, 2008) showed that about 3/4th of students believe video lectures helped improve their results, and even more students felt that video lectures made it easier for them to learn. Also, reduction in anxiety was reported by most students in (Traphagan et. al, 2009). With relation to studies on specific subjects and the acceptance of the students accordingly, several studies were conducted on medical students and the effects of video lectures on student performance on their Medical College Admission

Test (MCAT) results (Leadbeater et al., 2013). The results were not statistically different showing minimum improvements in using video lecture technology. Also, a survey conducted by the authors in (Owston et. al, 2011) on about 1000 students in a social sciences subject found that the rate of access to recorded lectures was significantly related to student grades. In depth investigation also found that the more the students access the video lectures per month, the higher their grades were indicating the positive effects on student performance. Another subject that was investigated was a freshman and sophomore level Biology subject where the authors in (Holbrook, et. al, 2009) found that freshman students using video lectures were more expected to miss lectures than sophomore students.

In a work that resonates with ours, the authors in (Craig et. al, 2009) analyzed the different options that several sophomore students used to access subject material online over two years. They found that after normal PowerPoint slides downloads, Rich Media formats (which synchronize Audio with PowerPoint in their online format) were accessed the most (22%), while whole video lectures which were available to students as well were accessed the least (10%). A major reason behind that was the perfect alignment of the teacher's audio to the slides being presented allowing the students to move at their own pace slide by slide. Some other notable work includes the work by (Van Zanten et. al, 2012) where they researched students' inclinations for short summary audio podcasts and full length video podcasts. They found that audio additions were downloaded more and students preferred them over normal video lectures. They used the audio formats to remind them of major course content to review before real exams and major assessments. Students noted that full length video lectures were sometimes time consuming and could become boring compared to direct access to slides and augmented audio. To conclude, most researchers agree that students find video lectures to be a useful and helpful and would probably increase their academic performance if used with conjunction with live lectures. There is an evident research gap on video lectures or PowerPoint slides augmented with audio on technical mathematical subjects and the corresponding effects on performance.

Methods

In this research work, we are primarily concerned with the following research questions:

- What are the effects of augmenting PowerPoint slides with teacher's audio and handwritten notes recorded during the live lectures on academic performance in Mathematics subjects?
- What are the students' perception of the video (slides + audio + notes) lectures?

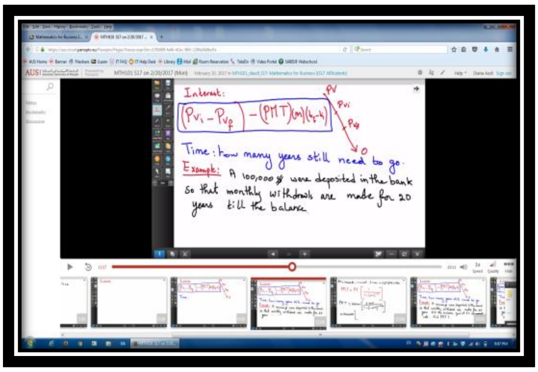
To attempt to answer the above research questions, we applied our proposed technologies on two different mathematics subjects over the course on one year (experimental group) and compared our results with the performance of students in previous semesters during the two years before (control group). The experimental group consisted of 136 students and the classes were equipped with an audio recorded synced with the interactive screen, installed lecture capture software and a digital stylus. Once the lecture was recorded, the lecturer built the content to be uploaded on the university's learning management system. Students were encouraged to attend the class as a regular face-to-face classroom and they were informed that these lectures will also be available online for them to review or in case they missed any lectures. During the whole semester the student behavior, performances as well as technology stability were monitored. In addition to the primary performance data, a descriptive survey was conducted to measure student satisfaction with the technology after the first exam and also at the end of the semester. The control groups consisted of the same subject (Math 104) taught by the same instructor over the last years and the performance of the students in the first midterm was collected and analyzed. A summary of our sampling size and data collection techniques used for both the experimental and control groups is summarized in table 1.

Table 1. Data sampling

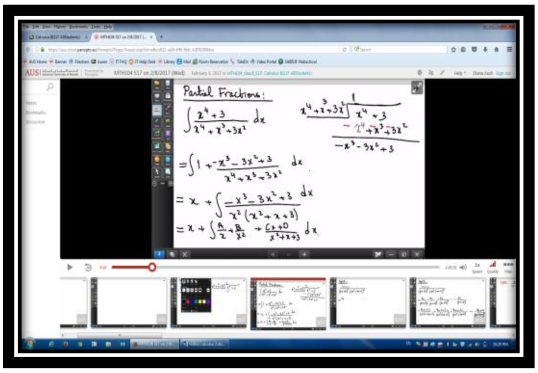
EXPERIMENTAL GROUPS	TITLE	SAMPLE SIZE	SEMESTER
MATH 101	Math for Business	70	Fall 2016
MATH 104	Calculus 2	66	Spring 2017
	TOTAL	**136**	

CONTROL GROUPS	TITLE	SAMPLE SIZE	SEMESTER
MATH 104	Calculus 2	~ 250	Spring 2013, 2014,2015, Fall 2014

Data was cleaned involving the removal of blank records. Data was exported to SPSS where quantitative statistical analysis were conducted to determine whether findings were statistically significant and to find the associations between different items of the survey, when different items of the survey were cross-tabulated with the item which pertains to the overall satisfaction of students learning experience while using the proposed technology. A dedicated team along with instructional and technical staff in the Mathematics department at the America University of Sharjah, UAE worked on delivering the subject for the experimental groups. All recorded lectures presented the same experience as in the class. Students were able to see the notes as well as listen to the high quality audio attached to each slide. An example of what students were able to download and listen to is depicted in Figure 1.



(a)



(b)

Figure 1. Snapshot of student view of delivered lecture notes on (A) Math 101 And (B) Math 104 respectively

Results and Findings

Students largely perceived proposed method to be useful in aiding understanding and learning, both during the course and in preparation for assessment. It particularly helped the students understand lectures and revise content at their own pace. On-line lectures helped students become familiar with the program's websites and web resources and provided an opportunity to practice note-taking. This innovative video lecture was regarded as a more effective use of time than face-to-face lectures. More specifically, the following results were collected.

A. Reasons Behind Using the Video Lectures

From the data collected from the survey at the end of the semester for Math 101 and after the midterm exam for math 104, 100% of Math 101 and 66% of Math 104 students indicated that they have watched or downloaded the video lectures at least once per week during the semester. For those who answered yes, the reasons behind that was spread between: being absent, helping in better understanding and to review for quizzes or major exams. Completing class notes was more dominant in Calculus compared to Mathematics for Business and the reasons behind that is related to the fact that calculus requires technical note taking and the time during lectures might not be sufficient to complete all note taking. The results for both experimental subjects are shown in Figure 2 and 3.

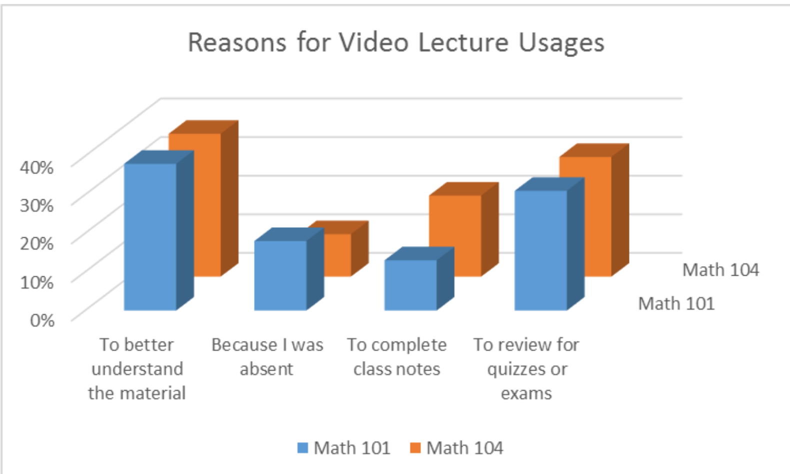


Figure 2. Reasons for using video lectures in mathematics for business and Calculus 2 respectively

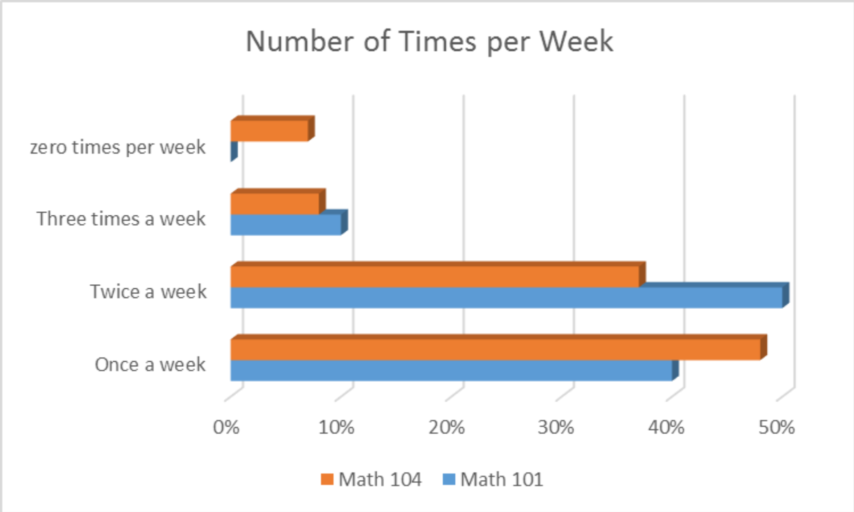


Figure 3. Number of times per week video lectures were accessed

A. Qualitative Data Collected from Survey

Several parts from the survey requested from the students to explain their answers and what they saw positives or negatives about the use of the lecture capture technology.

Usefulness: Most students agreed that the technology was very useful and one student mentioned that: "*They helped if we missed an explanation or need it... They give immediate explanation to doubts, and are a nice way to review for the exams as everything important is mentioned in the videos*" Another student explained that: "*It helps people who work at a slower pace… because after a period of time you might forget the material so it helps you remember. They reinforce the thought explained in class*."

Impact on Understanding: Regarding the impact on course understanding, most students agreed that using the video lectures has a very positive impact on their understanding of the material and one comment was; "*They cleaned up some information which I found confusing at first...*" Another student mentioned: "*I felt I needed a recap.... They helped me revise my understanding and highlight the important tricks..*."Another comment was: "*It's good because they give a second explanation. They allowed me to solve the questions alone and have explanation if I got the answer wrong"*

Impact on Grade: Most students believed the technology affected their grades positively.One comment was: *"it impacted me a lot, my midterm 2 grades improved after watching the videos"* Another comment was: *"It explained some steps that were forgotten and I remembered by watching the videos. They are comprehensive." One notable comment was also: "I failed exam 1 because I didn't watch the videos and got a passing grade for exam 2 because I watched the videos… solving the examples in the videos was a good practice...Small details are being explained…"*

Major Features: When asked about what major features that they liked about the technology, some interesting comments from the students were:

"They explain the material thoroughly.
That was easier to focus, since you can pause and replay until you understand the concept
They are simple and easy to understand
It was like being in class, but you got to repeat it
They are clear and contain all the exact material. They were like a normal class
It is like attending a class all over again."

A. Quantitative Data Collected from Survey

In this section, we use the control group of more than four hundred students to analyze the effects of the introduced lecture capture technology on the experimental group enrolled in Calculus 2 in spring 2017 after the midterm exam results were collected. Table 2 summarizes the data collected on midterm performance for the different groups:

Table 2. Summary of exam grades

SEMESTER	NUMBER OF STUDENTS	MIDTERM AVERAGE	STANDARD DEVIATION
SPRING 2013	32	68%	20.1923077
SPRING 2014	66	66%	19.2857143
FALL 2014	46	68%	18.5714286
SPRING 2015	58	71%	20
SPRING 2017	66	79%	17.3333333

As shown in Figure 4, there is a very notable increase in performance after lecture capture technology was introduced in Spring 2017 compared to other semesters without using such technology. All the students took these courses exactly at the same time during their study and were taught by the same instructor, with the same books, and in the same format. Grade-point average (GPA) and number of course credits should be compared for the groups at the time of graduation in future studies. There was no statistical difference between the groups, suggesting that the groups were very similar in background and ability prior to the Calculus course.

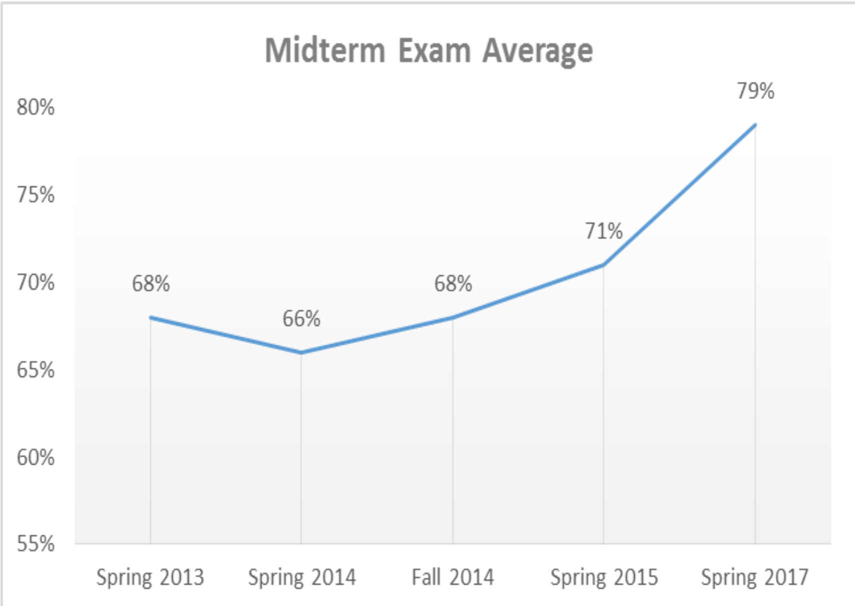


Figure 4. Performance results in midterm 1 in four semesters without using technology compared to Spring 2017 where lecture capture was used

Preforming a one-way ANOVA test results in the following summary data:

	SS	df	MS	F	p
Between:	6,571.164	4	1,642.791	4.695	0.001
Within:	92,030.000	263	349.924		
Total:	98,601.164	267			

At 95% confidence level, we have sufficient evidence to prove that there is a major difference in the means and using technology in spring 2017 resulted in notable increase in exam performance.

A. Teacher Evaluations

Another analysis that were collected is teacher evaluations conducted at the end of the semester. The results are useful to compare the Instructors performance compared to the mathematics department faculty and also to the university as a whole. As can be seen in Table 3 and Figure 5, the instructor results were very positive and the subject evaluations were considerably higher than the rest of the department and also the university. Analysis of the same instructors' evaluations over previous semesters where technology of lecture capture was not used showed notable increase when technology was used in teacher's evaluation.

Table 3. Teacher evaluations

CAS - Course & Faculty Course Experience		Audi, Diana M										--- Survey Comparisons ---					
		Responses					Individual					MTH			All		
		SA	A	N	D	SD	N	Mean	Med.	Mode	Std Dev	N	Mean	Pct Rnk	N	Mean	Pct Rnk
Q1	The course was well organised	18	9	0	1	0	28	4.57	5	5	.68	2.5K	4.20	84	11K	4.27	76
Q2	The course objectives were carefully and clearly defined	17	9	1	1	0	28	4.50	5	5	.73	2.5K	4.19	79	11K	4.29	70
Q3	The course grading scheme was clearly defined	19	5	2	2	0	28	4.46	5	5	.91	2.5K	4.22	79	11K	4.29	71
Q4	The textbook(s) and supplemented material were useful to your understanding of the course content	11	11	4	1	1	28	4.07	4	4,5	1	2.5K	3.94	66	11K	4.00	57
Q5	The assignments and reading material were helpful in improving your understanding of the subject	13	10	4	1	0	28	4.25	4	5	.83	2.5K	4.01	68	11K	4.12	61
Q6	The classroom interaction helped you learn and understand the material	16	8	1	3	0	28	4.32	5	5	.97	2.5K	3.99	76	11K	4.18	55
Q7	The course made you want to learn more about the subject	10	8	8	1	1	28	3.89	4	5	1.05	2.5K	3.70	61	11K	3.94	42
Q8	The course was demanding compared to other courses	14	8	3	3	0	28	4.18	4.5	5	1	2.5K	3.90	81	11K	3.90	76
Q9	The course had high standards compared to other courses	12	9	5	2	0	28	4.11	4	5	.94	2.5K	3.91	65	11K	3.94	64
Q10	The course objectives were accomplished	12	14	2	0	0	28	4.36	4	4	.61	2.5K	4.11	76	11K	4.21	65
Q11	Overall, this course was excellent	10	13	4	1	0	28	4.14	4	4	.79	2.5K	3.90	63	11K	4.05	53

Responses: [SA] Strongly Agree=5 [A] Agree=4 [N] Neutral=3 [D] Disagree=2 [SD] Strongly Disagree=1
Pct Rnk: Percentile Rank (100 is best, calculated vs. precise Mean)

CAS - Course & Faculty Course Instructor		Audi, Diana M										--- Survey Comparisons ---					
		Responses					Individual					MTH			All		
		SA	A	N	D	SD	N	Mean	Med.	Mode	Std Dev	N	Mean	Pct Rnk	N	Mean	Pct Rnk
Q12	The instructor started and finished the class on time	19	8	1	0	0	28	4.64	5	5	.55	2.5K	4.40	75	11K	4.46	68
Q13	The instructor was ready to answer your questions	16	8	3	1	0	28	4.39	5	5	.82	2.5K	4.35	45	11K	4.48	29
Q14	The instructor evaluated your work fairly	16	7	5	0	0	28	4.39	5	5	.77	2.5K	4.24	61	11K	4.28	58
Q15	The instructor evaluated your work on time	10	11	6	1	0	28	4.07	4	4	.84	2.5K	4.29	23	11K	4.32	20
Q16	The instructor's comments on your work were clear, specific and helpful	12	9	7	0	0	28	4.18	4	5	.80	2.5K	4.05	53	11K	4.19	41
Q17	The instructor was very effective in helping you understand the course material	16	10	1	1	0	28	4.46	5	5	.73	2.5K	4.04	73	11K	4.23	64
Q18	The instructor demonstrated a thorough knowledge of the subject	19	7	1	1	0	28	4.57	5	5	.73	2.5K	4.25	74	11K	4.40	64
Q19	Overall, the instructor was excellent	15	11	1	1	0	28	4.43	5	5	.73	2.5K	4.08	66	11K	4.26	57

Responses: [SA] Strongly Agree=5 [A] Agree=4 [N] Neutral=3 [D] Disagree=2 [SD] Strongly Disagree=1
Pct Rnk: Percentile Rank (100 is best, calculated vs. precise Mean)

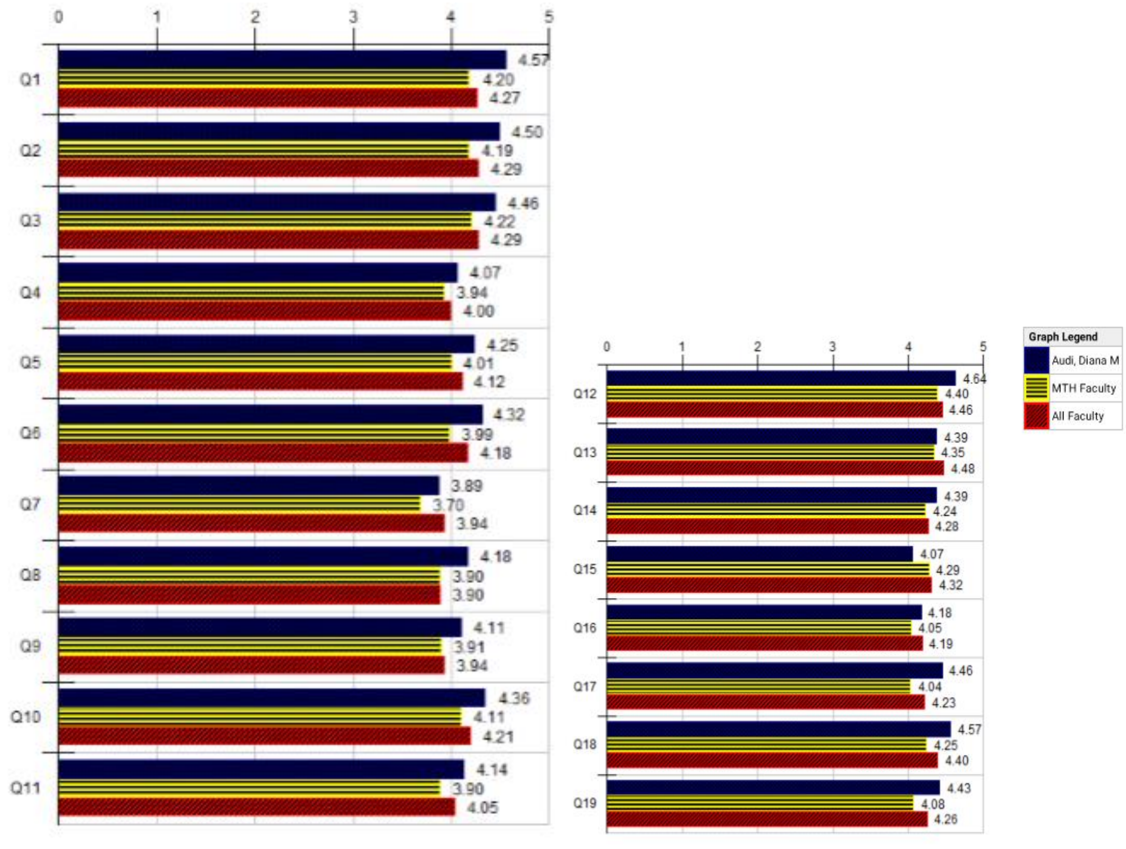


Figure 5. Teacher evaluations for math101 with the usage of technology

Conclusion

In this paper, the concept of introducing rich text format lecture capture technology in Mathematics subjects (Math for Business and Calculus 2) was rigorously analyzed. Both control groups without using any form of technology and experimental groups with using the proposed technology were compared in terms of student acceptance and academic performance improvements. Both qualitative and quantitative analysis were used and the results are very promising. Students saw the added benefits and found the technology very useful. Exam performance was compared and using the technology showed positive improvements over previous semesters.

References

Craig, P. et al. (2009). Student use of web based lecture technologies in blended learning: Do these reflect study patterns? In Same places different spaces. Proceedings ascilite Auckland 2009. pp. 158–167.

Gorissen, P., Van Bruggen, J. &Jochems, W. (2012). Students and recorded lectures: survey on current use and demands for higher education. Research in Learning Technology, 20, pp.143– 153.

Gosper, M. et al. (2008). Final Report: The Impact of Web-Based Lecture Technologies on Current and Future Practices in Learning and Teaching, Sydney: Australian Learning and Teaching Council.

Holbrook, J. &Dupont, C. (2009). Profcasts and Class Attendance – Does Year in Program Matter? Bioscience Education, 13(June). Available at: www.bioscience.heacademy.ac.uk/journal/vol13/beej-13-c2.pdf.

Inglis, M. et al. (2011). Individual differences in students' use of optional learning resources. Journal of Computer Assisted Learning, 27(6), pp.490–502.

Leadbeater, W. et al. (2013). Evaluating the use and impact of lecture recording in undergraduates: Evidence for distinct approaches by different groups of students. Computers Education, 61, pp.185–192.

Owston, R., Lupshenyuk, D. & Wideman, H. (2011). Lecture capture in large undergraduate classes: Student perceptions and academic performance. The Internet and Higher Education, 14(4), pp.262–268.

Phillips, R. et al. (2011). Learning analytics and study behaviour : A pilot study. In In G. Williams, P. Statham, N. Brown & B. Cleland (Eds.), Changing Demands, Changing Directions. Proceedings ascilite Hobart 2011. pp. 997–1007.

Settle, A., Dettori, L. & Davidson, M.J. (2011). Does lecture capture make a difference for students in traditional classrooms. In Proceedings of the 16th annual joint conference on Innovation and technology in computer science education - ITiCSE 2011. New York City, New York, USA: ACM Press, p. 78.

Soong, S.K.A., Chan, L.K. & Cheers, C. (2006). Impact of video recorded lectures among students. In Proceedings of the 23rd annual ascilite conference: Who's learning? Whose technology? Ascilite 2006. Sydney, The University of Sydney. Sydney, pp. 789–793.

Traphagan, T., Kucsera, J. V &Kishi, K. (2009). Impact of class lecture webcasting on attendance and learning. Educational Technology Research & Development, 58(1), pp.19–37.

Van Zanten, R., Somogyi, S. & Curro, G. (2012). Purpose and preference in educational podcasting. British Journal of Educational Technology, 43(1), pp.130–138.

Von Konsky, B.R., Ivins, J. & Gribble, S.J. (2009). Lecture attendance and web based lecture technologies : A comparison of student perceptions and usage patterns. Australasian Journal of Educational Technology, 25(4), pp.581–595.

Woo, K. et al. (2008). Web-based lecture technologies: blurring the boundaries between face-to-face and distance learning. Alt-J, Research in Learning Technology, 16(2), pp.81–93.

Williams, J. &Fardon, M. (2007). Lecture recordings: extending access for students with disabilities. In Research paper for ALT-C: Beyond Control 2007, University of Nottingham. Nottingham.

Williams, J. (2006). The Lectopia service and students with disabilities. In Proceedings of the 23rd annual ascilite conference: Who's learning? Whose technology? Ascilite 2006. The University of Sydney. Sydney, pp. 881–884.

The Eurasia Proceedings of
Educational & Social Sciences (EPESS)
ISSN: 2587-1730

The Eurasia Proceedings of Educational & Social Sciences (EPESS), 2017

Volume 6, Pages 9-13

ICEMST 2017: International Conference on Education in Mathematics, Science & Technology

LEARNING TO UNDERSTAND INCLUSION RELATIONS OF QUADRILATERALS

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Abstract: Learning to identify geometric shapes and understand inclusive properties among these shapes is prerequisite for learning more complex concepts such as spatial reasoning or deductive thinking. Despite the importance of understanding geometric shapes and inclusion relations among these shapes, it has evidenced that pre-service teachers' subject knowledge of geometry is amongst their weakest knowledge of mathematics.This study aimed to investigate pre-service mathematics teachers' (PSMT), who are going to teach middle grade mathematics (grade 5-8), understanding of inclusion relationships of quadrilaterals. A designed questionnaire was administered to 52 PSMTs at the beginning of the semester and again by the end of the semester. The findings of this study demonstrated that the majority of the PSMTs struggled with identifying quadrilaterals and especially inclusion relations of quadrilaterals primarily. The majority of them held static view of quadrilaterals which inhibited their understanding of inclusion relations of quadrilaterals. However, the number of the PSMTs who understood hierarchical relationship between quadrilaterals increased through the end of the semester.

***Keywords*:** Geometry, hierarchical thinking, inclusion relations, quadrilaterals, pre-service teachers.

Introduction

The learning of geometrical concepts, specifically inclusion relations among quadrilaterals, is not an easy feat and demonstrates a complex process that includes both visual and property-based reasoning. Many researchers have shown that students are not very successful at identifying non-prototypical shapes (e.g. Kaur, 2015).For instance, Hershkowitz (1989) showed that young children use prototypes and imposed properties (such as orientation or the side lengths of a prototypical shape) either to accept or reject the categorization of a given geometric figure into a named class of shapes. This difficulty of correctly identifying non-prototypical shapes persists for middle school students (Clements & Battista, 1992) or even after middle school (Jones 2000; Fujita & Jones, 2006; Zilkova, 2015). Fujita and Jones (2007), in their study with pre-service teachers also found that reliance on prototypical shapes cause difficulty in their understanding of inclusion relations of geometric shapes.
De Villiers (1994) suggests that classifying shapes is closely related to defining and can be seen either as hierarchical or as partitional. According to hierarchical definitions or inclusive definitions as used in different resources (Fujita, 2012), a trapezoid is a quadrilateral with at least one pair of parallel sides, which means that a parallelogram or a rhombus are special forms of trapezoid. Using partitional or exclusive definitions, on the other hand, defines a trapezoid as a quadrilateral with only one pair of sides being parallel, which excludes parallelograms or rhombus from being classified as special forms of trapezoids.In general, in mathematics, hierarchicaldefinitions arepreferred; although, it should be stressed that patitional definitions are not incorrect mathematically, but just less useful (Jones, 2000).

This study aims to investigate pre-service mathematics teachers' (PSMT), who are going to teach middle grade mathematics (grade 5-8), understanding of inclusion relationships of quadrilaterals. Despite the importance of understanding geometric shapes and inclusion relations among these shapes, it has evidenced that pre-service teachers' subject knowledge of geometry is amongst their weakest knowledge of mathematics (Fujita & Jones, 2007; Zilkova, 2015). Thus, this study also aims to investigate how the PSMTs come to understand that some geometric shapes belong to the subset of different shapes during a geometry course. Specifically, the following questions guide this study:
1- What do PSMTs know about inclusion relations of quadrilaterals?

- Selection and peer-review under responsibility of the Organizing Committee of the conference
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a. Which types of quadrilaterals do PMSTs have the biggest problems with? Or which types of quadrilaterals do PSMTs seem to understand the inclusion relations easily?

2- How do PSMTs' understandings of inclusion relations of quadrilaterals evolve during a geometry course?

Understanding Inclusion Relations of Quadrilaterals

To document learners' understanding of quadrilateral classifications, especially understanding inclusion relations of quadrilaterals Fujita (2012) proposes a theoretical model to describe cognitive development of understanding of inclusion relations of quadrilaterals by synthesizing past theories (i.e. van Hiele theory). However, Fujita (2012) explicitly focused on the relationships between certain special quadrilaterals—parallelograms with squares, rectangles, and rhombi and the relationship between squares with rectangles. Fujita's classification levels of these specific quadrilaterals were adopted; but extended to include other quadrilaterals such as trapezoids or kite.These classification levels were used to analyze the responses of the participants.

Table 1.Levels of understanding inclusion relations of quadrilaterals

Levels	**Descriptions**
Level 3: Hierarchical	Learners can understand hierarchical relationships among quadrilaterals. The inclusion relationships of quadrilaterals are understood and can be used for all quadrilaterals. 'The opposing direction inclusion relationship' of definitions and attributes is understood.
Level 2: Partial Prototypical	Learners have begun to extend their figural concepts to understand inclusion relations of quadrilaterals. However, their understanding is limited and specific to some quadrilaterals.
Level 1: Prototypical	Learners have their own limited personal figural concepts. Their judgments regarding to identifying relationships of quadrilaterals are judged by their limited figural concepts.
Level 0	Learners do not have basic knowledge of quadrilaterals.

Methods

Participants

52 pre-service mathematics teachers (PSMTs), who are going to teach middle grade mathematics (grade 5-8), participated in this study. Participants enrolled in a three-credit geometry course, which was taught by the author when this study was conducted. The participants were chosen by purposeful sampling method used for qualitative research studies (Patton, 1990).

Data Sources

A geometry questionnaire with sixteen open-ended questions was used to investigate PSMTs' subject matter knowledge of geometry. The questions in the questionnaire were prepared based on existing literature (e.g. Fujita & Jones, 2006, 2007; Zilkova, 2015). In addition to the questionnaire results, the PSMTs' responses to the midterm and the final questions, which were related to quadrilaterals, were also used as secondary data sources.

Data Analysis

The framework adopted from Fujita (2012) guided the analysis of the data. PSMTs' responses to the questionnaire questions and their class work and assignments were coded in three categories (level 0 was excluded since all the participants have taken high school geometry and have basic knowledge of quadrilaterals). Data analysis began by examining the written work of each participant and grounding it in a constant comparative method of coding (Glaser & Strauss, 1967) in which participant responses were coded with external and internal codes. Coding of the data began with a set of external codes that were derived from the framework (see Table 1).Such external coding schemes provided a lens with which to examine the data. By examining the data and reviewing the written responses, emerging themes of participants' comments on quadrilaterals, the inclusion and transitive relations of quadrilaterals were also developed. After proposing these internal (data-grounded) codes, each written work was reexamined and recorded to incorporate these new codes.

Findings

The pre-questionnaire results of the PSMTs' showed that the pre-service mathematics teachers' struggled with identifying inclusion relations of quadrilaterals. As can be seen in the table 2 below, the majority of the PSTMs (60%) demonstrated partial prototypical reasoning. That is, they demonstrated some sorts of difficulty understanding inclusion relations of quadrilaterals. While 60% PSTMs demonstrated partial prototypical reasoning, only 2 (4%) PSTMs demonstrated hierarchical reasoning. However, even these two PSMTs struggled with opposing direction inclusion relations. Walcott and others (2009) argue that the dynamic figural concept, which consists of the visual, verbal, written, symbolic, and/or formal properties of shapes, are essential to understand opposing direction inclusion relationship since inflexible prototypes are static and non-changing. Students who hold inflexible visual prototypes are unwilling to see movement upon the shape, which resulted in not accepting that a rectangle sometimes have all equal sides. Research supports the idea of mental manipulation of shapes in the minds in order to develop such reasoning (Archavsky & Goldenberg, 2005).

Table 2. Percentages of the PSMTs' understanding of inclusion relations of quadrilaterals

	Pre-Questionnaire		**Post-Questionnaire**	
	Frequency	***Number of the PSMTs***	***Frequency***	***Number of the PSMTs***
Hierarchical Reasoning With Opposing Inclusion Relations			%62	(32)
Hierarchical Reasoning With Limited Opposing Inclusion Relations	%4	(2)	%38	(20)
Hierarchical Reasoning (With Limited Opposing Inclusion Relations)With An Exception	%10	(5)		
Partial Prototypical Reasoning	%60	(30)		
Prototypical Reasoning (With An Exception)	%14	(7)		
Prototypical Reasoning	%12	(6)		

Six PSTMs held entirely prototypical reasoning about quadrilaterals. Seven PSTMs, on the other hand, were able to extend their figural concept of one specific quadrilateral, which was either recognizing a square as a rhombus or a rhombus as a parallelogram. Since these seven PSMTs relied heavily on their prototypical examples for all quadrilaterals, except just for one specific quadrilateral, they were coded in Prototypical level. However,these PSTMs were acknowledged as in transition to Partial Prototypical level. Figure 1 below demonstrates the pathway of the PSMTs while learning inclusion relations of quadrilaterals.

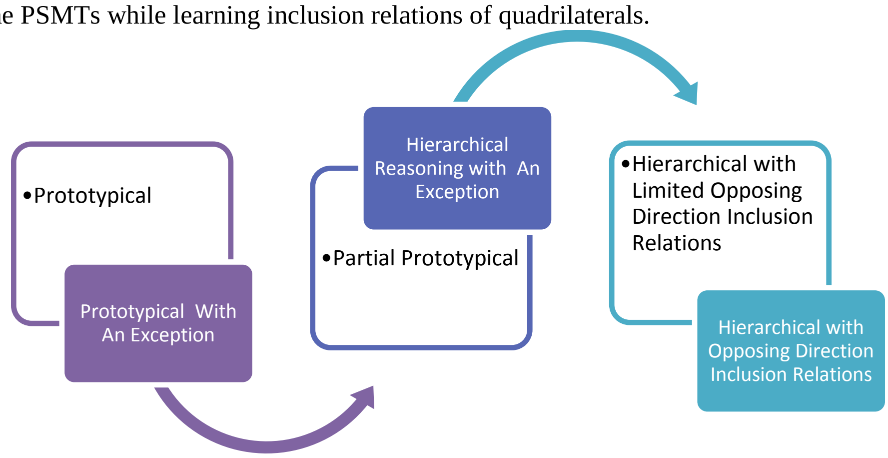

Figure 1. The pathway of understanding inclusion relationships of quadrilaterals

The study concluded that although the pre-service teachers possessed formal definitions of quadrilaterals, their prototypical images affected their personal figural concepts. The pre-service teachers found rhombus □parallelogram, square□ rhombus, and rectangle □parallelogram relationships easier and less problematic.

However, accepting square, rectangle, parallelogram and rhombus as a trapezoid was more problematic for the PSMTs. The PSMTs understand trapezoid as a disjoint class. These results aligned with the results of Zilkova (2015) who found that for pre-service teachers some inclusion relations were easier to establish such as square □parallelogramthantherelationships between other quadrilaterals such askite □quadrilateral.

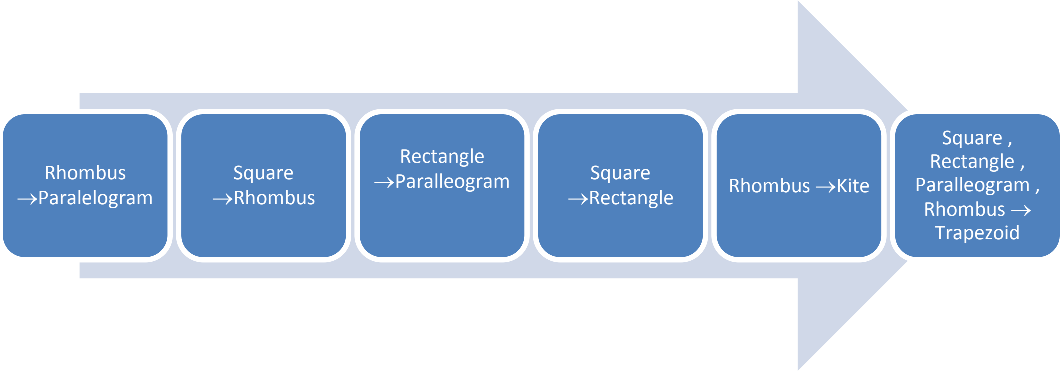

Figure 2. The pathway of extending inclusion relationships of quadrilaterals

According to the post-questionnaire results, the number of the PSMTs who could reason hierarchically increased significantly (see Table 2). Although 62% of the PSMTs were able to develop opposing direction inclusion relation, 38% of the PSMTs still struggled with opposing direction inclusion relation. That is, they were able to state that a square is always a rhombus however a rhombus can never be a square as it was evidenced in the figure below. Although the PSMT in his work in figure 3 was able to draw the Venn diagram to demonstrate the relationships among quadrilaterals correctly, he argued that a rectangle cannot have all four equal sides or a parallelogram cannot have a 90-degree angle.

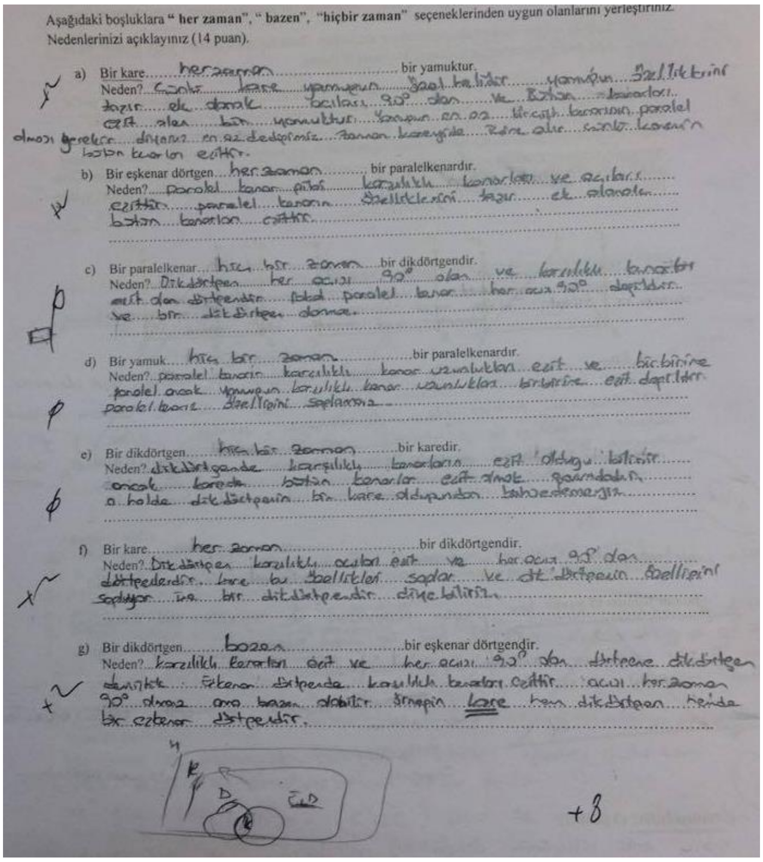

Figure 3. A sample response to demonstrate limited opposing direction inclusion relation

References

Archavsky, N., & Goldenberg, P. (2005). Perceptions of a quadrilateral in a dynamic environment. In D. Carraher, & R. Nemirovsky (Eds.), *Medium and meaning: video papers in mathematics education* *research, Journal of Research in Mathematics Education Monograph XIII[CD-ROM]*. Reston, VA: National Council of Teachers of Mathematics

Clements, D. H., & Battista, M. T. (1992). Geometry and spatial reasoning. In D. A. Grouws (Ed.), *Handbook of research on mathematics teaching and learning* (pp. 420–464). New York, NY: MacMillan.

De Villiers, M. (1994). The role and function of a hierarchical classification of quadrilaterals. *For the Learning of Mathematics, 14*(1), 11–18.

Fujita, T. (2012). Learners' level of understanding of the inclusion relations of quadrilaterals and prototype phenomenon. *The Journal of Mathematical Behavior, 31*, 60-72.

Fujita, T., &Jones, K. (2006). Primary trainee teachers' understanding of basic geometrical figures in Scotland. In J. Novotná, H. Moraová, M. Krátká, & N. Stehlíková (Eds.), *Proceedings of 30th conference of the international group for the psychology of mathematics education* (pp. 129-136). Prague: PME.

Fujita, T., & Jones, K. (2007). Learners' understanding of the definitions and hierarchical classification of quadrilaterals: Towards a theoretical framing. *Research in Mathematics Education, 9*(1, 2), 3–20.

Glaser, B. G., & Strauss, A. L. (1967). *Discovery of grounded theory*. MillValley, CA: Sociology Press.

Hershkowitz, R. (1989). Visualization in geometry: Two sides of the coin. *Focus on Learning Problems in Mathematics, 11*(1), 61–76.

Jones, K. (2000). Providing a foundation for deductive reasoning: Students' interpretations when using dynamic geometry software and their evolving mathematical explanations. *Educational Studies in Mathematics, 44*(1/2), 55-85

Kaur, H. (2015). Two aspects of young children's thinking about different types of dynamic triangles: prototypicality and inclusion. *ZDM Mathematics Education, 47*, 407-420.

Patton, M. Q. (1990).*Qualitative evaluation and research methods* (2nd ed.). Newbury Park, CA: Sage Publications, Inc.

Walcott, C., Mohr, D., & Kastberg, S. E. (2009). Making sense of shape: An analysis of children's written responses. *The Journal of Mathematical Behavior, 28*, 30-40.

Zilkova, K. (2015). Misconceptions in pre-service primary education teachers about quadrilaterals. *Journal of Education, Psychology and Social Sciences, 3*(1), 30-37.

The Eurasia Proceedings of
Educational & Social Sciences (EPESS)
ISSN: 2587-1730

The Eurasia Proceedings of Educational & Social Sciences (EPESS), 2017

Volume 6, Pages 14-23

ICEMST 2017: International Conference on Education in Mathematics, Science & Technology

GENERATION STUDY OF PISA MATHS PROFICIENCY LEVELS IN TURKISH 6TH GRADE STUDENTS

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Abstract: PISA is an international exam which aims to assess whether 15-year-old students are able to convert their academic outcomes into solving daily life issues as well as analyzing high level cognitive skills. PISA evaluates the outcomes through item-based skills classification constituted by IRT technique with the help of the samples gathered from each participant country. Skill classification is a grouping process which helps to interpret the proficiency of students at different points in accordance with the ranges described for each level. For the Maths proficiency level of classes gathered by this process increasing from 1 to 6 hierarchically: the ability to give the correct answer at Level 1 only when all related information is presented and questions are clearly explained is recognized, whereas it is more frequent to recognize the correct answer at Level 6 in which high level cognitive skills are used, necessary knowledge is organized and interpreted to solve the problem. Of all the OECD countries, 15.8% of China and 10% of Japan are at Level 1, which is 52% for Turkey. An experimental study is being pursued in an attempt to enhance the Maths literacy success of 6th grades by increasing the number of implementations in large-scale international exams with TUBITAK Research Project numbered 115K531. About 3200 students are included within the project as a longitudinal study. The equivalence of the tests to that of PISA has been assured. At this point, the study aims to determine whether the classifications made for PISA Turkey similarly range also in the younger age group, as well as aiming to find out whether the origin of the distinction between Turkey and other OECD countries in the higher levels begins at an earlier age. In Izmir province, 6th grade students who were determined randomly by the stratification method were subjected to tests that required multiple levels of thinking and represented 6th grade Maths subjects through test items in the form of multiple choice, true-false and open-ended. Plausible scores appropriate for PISA procedures and the cut points determined by using those scores and PISA standards were designated and proficiency levels were obtained. The proficiency levels of 6th grade students in the sample were specified with the help of this method. When the results of the study are analyzed in detail, it is clearly seen that the percentages described in the PISA 2015 Report show a similar distribution across the classrooms.

***Keywords*:** Maths proficiency, PISA, rasch model.

Introduction

The Programme for International Assessment (PISA), first implemented in 2000 by the Organization for Economic Co-operation and Development (OECD) which is an intergovernmental organization of industrialized countries, is an international assessment system that measures math literacy, science literacy and reading skills of 15-year-old students every 3 years. According to 2015 data, it covers 35 OECD countries, 37 partner countries and economies.

The first goal of education for all politicians around the world is to fully realize the potentials of their citizens and to enable them to develop their skills in accordance with changing world conditions. In this context, PISA results indicate much more than points or rankings. It is also the world's leading education benchmark used to assess the quality, equality and productivity of school systems. This provides governments and educators with

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the definition of effective educational policies that can adapt their own values by specifying the characteristics of high-performance educational systems. (PISA, 2015)

In Turkey, it is seen that the success graph of PISA is below the expectations and decreasing gradually. Therefore, in this research, we examined the similarities and differences in the ability distribution of the Turkish sample in the PISA applications at earlier education levels. The measurements made and the findings obtained were compared with the countries in the upper row in PISA applications and OECD averages. In this way, it is aimed to generalize the level of success that Turkey has in PISA applications to other education levels and to reach the findings about the reasons for the achievement below the expected level.

About PISA

The OECD Programme for International Student Assessment (PISA) is an international large-scale study that focuses on the capabilities of 15-year-old students' math literacy, science literacy and reading skills. PISA defines mathematical literacy as follows: An individual's capacity to identify and understand the role that mathematics plays in the world, to make well-founded judgements and to use and engage with mathematics in ways that meet the needs of that individual's life as a constructive, concerned and reflective citizen.

Starting from 2000, PISA is conducted every 3 years with a primary focus on one area for each cycle.

Table 1. PISA cycle topics by years

PISA Administration cycle						
Assessment year	2000	2003	2006	2009	2012	2015
Subjects assessed	**Reading** Mathematics Science	Reading **Mathematics** Science Problem solving	Reading Mathematics **Science**	**Reading** Mathematics Science	Reading **Mathematics** Science Problem solving	Reading Mathematics **Science**

(OECD, 2009)

From 2000 to 2015, each cycle focused on a different area. As shown in Table 1, the focus was on reading in 2000, followed by mathematics and science, and in 2009, the cycle began again with Reading and repeated in the same order. Apart from this, problem solving was added in 2003 and 2012 as well.

Pisa Sampling

PISA has a two-stage formed layered and random sample design. The first layer is the schools and the second is the students in the schools. The first step in the sample is the need to identify the target population of PISA students. It is generally considered to be 15-year-olds, but more precisely, it represents a sample of the age group of 15 and between the completed months of + 3 and -3 and the age group of 16 and the completed months of -2 and +2. The size of the sample taken from each country was determined as at least 150 school samples and at least 4500 students.

Ability Estimation in PISA RASCH

PISA uses Rasch Model among IRT (*Item Response Theory*) models statistically while determining the levels of student abilities. IRT is an approach that provides mathematical models which can overcome the weaknesses of classical test theory. It is a growing theory that psychometricians tend to use it, especially because of the claim of "sample-independent substance parameter" estimation and "ability to test independently". On the other hand, because of the large number of models available, it is possible to apply FTC analyzes to different measurement results. It also makes it easier to make accurate inferences about individuals and test items by offering the ability to compare individual skill levels with difficulty levels of questions, since individuals can calibrate the ability parameters and the difficulty parameters of the items at the same scale level. It offers different models such as logistic models with 1, 2, 3 and 4 parameters according to the number of MTK parameters; single and multi-dimensional models according to the number of dimensions; dual and multiple (multi-categorized) scoring models. The Rasch Model is defined as a single-parameter model because the item characteristics curves depend solely on item difficulty. In the three-parameter logistic model, the characteristics curves of the item depend on (*i*) the item difficulty parameter, (*ii*) item discrimination parameter and (*iii*) the “guess” parameter. This last parameter concerns the possibility of all students in the multiple choice test to answer the item correctly, no matter how difficult it is.

The Rasch Model is designed to create a symmetrical continuity with both item difficulty and student competence. Item difficulty and student competence are related to a logistical function. With this function, it is possible to calculate the likelihood that a student will correctly answer an item. Moreover, because of this possibility connection, it is not necessary to apply every item sequence to every student. If some anchor items are warranted, Rasch Model may create a scale with each item and every student. This last feature of the Rasch Model is one of the main reasons why it is fundamental in educational research and especially in PISA practice (Edition, 2009)

Rasch is able to describe student ability continuously using dichotomic data. With three basic principles, we can lay the groundwork for the construction of Rasch continuity. The first principle concerns item difficulties. Take, for example, two items consisting of two questions. We cannot compare difficulties for these two items if the patterns of responses given to items 1 and 2 are (0, 0) and (1, 1) (indicating 1 success and 0 failure). On the other hand, the response pattern obtained in (1, 0) and (0, 1) is informative in terms of comparison. If we assume that the response pattern in this way is 50 students (0, 1) and 10 students (1, 0), we can reach the result that the second item is easier than the first. In fact, 50 students responded incorrectly to the first item, the second correctly answered, and only 10 responded correctly to the first item and the second item incorrectly. This indicates that when one person correctly answers one of the two items, the probability that the correctly answered question in the second item is 5 times the probability that it is the first item. Therefore, it is easier to answer the second question correctly than the first one correctly. However, we should not ignore that the relative difficulty of the two items is independent of the student abilities.

The second principle concerns the identification of the reference point. In the Rasch Model, the unit of measurement is defined by the probability function, which includes the item difficulty and the parameters of the student's ability. For this reason, it has been accepted that only one reference point has to be defined. The most common reference point is the zero point of item difficulties. However, accepting a zero center in the student's ability can be used as another relative reference point.

The third principle emphasizes continuity. Continuity plays a role in the calculation of the relative difficulty of the items that are presented to different subpopulations in part. Suppose that the first item is given to all students and the second item is given only to low-ability students. Comparisons of the items will only be made on the lower populations studied, i.e. on the low-skilled student population. The difficulty of the two relative items will depend on the common subgroup of these students (Edition, 2009). Student scores can be calculated when item difficulties are placed in Rasch continuity.

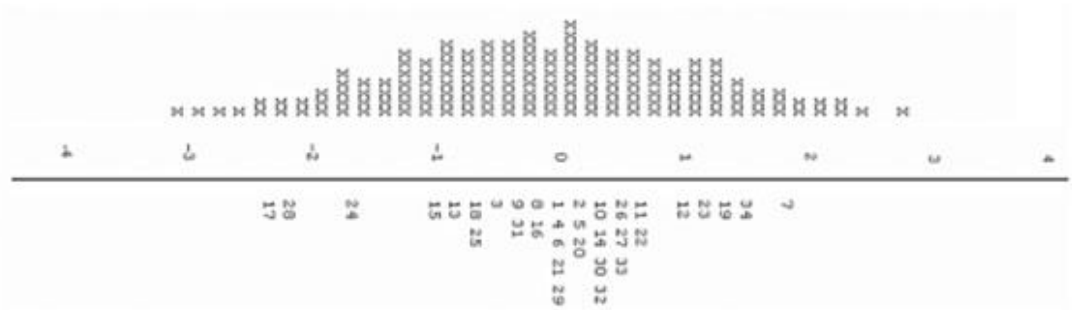

Figure 1. Student score and item difficulty distribution on a Rasch continuum

The line in Figure 1 represents Rasch continuity. Item difficulties are above and item numbers are below the line.

For example, item 7 represents a difficult item and item 17 represents an easy one. This test includes several easy items, a large number of intermediate items and a few difficult items. The symbols x above the line represent the distribution of student scores (OECD, 2009).

Calculating the student's score in Rasch Model

After the item difficulties are determined on the Rasch scale, student scores can be calculated. For a student whose ability is represented by B_i, the possibility of giving a correct answer to the item j whose difficulty level is represented by D_j is as follows:

$$p\left(X_{,j} = 1 \middle| \beta , \delta \right) = \frac{\exp(\beta_i - \delta)}{1 + \exp(\beta_i - \delta)}$$

Similarly, the possibility of giving a wrong answer is as follows:

$$p\left(X_{,j} = 0 \middle| \beta , \delta \right) = \frac{1}{1 + \exp(\beta_i - \delta)}$$

Rasch Model assumes the independence of items, so the probability of a correct answer is not dependent on the answers given to other items. As a result, the possibility of success from two items equals to the multiplication of two success probabilities.

Rasch ability estimations are often specified as the maximum likelihood estimation (or *MLE*). As shown in these figures, Rasch Model only returns a maximum probability estimate per raw score, i.e. zero correct answers, one correct answer, two correct answers, and so on.

Warm (1989) has shown that this maximum likelihood estimation is biased and suggested to weight the contribution of each item according to the information that this item can give. Warm estimations and *MLE*s are similar to students' individual skill estimations.

When the Warm estimation is corrected for the small bias in the MLE, it is usually an estimation of one's temperament. Therefore, in PISA, weighted likelihood estimations (*WLE*s) are calculated by applying weights to *MLE* in order to account for the bias inherent in *MLE*, as Warm proposed (OECD, 2009).

Plausible Value

Producing plausible values from a training test consists of drawing random numbers from posterior distributions. In its most basic sense, "Plausible values say that a learner is a demonstration of the abilities that it can have at a reasonable level. Instead of estimating the ability of a student directly, it estimates a student's probability distribution for Q. That is, instead of taking a point account for a Q as in *WLE*, a range of possible values of a student for Q and the combined probability for each of these values are estimated. Plausible values are random lines from this (estimated) distribution for a student's Q" (Wu and Adams, 2002).

All this methodology aims to create a continuum from a set of discontinuous variables (i.e. test score). It is aimed to avoid biased inferences as a consequence of measuring the underlying ability that cannot be observed through a test using a relatively small number of items.

Finally, an individual estimation of student ability can also be derived from posterior distributions. This derived individual estimation is called expected posteriori estimator (*EAP*). Instead of assigning a series of random values from the posterior distributions, the averages of the posterior distributions are given. For this reason, *EAP* can be considered as the average of a group of reasonable values for a particular student (Edition, 2009).

PISA Proficiency Levels

Proficiency levels have been proposed to be powerful tools that can be used to communicate results from large-scale assessment studies to the wider public with higher levels indicating higher proficiency. Importantly, proficiency levels describe the cognitive skills and the knowledge of which a student is capable (Fischbach, Keller, Preckel & Brunner, 2013).

Each proficiency scale is standardized to have M=500 and SD=100 across OECD countries. Furthermore, these scales can be subdivided into six proficiency levels for the mathematics and science tests and five proficiency levels for the reading test.

The first stage in creating proficiency levels begins with the putting possible scales and dimensions in written forms that can be used by the experts in each field for reporting. This step is defined as *identifying possible scales*. The advantage of this process is that multiple scales developed for the weighted area, which is concentrated in cycles, are more meaningful and potentially more useful for feedback and reporting purposes. The second stage deals with *assigning items to scales*. Each question item is associated with a thought scale. Experts, then, evaluate the properties of each item according to the classification in the evaluation framework. Then statistical analysis of the item scores obtained from the pilot application is used to obtain an objective criterion related to the distribution of the items in the scale. The skills are controlled in the third stage, which is known as *skills audit*. This stage involves analyzing the subject area of each item in detail by the expert, in relation to the definition of the relevant subscale in the evaluation framework, and evaluating the partial scores and points scored. The knowledge and skills required to achieve each point are described and explained. The fourth stage deals with *analyzing field trial data*. First, the data obtained from the pilot application is analyzed according to the IRT and the item difficulty for each achievement threshold is calculated. In general, when there is only one achievement bias for the items, more than one achievement threshold can be calculated for the ones that require partial scoring. Subsequently, achievement thresholds within each scale are placed along a continuous difficulty continuum, associated with student skills. The fifth stage includes *defining the dimensions*. The field expert combines the results from the analyzes done in stages 3 and 4. Subsequently, the item score steps for each set of scales are sorted by reference to the associated thresholds and then linked to the descriptions of the relevant knowledge and skills. These processes create a hierarchy of knowledge and skills that define the final dimension. The sixth stage consists of *revising and refining with main study data*. When this step is reached, the information obtained from the statistical analysis of the relative difficulty of the item thresholds is updated, as the data in the actual application is now ready to be used. After this, specialists are in charge of revising and checking the data. The seventh stage involves the *validating process*. First, knowledgeable experts are recruited who have the necessary materials to enable them to evaluate the indicators on which the levels defined for the PISA items are based. Then comes the consultation process during which the defined scales are presented to the national coordinators of all PISA countries. This stage allows one to reach the conclusions about how well the users of the defined levels find them informative (Anıl, Özkan & Demir, 2015).

PISA revises and updates description of proficiency levels each semester, which is determined in such a way as to reflect changes in evaluation and in the framework and requirements of new tasks developed for the evaluation. The most recent statement of proficiency levels is based on the PISA 2012 evaluation (OECD, 2014). PISA results demonstrate what is possible in education by showing what the students in the fastest growing education system can do best (PISA, 2015).

Content of PISA Mathematics Proficiencies

(Summary description of the six levels of mathematics proficiency in PISA 2015)

The mathematical proficiency levels identified by the PISA consist of six levels. While there is a hierarchical increase from 1 to 6 among these levels, the ability to respond correctly at the first level is given when all relevant information is provided and when the questions are clearly defined. Level 6, on the other hand, has the right frequency of answers where high-level thinking skills can be used, the information required for solution of the problem is organized, and where it is desired to be interpreted as the result. The item-based ability classification process is used when the score ranges of the levels are determined. Here, basically the difficulty levels of the items and the number of students who respond correctly to these items are taken as references. For this, the items are sorted according to their difficulty level. For instance, items 1 and 2 are in low difficulty, items 3 and 4 are in medium difficulty, and items 4 and 5 are in high difficulty. If the student cannot answer the 1st and 2nd items correctly, she is expected not to answer the 3rd and 4th items correctly as well. Assuming that another student can answer all the items correctly from 1 to 5, it is probably interpreted that she could answer the 6th item correctly. In the same way, it can be understood that a student who answered correctly the 1st and 2nd item but did not answer the 5th and 6th items correctly cannot answer the 4th item correctly, either. In Table 2, range of points are given by levels.

Table 2. Range of points for PISA 2012 mathematical proficiency levels

Under 1	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6
- 357.77	357.77-420.07	420.07-482.38	482.38-544.68	544.68-606.99	606.99-669.30	+ 669.30

Aim

This research focuses on the distribution of skills of the Turkish sample in PISA applications, their similarities and differences in earlier education levels. The measurements made and the findings obtained were compared with the countries in the upper rows in PISA applications and OECD averages. In this way, it is aimed to generalize the level of success that Turkey has in PISA applications to other education levels and to reach the findings about the reasons for the achievement below the expected level.

Methods

Sample

The research population consists of 448 Secondary State Schools in 30 districts affiliated to İzmir Provincial National Education Directorate. There is a total of 1822 branches and 45069 students at the 6th grade level in these schools. The confidence level and the confidence interval statistics were used when determining the sample size (Oulte, 2011; Thompson, 2012). When the confidence level was set at 99% and the confidence interval was set at t=2, the sample size was set at n=3809 for the population of 45069 (Lodico, Spaulding & Voegtle, 2006).

Taking this sample size into consideration, the schools in İzmir province of Turkey were determined according to the districts by randomized cluster sampling method and 148 branches and 4592 students in 20 schools were included in the study for the research sample. With the final state of the sample size, the confidence interval of the sample has been reduced to t=1,77, meaning that the power to represent the population has been increased. The TUBITAK project, numbered 115K531, consists of a total of 2 experiments and 1 control group as it is an experimental and longitudinal study. This research includes only the experiment 1 and the experiment 2 groups of the project sample. Thus, the sample of this research consists of 2672 students in these two groups.

The Instrument

The instrument used in this study is the first of the 4 monitoring tests applied in the TUBITAK project, numbered 115K531. This test consists of two books and 11 items to measure high-level thinking skills. The statistics for the items are given in Table 3.

Table 2. Test item parameters

No	Question Code	Item Difficulty (Pj)	Item Discriminatio n (rbis)
1	9796	0.41	0.5
2	3690	0.21	0.22
3	1027	0.18	0.45
4	1025	0.27	0.55
5	1033	0.51	0.48
6	1021	0.68	0.45
7	1032	0.4	0.41
8	7339	0.01	0.19
9	6728	0.29	0.38
10	5158_B	0.38	0.52
11	5158_C	0.31	0.49
	Average	0.33	0.43

As shown in Table 3, the item difficulty values range from 0,10 to 0,78 and the item discrimination values from 0,15 to 0,81. The average item difficulty was 0,31, and the average item discrimination was calculated as 0,56. As a result of the analysis, it was found that the test had sufficient discriminative value. At the same time, with the help of pilot implementation, the scoring keys to be used for open ended questions for the test items were determined.

Table 4. Test descriptive statistics

Average	3.65
Median	3
Standard Deviation	2.07
Variance	4.28
Skewness	0.63
Kurtosis	0.02

As shown in Table 4. the average score of the test is 3.65 and median score is 3. The standard deviation of the test was 2.07 and the variance was 4.48. Skewness and kurtosis values were found to be 0.626 and 0.016. respectively. A value of less than 1 means that the distribution does not deviate too much from the normal distribution.

It is very important to prove that the questions developed in the project have the same level and psychometric properties as the PISA and TIMSS questions. To this end. the averages were taken so that the statistics of the questions general test can be calculated. ANOVA analysis was performed for repeated measures to determine whether the developed questions correspond to PISA and TIMSS questions. According to the analysis results. there is no statistically significant difference between PISA. TIMSS and the average of the project questions ($F_{(896-2)}$=2.358. p>0.5).

Whether the variances of distributions are equal or not is examined by the Mauchly Sphericity test. According to the results of the analysis. it was seen that the assumption of sphericity is not distorted. that is. the variances of distributions are equal. ($\chi^2_{(2)}$=4.881. p>0.5). This is an indication that the questions produced within the project correspond to the PISA and TIMSS questions. At the same time. however. correspondence has also been examined in terms of scope and criteria. Test scores according to the criterion were statistically significant and highly correlated with each other (r=0.52. p<0.01).

Scope validation work was carried out by a team of 5 people consisting of expert project researchers and consultants in the field of two measurement and evaluation. two mathematics education and one program development. with at least associate degree. As a result of the study. it is seen that the questions produced in the project are compatible with PISA and TIMMS coverage.

Results and Findings

The research aims to examine the distributions of the mathematical proficiency levels determined for the students in the PISA applications in Turkey and to compare the distributions determined in a similar measurement targeting an earlier period than the PISA age range. To this end. it is first necessary to examine how the levels of proficiency are distributed to countries and the general average. Some results and country-based comparisons based on PISA 2012 results are given in Table 5.

Table 5. Country comparisons for PISA 2012 mathematical proficiency levels. as percentages

	Shanghai	Finland	OECD Avr.	Turkey
Level 1^{-}	0.85%	3.34%	8.02%	15.48%
Level 1	2.95%	8.92%	14.98%	26.50%
Level 2	7.51%	20.49%	22.46%	25.54%
Level 3	13.10%	28.82%	23.74%	16.52%
Level 4	20.17%	23.17%	18.15%	10.09%
Level 5	24.60%	11.71%	9.34%	4.67%
Level 6	30.83%	3.54%	3.31%	1.20%

Looking at the percentage distributions obtained with reference to the proficiency levels in Table 5. there is a 0.85% part in Shanghai below Level 1. while this corresponds to 8.02% in the OECD average. In Turkey. this ratio is 15.48%. When we look at Level 6. it is seen that only 1.20% of the students have reached this level in Turkey while there is a 30.83% part in Shanghai. The distributions of the countries can be seen more clearly in Figure 2.

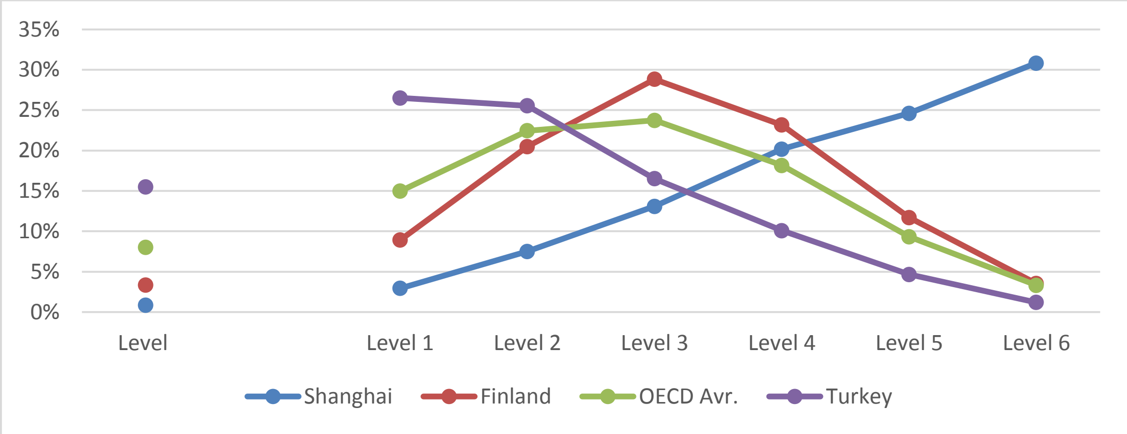

Figure 2. Country comparisons for PISA 2012 mathematical proficiency levels. as percentages

When the graph is examined in general. it is observed that Shanghai is distorted to the left. the average of Finland and OECD is normal. and Turkey is distorted to the right. This gives a good idea of the level of countries as a measure of success. Table 6 gives the mean and standard deviations of the compared countries.

Table 6. PISA 2012 Math average scores and standard errors by countries

	Shanghai	Finland	OECD Average	Turkey
Average Score	613	519	494	448
Standard Error	3.3	1.9	0.5	4.8

According to Table 6. Shanghai's average score is quite high when compared to the OECD average. When Turkey's average score is examined. it is seen that it is considerably lower than the other countries.

Within the scope of the project. the test scores proved to be corresponding to the PISA content and level were first analyzed with the Rasch Model in accordance with the PISA procedure. and the ability scores of the sample were determined and then statistically more reliable ability distribution was obtained by calculating plausible scores. Table 7 demonstrates the comparison of cut-off scores of percentage levels for PISA 2015 and Project measurements.

Table 7. PISA Turkey percentage cut-off scores for ages 15 and 12

	PISA Turkey Age 15	Project Age 12
10th	339	352
25th	382	392
50th	438	429
70th	507	499
90th	577	566
Mean	448	450

When Table 7 is examined. it is seen that the cut-off scores of 15-year-old and 12-year-old Turkey samples are very similar. Figure 3 shows the overlap level of cut-off scores for two tests.

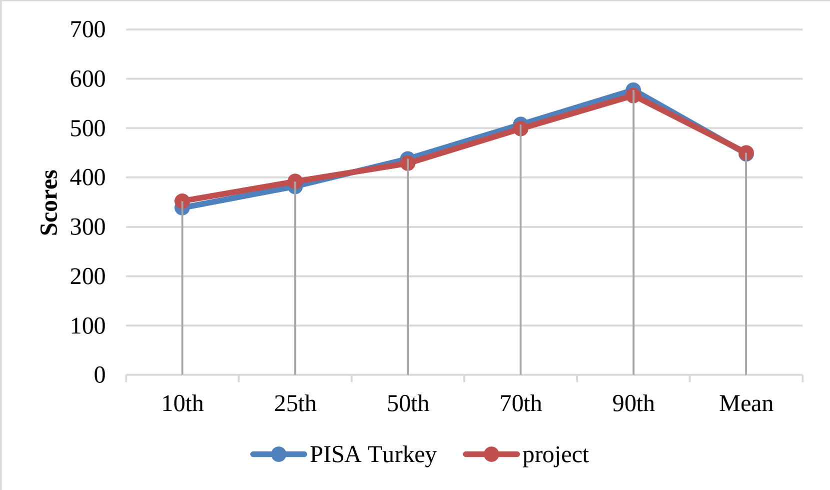

Figure 3. Overlap level of cut-off scores of PISA Turkey and the project

As can be seen in Figure 3. the cut-off scores of the two groups are very close. This shows that the percentage distributions of the two samples are very similar. At the next stage. the two groups were analyzed in terms of mathematical proficiency as percentages. Table 8 shows the mathematical proficiency levels of the 15-year and 12-year Turkey distribution.

Table 8. Percentage distribution of mathematical proficiency levels for PISA turkey and Project measurements

	PISA Turkey Age 15	Project Age 12
Level 1⁻	15.5	13.9
Level 1	26.5	18.6
Level 2	25.5	37.0
Level 3	16.5	20.2
Level 4	10.1	8.3
Level 5	4.7	1.4
Level 6	1.2	0.6

When Table 8 is examined. it is seen that the percentage distributions of mathematical proficiency levels are similar in both groups. In the age group of 15. Level 1⁻ is 15.5% while that of the 12-year-old is 13.9. Similarly. the 15-year-old group has a higher falling rate in Level 1. In Levels 2 and 3. the 12-year-old group appears to be in a higher percentage. At Level 4. 5 and 6. 15-year-old group is seen to be proportionally higher. Figure 4 shows the distribution of 12- and 15-year-old groups in terms of their mathematical proficiency levels.

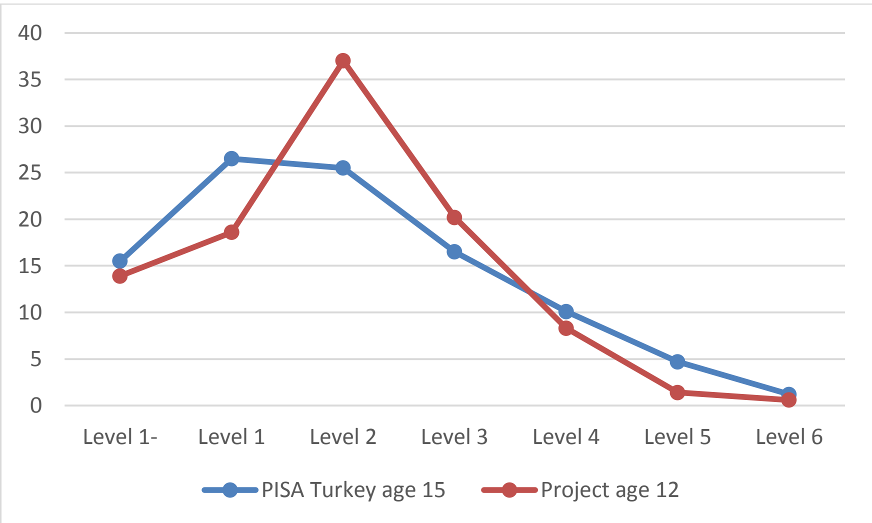

Figure 3. Distribution of 12- and 15-year-old groups in terms of their mathematical proficiency levels.

In Figure 4. it is seen that the 15-year-old group is higher at Level 1⁻ and Level 1. This indicates that in the sample of 15-year-olds. the number of students at Level 1⁻ and Level 1 is lower; that is. the number of students at the lower level is more than 12-year-old group. When Levels 2 and 3 are considered. it is seen that the percentage distribution of 12-year-old group is higher in this range. It seems possible to say that the distribution for 12-year-old group is moderately more intense. At Levels 4. 5 and 6. the 15-year-old group is higher than the 12-year-old group. It was determined that there were some differences in the two groups. but these differences were not statistically significant. In this case. it is understood that students in the 12- and 15-year-old groups do not differ in terms of PISA mathematical proficiency levels.

Conclusion

As the research findings show. a distribution similar to the percentages described in the PISA 2015 report of proficiency levels was achieved by the project sample. There are great similarities between 6th grade students and 15-year-old group in terms of mathematical proficiency levels. More specifically. project sample and PISA Turkey measurements have very close values in terms of the mean and standard distribution as well as cut-off point scores. point values falling in percentages and sample percentages of proficiency levels.

Findings indicate that there is no difference between the levels of having high level mathematical proficiency levels in the 6th grade and the 15-year-old group in Turkey. Although the research includes test correspondence. sample validity. and psychometric properties of the questions. it is clear that additional research is needed to generalize the findings since only one province and a single class level are taken as basis.

It is also seen that during the international examinations (PISA. TIMSS. PEARLS). the low level of achievement of the students in Turkey shows similar features at earlier stages of the education system. In this sense. we can say that in order to increase the level of Turkey's success in international examinations. more holistic and systematic solutions are needed.

References

Anıl. D.. Özkan. Y. Ö. & Demir. R. E. (2015). *Pisa 2012 araştirmasi ulusal nihai rapor.*

Bodin. A. (2005). What does PISA really assess? What it doesn't? A French view 1. (June). 1–25.

Edition. S. (2009). *PISA Data Analysis Manual: SPSS. Second Edition. Analysis*. https://doi.org/10.1787/9789264056275-en

Fischbach. A.. Keller. U.. Preckel. F. & Brunner. M. (2013). PISA proficiency scores predict educational outcomes. *Learning and Individual Differences*. *24*. 63–72. https://doi.org/10.1016/j.lindif.2012.10.012

Framework. R. (2013). 2 • Figure 2.2 •. 2012–2014.

Linneweber-Lammerskitten. H. & Wälti. B. (2005). Is the definition of mathematics as used in the pisa assessment framework applicable to the harmos project? *ZDM - International Journal on Mathematics Education*. *37*(5). 402–407. https://doi.org/10.1007/s11858-005-0028-y

OECD. (2009). *PISA Data Analysis Manual: SPSS*. *Oecd*. https://doi.org/10.1787/9789264056275-en

PISA. (2015). *PISA 2015 Results in Focus*. *Oecd* (Vol. I). https://doi.org/10.1787/9789264266490-en

Scale. P. (2014). Proficiency Scale. 1–4.

Tienken. C. H. (2017). Understanding PISA Results. *Kappa Delta Pi Record*. *53*(1). 6–8. https://doi.org/10.1080/00228958.2017.1264806

Wu. M. (2005). The role of plausible values in large-scale surveys. *Studies in Educational Evaluation*. *31*(2–3). 114–128. https://doi.org/10.1016/j.stueduc.2005.05.005

Wu. M. (2009). A comparison of PISA and TIMSS 2003 achievement results in mathematics. *Prospects*. *39*(1). 33–46. https://doi.org/10.1007/s11125-009-9109-y

The Eurasia Proceedings of
Educational & Social Sciences (EPESS)
ISSN: 2587-1730

The Eurasia Proceedings of Educational & Social Sciences (EPESS), 2017

Volume 6, Pages 24-30

ICEMST 2017: International Conference on Education in Mathematics, Science & Technology

IDENTIFYING STUDENTS' POSSIBLE SOLUTION STRATEGIES WHILE SOLVING QUESTIONS REGARDING THE CONCEPT OF MEAN

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Abstract: The purpose of this study was to investigate solution strategies used by seventh grade students regarding the concept of mean given in bar graph representations. Participants were 233 seventh grade students from two public middle schools in Gelibolu district of Çanakkale. Data were collected via a questionnaire. Students' possible solution strategies regarding the concept of mean were identified through item based in-depth analysis. The results of the study indicated that students used two different solution strategies to solve questions regarding the concept of mean. More specifically, the study indicated that the balance model and the average formula were identified as two solution strategies to solve the questions regarding the mean concept given in bar graph representations.

***Keywords*:** Mean, solution strategies, bar graph representations

Introduction

In recent years, the emphasis laid upon statistics in the mathematics curriculum has increased by means of international movements (Jacobbe & Carvalho, 2011). One of the reasons underlying this increase in emphasis may be that statistics is an essential part of daily life. Another reason may be that statistics establishes links between other areas, such as history, science and geography (Konold & Higgins, 2003). Moreover, *The Principles and Standards for School Mathematics* (NCTM, 2000) set out of 5 content areas, one of which is Data Analysis and Probability (Pratt, 2005). Similarly, in Turkey, with the changes made in the mathematics program in 1990 and 1992, numerous concepts related to probability and statistics were added, and the new textbooks included basic concepts, such as measures of central tendency, measures of spread and probabilistic events (Bulut, Ekici, & Iseri, 1999). In addition, the elementary mathematics curriculum in Turkey included real life contexts for the purpose of making interpretations and making decisions by resorting to statistical knowledge (MoNE, 2005, 2013).

In accessible literature, although there are several studies that examine the problem solution strategies used by students (Becker, 1992; Cai 1995; 1998), there is a limited number of studies on the solution strategies used by students while solving questions regarding statistical concepts (Cai, 2000). Identifying students' possible solution strategies is significant because if a student have conceptual understanding regarding the averaging algorithm of the mean, the student can correctly and flexibly apply the averaging algorithm to solve questions regarding the concept (Cai, 1998; Watson & Moritz, 2000). However, the number of studies in Turkey is not sufficient regarding students' solution strategies while solving questions regarding the measures of central tendency concepts (Uçar & Akdoğan, 2009). In order to reveal important information about students' understanding of the average concepts, students' solution strategy preferences while trying to solve questions related to these concepts can be focused (Cai, 1998). Therefore, the purpose of the present study is to analyze the solution strategies utilized by students while solving questions regarding the concept of mean.

- Selection and peer-review under responsibility of the Organizing Committee of the conference

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Method

The Research Design

In this study, the survey research design was preferred because surveys are conducted to define some aspects and characteristics of a population or a sample (Fraenkel & Wallen, 2006). More specifically, the cross-sectional survey design was used since it requires collecting data at one point of time from a selected sample from a predetermined population to describe the characteristics of the population (Fraenkel & Wallen, 2006).

Participants

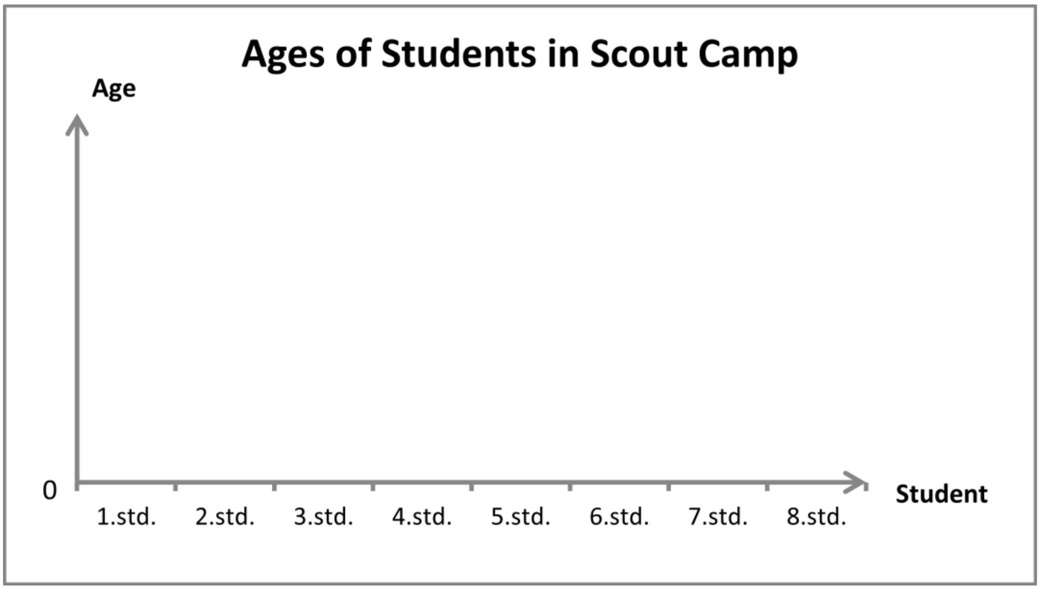
Data was collected from 233 seventh grade students including 106 girls and 127 boys from 2 public middle school students in the Gelibolu district, Çanakkale, Turkey.

Instrument and Data Collection

In the research, a questionnaire was used as a data collection tool. The questionnaire consists of two open-ended questions in order to investigate solution strategies used by 7th grade students regarding the concept of mean given in bar graph representations. Two questions and their details were given below:

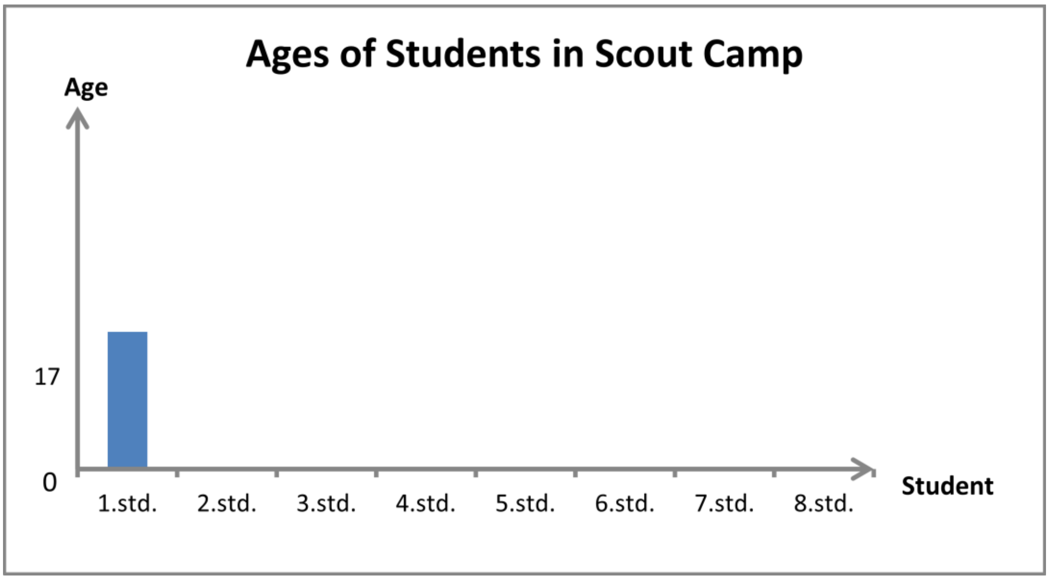
Question 1, which was adapted from study of Mokros and Russell (1995), consists of two parts. The question was asked to investigate students' solution strategies used to solve questions regarding the mean through construction of a data set for the given average.

Question 1:
a) In a scout camp, there are 8 students whose ages are different from each other. Average age of the students is 15. Based on the information, what could their ages be? Draw a bar graph in order to show a possible data set for students' ages in the camp.



How did you give your answer? Explain.
……………………………………………………………..

b) In a scout camp, average age of 8 students is 15 and if age of a student is 17, what could be ages of other students so the average still comes out to 15? Draw a bar graph to show a possible data set for students' ages of the camp.

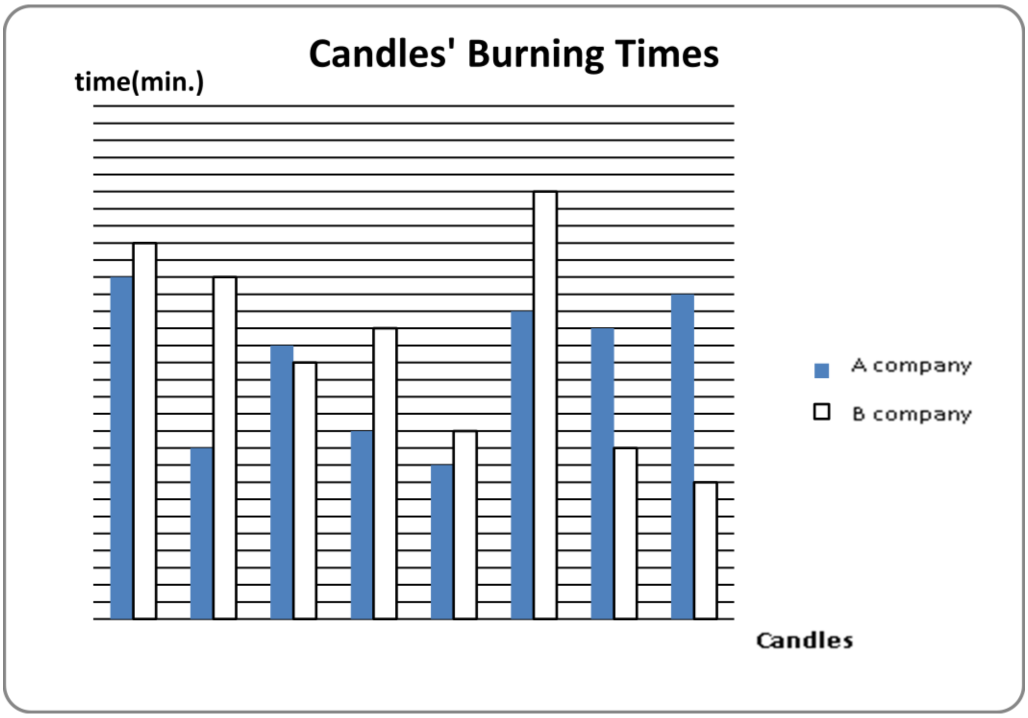


How did you give your answer? Explain.
....

Figure 1. The first and second part of question 1 in the questionnaire

Question 2 was developed by the researchers. The question was asked in order to identify used solution strategies to solve questions which were required calculation of the mean given in bar graph representations.

Question 2: Burning times of candles which A and B companies produced are wanted to be compared. In order to compare burning times of candles of A Company and B Company, the same size 8 candles from each company were chosen and the candles. Then, the candles were burned and the number of minutes that each candles burned were recorded.



Determine the mean of burning times of candles for each company.
<u>Mean</u>
A Company ….......
B Company ………

b) Determine the median of burning times of candles for each company.
<u>Median</u>
A Company ….......
B Company ………

c) Ahmet claims that candles of A Company have longer burning times than candles of B Company. Do you agree with Ahmet?

....

- How did you decide whether Ahmet is right or not? Explain your reasoning.

....
……………………………………………………………………………………………
………………………………………………………

Figure 2. Question 2 in the questionnaire

In general, the aim of asking these questions was to get knowledge about participants' alternative solution strategies while solving questions regarding the concept of mean. The items were reviewed by three experts from the Elementary Mathematics Education Department of different universities to provide content related evidence of validity of the instrument. As part of reliability, two researchers analyzed students' answers. A correlation of 98% was found between the two scorings. In order to identify students' solution strategies while solving questions regarding the concept of mean, item based in-depth analysis was conducted.

Findings

Solution Strategies

In accordance with purpose of the study, students' solution strategies were categorized for the mean concept. More specifically, *balance model* and *average formula* strategies were identified as solution strategies in order to solve questions regarding the mean concept. Table 1 presents frequencies of the solution strategies employed by the students providing correct responses, for each item.

Table 1. Frequencies (and percentages) of solution strategies employed by students providing correct responses

	MEAN	
STRATEGIES / ITEMS	**Balance Model**	**Average Formula**
1-a	23 (31.1%)	51 (68.9%)
1-b	19 (30.2%)	44 (69.8%)
2	0	94 (100%)

As can be observed in Table 1, findings indicated that the majority of the students who solved the questions correctly used *average formula* as a solution method. For example, 100% of the participants used the averaging solution strategy to solve item 2. On the other hand, *balance model* and *average formula* solution strategies were used for items 1-a and 1-b as solution strategies. Examples of students' appropriate solution strategies for each identified strategy to solve questions regarding the mean are presented below.

1. Balance Model

The students, who used the balance model as a solution strategy, accepted the mean as a point of balance. For example, in one question, the mean of a data set is 5, and three of four data are 2, 4, and 6. While solving the question, student says that the mean of 4 and 6 is 5, then other data is 8 because 2 is balanced with 8 to obtain 5 as mean of the data set. Therefore, in this solution strategy, a value from a data set is balanced with the other value in order to obtain the mean of the data set. According to Table 1, the balance model was most frequently used solution strategy for item 1-a. It was seen that 23 students (31.1%) among 74 students who solved the item correctly used the balance model solution strategy to solve the item. On the other hand, 19 students (30.2%) among 63 students who solved item 1-b correctly also used the strategy to solve the item.
To illustrate, the solution strategy employed by Participant 19 for item 1-a is presented below:

Participant 19:

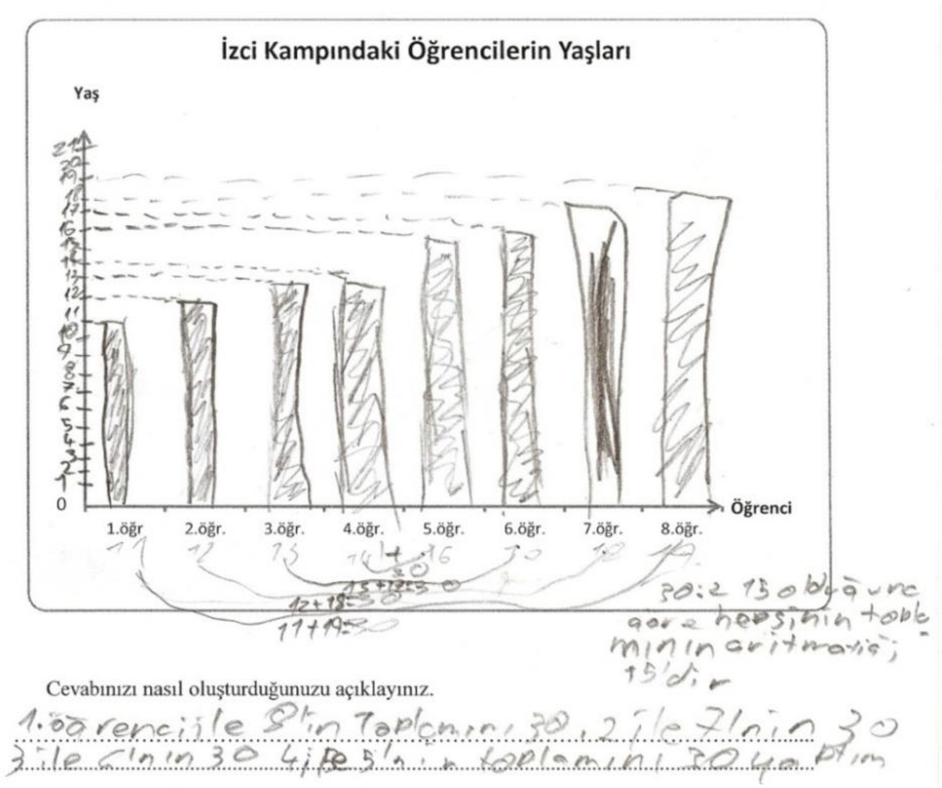


Figure 3. Answer of participant 19 to item 1-a

Participant 19 stated that each value in the data set was balanced with the other value in the data set while constructing a possible data set for the given mean. Age of student 1 was accepted as 11 and the value was balanced with age of student 8 as 19 since he believed that the mean of 11 and 19 was 15. In addition, the age of student 2 was accepted as 12 and it was balanced with the 7th student's age which is decided as 18 since the mean of 12 and 18 was 15. Participant 19 identified the ages of the other students using the same procedure.

2. Average Formula: Students who used the average formula solution strategy while solving the questions regarding the mean concept used the "add and then divide "algorithm to solve the given questions. Thus, when the average of a data set was asked, the students added all the values in a data set and then divided it by the number of values. On the other hand, when a question was asked with a missing value from a data set, first the total number of values was found and then the total number of the given values in the data set was subtracted.
As can be seen in Table 1, the solution strategy was most frequently used in solving item 2. More specifically, it was observed that 94 students (100%) had used this solution strategy. Furthermore, 51 students (68.9%) among 74 students used average formula solution strategy to solve item 1-a and 44 students (69.8%) among 63 used strategy to solve item 1-b.
For example, Participant 154 used the solution strategy to solve item 2 as presented below:

Participant 154:

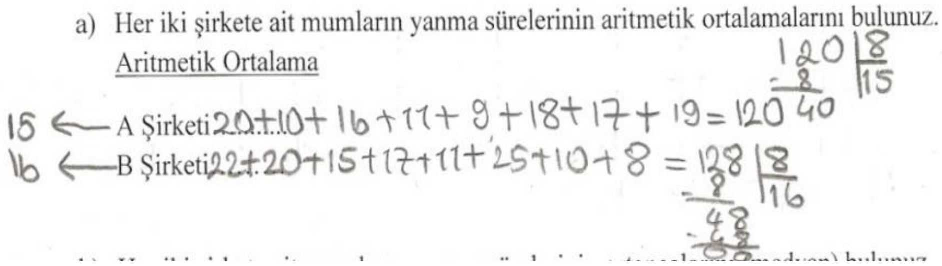


Figure 4. Answer of participant 154 to item 2-a

As can be observed in the solution of Participant 154, to find arithmetic average of the burning times she added all the burning times of the candles for each company and then divided the sum by the number of candles in the companies. Thus, the participant used the average formula solution strategy.

In general, based on the results of the study, the average formula solution strategy was most frequently used in the questions requiring the calculation of the mean when values of a data set were given. On the other hand, the strategy was also used in the questions requiring construction of a data set for the given mean of a date set.

Conclusion

Findings of this study revealed that the seventh grade students used two different solution strategies to solve the questions regarding the concept of mean. The solution strategies were named as the balance model and the average formula.

In the present study, while finding the mean of a data set or a missing value of a data set for the given mean, the average formula solution strategy was used mostly. This finding was in agreement with the study of Mokros and Russell (1995), where average of a data set was given and the construction of a possible data set was required. In other words, one of the five different constructions of representativeness was algorithm (arithmetic average) in the study of Mokros and Russell (1995). More precisely, most of the students used the average formula solution strategy while constructing a data set for the given mean (Mokros & Russell, 1995). This finding was also consistent with the results of studies conducted by Cai (1998; 2000) who stated that most of the participants also used average formula solution strategy to solve averaging problems. Students' tendency to use the average formula solution strategy to solve the items could be attributed to the fact that only this strategy might have been used by the mathematics teacher to find the mean of a data in the mathematics classes.

On the other hand, some of the students used the balance model solution strategy to solve these kinds of questions. The balance model solution strategy was generally used while constructing a possible data set for the given mean compared with the solution of the questions which required finding the mean of a data set. This finding was also in agreement with the study of Mokros and Russell (1995) since the findings of the study indicated that one of the constructions of representativeness of average was accepted as the balance point. Furthermore, the results of the studies of Cai (1998; 2000) showed that participants used the levelling solution strategy to solve questions regarding the mean, which was similar to the balance model solution strategy used in the present study. The balance model solution strategy could be considered as an invented strategy since the mathematics' textbooks in Turkey do not include this model as a solution strategy to solve the mean questions. Thus, this strategy could be included into the textbooks as an alternative strategy to solve the questions related to the concept of mean.

Recommendations

Findings of the present study were limited with two questions of the questionnaire however when different questions were asked related to the concept of mean, different findings could be reached. Furthermore, a similar study might be conducted in private schools to investigate private middle school students' understandings regarding the concept of mean. Moreover, a longitudinal study could be conducted to investigate the development of middle school students' procedural and conceptual knowledge regarding the mean concept based on their grade level.

References

Becker, J. P. (Ed.), 1992. *Report of U.S.–Japan Cross-National Research on Students' Problem Solving Behaviors*. Columbus, OH: ERIC/SMEAC Clearing House, ED 351/204.

Bright, G. W. & Friel, S. N. (1998). Graphical representations: Helping students interpret data. In S. P. Lajoie (Ed.), *Reflections on statistics: Learning, teaching, and assessment in grades K–12* (pp. 63–88). Hillsdale, NJ: Lawrence Erlbaum Associates.

Bulut, S., Ekici, C. & Iseri, A. I. (1999). Bazı olasılık kavramlarının gelişimi için çalışma yapraklarının geliştirilmesi. *Hacettepe University Journal of Education*, *15,* 129-136.

Cai, J. (1995). Beyond the computational algorithm: Students' understanding of the arithmetic average concept. In L. Meria & D. Carraher (Eds.), *Proceeding of the 19th Psychology of Mathematics Education Conference* (Vol. 3. pp. 144-151).

Cai, J. (1998). Exploring students' conceptual understanding of the averaging algorithm. *School Science and Mathematics*, *98*(2), 93-98.

Cai, J. (2000). Understanding and representing the arithmetic averaging algorithm: an analysis and comparison of US and Chinese students' responses. *International Journal of Mathematical Education in Science and Technology, 31*(6), 839-855.

Fraenkel, J. R., & Wallen, N. E. (2006). *How to design and evaluate research in education*. New York, the USA: McGraw-Hill.

Jacobbe, T., & Carvalho, C. (2011). Teachers' understanding of averages. In C. Batanero, G. Burrill, & C. Reading (Eds.), *Teaching statistics in school mathematics – Challenges for teaching and teacher education* (pp. 199–209). Dordrecht: Springer.

Ministry of National Education [MoNE]. (2005*). İlkögretim matematik dersi ö*g*retim programı 6-8. sınıflar: Ö*g*retim programı ve kılavuzu* Ankara,Turkey.

Ministry of National Education [MoNE]. (2013). *İlköğretim Okulu Ders Programları: Matematik Programı 5-6-7-8 (Elementary Curricula Programs:Mathematics Curricula Program for Middle Grades)*.Retrieved from http://ttkb.meb.gov.tr/www/guncellenen-ogretim-programlari/icerik/151.

Mokros, J. & Russell, S. J. (1995). Children's concepts of averages and representativeness. *Journal for Research in Mathematics Education, 26,* 20-39

Konold, C & Higgins, T. L. (2003), "Reasoning about data", In J. Kilpatrick, W. G. Martin, & D. Schifter (Eds.), *A research companion to Principles and Standards for School Mathematics*, Reston, VA: National Council of Teachers of Mathematics, pp.193-215.

Pratt, D. (2005). Probability in teacher education and development. In G. A. Jones (Ed.), *Exploring probability in school* (pp. 171-190). New York: Springer Science+Business Media, Inc.

Uçar, Z. T. & Akdoğan, E. N. (2009). Middle school students' understanding of average. *Elementary Education Online, 8(*2), 391-400.

Watson, J. M. & Moritz, J. B. (2001). Development of reasoning associated with pictographs: Representing, interpreting, and predicting. *Educational Studies in Mathematics, 48*, 47-81.

The Eurasia Proceedings of
Educational & Social Sciences (EPESS)
ISSN: 2587-1730

The Eurasia Proceedings of Educational & Social Sciences (EPESS), 2017

Volume 6, Pages 31-37

ICEMST 2017: International Conference on Education in Mathematics, Science & Technology

INVESTIGATING TEACHING PRACTICES FOR ALGEBRAIC EXPRESSIONS WITHIN A MULTIPLE CASE STUDY

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Abstract: As effective teaching practices support students' learning; it is essential to investigate teachers' teaching practices. It can also shed light on the causes of students' difficulties. In this regard, proposing teaching practices might be important as the practices can give insight about what is going on in teaching process. Thus, the aim of this study is to extract the practices by focusing on the teachers' actions during the teaching of operations with algebraic expressions. Mathematical Knowledge for Teaching (MKT) model which is a practice-based approach to the knowledge concept is used as a framework in this study. Thus, this study focuses on teaching practices of operations with algebraic expressions (addition, subtraction, and multiplication). Data were collected from two middle school mathematics teachers' instructions. The two teachers were the cases in this qualitative research and the data were analyzed by compare and contrast method. The practices that are found in the study are: defining the concept of term, like term, constant term, and coefficient; using equal sign; using analogies to explain addition and subtraction; using algebra tiles; providing mathematical explanations for distributive property; and noticing students' misconceptions in simplification and equivalence of algebraic expression. The results suggest that the conceptual teacher knowledge influences teaching practices positively and teacher knowledge should be used in appropriate pedagogical organization to develop teaching practices.

***Keywords*:** Algebraic expression, middle school mathematics teacher, teaching practice

Introduction

One of the factors that have an influence on students' learning is teaching practices (Saxe, Gearhart, & Seltzer, 1999) as the examination of teaching practices can shed light on the causes of students' difficulties. Practices are defined as "core activities that could and should occur regularly in the teaching of mathematics" (Franke, Kazemi & Battey, 2007, p. 249). In this regard, proposing teaching practices might also be different and significant as Charalambous (2016) stated. Teaching practices can give insight about how teachers use their knowledge in teaching process and it is meaningful to understand how students learn. Thus, the aim of this study is to extract the practices by focusing on the teachers' actions throughout the instruction of operations with algebraic expressions.

The Significance of the Study

As Wilkie (2014) indicates, the studies about teaching practice for algebra was scarce; thus this study is important for filling the void about practicing teacher algebra knowledge in classroom research. Tirosh, Even and Robinson (1998) found that the teachers who had conceptual knowledge and the knowledge of students could show effective practice with explaining like term and unlike term, and use strategies for simplification algebraic expressions appropriately. In equivalence of algebraic expression, Hallagan (2004) showed the importance of teacher's using algebra tiles appropriately underlying with area concept in learning the application of distribution.

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In algebra learning, both conceptual and procedural development of the algebraic expression is essential for forming an equation and solving it (Capraro & Joffrinon, 2006). However, manipulating algebraic expressions is one of the difficult algebra topics for students (Banerjee & Subramaniam, 2012; Livneh & Linchevski, 2007; MacGroger & Stacey, 1997; Seng, 2010). At this point, the studies about algebra teaching are scarce and there is also a need to understand the causes of students' difficulties in algebra learning. Thus, this study focuses on teaching practices of operations with algebraic expressions (addition, subtraction, and multiplication).

The Aim of the Study and Research Question

The aim of this study is to extract the practices by focusing on the teachers' actions throughout the teaching of algebraic expressions (simplification and equivalence of algebraic expressions). Thus, the following research question is framed: what is the nature of middle school mathematics teachers' teaching practices in the instruction of operations with algebraic expressions?

The Framework

Mathematical Knowledge for Teaching (MKT) model that is a practice-based approach to the knowledge concept by Ball, Thames, and Phelps (2008) is used as framework in this study (see Figure 1). MKT is defined as "the mathematical knowledge needed to carry out the work of teaching" (Ball et al., 2008, p. 395).

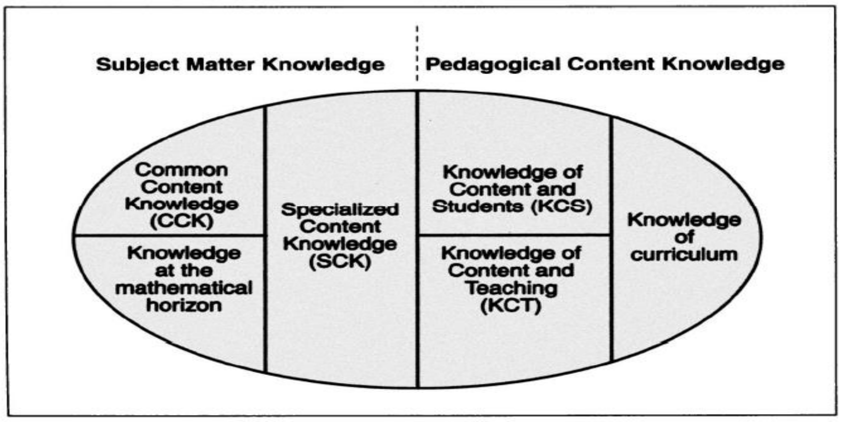

Figure 1. Mathematical knowledge for teaching model (Ball et al., 2008, p. 395)

This model has two main domains as subject matter knowledge and pedagogical content knowledge. The domains have also sub-domains. Ball and her colleagues explained the model with the descriptors based on mathematical demands of teaching. To illustrate, "using terms and notation correctly writing on the board" (p. 399) and; "how mathematical language is used; how to choose, make, and use mathematical representations effectively" as examples for subject matter knowledge (p. 400); "anticipating or predict the mistakes or misconceptions that commonly arise during the instruction" as an example for pedagogical content knowledge (p.375). The current study investigated these mathematical practices for teaching algebraic expressions.

Methods

In this study, qualitative research design was used to investigate middle school mathematics teachers' teaching practices in the context of simplification and equivalence of algebraic expressions. In the qualitative research, a problem or issue is handled with detailed data that are got from different aspects and sources and participants' interpretations (Creswell, 2007). The two teachers were the cases in this qualitative research and the findings were presented by compare and contrast method. Particularly, multiple-case study design with single unit of analysis was used from types of case study designs (Yin, 2003).

The participants were two middle school mathematics teachers and they have been working in the same public school. They were teaching algebra topics to 7th grade students at the same time during the data collection. These teachers were selected and convenient sampling method was used because of the accessibility and their volunteering. The main data were collected from two middle school mathematics teachers' instructions. The researcher observed the lessons in two different 7th grade classes, took field notes, and video-recorded with a camera. After each class session, the researcher conducted post-observation interviews with each teacher separately.

The instructions of two teachers were analyzed and described independently first. The practices of the teachers were grouped based on the common patterns in the teacher's actions that they performed throughout the instructions. MKT model was used in order to determine the practices. The practice-based descriptions of domains were used to explain the practices.

Findings

The extracted practices in this research were: defining the concept of term, like term, constant term, and coefficient; using equal sign; using analogies to explain addition and subtraction; using algebra tiles; providing mathematical explanations for distributive property; and noticing students' misconceptions in simplification and equivalence of algebraic expression.

1. Defining the Concept of Term, Like Term, Constant Term, and Coefficient

At the beginning of the instruction, Teacher B distributed the worksheet to remind algebraic expressions that the students learnt at 6^{th} grade. She reminded what the algebraic expression, term, coefficient, constant term, and like term was. She defined term, like term, constant term, and coefficient concepts correctly by working on the worksheet which had definitions and examples for these concepts. She emphasized the importance of like terms in order to do addition and subtraction with them.

On the other hand, Teacher A had lack of knowledge about the constant term concept as she did not accept it as a term. For example; in $9x+5x^2-9x-7$, she indicated -7 as constant, but she did not accept it as a term. The lack of her knowledge caused incorrect defining of constant term. In the post interview, she admitted to the researcher that she had defined the concept of constant incorrectly when the researcher explained what the constant was.

2. Using Equal Sign

The students did not use equal sign appropriately in expressions. However, Teacher A did not correct them and make any explanations. The student answered 8m correctly, but he used the equal sign inappropriately to show the result that he found as it is shown in the Figure 2. The student added the variables and constant terms separately. He started to write the addition of variables as if it equaled the whole expression. He first added 12m + (-5m), got 7m. Then, he wrote 7m after the equal sign and added m, and got 8m. In this case, 8m was the result of the question regarding the using of equal sign. Teacher A did not intervene any of these representations. However, the student used the equal signs incorrectly. After Teacher A asked to add the constant term, the student added them (1-9) separately and found -8. Teacher A wrote the results together as 8m-8 at the bottom instead of the place of the answer.

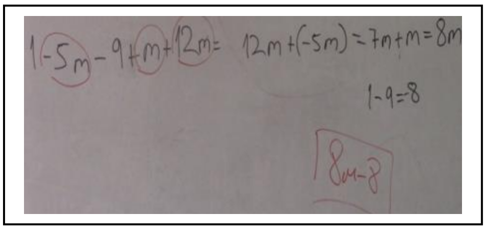

Figure 2. The use of equal sign as the result indicator

On the other hand, Teacher B was aware of students' incorrect writings and corrected them throughout the instruction. For example; she corrected the students' incorrect writings (see Figure 3) when they collected the like terms separately in another place, and they did not write as the result. Teacher B warned students against leaving the results of the addition of like terms. She suggested writing the results on the right side of the equal sign after finding the answers.

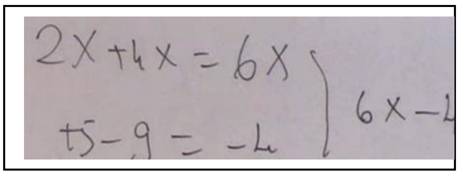

Figure 3. The simplification of 2x+5+4x-9

3. Using Analogies to Explain Addition and Subtraction

Teacher B used analogies in order to teach addition and subtraction in simplification of algebraic expression. For example, she used apple and pear analogy as well as the net worth (i.e. asset and debts) analogy to express different kind of the variables. For example, the explanations of Teacher B's for solving '2a+3-a-4' was as in the following:
B: I have 2 pears, if I give one of them, I have 1 pear. It is represented as 1a. I have 3 TL assets, 4 TL debts. Even if I get the assets, I will have 1 TL debt. Look if the algebraic expression is alone, it means 1 of it. So, we do not need to write 1. You have to know 1 before it.

Teacher B generally used asset and debt concepts and apple-pear representations for explaining the solution of these questions as indicated above. The students could understand much better when the teacher used the concept of variables with analogies. On the other hand, Teacher A did not use any analogies.

4. Using Algebra Tiles

Teacher A used algebra tiles as mathematical representations inadequately to explain multiplication since she did not explain area calculation of rectangles. Instead of this, she explained repeated addition for 2.(3x+3) as in the Figure 4. This representation can be used, but the nature of algebra tiles requires explaining area concept. First, she should have explained x and 1 which were written on the tiles were the areas of the tiles. The tiles were rectangles (for x) and squares (for 1). For x tile, the multiplication of x by 1 is 1; and for 1 tile the multiplication of 1 by 1 is 1. Then, she could have explained the sides of the modeling as rectangle in the figure. One of the sides was 6 unit, and the other side x+1, and the sum of areas was 6x+6.

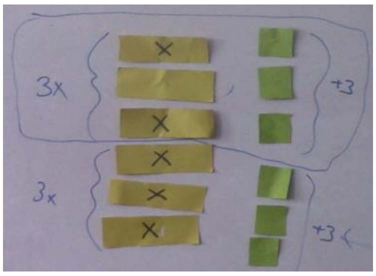

Figure 4. The representation of 2.(3x+3) with algebra tiles

On the other hand, Teacher B had stated that underlying idea of using algebra tiles was the area concept in planning process; she did not use them in teaching multiplication of algebraic expressions. Instead of modeling with tiles, she taught the multiplication procedurally by explaining the rules. Teacher B gave 4.(5-3x) to show the application of distributive property for algebraic expression. She asked the students to use the distributive property in order to do multiplication since 3x could not be subtracted from 5. She multiplied 4 by 5 and -3x respectively, and got 20-12x as the result. She stated that the result was 20-12x because of the absence of like terms that could be added or subtracted.

5. Providing Mathematical Explanations for Distributive Property

Two teachers explained and showed the application of distribution property within different strategies. Teacher A connected repeated addition with distributive property in multiplication appropriately. For example, she asked to the students to express the perimeter of the rectangle whose sides were m and n length algebraically. When the students found 2m+2n, she represented it as 2(m+n) to show distribution property as in the script:

Student: m+m+n+n=2m+2n

A: Okay, what is the common in two expressions?

Student: 2.

A: Then, we can take the parenthesis of 2, we take m and n from the expression. (She is writing 2(m+n)). It is the distribution property of multiplication to addition.

In this situation, the student added the variables separately and he did not use multiplication. Teacher A guided him to find the common number in the expression and she wrote 2(m+n) herself. She explained that it was the distribution property of multiplication to addition. This question could be useful for students for the reason that it provided to connect the repeated addition with multiplication.
On the other hand, Teacher B connected with integers to explain the application distributive property appropriately. For example; she reminded how they find the result of 3.(4-1) by distribute property, then she asked the students to compare it with 3(x-1). Two teachers did not use algebra tiles based on area concept to explain distribution.

6. Noticing Students' Misconceptions in Simplification and Equivalence of Algebraic Expression

Teacher A emphasized the kind of variable without considering its power while studying on like terms. However, x and x^2 had same variable but they were unlike terms. Thus, she may cause misconceptions with this definition. Actually, most of the students had difficulty in determining like terms to simplify expressions. On the other hand, Teacher B was more careful so that she provided explanations about like term concept correctly, the procedures of addition operation, and the sign before the parenthesis adequately considering the needs of the students. Two teachers noticed some misconceptions in simplification of algebraic expressions throughout the instruction such as; thinking of 4.x as two-digit number, x.x as 2x, and adding unlike terms. For example, some students tried to add or subtract the terms that were not like such as addition of an integer and an algebraic expression. A similar error was observed in simplifying of 3n-6-3(n+2), Teacher B explained the requirement of like terms to add or subtract as in the following:

Student: I will distribute 3 to (n+2), Then I will add 3n and 3n, subtract from 6.

B: Your friend has said that he would add 3n and 3n and subtract from 6. Are there any unknowns with 6? Variable? None. We do operations only like terms.

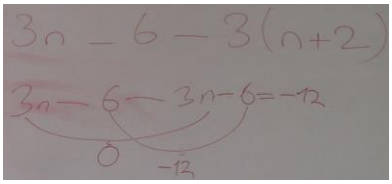

Figure 5. The simplification of the expression by the student

In this situation, Teacher B indicated that 6 was not an algebraic expression and so it could not be operated with algebraic expressions, when the student tried to do it. She noticed the misconception and addressed it by explaining like term concept.

In sum, the practices that are explained above can be presented in the following table:

Table 1. The practices in the instruction of algebraic expressions

Practices	Teacher A	Teacher B
1. Defining the concept of term, like term, constant term, and coefficient	*not accepting the constant as a term *defining of «like term» can cause misconception (having same kind of variable)	*defining the concepts correctly
2. Using equal sign	*using correctly *not correcting students' incorrect uses	*using correctly *correcting students' incorrect uses
3. Using analogies to explain addition and subtraction	*not using	* expressing the kind of the variable with apple and pear analogy *expressing the procedures with net worth concept by using assets and debts concepts

4. Using algebra tiles	*using algebra tiles as repeated addition *not explaining area calculation of rectangles in multiplication	*not using
5. Providing mathematical explanations for distributive property	*connecting with repeated addition	*connecting with integers
6. Noticing students' misconceptions in operations	(Two teachers noticed the misconceptions that arose in the instruction) *noticing the following misconceptions thinking of 4x as two-digit number, x.x as 2x, adding unlike terms	

Conclusion and Discussion

The teachers' practices of how to use mathematical representations as algebra tiles was inadequate. They did not explain the area concept that was underlying the idea of using algebra tiles. However, the instruction with connecting models or representations mathematically, particularly with algebra tiles in algebra, supports students' understanding (Çağlayan, 2013; Tchoshanov, 2011). The students had difficulty in understanding the concept of distributive property, since they did not have adequate understanding of the structure of expressions (Kieran, 1989). However, the teachers did not use algebra tiles to teach multiplication and particularly to show the application of distributive property. The equivalence of expressions using area modeling supports students' understanding of the application of distributive property (Caglayan, 2013; Hallagan, 2004).

In using mathematical language, the remediation of incorrect writings in using equal sign can provide the students an understanding of the function of the equal sign as relationship between the first algebraic expression and the simplified expression (Alibali et al., 2007). Teacher B's use of analogies to explain the procedures in the simplification of algebraic expressions is a suggested method in the literature. For example, Ojose (2015) suggested the use of real-life examples such as apple and orange as a model to teach adding unlike terms. Similarly, Filloy and Sutherland (1996) asserted that the use of concrete models such as tiles, or apple-pear analogy provides translation to abstract level of algebraic expression to facilitate students' learning.

In the aspect of the practice related to students' thinking, Teacher B had more conceptual subject matter knowledge and she could catch students' misconceptions in the instruction. Similarly, the researchers stated that when the teachers had strong subject matter knowledge, they took into account the students' thinking (Baş, Çatinkaya, & Erbaş, 2011; Depaepe et al., 2015; Jacobs, Lamb, & Brown, 2010). Thus, teacher knowledge including students' understanding and needs is essential for effective teaching practices (Anderson, White, & Sullivan, 2005).

Suggestions

Effective teaching practices require using appropriate and adequate knowledge pedagogically (Doerr, 2004; Fennema & Franke, 1992). Teachers can improve their teaching by having meeting together and share good examples and experiences from their classes. Additionally, they can ask for suggestions to their colleagues when they have difficulties in teaching. The mathematics education researchers also can present the results of the studies and suggest different type of activities or examples from the literature in in-service trainings in order to enhance teachers' practices of teaching algebra.

References

Alibali, M. W., Knuth, E. J., Hattikudur, S., McNeil, N. M., & Stephens, A. C. (2007). A longitudinal examination of middle school students' understanding of the equal sign and equivalent equations. *Mathematical Thinking and Learning, 9*(3), 221-247.

Anderson, J., White, P., & Sullivan, P. (2005). Using a schematic model to represent influences on, and relationships between, teachers' problem-solving beliefs and practices. *Mathematics Education Research Journal, 17*(2), 9-38.

Ball, D. L., Thames, M. H., & Phelps, G. (2008). Content knowledge for teaching: What makes it special? *Journal of Teacher Education, 59* (5), 389- 407.

Banerjee, R., & Subramaniam, K. (2012). Evolution of a teaching approach for beginning algebra. *Educational Studies in Mathematics, 80*(3), 351-367.

Baş, S., Çetinkaya, B., & Erbaş, A. K. (2011). Öğretmenlerin dokuzuncu sınıf öğrencilerinin cebirsel düşünme yapılarıyla ilgili Bilgileri. *Eğitim ve Bilim*, *36*(159).

Caglayan, G. (2013). Prospective mathematics teachers' sense making of polynomial multiplication and factorization modeled with algebra tiles. *Journal of Mathematics Teacher Education*, *16*(5), 349-378.

Capraro, M. M. & Joffrion, H. (2006). Algebraic equations: Can middle-school students meaningfully translate from words to mathematical symbols? *Reading Psychology, 27,* 147–164.

Charalambous, C. Y. (2016). Investigating the knowledge needed for teaching mathematics an exploratory validation study focusing on teaching practices. *Journal of Teacher Education*, *67*(3), 220-237.

Creswell, J. W. (2007). *Qualitative inquiry and research design: Choosing among five traditions* (2nd ed.). Thousand Oaks, CA: Sage Publications.

Depaepe, F., Torbeyns, J., Vermeersch, N., Janssens, D., Janssen, R., Kelchtermans, G., ... & Van Dooren, W. (2015). Teachers' content and pedagogical content knowledge on rational numbers: A comparison of prospective elementary and lower secondary school teachers. *Teaching and Teacher Education, 47,* 82-92.

Doerr, H. M. (2004). Teachers' knowledge and the teaching of algebra. In K. Stacey & H. Chick (Eds.), *The Future of the Teaching and Learning of Algebra: The 12th ICMI Study* (pp. 267-290). Dordrecht, The Netherlands: Kluwer.

Fennema, E., & Franke, M. L. (1992). Teachers' knowledge and its impact. In D. A. Grouws (Ed.), *Handbook of research on mathematics teaching and learning* (pp. 147-164). NewYork: Macmillan.

Filloy, E. & Sutherland, R. (1996). Designing curricula for teaching and learning algebra. In A. Bishop, K. Clements, C. Keitel, J. Kilpatrick, & C. Laborde (Eds.), *International handbook of mathematics education* (vol. 1, pp. 139-160). Dordrecht: Kluwer Academic.

Franke, M. L., Kazemi, E., & Battey, D. (2007). Mathematics teaching and classroom practice. In F. K. Lester (Ed.) *Second handbook of research on mathematics teaching and learning* (vol. 1, pp. 225-256). USA: Information Age Publishing.

Hallagan, J. E. (2004). A teacher's model of students' algebraic thinking about equivalent expressions. In M. J. Hoines, & A. B. Fuglestad (Eds). *Proceedings of the 28th Conference of the International Group for the Psychology of Mathematics Education* (vol. 3, pp. 1-8). Bergen, Norway: International Group for the Psychology of Mathematics Education.

Jacobs, V. R., Lamb, L. L. C., & Philipp, R. A. (2010). Professional noticing of children's mathematical thinking. *Journal for Research in Mathematics Education, 41*(2), 169–202.

Kieran, C. (1989). The early learning of algebra: A structural perspective. *Research Issues in the Learning and Teaching of Algebra*, *4*, 33-56.

Livneh, D., & Linchevski, L. (2007). Algebrification of arithmetic: Developing algebraic structure sense in the context of arithmetic. In J. W. Woo, H. C., Lew, K. S. Park, & D. Y. Seo (Eds). *Proceedings of the 31st Conference of the Psychology of Mathematics Education* (vol. 3, pp. 217-225). Seoul, Korea: International Group for the Psychology of Mathematics Education.

MacGregor, M., & Stacey, K. (1997). Students' understanding of algebraic notation: 11–15. *Educational Studies in Mathematics, 33*(1), 1–19.

Ojose, B. (2015). *Common Misconceptions in Mathematics: Strategies to Correct Them*. America: University Press of America.

Saxe, G. B.., Gearhart, M., & Seltzer, M. (1999). Relations between classroom practices and student learning in the domain of fractions. *Cognition and Instruction, 17,* 1–24.

Seng, L. K. (2010). An error analysis of form 2 (grade 7) students in simplifying algebraic expressions: A descriptive study. *Electronic Journal of Research in Educational Psychology*, *8*(1), 139-162.

Tchoshanov, M. A. (2011). Relationship between teacher knowledge of concepts and connections, teaching practice, and student achievement in middle grades mathematics. *Educational Studies in Mathematics*, *76*(2), 141-164.

Tirosh, D., Even, R., & Robinson, N. (1998). Simplifying algebraic expressions: Teacher awareness and teaching approaches. *Educational Studies in Mathematics, 35,* 51-64.

Wilkie, K. J. (2014). Upper primary school teachers' mathematical knowledge for teaching functional thinking in algebra. *Journal of Mathematics Teacher Education*, *17*(5), 397-428.

Yin, R. K. (2003). *Case study research: Design and methods* (3rd ed.). Thousand Oaks, California: Sage Publications.

ISRES Publishing

The Eurasia Proceedings of
Educational & Social Sciences (EPESS)
ISSN: 2587-1730

The Eurasia Proceedings of Educational & Social Sciences (EPESS), 2017

Volume 6, Pages 38-42

ICEMST 2017: International Conference on Education in Mathematics, Science & Technology

PROSPECTIVE MATHEMATICS TEACHERS' MAKING SENSE OF THE DECIMAL REPRESENTATION OF REAL NUMBERS AS RATIONAL NUMBER SEQUENCES THROUGH QUANTITATIVE REASONING

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Abstract: Previous studies have revealed that students have misconceptions on numbers specifically on real numbers (Tall & Schwarzenberger, 1978; Ely, 2010). In order to eliminate the misconceptions, Voskoglou (2013) suggested that teaching should emphasize the use of multiple representations of real numbers and flexible transformations among the representations. In the current study, we conducted classroom teaching experiments (Cobb, 2000) with 19 prospective mathematics teachers in an English-medium university in İstanbul about the decimal representation of real numbers with the emphasis of quantitative reasoning (Thompson, 2011; Karagöz-Akar, 2016). The ongoing and retrospective data analysis was done through line by line analysis of the transcriptions of the video records and the written artifacts. Results showed that thinking through quantities depicted in diagrams, once prospective teachers related long division with multiple representations of rational numbers such as fractions, equivalent fractions and decimals through the mental actions of equal partitioning, grouping and counting, they were able to deduce that all these representations corresponded to the same number and squeezing the decimal representation of both rational and irrational numbers, prospective teachers were able to deduce that real numbers could be represented by the limits of rational number sequences. Results might contribute to the mathematics education field by providing task sequences showing how difficulties regarding the real numbers could be eliminated via focusing on quantities.

***Keywords*: Real numbers, quantitative reasoning, decimal representation, prospective teachers**

Introductıon

Numbers are in the center of mathematics learning and curriculum. Due to the importance of the numbers in mathematics education, researchers focused on students, pre-service and in-service teachers conceptions of numbers. Particularly, Tall and Schwarzenberger (1978) emphasized that students have misconceptions about the relationships between decimal and limit concept and decimal and fractions. Difficulty aroused about real numbers was that students had a confusion when two different decimals represented the same real number (Tall & Schwarzenberger, 1978). Similarly, in an another study (Ely, 2010) about students' conceptions on infinitesimals, an undergraduate calculus student was interviewed. The researcher revealed a similar misconception: the student did not think that 3,99999.... and 4 represents the same number. In addition, Voskoglou and Kosyvas (2012) examined students' difficulties in understanding real numbers via quantitative and qualitative studies. The results of the study showed that students had an incomplete understanding of rational numbers;they preferred to deal with decimal representation more than fractions; and, students having difficulties in rational numbers could not answer the questions about irrational numbers, too. They suggested that while teaching real numbers, the use of multiple representations of real numbers and flexible transformations among them shoucl be emphasized (Voskoglou, 2013, p.41). Similarly, it is proposed that for the teaching of real numbers, quantitative reasoning (Thompson, 2011) could be used (Karagöz-Akar, 2016). Therefore, in the study, we investigated the following research questions: How do prospective mathematics teachers reason while

- Selection and peer-review under responsibility of the Organizing Committee of the conference

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developing the decimal representation of real numbers through quantitative reasoning? What meanings of real numbers do prospective mathematics teachers develop during an instructional sequence involving quantitative reasoning?

Method

In this section, we describe participants, data collection and data analysis. The sample of the study (N=19) was the prospective primary and secondary mathematics teachers (from now on called as students) in the same university. The design of the study was classroom teaching experiment (Cobb, 2000) in which "the researchers engage in promoting the development as part of cycle of interaction and reflection" (Simon & Tzur, 1999, p. 253). The teaching sequencewas divided into four phases: Phase I included a review on rational numbers, fractions, equivalent fractions and their relationships. Phase II included students' representing examples of terminating and non-terminating positive rational numbers and their making sense of the relationships among different representations such as long division, division algorithm and diagrams. Phase IIIa-b included students' re-writing and examining the properties of the decimal representations of any rational number as sequences. Phase IV involved examining irrational numbers through decimal representations and students' reaching at an altenative definition of real numbers (Usiskin, Peressini, Marchisotto & Stanley, 2003). Throughout the teaching sessions done by the first author, along with the individually written artifacts, students' discussions and class work were videotaped and recorded. Also, before and after the teaching sessions, to assess students' current knowledge a written assessment was given. After the completion of teaching sessions, the data were transcribed by the first researcher. For the analysis, both ongoing andretrospective analysis (Steffe & Thompson, 2000) was followed:Reading line by line the transcipts of the teaching sessions,the researcher thought of both the individuals' mathematical thinking and class' mathematical thinking as a group (Heinz, 2000). The reason of focusing on individual students' mathematical reasoning was that "the individual students' mathematical activity and the activity of the classroom was related" (Heinz, 2000, pp.59).

Results and Findings

Since the focus of analysis was students' quantitative reasoning throughout the teaching sessions, while doing that individual students' and also the inclassroom's thought processes wererevealed. Mainly the results about Phase II, Phase IIIa and Phase IV are shared in this section. Though we would like to briefly poin to the taken-as-shared meanings from Phase I. At the begining of the instruction, in Phase I, students were asked to define rational numbers, fractions,equivalent fractions and the relationship among them. Mostly students stated rational numbers as the ratio of two integers with the denominator not equal to zero. Students thought that rational numbers differed from fractions in the sense that rational numbers could take negative values. Also, some students knew and explained that fractions represent amounts. That is why all the students agreed upon the idea that fractions could be represented as positive rationals. Some students also stated and all the others agreed that equal fractions represented the same amounts. They were also able to draw diagrams representing both fractions and equivalent fractions. Realizing students' current stage of knowing, we emphasized that they would work on fractions and equivalent fractions as representing amounts and they would be asked to draw diagrams throughtout the whole teaching sessions. Also, during the Phase I, we asked students to show the decimal representation of 7/2 using three representations: long division, division algorithm and diagrams. Then, in Phase II, we asked students to express the decimal representation of 11/3 using three representations again: long division, division algorithm and diagrams. The reason together with working on the example 7/2 was to take their attention to the fractions with both non- repeating and repeating decimals. In the following excerpt we share the classroom discussion on the use of diagrams for finding the decimals of 11/3 with relation to the long division:

R: How did you continue to division?
S1: After the remainder 2, I put comma next to quotient and zero next to remainder.
R: Why did you do like that?
S1: Since I could not divide 2 by 3.
R: What does this mean in terms of diagrams?
S4: Expanding the fraction 2/3 by 10.
S9: Equal-partitioning.
R: So what happens to 2/3?
S1: 20/30.
R: How can you represent 20/30 in the diagram?
Class: We partition each piece into 10.

S1: We are looking for 1/10 ths in 2/3. We know that the little piece is 1/30. Therefore, I can take 3 piece (groups) of 1/30. Then I get 1/10 (showing the first three pieces). Actually I am searching for 3/30 ths in 2/3.

R: So how many 1/10 th do you have in the diagram?

S1: 1 2 3 4 5 6 many 1/10 th. I scanned 6 many 1/10 in the diagram by grouping 1/30 th by 3 and there is remaining portion 2/30.

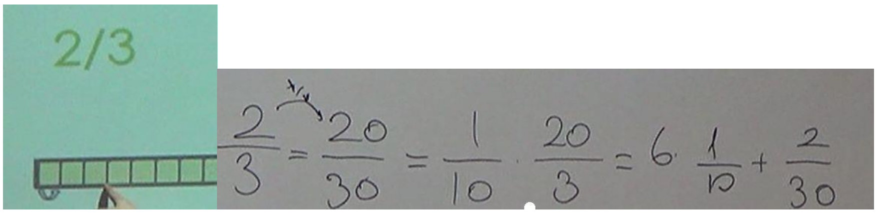

Figure 1. Expression for 2/3 through decimals

As the excerpt shows, the students related putting zero next to remainder and comma next to quotient in the long division through diagrams. They knew that getting equivalent fractions to 2/3 by partitioning each piece into 10 pieces meant putting zero next to the remainder in the long division. They also knew that they ooked for 1/10's after comma in the long division. Thus, in the diagram, they focused on the little piece they obtained through re-partitioning which was 1/30. Through grouping 3 of 1/30's which equaled to 1/10 students came up with the number of 1/10's in 2/3=20/30. As a result they found 6 many 1/10's and a remaining portion and grouped portion as 2/30. This reasoning showed that students worked on the fractional parts (e.g., 2/3) as quantities and engaged in partitioning and grouping. leading to That is, they not only regarded 2/3 as a number but as also a quantity. Therefore, quantitatively, they were able to measure 2/3 by 1/10's, resulting in 6 many of them with the left over part of 2/30. The following student work illustrated how they continued finding further decimals by just zooming in the ungrouped-left over part (2/30, 2/300 etc.) through re-partitioning by 10 and grouping by 3 again:

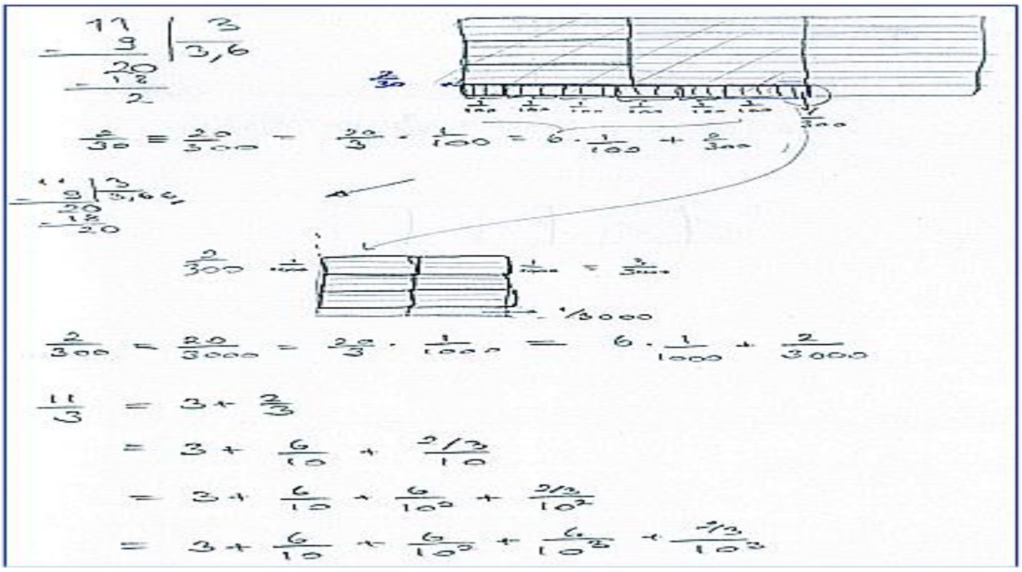

Figure 2. A student's work on the decimal representation of 11/3 through 3 representations

As the data indicated, students were able to think of 2/30 (the left over part) in the diagram as a quantity and re-partition it into 10 more equal pieces getting at 20/300. Then, regrouping 3 of the 1/300 getting at 1/100, they were able to find the number of 1/100 in 20/300. They knew they looked for 1/100s because they did not have any 1/10 any more in the left over part, 20/300 (e.i., 2/30). This way they knew there were 6 many 1/100 in 20/300 with left over 2/300. The Figure 2 also points to their repartitioning 2/300 (i.e., 20/3000) and regrouping 1/300 to come up with the number of 1/1000 in 20/3000 (i.e., 2/300).

Then, writing the decimal expansion of 11/3 as in the figure above (the last line in the figure), students were asked to squezze the decimals in nested intervals. By doing this students focused on the ungrouped parts of the diagram and based on these parts they obtained the intervals as in the figure 3.

After that students were asked to focus on the lower bounds and upper bounds separately and they were asked whether these lower and upper bounds formed sequences or not. Students agreed that the were sequences. Then, they examined the properties of the sequences and obtained that the lower bounds formed increasing bounded rational number sequences and upper bounds formed decreasing bounded rational number sequences. By finding the differences between corresponding terms of the sequences starting from the first setp and ending at the last step as in Figure 3, and finding that the difference in the last step was equal to $1/10^n$ they realized that when n goes to infinity the difference approached zero. Since the number between these sequences was 11/3, they cameup with the result that both sequences represented 11/3.

1.Step:

$3 + 6/10 < 3 + 6/10 + 2/3/10 < 3 + 6/10 + 1/10$

2.Step:

$3 + 6/10 + 6/10^2 < 3 + 6/10 + 6/10^2 + 2/3/10^2 < 3 + 6/10 + 6/10^2 + 1/10^2$

3.Step:

$3 + 6/10 + 6/10^2 + 6/10^3 < 3 + 6/10 + 6/10^2 + 6/10^3 + 2/3/10^3 < 3 + 6/10 + 6/10^2 + 6/10^3 + 1/10^3$

n.Step:

$3 + 6/10 + 6/10^2 + \ldots + 6/10^n < 3 + 6/10 + 6/10^2 + \ldots + 6/10^n + 2/3/10^n < 3 + 6/10 + 6/10^2 + \ldots + 6/10^n + 1/10^n$

Figure 3. Interval for 11/3

Then during Phase III, they generalized their findings to any positive rational number using symbols and notations. Then, in Phase IV, they focused on the irrational number case using the generic example √3. For the irrational number case, students thought of number line and as in the rational number case, they did repartitioning by 10 on the number line for the interval of √3. By taking squares of the bounds they placed 3 in the interval and then they took the square root of 3 for finding the interval of √3. By going this way they obtained nested intervals as (1.7, 1.8) ⊃(1.73, 1.74) ⊃(1.732, 1.733) ⊃.... Again focusing on then lower and upper bounds separately, they concluded that the lower bounds formed increasing bounded rational number sequences and upper bounds formed decreasing bounded rational number sequences. By finding the differences between corresponding terms of the sequences as they did earlier, theyanalyzed that when n goes to infinity the difference at the las step, $1/10^n$,approached zero. Since the number between these sequences was √3., they again concluded that both rational number seqeunces represented √3.

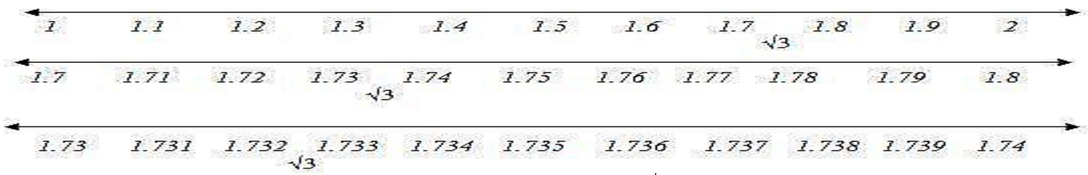

Figure 4. Interval of √3

Finally, by examining both a positive rational number and a positive irrational number, students concluded that positive real numbers can be represented by both increasing and decreasing bounded rational number sequences.

Conclusıon

Results from this study showed that reasoning on quantities depicted in diagrams, once students related long division with multiple representations of rational numbers such as fractions, equivalent fractions and decimals through the actions of equal partitioning, grouping and counting, they were able to deduce that all these representations corresponded to the same number. This was important because research has shown that students had difficulties regarding different representations showing the same number (Voskoglou & Kosyvas 2012). Similarly, squeezing the decimal representation of positive rational numbers, they were able to deduce that rational numbers could be represented by rational number sequences. Also, through partitioning and re-partitioning of the intervals on an example of an irrational number, they realized that irrational numbers also could be squeezed by two rational number sequences. Therefore, they could conclude that not only rational numbers but also irrational numbers could be thought of as the limits of sequences of rational numbers. This was also important because previous research has shown that students had difficulties in reasoning about rational numbers, irrational numbers and hence real numbers (Voskoglou, 2013). In our case, since students were able to deduce an alternative defintion of real number by using rational number sequences multiple representations as fractions diagrams, decimals and rational number sequences, they were able to think that different decimals could correspond to the same real number.

References

Cobb, P. (2000). Conducting teaching experiments in collaboration with teachers. In A. E. Kelly, R. A. Lesh (Eds), *Handbook of Research Design in Mathematics and Science Education,* pp. 307–333. Lawrence Erlbaum Associates.

Ely, R. (2010). Nonstandard student conceptions about infinitesimals. *Journal for Research in Mathematics Education*, *41*(2), 117–146.

Heinz, K. A. (2000). *Conceptions of ratio in a class of pre-service and practicing teachers.* Ph.D. Thesis, The Pennsylvania State University.

Karagoz Akar, G. (2016). Nicel muhakeme ve nicel muhakeme yoluyla kesirler üzerinden gerçek sayıların inşaası. In E. Bingölbali, S. Arslan, & İ. Ö., Zembat (Eds.), *Matematik Eğitimi Teorileri* (pp.117–133). Ankara: Pegem Akademi.

Simon, M. A. and Tzur, R. (1999). Explicating the teacher's perspective from the re- searchers' perspectives: Generating accounts of mathematics teachers' practice. *Journal for Research in Mathematics Education*, *30*(3), 252–264.

Steffe, L. P. and Thompson, P. W. (2000). Teaching experiment methodology: Underlying principles and essential elements. *Handbook of research design in mathematics and science education*, pp. 267–306.

Tall, D., & Schwarzenberger, R. L. (1978). Conflicts in the learning of real numbers and limits. *Mathematics Teaching*, *82*, 44–49.

Thompson, P.W. (2011). Quantitative reasoning and mathematical modeling. In S. Chamberlin, L.L. Hatfield, & S. Belbase (Eds.), *New perspectives and directions for collaborative research in mathematics education: Papers from a planning conference for WISDOM* (pp. 33-57). Laramie: WY: University of Wyoming.

Usiskin, Z., Peressini, A., Marchisotto, E. A. & Stanley, D. (2003). *Mathematics for high school teachers.* Prentice Hall: Upper Saddle River, New Jersey.

Voskoglou, M. and Kosyvas, G.D. (2012). Analyzing students' difficulties in understanding real numbers. *Journal of Research in Mathematics Education, 1*(3), 301–336.

Voskoglou, M. G. (2013). An application of the APOS/ACE approach in teaching the irrational numbers. *Journal of Mathematical Sciences and Mathematics Education, 8*(1), 30–47.

The Eurasia Proceedings of
Educational & Social Sciences (EPESS)
ISSN: 2587-1730

The Eurasia Proceedings of Educational & Social Sciences (EPESS), 2017

Volume 6, Pages 43-54

ICEMST 2017: International Conference on Education in Mathematics, Science & Technology

GENDERED TEACHER-STUDENT INTERACTIONS IN JUNIOR SECONDARY MATHEMATICS CLASSROOMS IN NIGERIA

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Abstract: Mathematics teachers do not remember how they interact with their students' in mathematics classrooms and also do not have ample time to reflect and analyse their pattern of interaction with the students; however, they continue interacting differently with females and males without knowing. This study aimed to investigate teacher-student interactions at junior secondary (JS3) mathematics classroom for gender bias. Mixed method research design was employed. Two instruments were used such as Interaction for Sex Equity in Classroom Teaching (INTERSECT) with a coding sheet and interviews. Six mathematics teachers, three males and three females were observed three times each. The researchers recorded 361 interactions of 180 male and 150 female students who were present in the observed classrooms. The findings revealed that males received significantly more acceptance-intellectual interactions than females did, the female learners receive significantly more remediation– intellectual interactions than males did.

Keywords: Gender bias, mathematics classrooms, teacher-student interactions

Introduction

There is a global rise in the consciousness of the impact of gender issues in education (Modo, 2011; UNICEF, 2014). All over the world, gender issues have become topical due to their ripple effects on all spears of human existence (Banks, 2005; British Council, 2012; Egbe-Okpengen & Orhungur, 2012; Miller et al., 2009; Sadker & Zittleman, 2009), Nigeria is no exception. The occurrence of gender bias in teacher-student interactions in mathematics classrooms in Nigeria is subtle in nature as such teachers are not aware that biases existence. This happens on the daily basis decisions on regarding the classroom interactions of teachers with their students; where teachers have no time to reflect or think back on their interactions with students in their respective classrooms. Despite that many studies have addressed gender bias on teacher - student interactions in the classrooms (Duffy et al., 2001; Hassaskhah & Zamir, 2013; Kokas, 2012) gender bias still exist. It suffices to say that presently, gender bias is persisting in Nigeria mathematics classroom as established by Farajimakin (2010), in which, male students are favoured in the classrooms in various subjects such as mathematics, physics, science and technology. Teachers give more attention to male students than female students (Salman et al., 2011). The bias is often subtle and unintentional, but its result is harmful. Adeyemi and Akpotu, (2004), Sadker and Zittleman, (2009, 2007) claimed that gender roles difference is prevalent in Nigeria and other parts of the world. Farajimakin (2010), Mustapha (2013), affirmed categorically that gender discrimination in classrooms is still prevailing.

Literature Review

In a study of teacher–student interactions a sample of one hundred fourth, sixth, and eighth grade classrooms, the findings showed that male students consistently out-talked and as well as out-participated female students (Sadker et al., 2007). Similarly, Becker (2001) also discovered that teachers began conversation with males more than females. However, these findings are similar to those of She (2000), who found that most of the teacher-

- Selection and peer-review under responsibility of the Organizing Committee of the conference
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initiated interactions involved more male students by using Brophy-Good Dyadic Child Interaction System, she (2000) found out that 355 teacher-initiated questions, male students responded 78.7% to the teacher questions in a mathematics classroom of 50:50 sex distribution. In another study, Kaily (2015) investigates gender bias in the mathematics classrooms in the South western British Columbia Canada Christian middle school whether boys and girls receive the same kind of attention from the teachers. Quantitative analysis of observation was conducted on different teachers. A sample of eight teachers of grades six, seven and eight was used. The findings revealed that boys received 13.58% more of teacher interactions and the girls received a less behavioural type of interaction from the teachers than boys and both girls and boys receive similar amount neutral interpretations from their teachers. Unfortunately, inferential statistics were not used in Kaily (2015) and Shel (2000) studies, it is not clear whether there is significant difference between female and male teachers' interactions patterns. Therefore, there is a need for inferential statistics to determine the significant different of the teacher interactions with both male and female students.

We reviewed the study of Einarsson and Granstrom (2002) that investigated the interactions of teachers and students in the high school aiming at the effects of the teacher gender and student gender in mathematics. A total of 597 students (294 males and 303 females) and 28 male and 8 female teachers were used in the study. The observation instrument used was Interaction for Sex Equity in Classroom teaching (INTERSECT). Their findings revealed that female and male teachers interacted with males more than females. But in contrast, Jones and Dindia (2004), findings suggested that teacher interacts more with female students. More recently, Bag et al., (2014) examined female and male teachers' interaction with female and male students in preparatory mathematics lesson at State University Turkey. The instrument used was video-recorded and observation Sinclair and Coulthard's Classroom Discourse analysis model was adopted. The findings of their study suggest that there is no equal distribution between the teachers' moves in both academic and non-academic directed to male and female students in classrooms. The findings of Bag et al (2014) are contradicted by the results of Leder et al., (2014) that examined teacher-interaction with high achievers' male and female students of grades 7 and 10 in Australia which shows that teacher gives greater attention to male students with high achiever than female students with higher achievement too. Most of the studies on gendered teacher-student interactions in mathematics classrooms have been conducted in western world (Howe & Abedin, 2013). It is repeatedly suggested to explore whether these results can be reproduced in other nations.

Studies by Kechen (2007), Khine and Fisher (2003) examined teacher and pupil interactions in mathematics classroom levels at each different stage of classes in Northeast England. A modified version of INTERESCT was used to record the classrooms interactions. The findings revealed that female learners received more positive feedback from the teachers than males. Secondly, male learners are active more in the morning lessons, while in contrast, female learners get attention more in the later period of the lesson than males. The results of Kechen (2007), Khine and Fisher (2003) are contradicted with the findings of Koca (2009), Sobel et al., (2004) that indicated female and male teachers interact more with male learner more than their female counterparts. It is interestingly to note that the results of the study would have pedagogical and psychological implications which require further studies. Many of these researches on gendered teacher-student interactions in mathematics classroom has generated inconsistent findings in various studies. That is negative feedback found in females than in males but it is still unclear which female students that account for these negative feedback increased (Howe & Abedin, 2013). Previous studies on teacher-student interactions in mathematics classrooms focused on secondary and university mathematics students. This present study extends to JS 3 mathematics classes in Nigeria.

Gul et al, (2012) in their study found that teachers interact with male students which are paralleled to the findings of Shomoossi et al., (2008). However, Staverman (2012) found that in grades 7 -9 of middle school mathematics, although male teachers interact more with male learners than females, but however, female teachers interact equally with female and male learners. The findings of Gul et al, (2012) study are interested simple because of the size of the sample of 155 teachers from 21 schools, the stratified random sampling and inferential statistics analysis were used in the study. However, there is difference between the studies of Gul et al, (2012) and Staverman (2012) whether the middle female teachers are equally interacting may be as a result of either (i) weak statistical effects which could be expecting to fluctuate from studies to studies or (ii) different population of participants in the study. In sum, the findings suggested that females sometimes are receiving messages that are subtle which can affect their academic negatively.

Problem Statement

Gender bias is manifested in teacher-student interactions in mathematics classroom have a negative implication for both male and female students which may affect them from reaching their full potential (McDonnell, 2007. The occurrence of gender bias in the mathematics classrooms is subtle in nature as such, teachers are not aware of its existence. Female students are continually treated differently in mathematics classrooms besides the fact that teachers give more attention to male students than female students. Improvement of gender equity of teachers' interaction in mathematics has been a concern of researchers. It is based on this issue that the researchers choose to ascertain the extent of gendered interactions of teachers in mathematics classrooms. In Nigeria, research on gendered teacher-student interactions in mathematics classrooms is scare, however, the small amount of studies focuses on teacher-student interactions in primary science and physics (Kalu, 2005; Oyebola, 2003). Therefore, there is a need to investigate teacher-students' interactions at junior secondary mathematics classrooms in Nigeria to proffer solutions to the differential treatment of male and female students at junior secondary school mathematics classrooms.

Purpose of the Study

This study examined teacher- student interactions patterns for any possible gender bias in junior secondary mathematics classrooms (JS3) in Abuja Nigeria. Observations of the junior secondary school mathematics classrooms are important since a lot of female students begin their first senior education experience at junior secondary (JS3) level. In addition, since these students choose their career at junior secondary school, the junior secondary school is a place to observe for any possible gender bias. Teachers' differential treatment of females in mathematics classrooms, may cause student to chance their career choice.

Research Questions

The study sought to find answers to the following research questions thus;

1.What is the proportion of the four evaluative types and two contents of interactions in mathematics classrooms?

2.Is there any significant gender bias difference between teacher-student interactions based on four evaluative types of interactions in mathematics classroom?

3. How do teachers perceive their interactions with students at junior secondary mathematics classroom?

Methodology

To achieve the purpose of the study, we adopted mixed method research design approaches. The quantitative data were subjected to descriptive and nonparametric Chi-Square test statistics. And for qualitative aspect, Miles and Huberman (1994) model was adapted for thematic analysis. A sample of (3) three males and three (3) females' mathematics were used making a total of six mathematics teachers in the three sampled schools. Two teachers are used in each sampled schools and each was observed three times for a period of two weeks, and each observation lasted 40 minutes. A total of 330 students were in these classes which comprised of females (n =150 (45.5%)) and males (n = 180 (54.5%)). The six mathematics teachers were purposively selected for the interviewed, and two research assistants were used for the data collection from the observed mathematics classrooms.

Data Collection

A modified Interaction for Sex Equity in Classroom Teaching (INTERSECT) and coding sheet form for teacher-student interactions were adapted from Duffy et al., (2001). Specifically, the current instrument involved coding teacher-student interactions, (a) evaluative type; criticism, acceptance, praise and remediation and (b) evaluative content; intellectual and conduct enable the observers to code for eight (8) potential types of interactions between the teacher and the students.

The inter-rater reliability for each category of interactions observed was calculated by using each data of observations from the two research assistants that were employed. The inter-rater reliability analyses indicated that the four areas of interactions reflected good inter-rater reliability with the kappa of 0.68 of praise, 0.72 for acceptance, 0.62 for remediation and 0.78 for criticism. The themes reliability was 0.70 using Cohen kappa which shows the overall agreement of four evaluation types of interactions during pilot testing of the study.

Data Analysis Procedure

The six (6) mathematics teachers were observed three times, and each observation lasted for 40 minutes over a period of two weeks. Descriptive statistics was employed in quantitative part for patterns of four evaluative types of interactions (remediation, praise, criticism and acceptance) in mathematics classrooms, which was computed based on two evaluative contents (intellectual and conduct) of interactions and also chi-square statistic test was used. For qualitative data, Thematic Analysis (TA) using Miles and Huberman (1994) model was adopted.

Results and Findings

Research Question 1

What is the proportion of the four evaluative types and two contents of interactions in the mathematics classrooms?

The analysis of the observational data focused on the nature of a teacher and student interactions patterns that emerged and the distribution of teacher interactions between male and female students in the mathematics classroom. In this section, Z-tests were carried out on all these interactions for teachers and students' gender in mathematics class, and a Bonferroni correction of alpha .01 was used because of the data were split by gender. This help to counteract the problem of multiple comparisons (Goldman, 2008). Female teachers ($z = 2.82$, $p < .05$) directed more of interactions toward males than females. When a teacher directed interactions to the whole classroom, Bonferroni correction for alpha .01) which indicated there was no significant student gender difference for responding to the male teacher of mathematics ($z = 2.32$, $p < .05$) female mathematics teachers ($z = 1.94$, $p < .05$). The overall sum of interactions of male teachers indicated a greater interaction toward male students than female teachers in mathematics ($Z = 4.22$, $p < .05$). Table 1 presents the values that represented the overall percentage of interactions which was directed toward females and males by both female and male mathematics teachers at JS 3 mathematics classrooms.

Table 1. Number of male and female mathematics teachers interactions toward male and female learners in mathematics classrooms

Interactions directed by Mathematics Teacher	Student	
	Male	Female
Male teacher	.74	.26
Female teacher	.63	.37

The total sum of the interactions includes four substantive interactions and two evaluative content on each of the category of interactions and definitions are given the areas of interaction in this study are; praise, acceptance, remediation and criticism with evaluative contents; intellectual and conduct. All interactions that took place between teachers and students in mathematics classrooms were analyzed (see Table 2)

Male teachers directed praise- intellectual to male students which accounted .78 and .03 to female students. There is no praise conduct to both female and male students from male mathematics teachers. Female mathematics teachers directed .32 intellectual praise- intellectual interactions to male students and .14 to female students. There is no praise-conduct interactions from female teachers to male and female students in mathematics classrooms. This also followed by acceptance-intellectual in which, male teachers directed a proportion of .32 and .36 to male and female students respectively. Male teachers only directed .03 of acceptance conduct to male students and non to female students, while female teachers directed acceptance- intellectual proportion .13 for male and .07 for female students. There is .03 acceptance conduct of interactions toward male and .02 to female students by the female mathematics teacher.

In remediation intellectual interactions, male teachers directed .12 and .23 to male and female students respectively, while .02 is directed to both male and female students on remediation conduct interactions by male teachers. And female teachers directed remediation intellectual interactions .23 and .18 to male and female students respectively and also directed remediation conduct interactions of .02 to males and .04 to female students. And on intellectual criticism interactions, male teachers directed .13 to male, .05 to female students, while .01 criticism-conduct was directed to male and non to female students. Female teachers directed intellectual criticism interactions of .34 and .25 to male and female students respectively, while .05 of conduct criticism was directed to male and .07 to female students. Overall the intellectual praise .78 is the greater proportion of interaction that was directed by male teachers to male students, and .03 was the lowest intellectual praise directed toward female students by male teachers. While .03 acceptance conduct was directed to both male and female students which are the greater conduct while the lowest praise conduct to both male and female students and also criticism conduct. The greater proportion of female teacher intellectual was acceptance .36 to male students and zero is the lowest conduct directed by the female teacher to female students at .00. These proportion of evaluative types of interactions are showed in Figure 1.

Table 2. Proportion of evaluative type interaction in mathematics by gender of student and gender of teacher

Interactions		Mathematics teacher	
		Male	Female
Praise towards			
Male students			
	intellectual	.78(100)	.32(18)
	conduct	.00(0)	00(0)
Female students			
	intellectual	.03(4)	.14(8)
	conduct	.00 (0)	00(0)
Acceptance toward			
Male students			
	intellectual	.32 (41)	.36(20)
	conduct	.03(4)	00(0)
Female students			
	intellectual	.13(16)	.07(4)
	conduct	.03 (4)	.02(1)
Remediation toward			
Male students			
	intellectual	.12(15)	.23(13)
	conduct	.02(2)	.02(1)
Female students			
	intellectual	.23(30)	.18(10)
	conduct	.02(3)	.04(2)
Criticism toward			
Male students			
	intellectual	.13(17)	.34(19)
	conduct	0.01(1)	.05(3)
Female students			
	intellectual	.05(7)	.25(14)
	conduct	.00(0)	.07(4)

Note. Proportions were calculated within each of the four groups in mathematics and gender of student. The values in the round brackets are observed frequencies. There are 180 males and 150 females in these observed classrooms.

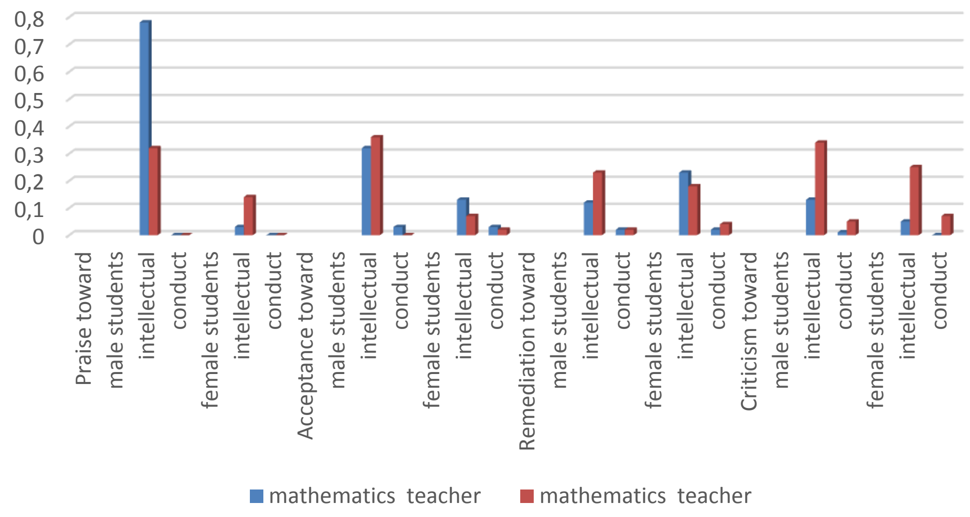

Figure 1. Proportion of evaluative type interaction in mathematics by gender of students and gender of teachers

Discriminant analysis was employed in order to see if teachers' gender, the gender of students and mathematics are differentiated the types of the evaluative teacher to student interactions of praise, remediation, acceptance, and criticism. Function one indicated a significant different between four evaluative types of interactions $\Lambda = .86$, $p < .05$. Therefore, function one is associated with students gender $r = .73$ and it accounts for 73% of the variance between types of interactions in mathematics classrooms observed. Females received more remediation than males, whereas males received praise, acceptance and criticism more than their female counterparts as showed in Figure 2.

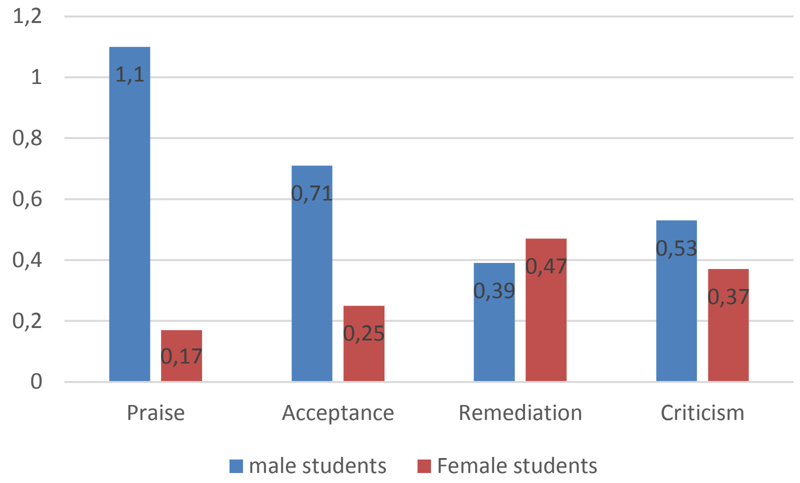

Figure 2. Proportion of teachers' evaluative type interaction in mathematics by gender of students

Research Question 2

Is there any significant gender bias difference between teacher-student interactions based on four evaluative types of interactions in mathematics classroom?

Discriminant function was used to determine the effect of teacher gender and mathematics on evaluative types of interactions. It was revealed that male teachers used more praise than female teachers $\chi2$ (1, N = 104) = 7.42; p < .05. Acceptance was used more by male teachers than female mathematics teacher $\chi2$ (1, N= 65) = 4.73; p < .05. In remediation, male teachers used more than their female counterparts $\chi2$ (1, N = 50) = 3.42; p < .05. On one hand, criticism was used more by female teachers than male teachers $\chi2$ (1, N = 40) =1.74; p > .05. It was found that praise was directed toward males significantly than females $\chi2$ (1, N = 118) = 8.12; p < .05. Acceptance was directed significantly more toward male students than directed toward their female students $\chi2$ (1, N =65) = 4.64; p < .05. Remediation was directed toward female students significantly more than male students $\chi2$ (1, N = 45) = 1.13; p > .05. Criticism was directed toward male student significantly more than toward female students $\chi2$ (1, N = 40) = 1.10; p < .05. It was found that 93% of the interaction were intellectual and 7% of the interaction was conducted which was based on four evaluative types of interactions such as praise, acceptance, remediation and criticism as shown in Figure 3.

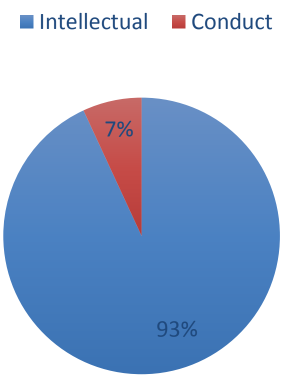

Figure 3. Frequency of evaluative content of interactions of teachers with gender

Discriminant analysis was also conducted in order to see if students' gender, teacher gender, and differentiated of evaluative content of teacher- student interactions. The function indicates a significant differentiation among four evaluative content of interactions, which, is $\Lambda = .96$, $p < .05$ and the function is associated with mathematics $r = .84$ and accounts for 84% of the variance between evaluative content of teacher -student interactions in which intellectual interactions 93% than 7% of conduct interactions in mathematics classes. Chi-square analysis was carried out to determine the differences in how 8 types of evaluative interactions were used. It was revealed that the type of interaction is depending on the gender of student $\chi2$ (8, N= 361) = 11.72; $p < .05$. Males received significantly more acceptance-intellectual interactions than females, $z = 4.23$, $p < .05$. Female students receive significantly more remediation– intellectual interactions than male students did, $z = 5.46$, $p < .05$ and male students received more criticism- intellectual interactions than female students' $z = 4.92$, $p < .05$. Female students received significantly more acceptance-conduct interactions and remediation-conduct interactions than male students, $z = 3.48$, $p < .05$.

Research Question 3

How do teachers perceive their interactions with students at junior secondary mathematics classroom?

The categories are created from the interviewed data from teachers that participated in this study. The interview question was "do you feel that male and female students need to be treated differently in your mathematics classroom If yes why and how? The data from the interviews represented a coalescence of data into patterns of behaviours. These categories are grouped into two themes of mathematics classroom interactions. The themes are; Teacher academic attention and interactions and Gendered differential treatment by teachers include different types of interaction which is related to teacher and student roles in mathematics classrooms

Themes 1: Teacher Academic Attention and Interactions

Teacher- student interactions in mathematics classrooms are important factors in behavioural and academic outcomes for both male and female students. For effective teacher- student interactions are essential for promoting long time success in mathematics at junior secondary 3. This includes acceptance, remediation, praise and criticism intellectual from the teachers to male and female students in their mathematics classes. Either male or female student who received negative attention from teachers has increased the problem emotionally and disruptive behaviours. Male students received more attention from both male and female teachers than female students in which is in all cases is academic attention. Participants are of the view as showed that;

> *"I give attention to the most intelligent male students since the student always…questions and … in my class I do not see that to be bad after all the male are doing… than the female students in mathematics and…"* (Male teacher).

Another participant with the similar view to (male teacher), this is illustrated below;

> *"You see…if whether a male student is not doing well in your class you need to tell him to work harder… same when the student is good in mathematics I…that is very good of … keep it up. This will the student to encourage and strive to see he answer questions often in the class" (*Female teacher).

The data suggested that a need for given attention to those with difficulties in their work by encouraging and monitor them in the classrooms. Thus a participant pointed that female students seemed not to be doing well in the subject which likely is, as a result, less attention is given to them, thus a female participant has this to say;

> *"Hmmm…after the female student answer the questions incorrect… as a teacher I …the female student seems not to…serious which they need to work hard so as a teacher I need to give those female students attention and also using eye contact to female students in the class…" (*Male teacher*).*

The mathematics teachers reacted positively to only those students that are good in their classes irrespective of the student gender. It is also noted that the boys and girls behave differently in their classroom from what is expected from them by the teachers.

> *"I think you need to improve your answer Janet... we want to know how you got that solution unlike the answer Audu gave which is better understandable. In this case, one does not need to… them the same because …These are the things you will notice when you are teaching"* (Female teacher).

Theme 2: Gendered differential treatment by teachers

The audio tape recording of teachers' interviews in mathematics classrooms at junior secondary mathematics classrooms in Nigeria on differential treatment of male and female students was an appropriate tool to create awareness and reflection on gender bias treatment among male and female learners by their teachers. The intention of the interviewer was to determine the existence of gender bias in mathematics classrooms in terms of teacher-student interaction based on four evaluative types and two evaluative contents of interactions. Some teachers during the interview critically analysed their own behaviour and thought about using alternative approaches for the treatment of male and female students in their classrooms in the future. Here are some examples that were presented.

> *"In my class when a male student is good in mathematics I… the student to feel really happy with the answer he has given. You … really good in mathematics. The praising of the student should focus on the effort the students has accomplished. This will help the student to work more hard to prepare for the next class or examination. It also helps the student to see the link between the efforts he has invested in a task which has improved his academic performance in mathematic" (Male teacher)*

Another participant pointed that male students are found of disturbing and distracting the attention for those want to learn and therefore their treatment is different from that of female students. An example for differential treatment as;

> *"Ahaha… am…know the male student are found of disturbed the whole I thereby reprimand them more since the female students are always quietly and attentive. I do praise appreciate the female students for … Hmmm…hmm, the male students are always making noise and moving from… and I need to treat that student differently"* (Male teacher).

In additional, there are views from participants on teachers been harsh to female students simply because they are not able to answer questions in mathematics classroom.

> *"Wow! I'm... overreacting on female students that do not answer my…. In class. Some female students are saying that I'm harsh … which i think I am not but just because they seem not to like mathematics. I do tolerate them a lot. Well… with the boys, there is no need to be harsh to them they are good in mathematics. But I still appreciate any girl that is good in my class. I have to say to good female student "Mary you are making me proud … of doing well unlike the other girls"* (Male teacher)

Students are treated as an individual, not as girls or boys; the boys and the girls do not receive the same treatment on the basis of discipline, and boys received more punishment and detentions than girls, this was due to the facts that boys are more indiscipline in behaviour and as well inadequate in working pattern; This is an example from the interviewees;

> *"Yes, in fact, I treat them differently because I did that when John was disturbing mathematics class and not when Bola does the same... Its right, I think because John is found of doing that almost in every mathematics class, the male students are distracted more than the female students…there are some students that you always prefer. But you do not need them to know because all are equal before the school rules and regulations"* (Female teacher).

It is somewhat not surprising despite the perceptions of female students about the teacher's behaviours towards them, some teachers that were interviewed in junior secondary mathematics classrooms, reiterated that they do not treat both girls and boys equally in their mathematics classrooms. Some of the teachers were very clear that they give unequal treatment thus;

> *"Oh … there is difference in my teaching of males or females … I enjoy teaching mathematics and I have experience and skilled. Different treatment of girls and boys…yes, I know about it"* (Female teacher)

Some participants supported the different treatment of male and female students in mathematics classrooms which may be unintentional by teachers which they are not aware of. Thus,

> *"Am … not aware of treating females differently to males. Having …. said that, I do not … know if that happened without my knowing which is not intentional. So…am not aware … it, which it can be possible"* (Male teacher)

In the broader perspectives most teachers have the belief that they are giving equal treatment to both male and female students in the mathematics classroom in order to support the students learning, but it has been observed that it is very rarely to achieve. In most of our school's male students appear to dominate the classrooms interactions, and while the female students participate more in teacher-student interactions which are supporting learning. Mathematics teachers that participated in this study provided an insight into the different treatment of male and female students in mathematics classroom in Nigeria. The combination of the classroom observations and interviews reveal that the content of gender bias in teacher-student interactions exist in mathematics lessons, which the result may limit the female self-esteem and lower their achievement in mathematics.

Discussion of Findings

The results obtained from the classrooms observations on four evaluative types and two evaluative content of interactions in Table 3 shows that both male and female teachers at junior secondary mathematics classes in Nigeria directed praise intellectual (.78, .32), acceptance –intellectual (.32, .36), criticism-intellectual (.13, .34) and remediation intellectual (.12, .23) towards male students' more than female students in mathematics classrooms. These findings are commensurate with past literature which reveals that male students received all intellectual evaluative types of interactions than the female student from both male and female teachers (Duffy et al., 2001; Jones & Dindia 2004; Kaily 2015). The findings further reveal that female teachers directed more criticism –conduct (.07) and remediation–conduct (.04) towards female than male students in mathematics classrooms. The results are inconsistent with previous literature, which shows that female teachers directed less criticism –conduct and remediation-conduct to female students than male students in mathematics classroom (Einarsson & Granstrom, 2002; Eriba & Achor, 2010; MCDonnell, 2007). In this current study, female students received fewer interactions than male students from both male and female mathematics teachers which are commensurate with the study of (Hassaskhah & Zamir, 2013; Author, 2015). The finding shows there is a significant different between male and female teachers direct four evaluative types and two content of interactions more towards male students than female students.

Triangulation of the Findings of Quantitative and Qualitative

This section of the study used (classroom observations) quantitative statistical analyses to confirm or reject the existence of gender bias in teacher-student interaction based on four evaluative types and evaluative contents of interactions and mathematics textbooks. In addition, interview data based on these evaluative types and evaluative contents on gender bias (qualitative data analysis) was used to explore other gendered bias on teacher-student interactions in mathematics classrooms which has not been earlier theorised. Combining the classroom observations findings with the interviews results have conceptually stronger than using only single data for the existence of gender bias in teacher-student interactions in mathematics classrooms setting at junior secondary mathematics classroom in Nigeria.

Combining the quantitative and qualitative data represented one can conclude that is differential treatment occurring in teacher-students' interactions in mathematics classrooms based four evaluative types and two evaluative content of interactions. Although the two categories of teacher-students' interactions are interrelated in a consistent pattern of teacher-student interactions which male and female teachers, certainly treat them unequally. Teachers in the study treated the male and female student differently in all four evaluative type and evaluative contents of interaction in mathematics classroom (criticism, acceptance, remediation and praise). Generally, the difference in treatment is negative ways for male and female teacher give more attention to male students.

Conclusion

In sum, there is differential treatment of male and female students by both female and male teachers in mathematics classroom at junior secondary mathematics classroom in FCT Abuja Nigeria. The findings of the study revealed that the gender of the student affects their interaction with the mathematics teacher. Male and female mathematics teachers' interaction with more male students in the four categories of interactions than with female students at junior secondary school (JS3) mathematics classrooms. For male and female students to experience equal treatment by their teachers in mathematics classrooms, there must be gender equity in her educational system. Equal treatment can only be achieved the moment the notion of females is being inferior to males is eliminated. Female students should be given their own desire recognition to actualise their dreams and potential. Both new and old mathematics teachers need to go for training and retraining on the issue of gender equity on yearly basis in order to create awareness among mathematics teachers. The results of this study revealed that teachers at junior secondary three (JS3) mathematics classrooms are not aware of gender bias exhibited toward male and female students in their interaction.

The qualitative findings of research question 1a reveal that both male and female teachers give more interaction to the most intelligent students in mathematics irrespective of their sex, which is in line with the findings of Shomoossi et al., (2008) reports that only intelligent students received more interaction in the classroom. The findings are also consistent with previous studies Beam et al., (2006), Brandell and Staberg (2008), Cameron (2005) and Myhill (2002). These results suggested that male students do not generally monopolise mathematics classroom interactions. There is gender bias in mathematics classrooms as demonstrated through teacher to student interactions by observations and interviews. The reasons why female and male teachers are interacting with males more may be due to the fact that male students interact more in mathematics classrooms than female students. Secondly, it could be due to the notion that mathematics is a male domain, and the cultural belief of some part of Nigeria is that any female that is good in mathematics is termed "smarter" as such, no man will want to marry that lady. This study could be extended to senior secondary mathematics classroom to investigate the patterns of gender difference of interactions between teachers and their students.

Recommendations

Based on the findings of this study, future study is required to examine other factors that may likely cause teacher – student interactions in mathematics classrooms which may explain gender differences in teacher-student interactions patterns in mathematics.

References

Adeyemi, K., & Akpotu, N. (2004). Gender Analysis of Student enrolment in Nigeria Universities. Springer Higher Education Journal 48: 361-378.

Bag, E., Martu, L., & Bayyurt, Y. (2014). Gender and Classroom interaction: Examining a female and a male teacher's moves directed towards female and male students, University Journal of Education 31(1), 59-80.

Banks, S. R. (2005). Classroom Assessment: Issues and Practices. First Edition,

Boston: Pearson Education. 344 pages.

Beaman, R., Wheldall, K. & Kemp, C. (2006). Differential Teacher Attention to Boys and Girls in the Classroom, Educational Review, 58(3), 339–366.

Becker, J.R. (2001). Differential Treatment of Females and Males in Mathematics Classes. Journal for Research in Mathematics Education.12 (1), 40-53.

Brandell, G., & Staberg, E. M. (2008). Mathematics: a female, male or gender-neutral domain? A study of attitutes among students at secondary level, Gender and Education, 20 (5), 495-509, DOI: 10.1080/09540250701805771.

Cameron, D. (2005). Language, Gender and Sexuality: Current Issues and New Directions. Applied Linguistics, 26/4: 482-502.

Duffy, J., Warren, K., & Walsh, M. (2001). Classroom Interactions: Gender of teacher, Gender of Student, and Classroom Subject. Gender Roles, 45,579-593.

Einarsson, C. & Granstrom, K. (2002). Gender Biased Interaction in the Classroom: the influence of Gender and Age in the Relationship between Teachers and Pupils. Scandinavian Journal of Educational Research, .46(22).

Egbe-Okpengen, E. G., & Orhungur, M. M. (2012). Gender Issues in Entrepreneurial Development in Benue State (Nigeria) and Counselling Implications. Bulgarian Journal of Science and Education Policy (BJSEP), 6(2), 386-397.

Eriba, J. O., & Achor, E.E. (2010). Effects of School Type and Teacher Gender on Classroom Interaction Patterns in Integrated Science Classes. Brunei international Journal of Science and Mathematics Education 2(1) 48-58.

Farajimakin, I. O (2010). Gender issues: Students Performance in Senior Secondary School Mathematics Examination in Nigeria Retrieved from http://files.eric.ed.gov/fulltext/ED512116.pdf on 07/09/2015.

Goldman, M. (2008). Sta C141 Bioeng C141-Statistics for Bioinformatics Lecture Notes. Retrieved from www.sta.berkeley.edu/mgoldman/section 0402 pdfs on 16/08/2016.

Gul, S., Khah, M. B., Mughal, S., Rehmen, S. U., & Saif, N. (2012). Gender Stereotypes and Teachers Perceptions. (The Case of Pakistan) Information and Knowledge Management,

Hassaskhah, J., & Zamir, S. R. (2013). Gendered Teacher–Student Interactions in English Language Classrooms: A Case of Iranian College Context. SAGE Open DOI: 10.1177/2158244013502986.

Howe, C., & Abedin, M. (2013). Classroom dialogue: A systematic review across four decades of research. Cambridge Journal of Education, 43, 325-356.

Jones, S. M., & Dindia, K. (2004). A metal- Analysis perspective on Sex Equity in the Classroom. Review of Education Research 74 (4), 443-471.

Kaily, S. (2015). Gender Bias in Teacher-student interactions with students Master of Education Program Thesis paper 90. Retrieved from http://digitalcollections.dordt.edu/med_theses.

Kalu, I. (2005). Classroom Interaction Behaviour in Physics Lessons, relative to Students' Sex, African Journal of Research in Mathematics, Science and technology Education, 9(1), 55-66.

KeChen, (2007). A study of Primary Classroom Interactions: Is there still Gender imbalance in the Primary Classroom? www.research.nclac on 03/08/2015.

Khine, M. S., & Fisher, D. (2003). Teacher-Student Interactions in Science Classrooms in Brunei, Journal of Classroom Interaction, 38(2).

Koca, C (2009). Gender Interaction in COED Physical Education: A study in Turkey, Adolescence, .44(173), 165-185.

Kokas, K. E. (2012) The Gender Gap: the Effects of Gender Stereotyping on Students Achievement and where the Girls and Boys really are. Unpublished Master's Thesis Submitted to Penn State University.

Leder, G. C. Forgasz, H., & Jackson, G. (2014). Mathematics, English and Gender Issues: Do Teachers Count? Australian, Journal of Teacher Education; 39 (9).

McDonnell, L.M. (2007). Gender Bias in the College Algebra Classroom? PhD Thesis Submitted to University of Arizona. U.S.A.

Miles, M. B., & Huberman, A. M. (1994). Qualitative Data Analysis: An Expanded Source book second edition SAGE thousand Oaks London New Delhi.

Miller, C. F., Lurye, L. E., Zosuls, K. M., & Ruble, M. D. (2009). Accessibility of gender stereotypes domains: developmental and gender difference in children. Sex Roles 60, 870-881 doi: 10.1007/s11199-009-9584-x.

Modo, F. N. (2011). Gender Equity and Family Re-organisation: The Counsellor's View, Journal of International Gender Studies (JIGS), and No.7. An Annual Publication of the International Association for Gender Equity (IAFGE).

Mustapha, A. S. (2013). Gender and Language Education Research: A Review, Journal of Language Teaching and Research .4(3), 454-463.

Myhill, D. (2002). Bad Boys and Good Girls? Patterns of interaction and Response in whole Class Teaching, British Educational Research Journal, 28, 340-352.

Oyebola, O. (2003). Gender Issues in textbook development: a study of gender balance in illustrations of selected textbooks for upper primary Level. Retrieved from http://nigeria-education.org/content/gender-issues-textbook-development-study-gender-balance-illustrations-selected-textbooks.

Sadker, D., & Zittlman, K. (2007). Multicultural education: issues and perspectives, edited by James A. Banks and Cherry A, McGeeBanks. Hoboken, Gender bias from the Colonial America to today's classroom. 137-169. New Jessy: John Wiley and sons. Inc

Sadker, D., Zittleman, K., Earley, P., McCormick, T., Strawn, C., & Preston, J. (2007). The Treatment of Gender Equity in Teacher Education. In S. Klein (Ed.), The handbook for Achieving Gender Equity through Education (2nd ed.) (131–150). Hillsdale, NJ: Erlbaum.

Sadker,D. Sadker M., & Zittleman, K.R. (2009). Still failing at Fairness: How Gender Bias Cheats Girls and Boys in School and what we can do about it.1-361, New York: NY. A Division of Simon & Schuster, Inc.

Salman, M. F.,Yahaya, L. A., & Adewara, A. A. (2011). Mathematics Education in Nigeria: Gender and Spatial Dimensions of Enrollment. International Journal Education Science, 3(1) 15-20.

She, H. C. (2000). The interplay of a biology teacher is beliefs teaching practices and gender based student-teacher interaction, Education Research, 42, 100-111.

Shel, T. A. (2007) Gender and Inequity in Education literature review. "Paper commissioned for the EFA Global Monitoring Report 2008, Education for All.

Shomoossi, N., Amouzadeh, M., & Ketabi, S. (2008). Classroom Interaction Mediated by Gender and Technology: The Language Laboratory course, Novitas Royah Research on Youth and Language, 2(2), 176-184.

Sobel, S., Marconi, L., & Ellison, B. (2004). Find Gender in the Classroom. Human Nature Team Blaisdell/MCphail. Retrieved from www. Jrsciece.wup.muohio.edu on 3/8/15.

Staverman, K. (2012). Does Sex Matter? A Look at Middle and High School Science Classrooms. Thesis submitted to Eastern Kentucky University USA. Retrieved www://localhost/Users/tobybernert/Desktop/Sex%20Matter%20Thesis-21/4/15.

UNICEF, (2014). Basic Education and Gender Equality: Girls Education and Gender. Retrieved from https://www.unicef.org/education/index_44870.html.

Appendix

coding sheet form for teacher-student i
Name of School………...Date……..Name of Teacher …………………Gender....................................

Substantive areas of interaction and the four additional areas of evaluation comments

s/n	Areas of interactions and the four additional areas of evaluation comments	**Tally**		**Total frequency**	
		Male	female	Male	female
1	**PRAISE**				
	Intellectual				
	Conduct				
2	**ACCEPTANCE**				
	Intellectual				
	Conduct				
3	**REMEDIATION**				
	Intellectual				
	Conduct				
4	**CRITICISM**				
	Intellectual				
	Conduct				

Note

Intellectual: Concerning cognitive and academically related topics

Conduct: This include the behaviour and deportment of students

Definition of 8 interactions coded using code sheet from checklist

Type of interaction	Definition
Praise- intellectual	Teacher's positive reaction to students on mathematics response
Praise- conduct	Teacher's positive reaction towards student behaviours
Acceptance –intellectual	An indication of simple correctness of students' academic response
Acceptance-conduct	Indication of student correctness in behaviour
Remediation-intellectual	Teachers' indication of lack of correctness of student's academic response. Teacher may suggest alternative
Remediation-conduct	Teacher's indication of lack correctness of non-academic behaviour
Criticism-intellectual	Teachers' negative evaluation of student's academic response
Criticism-conduct	Teacher's negative evaluation of student's non-academic behaviour

The Eurasia Proceedings of
Educational & Social Sciences (EPESS)
ISSN: 2587-1730

The Eurasia Proceedings of Educational & Social Sciences (EPESS), 2017

Volume 6, Pages 55-60

ICEMST 2017: International Conference on Education in Mathematics, Science & Technology

INVESTIGATING ACHIEVEMENT LEVELS OF SIXTH GRADE STUDENTS REGARDING ORDERING INTEGERS

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Abstract: The aim of this study was to investigate middle school sixth grade students' achievement levels regarding ordering of integers. Partipants were 262 sixth grade students from one public middle school in Etimesgut district of Ankara. Data were collected via a questionnaire. Findings indicated that achievement levels of the participants in ordering questions were moderate.

***Keywords*:** Integer, ordering, achievement levels, sixth grade students

Introduction

Integers have a crucial role in learning mathematics by understanding it because results of many studies investigating the integer conception revealed that integer is both complex and requires great effort to learn (Dereli, 2008; Janvier, 1983; Kilhamn, 2008; Mc Corkle, 2001). Since there are strong prerequisite relationships among integers and other issues, a student who already has learning difficulties in integers will find it difficult to succeed in the following subjects such as algebra (Lamb et al., 2012; Vlassis, 2004).
Integers are one of the mathematics topics in the mathematics curriculum as of 6^{th} grade, and the topic of integers is quite important because it is functional in the other following topics. The role of integers in the development of higher level mathematical concepts, such as algebra, makes it one of the most important and essential conceptual subjects in the middle school mathematics curriculum (Christou & Vosniadou, 2012, Vlassis, 2004). When students get to second term of sixth year, they begin to learn algebra that is based on integers. Furthermore, teaching and learning rational numbers and exponential numbers that are based on integers begin in seventh grade and continue in eighth grade. This situation indicates that the topic of integers should be handled and studied differently at different levels. Hence, it is significant to conduct a study which shows students' achievement levels regarding integers. The results of such a study would give valuable information related to ordering of integers.

Methods

The Research Method and Participants

In this study, the cross-sectional survey design was used in order to identify students' achievement levels. Cross-sectional survey design includes collecting data at a single point in time from a sample that represents the population (Fraenkel and Wallen, 2006). Data was collected from 262 students who were sixth grade students in one of the public middle schools in the Etimesgut district, Ankara.

- Selection and peer-review under responsibility of the Organizing Committee of the conference
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Instrument and Data Collection

A questionnaire was developed to identify middle school sixth grade students' achievement levels related to ordering of integers. The questionnaire was composed of two open-ended items. Explanations and details of two items are given below.

The first item in the questionnaire measures the students' knowledge of ordering integers. In the question, three girls' comparisons of their hair lengths were given and these comparisons included negative integers. Students were expected to explain the ordering of these integers, which represented girls' hair lengths. The 1nd question is presented in Figure 1 below:

> Question 1:
>
> Simge and Rüya are comparing their hair length to their friend Yağmur's hair length. Simge states that her hair is +4 cm compared to Yağmur's hair and Rüya states that her hair is3 cm compared to Yağmur's hair. Who has the shortest hair? Write the girls' names in order of their length from the shortest to the longest.

Figure 1. The first item in the questionnaire

The second item in the questionnaire was developed by the researcher, measures the students' knowledge of ordering integers. In the question, all buttons of an elevator were given in the figure and ground floor was represented as zero. Students were expected to identify the numbers of the elevator buttons, which were pressed by Ayşe and the nurse. The second question is presented in Figure 2 below:

Figure 2. The second item in the questionnaire

Question 2:

When Ayşe took the elevator from the ground floor in a hospital, she pressed the wrong elevator button. She went to the radiology service instead of the blood collection service. With the aid of a nurse in the elevator, the upper floor was pressed. Identify the number of buttons which were pressed by Ayşe and the nurse. Please explain your answer.

Ayşe:
…………………………………………………………………
…………………………………………………………………
…………………………………………………………

Nurse:…………………………………………………………
…………………………………………………………………
…………………………………………………………………
……………………………………………………...

In general, the aim of asking these questions was to get knowledge about students' achievement levels regarding ordering of integers.

Three mathematics educators in the Middle School Mathematics Education program of two different universities had evaluated the items of the questionnaire in terms of appropriateness of the items in relation to the objectives and the purposes of the study, the table of specification, the usage of mathematical terms, and the clarity of the statements.

As part of reliability study for items of the questionnaire, two researchers analyzed students' answers. A correlation of 98% was found between the two scorings.

In order to identify the achievement levels of the students, rubrics were developed by the researchers for each objective to evaluate the achievement levels of the participants.

Findings

In the first question, students were asked to order girls' hair lengths from the shortest to the longest. Sixth grade students' answers were analyzed according to the rubric below:

Table 1. Rubric for question 1

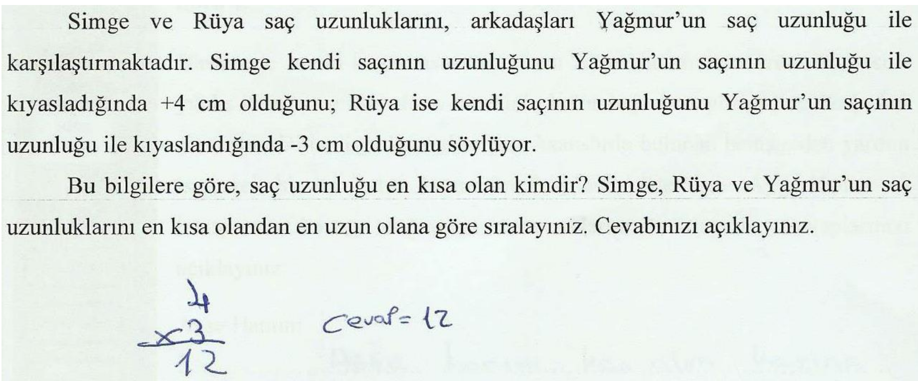
Scores	Answer Types
0	No answer/ Had no mathematical understanding
1	Ordered the girls' hair lengths incorrectly
2	Ordered some girls' hair lengths correctly but some incorrectly
3	Ordered some girls' hair lengths correctly but some were not evaluated
4	Ordered girls' hair lengths correctly but without explanations or with inappropriate explanations
5	Ordered girls' hair lengths correctly but had limited mathematical knowledge
6	Ordered girls' hair lengths correctly with an acceptable explanation

To summarize, students' answers were coded as 1 and 2 if their answers were wrong and their answers were coded as 3, 4, 5 and 6 if their answers were correct.
The frequency of answers 262 6th grade students' answers are presented in Table 4.16 below:

Table 2. Frequency of the Answers for Question 1

Codes	0	30 (11.5%)
	1	51 (19.5%)
	2	9 (3.4%)
	3	37 (14.1%)
	4	58 (22.1%)
	5	31 (11.8%)
	6	46 (17.6%)
Total		262 (100.0%)

To illustrate, the incorrect answer of Participant 24, which is an example of "had no mathematical understanding", is presented below:
The response of Participant 24 is as follows:


Simge ve Rüya saç uzunluklarını, arkadaşları Yağmur'un saç uzunluğu ile karşılaştırmaktadır. Simge kendi saçının uzunluğunu Yağmur'un saçının uzunluğu ile kıyasladığında +4 cm olduğunu; Rüya ise kendi saçının uzunluğunu Yağmur'un saçının uzunluğu ile kıyaslandığında -3 cm olduğunu söylüyor.

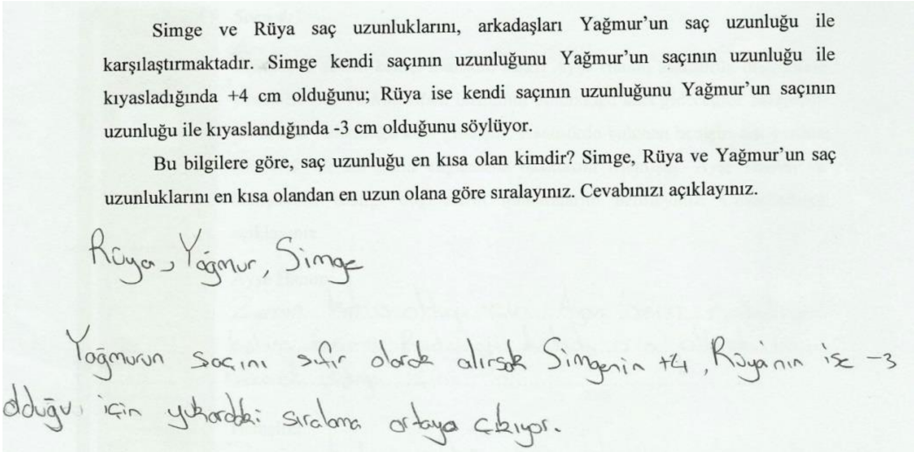
Bu bilgilere göre, saç uzunluğu en kısa olan kimdir? Simge, Rüya ve Yağmur'un saç uzunluklarını en kısa olandan en uzun olana göre sıralayınız. Cevabınızı açıklayınız.

4
x3
12

Cevap= 12

Figure 3. Answer of participant 24 to Item 1

As observed in the participant's response, "4x12=12" was not relevant to the correct answer of item 2.
To illustrate, the correct answer of Participant 92 is presented below:
Participant 92:


Simge ve Rüya saç uzunluklarını, arkadaşları Yağmur'un saç uzunluğu ile karşılaştırmaktadır. Simge kendi saçının uzunluğunu Yağmur'un saçının uzunluğu ile kıyasladığında +4 cm olduğunu; Rüya ise kendi saçının uzunluğunu Yağmur'un saçının uzunluğu ile kıyaslandığında -3 cm olduğunu söylüyor.

Bu bilgilere göre, saç uzunluğu en kısa olan kimdir? Simge, Rüya ve Yağmur'un saç uzunluklarını en kısa olandan en uzun olana göre sıralayınız. Cevabınızı açıklayınız.

Rüya, Yağmur, Simge

Yağmurun saçını sıfır olarak alırsak Simgenin +4, Rüyanın ise -3 olduğu için yukardaki sıralama ortaya çıkıyor.

Figure 4. Answer of participant 92 to Item 1

As can be seen in the participant's answer, Participant 92 ordered the girls' hair lengths from the shortest to the longest correctly. Rüya's hair length is the shortest; Simge's hair length is the longest according to the student's answer.

In the question 2, students were asked to express the numbers of the elevator buttons which were pressed by Ayşe and the nurse. Ayşe pressed -4 and the nurse pressed -3, which are the correct answers to this question.

Students' answers were analyzed according to the rubric presented below.

Table 3. Rubric for question 1

Scores	Answer Types
0	No answer/ Had no mathematical understanding
1	Ordered buttons incorrectly
2	Ordered some buttons correctly but some incorrectly
3	Ordered some buttons correctly but some were not evaluated
4	Ordered buttons correctly but without explanations or with inappropriate explanations
5	Ordered buttons correctly but had limited mathematical knowledge
6	Ordered buttons correctly with an acceptable explanation

To summarize, students' answers were coded as 1 and 2 if their answers were wrong and their answers were coded as 3, 4, 5 and 6 if their answers were correct.

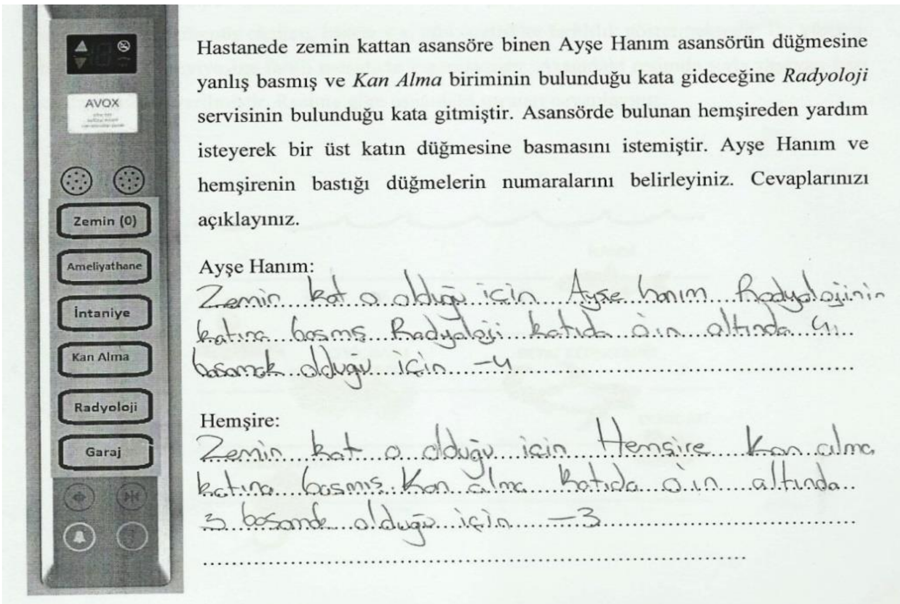
The results obtained from the analyses of the answers are presented in Table 4.

Table 4. Frequency of the answers for question 2

Codes	0	47 (17.9%)
	1	83 (31.7%)
	2	11 (4.2%)
	3	6 (2.3%)
	4	45 (17.2%)
	5	5 (1.9%)
	6	65 (24.8%)
Total		262 (100.0%)

To illustrate, the correct answer of Participant 3 for item 2 is presented below:

Participant 3:


AVOX
Zemin (0)
Ameliyathane
İntaniye
Kan Alma
Radyoloji
Garaj

Hastanede zemin kattan asansöre binen Ayşe Hanım asansörün düğmesine yanlış basmış ve *Kan Alma* biriminin bulunduğu kata gideceğine *Radyoloji* servisinin bulunduğu kata gitmiştir. Asansörde bulunan hemşireden yardım isteyerek bir üst katın düğmesine basmasını istemiştir. Ayşe Hanım ve hemşirenin bastığı düğmelerin numaralarını belirleyiniz. Cevaplarınızı açıklayınız.

Ayşe Hanım:
Zemin kat 0 olduğu için Ayşe hanım Radyolojinin katına basmış Radyoloji katında 0 ın altında 4ı basmak olduğu için -4

Hemşire:
Zemin kat 0 olduğu için Hemşire Kan alma katına basmış Kan alma katında 0 ın altında 3 basamak olduğu için -3

Figure 5. Answer of participant 3 to Item 2

As can be seen in the participant's answer, Participant 3 expressed the numbers of the elevator buttons as Ayşe pressing -4 and the nurse pressing -3.

Conclusion

To address the research question, the achievement levels of students in ordering of integers investigated. This high achievement level of students might be due to their experiences in the three understandings of number; namely, an ordinal, a cardinal, and a formal understanding of number (Bishop et al., 2013; Clements & Sarama, 2007). In more detail, students have experience related to cardinality of numbers so this experience might help students to identify integers. Another reason of the high achievement level of students might be due to their internal representations regarding negative numbers before they receive formal school instruction on negative integers (Peled, Mukhopadhyay & Resnick, 1988). In other words, before students learn the concept of integer in the school, they hold some information and experience related to negative numbers.

According to the results of middle school sixth grade students' answers to the ordering questions, it was found that nearly two third of them correctly answered ordering questions 1 and nearly half of them correctly answered ordering questions 2. More specifically, the number of students who answered ordering question 1 correctly was 172 out of 269. For ordering question 2, 121 students among 269 students answered the question correctly. A reason of this finding may be the case that students learn counting and reasoning about smaller and greater, children experienced ordering, initially (Bishop et al., 2013). In other words, they used to order reasoning about smaller and greater. However, reasoning about greater and smaller with negative numbers is difficult for students when the findings of İşgüden (2008) are taken into account. Students still think that the way to compare two negative numbers is the same as the way to compare two positive integers (Julie et al., 2013). This erroneous way of thinking might be the reason why the achievement level of students in the ordering questions was not high. To be more specific, the moderate achievement level of students in ordering question 1 may derive from students' reasoning about smaller and greater because many of the students solved these questions using the strategy of comparing instead of representing each hair length as an integer and then ordering these integers. As mentioned previously, students learn to reason about smaller and greater in early grades (Bishop, 2013 et al., 2013). The reason underlying the moderate achievement level of students in ordering question 2 might be students' challenges in understanding gradual parts of the question. In more detail, students have to answer the first part of the question before they answer the second part of the question.

Recommendations

Findings of the present study were limited with two questions of the questionnaire since when different questions were asked related to the concept of ordering integers, different findings could be reached. Furthermore, a similar study might be conducted in private schools to investigate private middle school students' understandings regarding the concept of ordering integers. Some recommendations might be made considering the sample of the study. In order to generalize the findings of the study to a population, the same study could be replicated with a sample randomly selected from nationwide schools in such a way that the sample would be representative of all sixth grade students in Turkey.

References

Bishop, J. P., Lamb, L. L., Philipp, R. A., Whitacre, I., Schappelle, B. P., & Lewis, M. L. (2013). Obstacles and affordances for integer reasoning: An analysis of children's thinking and the history of mathematics. *Journal for Research in Mathematics Education, 45*(1), 19-61.

Christou, K. P. & Vosniadou, S. (2012). What kinds of numbers do students assign to literal symbols? Aspects of the transition from arithmetic to algebra. *Mathematical Thinking and Learning, 14*(1), 1-27.

Clements, D. H., & Sarama, J. (2007). Early childhood mathematics learning. In F. K. Lester (Ed.), *Second handbook of research on mathematics teaching and learning* (pp. 461–555). Charlotte, NC: Information Age.

Dereli, M. (2008). *Tam sayılar konusunun karikatürle öğretiminin öğrencilerin matematik başarılarına etkisi*. Yüksek Lisans Tezi, Marmara Üniversitesi Eğitim Bilimleri Enstitüsü, İstanbul.

Fraenkel, J. R., & Wallen, N. E. (2006). *How to design and evaluate research in education*. New York, the USA: McGraw-Hill.

İşgüden, E. (2008). *7. ve 8. Sınıf öğrencilerinin tamsayılar konusunda karşılaştıkları güçlükler*. Unpublished Master's Thesis, Eskişehir Osmangazi Üniversitesi, Fen Bilimleri Enstitüsü: Eskişehir.

Janvier, C. (1983). The understanding of directed numbers. In J. C. Bergeron & N. Herscovics (Eds.), *Proceedings of the Fifth Annual Meeting of the North American Chapter of the International Group for Psychology of Mathematics Education* (pp. 295-300). Montreal: Universite de Montreal, Faculte de Sciences de l'Education.

Julie, H., Suwarsono S., & Juniati D. (2013). First cycle developing teaching materials for integers in grade four with realistic mathematics education. *Journal Mathematics Education*, *4*(2), 172-187.

Kilhamn, C. (2008). *Making sense of negative numbers through metaphorical reasoning.* Retrieved from http://www.mai.liu.se/~chrbe01/SMDF/madif6/Kilhamn.pdf

Lamb, L. C., Bishop, J. P., Philipp, R. A., Schappelle, B. P., Whitacre, I., & Lewis, M. (2012). Developing symbol sense for the minus sign. *Mathematics Teaching in the Middle School*, *18*(1), 5–9.

McCorkle, K. L. (2001). *Relational and instrumental learning when teaching the addition and subtraction of positive and negative integers.* California StateUniversity, Dominguez Hills, CA.

Peled, I., Mukhopadhyay, S., & Resnick, L. B. (1988). *Formal and informal sources of mental modes for negative numbers.* Paper presented at the Twenty-ninth meetingof the Psychonomics Society, Chicago, IL.

Vlassis, J. (2004). Making sense of the minus sign or becoming flexible in 'negativity'. *Learning and Instruction*, *14*, 469-484.

The Eurasia Proceedings of
Educational & Social Sciences (EPESS)
ISSN: 2587-1730

The Eurasia Proceedings of Educational & Social Sciences (EPESS), 2017

Volume 6, Pages 61-67

ICEMST 2017: International Conference on Education in Mathematics, Science & Technology

PRESERVICE MIDDLE SCHOOL MATHEMATICS TEACHERS' KNOWLEDGE ABOUT STUDENTS' MATHEMATICAL THINKING RELATED TO PERIMETER AND AREA

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Abstract: The purpose of the current study is to examine preservice middle school mathematics teachers' knowledge about students' mathematical thinking related to perimeter and area and determine the consistency between this knowledge and students' actual mathematical thinking. Case study, one of the qualitative research designs, was used to gain an in-depth understanding of the situation. The study was conducted with four senior preservice middle school mathematics teachers who enrolled in the program of elementary mathematics education at a public university. The data obtained through video recordings from the process of planning, teaching and reflecting on two lessons towards perimeter and area. The videos from teaching were used to identify students' mathematical thinking, difficulties, mistakes and misconceptions whereas the videos from planning and reflecting were used to describe preservice teachers' knowledge of students' mathematical thinking. The data were analyzed through content analysis method. The findings showed that students had lack of knowledge about the meanings of the concepts of perimeter and area, made mistakes related to calculation and use of measurement units. In addition to this, preservice teachers' predictions and expectations about students' mathematical thinking were very limited. Finally, it was observed that there were important differences between students' thinking ways, difficulties, misconceptions and possible mistakes and preservice teachers' expectations and predictions about these issues.

Note: This study was supported by İstanbul University BAP Office with the project of BEK-2017-25282.

***Keywords*:** Knowledge of students' thinking, preservice teachers, perimeter and area

Introduction

Geometric concepts such as perimeter, area and surface area have taken important roles in mathematics curricula because of their practical properties and usage in daily lives. However, students are not able to comprehend these concepts (Martin & Strutchens, 2000). Students have various mistakes, difficulties and misconceptions regarding these concepts (Cavanagh, 2007; Zacharos, 2006) due to inabilities in understanding the meaning of them completely (Zacharos, 2006). Research also mentions teachers' and preservice teachers' misunderstanding related to these concepts and their insufficient understanding of students' thinking regarding them (Reinke, 1997; Simon & Blume, 1994). These gaps in their understanding may cause problems in the future because teachers' knowledge affects teaching and student learning (Ball & McDiarmid, 1989). Similarly, Kellogg (2010) advocates that preservice teachers reflect their such misconceptions to their future students and their students might also have them.

When the confusions, difficulties and mistakes of both students and preservice teachers regarding perimeter and area concepts were considered, the importance of planning and teaching based on students' mathematical thinking and investigating preservice teachers' knowledge of it arose. One of the topics in teacher education that was paid more attention is student thinking (Kellogg, 2010). Teachers should know how students think

- Selection and peer-review under responsibility of the Organizing Committee of the conference

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mathematically (e.g. the subjects of perimeter and area), what kind of difficulties and misconceptions they may have regarding the subject and what the possible reasons behind these obstacles are (Simon & Blume, 1994).
Several studies highlight that teachers' knowledge about and abilities to anticipate, interpret and use students' thinking in their practices help them to improve their students' achievement (Carpenter, Fennema & Franke, 1996). However, teachers are neither good at predicting students' reactions, difficulties, misconceptions and what they can do (Goldsmith & Seago, 2011; Nathan & Koedinger, 2000a; Kazemi & Franke, 2004), nor in tendency to attend to, anticipate and make sense of students' thinking (Goldsmith & Seago, 2011; Kazemi & Franke, 2004; Wallach & Even, 2005) and incorporate it into the lesson and use it for making instructional decisions (Baş, 2013). If teachers have difficulties in this issue, it is likely that preservice teachers might have similar problems. From this point of view, the purpose of the current study was to examine preservice middle school mathematics teachers' knowledge about students' mathematical thinking related to perimeter and area and determine the consistency between this knowledge and students' actual mathematical thinking. The following research question guided the study:

What is preservice middle school mathematics teachers' knowledge about students' mathematical thinking related to the subjects of perimeter and area?

Method

Case study, which one of the qualitative research methods, was used in the study. Merriam (1998) states that case study is "an intensive, holistic description and analysis of a single instance, phenomenon or social unit" (p. 21). In this study, it was aimed to present preservice teachers' knowledge of students and to what extent their knowledge reflected students' actual mathematical thinking. Four senior preservice middle school mathematics teachers (1 female, 3 male) who enrolled in the program of elementary mathematics education at a public university participated in this study.

The study was conducted under a cyclical process that included phases of planning, teaching and reflecting.

- In the planning phase, preservice teachers endeavored to determine the activities and questions that would be included in the lesson plan, discussed on how students think mathematically, made suggestions on how to respond to them and concluded which materials to use collaboratively. They focused on what kind of solution approaches, mistakes and difficulties might be exhibited by the students.
- In the teaching phase, one of the preservice teachers taught the lesson in a real classroom whereas the other preservice teachers observed the lesson without interacting with the students in the classroom. Preservice teachers took notes on the copy of the lesson plan about the lesson to discuss after implementation together.
- In the reflecting phase, preservice teachers shared their ideas about the effectiveness of the lesson design and discussed on the teaching phase. They evaluated what worked well or not and what need to be changed. They emphasized unexpected responses and made suggestions to revise the lesson plan considering the points that they dwelled on.

This process was repeated for two lessons related to perimeter and area during 4 weeks. Preservice teachers prepared two lesson plans (the former was regarding perimeter and the later was regarding area), conducted two lessons and reflections. The data obtained through video recordings from the process of planning, teaching and reflecting on two lessons towards perimeter and area. The videos from teaching were used to learn students' mathematical thinking, difficulties, mistakes and misconceptions in order to determine the accuracy of preservice teachers' predictions and expectations about students' mathematical thinking. Besides, the videos from planning and reflecting were used to describe preservice teachers' knowledge of students' mathematical thinking. The data were analyzed through content analysis method.

Findings

In terms of students' mathematical thinking, it was found that students confused area and perimeter with each other; they had difficulty in measuring perimeter of a figure with the rope and rule; they did not find the unknown edges to find perimeter; they focused only images without considering the lengths; they confused the properties of rectangle and square; they did not know the meaning of some geometric concepts; they made some calculation mistakes and they used inappropriate measurement units.
Regarding preservice teachers' knowledge on students' mathematical thinking, it was found that there were consistent and inconsistent predictions and lack of knowledge about this issue. Three themes "expected and happened", "expected but not happened" and "not expected but happened" were observed. Preservice teachers

expected some ways of mathematical thinking to come out and they happened as they expected. One of the preservice teachers' comments on the theme of *expected and happened* were as the following:

For example, we prepared exercise sheets including some figures and we wrote numerical values on the edges but we left some edges blank for the students to find themselves. We thought that they might not find them and sum only the numbers that were written. In teaching, I observed that as we expected, students had difficulty in finding the lengths of edges. They could say that opposing edges were the same in a rectangle but they missed out finding and adding the unknown edges to find perimeter. They substantially summed the known edges as calculating the perimeter (see Figure 1). Some students noticed the missing point and emphasized that the unknown edges should be found at first in order to help their friends.

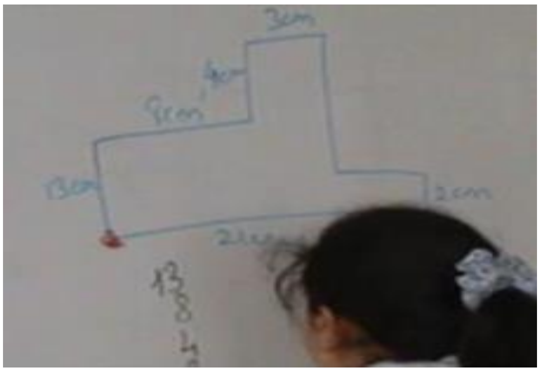

Figure 1. The geometric figure including the unknown edges

Another preservice teacher's explanations about students' mathematical thinking were as follows:

One of the members said that students counted points instead of distance while finding the length of an edge while planning the lesson. Therefore, we decided to use isometric papers and drew figures on them. We asked students to find the lengths of the edges and calculate perimeter of the figures. In teaching, I noticed that the students counted the points instead of the distance to find the lengths of edges on isometric paper and our predictions were correct (see Figure 2). For example, the length of one edge was 7 but the student said that it was 8 because he considered the points and found it as one more.

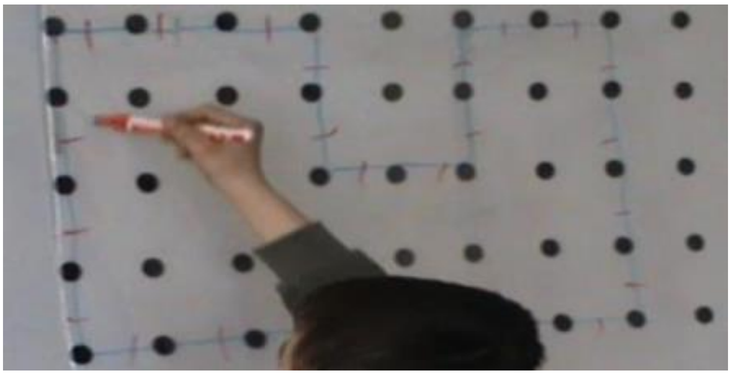

Figure 2. The figure related to calculation of perimeter

Another example addressing expectations and happenings was related to the confusion of perimeter and area. A preservice teacher's reflections on this issue were as below:

When it was asked how to find area of a square, some students said that ax4 or by multiplying one edge by four, namely, perimeter instead of area. I think that it was expected to hear ax4 because they confused perimeter and area and they wanted to make an operation with 4 because all edges of a square were equal. For example, one student found the perimeter of a square by multiplying 7 by 4 as 28 instead of calculating the area multiplying 7 by 7 as 49 (see Figure 3). However, it did not make me surprised because we expected this confusion.

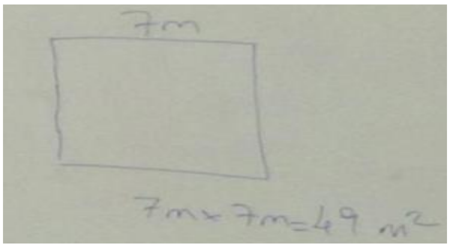

Figure 3. The question regarding area of a square

On the other hand, preservice teachers' predictions were not always consistent with actual mathematical thinking of students. There were situations that preservice teachers expected to occur while planning, however, they did not happen in teaching. One of the preservice teachers' comments on the theme of *expected but not happened* were as the following:

In one activity, we drew four different rectangles which had same perimeter and wanted students to predict perimeter of which figure was bigger. We thought that student might think that they needed to know lengths of all edges to say something about perimeter of the figures. However, there were no students who made comments on this point. It was not as we expected and students gave answers considering only images of the figures such as "perimeter of B is bigger because it is thicker" or "it is A, because it is longer" (see Figure 4).

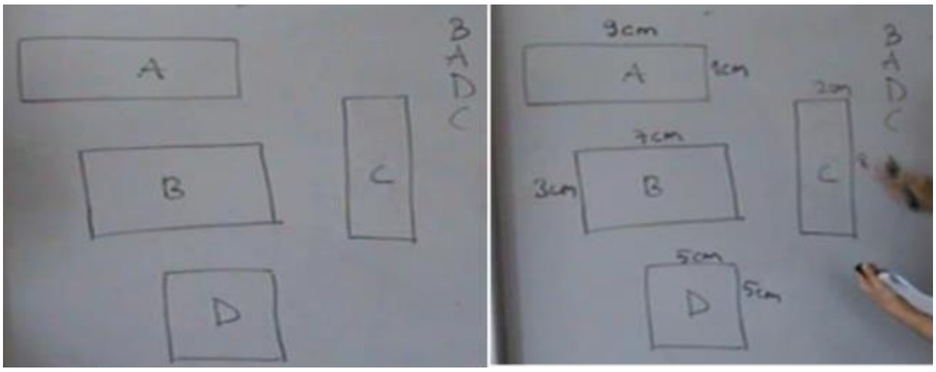

Figure 4. The question regarding different figures with the same perimeter

Another preservice teacher's explanations about students' mathematical thinking were as follows:

In one activity, we wanted the students to cover the same of two rectangles with different two squares to show the need for use of standard measurement units. We thought that students may have difficulty there and they may not understand the reason on why the numbers of squares to cover the rectangles were different. However, students explained the difference between the needed number of squares with statements like "one identical square was bigger than the other", "one square was 1x1 and the other was 4x4" and "their size is not the same", contrary to what we thought (see Figure 5).

Figure 5. The same rectangles with different size squares

Reflections of one of preservice teachers regarding expectations and happenings were as below:

As planning the lesson, we thought that we should make students discover the formula of area from the relationship between column and row, and we also thought that one example was not enough and asked two questions in order to help students generalize the area formula of a rectangle and square. However, they could understand formula at the first example on the contrary what we think and preservice teacher who taught the lesson decided to skip the second examples for both rectangle and square feeling that it would not be necessary. I think he gave the correct decision at this point (see Figure 6).

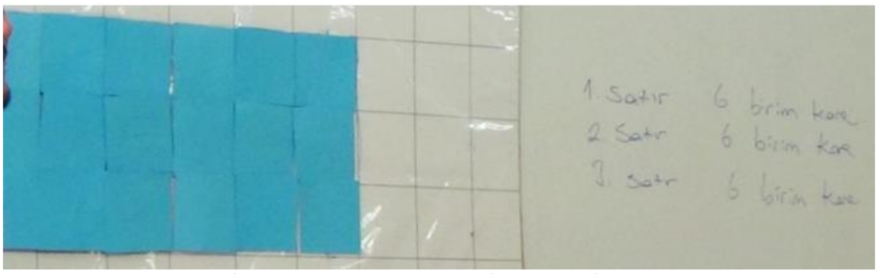

Figure 6. The activity for introducing the area formula of a rectangle and square

Furthermore, preservice teachers did not expect or could not predict correctly students' some mathematical thinking ways while planning the lesson but they arose in teaching. One of the preservice teachers' comments on the theme of *not expected but happened* was as the following:

For example, while students were summing the edges to find perimeter in one question, they confused which edges they wrote or not. Thus, they missed some lengths to include in calculation or they added twice (see Figure 7). We did not expect this confusion and we decided to determining a point on one corner, wanting students to write the edge lengths respectively until they reach this point in order not to be confused while calculating. Moreover, the students could not draw the figure on the isometric paper in their notebooks. It made me surprised because isometric paper and their notebook were similar and I expected them to have no difficulty here.

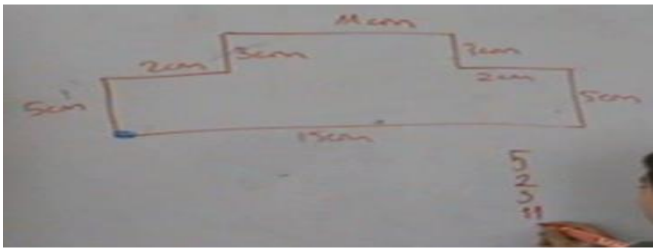

Figure 7. Another figure related to calculation of perimeter

Another preservice teacher's explanations about students' mathematical thinking were as follows:

For example, while drawing a rectangle, if it was similar to a square, students asked whether it was a square. Therefore, we must be careful to draw the figures correctly because they focus on this point. Students should understand long edge is bigger than short edge when they look at it. For example, even though we wrote 3 and 4 on the edges, they perceived it as a square without considering the numerical values and inequality of edges because the lengths of edges look alike in view (see Figure 8). We could not predict students' this approach while planning.

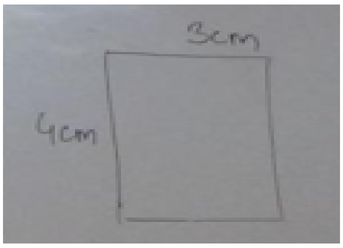

Figure 8. The figure that students perceive as square

Another example addressing expectations and happenings was related to the confusion of representations. A preservice teacher's reflections on this issue were as below:
While giving the formulas of perimeter and area, we did not expect but the letters of l and s confused the students. I think there is no difference between the use of a,b and l,s. On the contrary, l and s was more meaningful because "l" was used to represent the long edge and "s" was used to represent the short edge in line with their first letter. However, students got used to a and b and when they encountered with different representations such as l and s, they could not generalize and transfer knowledge. Therefore, we decided to use a and b to represent edges of rectangle and square (see Figure 9).

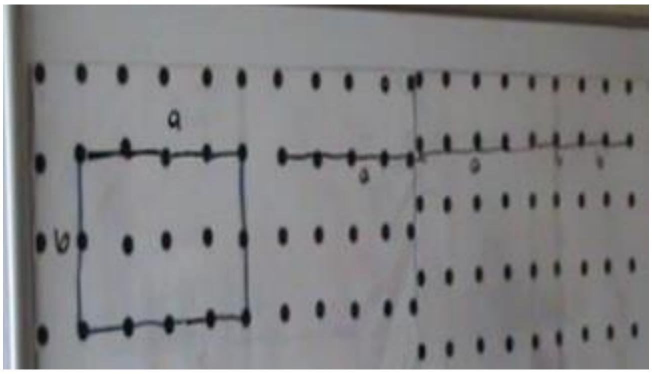

Figure 9. The activity to teach perimeter formula of a rectangle and square

Preservice teachers' some comments also showed their lack of knowledge about students' mathematical thinking and abilities directly. For example, they discussed on whether they should draw half squares in the form of triangle while calculating area of figures. However, they were not sure about the students' ability to complete two half squares to a whole unit square. Therefore, they did not ask this kind of question but they noticed that students could do it in teaching and their questions were easy. Preservice teachers' predictions and expectations about students' mathematical thinking were very low. In teaching phase, they mostly realized that the questions and activities in their lesson plans were very simple. Therefore, in reflecting phase, they discussed on making difficult some of them so that the content of lesson plans would be more convenience in terms of students' levels.

Discussion and Conclusion

The results indicated that there were differences between preservice teachers' expectations and students' actual mathematical thinking. Similarly, many studies also revealed that there were differences between students' mathematical thinking ways, difficulties, previous knowledge, misconceptions and teachers' expectations and predictions about these issues (Baş, Erbaş & Çetinkaya, 2011; Bergqvist, 2005; Hadjidemetriou & Williams, 2002; Nathan & Koedinger, 2000a, 2000b). Some research also showed that teachers and preservice teachers do not understand students' mathematical thinking ways sufficiently and they cannot utilize them during teaching (Kılıç, 2011; Tirosh, 2000).

In planning, it was observed that preservice teachers made incorrect or incomplete predictions about students' thinking (Baş et al., 2011; Bergqvist, 2005; Hadjidemetriou & Williams, 2002; Nathan & Koedinger, 2000a, 2000b). They had difficulty in determining some questions and activities since they were not sure about students' previous knowledge or they could not predict students' reactions. In this case, they underestimated students' potential and it was noticed that some questions were easy or the tasks did not include all necessary concepts. Bergqvist (2005) also indicates that teachers tend to underestimate the students' reasoning levels. The reasons behind preservice teachers' incorrect or incomplete predictions may result from their knowledge or the effects of their own thinking ways (Doerr & Lesh, 2003; Zeytun, Çetinkaya & Erbaş, 2010).

The results showed that students may mathematically think differently from what preservice teachers expected or recognized. It supported the results of the studies in literature (Bergqvist, 2005; Kılıç, 2011; Zeytun et al., 2010; Tirosh, 2000) and revealed that preservice middle school mathematics teachers' knowledge of students' thinking were limited (Didiş, Erbaş, Çetinkaya, Çakıroğlu & Alacacı, 2015). However, it was also found out that the preservice teachers were better in understanding students' mathematical thinking during the process that included planning, teaching-observing and reflecting. Therefore, it is recommended that this kind of process should be integrated into teacher education programs.

References

Ball, D. L., & McDiarmid, G. W. (1989). The Subject Matter Preparation of Teachers. Issue Paper 89-4.

Baş, S., Erbaş, A. K. & Çetinkaya, B. (2011). Teachers' knowledge about ninth grade students' ways of algebraic thinking. *Education and Science 36*(159), 41-55.

Baş, S. (2013). *An Investigation of Teachers' Noticing of Students' Mathematical Thinking In The Context of A Professional Development Program.* Unpublished doctoral dissertation. Middle East Technical University. Ankara, Turkey.

Bergqvit, T. (2005). How students verify conjectures: Teachers' expectations. *Journal of Mathematics Teacher Education, 8*, 171-191.

Carpenter, T. P., Fennema, E., & Franke, M. L. (1996). Cognitively guided instruction: a knowledge base for reform in primary mathematics instruction. *The Elementary School Journal, 97*(1), 3-20.

Cavanagh, M. (2007). Year 7 students' understanding of area measurement. *Australian Association of Mathematics Teachers Inc.*, 136.

Didiş, M., Erbaş, A., Çetinkaya, B., Çakıroğlu, E., & Alacacı, C. (2015). Öğrenci Çalışmalarını İncelemenin Öğrenci Düşünme Şekillerini Anlamadaki Rolü ile İlgili Matematik Öğretmen Adaylarının Düşünceleri. *Turkish Journal of Computer and Mathematics Education, 6*(2), 139-162.

Doerr, H. M., & Lesh, R. (2003). A modeling perspective on teacher development. In R. Lesh & H. M. Doerr (Eds.), *Beyond constructivism: Models and modeling perspectives on mathematics problem solving, learning, and teaching* (pp. 125–140). Mahwah, NJ: Lawrence Erlbaum.

Goldsmith, L. T., & Seago, N. (2011). Using classroom artifacts to focus teachers‟ noticing: Affordances and opportunities. In M. G. Sherin, V. R. Jacobs, & R. A. Philipp (Eds.), *Mathematics teacher noticing: Seeing through teachers' eyes* (pp. 169-187). New York: Routledge.

Hadjidemetriou, C., & Williams, J. (2002). Teachers' pedagogical content knowledge: Graphs, from a cognitivist to a situated perspective. In A. D. Cockburn & E. Nardi (Eds.), *Proceedings of the 26th Conference of the International Group for the Psychology of Mathematics Education, Vol. 3 (pp. 57-64). Norwich, UK: PME:*

Kazemi, E., & Franke, M. L. (2004). Teacher learning in mathematics: Using student work to promote collective inquiry. *Journal of Mathematics Teacher Education*, *7*, 203-235.

Kellogg, M. S. (2010). *Preservice elementary teachers" pedagogical content knowledge related to area and perimeter: a teacher development experiment investigating anchored instruction with web-based microworlds*. Unpublished doctoral dissertation. University of South Florida, USA.

Kılıç, H. (2011). Preservice secondary mathematics teachers' knowledge of students. *Turkish Online Journal of Qualitative Inquiry, 2*(2), 17–35.

Martin, W. G., & Strutchens, M. E. (2000). Geometry and measurement. In E. A. Silver & P. A. Kennedy (Eds.), *Results from the Seventh Mathematics Assessment of the National Assessment of Education Progress*, (pp. 193-234). Reston, Va.: National Council of Teachers of Mathematics.

Nathan, M. J., & Koedinger, K. R. (2000a). An investigation of teachers' beliefs of students' algebra development. *Cognition and Instruction*, *18*(2), 209-237.

Nathan, M. J., & Koedinger, K. R. (2000b). Teachers' and researchers' beliefs about the development of algebraic reasoning. *Journal of Research in Mathematics Education*, *31*(2), 168-190.

Reinke, K. S. (1997). Area and perimeter: Preservice teachers‟ confusion. *School Science and Mathematics, 97,* 75-77.

Simon, M., & Blume, G. (1994). Mathematical modeling as a component of understanding ratio-as-measure: A study of prospective elementary teachers. *Journal of Mathematical Behavior*, *13*, 183-197.

Tirosh, D. (2000). Enhancing prospective teachers' knowledge of children's conceptions: The case of division of fractions. *Journal for Research in Mathematics Education, 31*(1), 5–25.

Wallach, T., & Even, R. (2005). Hearing students: The complexity of understanding what they are saying, showing, and doing. *Journal of Mathematics Teacher Education*, *8*(5), 393-417.

Zacharos, K. (2006). Prevailing educational practices for area measurement and failure in measuring areas. *Journal of Mathematical Behaviour*, *25*, 224-239.

Zeytun, A., Çetinkaya, B., & Erbaş, A. K. (2010). Mathematics teachers' covariational reasoning levels and their predictions about students' covariational reasoning abilities. *Educational Sciences: Theory & Practice, 10*(3), 1573–1612.

The Eurasia Proceedings of
Educational & Social Sciences (EPESS)
ISSN: 2587-1730

The Eurasia Proceedings of Educational & Social Sciences (EPESS), 2017

Volume 6, Pages 68-72

ICEMST 2017: International Conference on Education in Mathematics, Science & Technology

PRESERVICE MIDDLE SCHOOL MATHEMATICS TEACHERS' CONCEPTION OF AUXILIARY ELEMENTS OF TRIANGLES

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Didem Akyuz
Middle East Technical University

Abstract: In the literature, there have been research examining different grade levels of students' understanding of geometric shapes such as triangles and their main elements as well as their auxiliary elements. The purpose of the current study is to investigate preservice middle school mathematics teachers' (PMSMT) conception of auxiliary elements of triangles. In order to achieve this, the activity sheets about definitions, constructions, and properties of auxiliary elements of triangles were designed and conducted to 23 junior PMSMT. The PMSMT engaged in these activity sheets. The data were collected through their written works and it was analyzed based on the content analysis which is a type of qualitative data analysis technique. It was found that, the PMSMT could effectively define auxiliary elements of triangles. However, they had difficulty in the properties and related theorems about auxiliary elements.

***Keywords*:** Auxiliary elements, conception, triangles.

Introduction

Preservice mathematics teachers need knowledge and skills in order to perform their responsibility of teaching geometrical concepts. They can acquire them in a learning environment designed by effective and useful geometrical tasks related to these knowledge and skills. In this respect, it is necessary that the preservice mathematics teachers should be in supported with a learning environment supported by rich opportunities to obtain experiences in order to understand the geometrical concepts. In this wave, they can improve their knowledge and understanding of geometry (Han, 2007; Henningsen & Stein, 1997).

In geometry, different grade level of learners are expected to attain knowledge about related concepts. Triangle is one of the most important concepts among them. Triangles are essential in teaching geometry, but different grade level of students unfortunately face with obstacles in understanding triangles (Damarin, 1981; Vinner & Hershkowitz, 1980). In the literature, there have been research examining the students' understanding of triangles. Some of these research explain that the triangles should be taught focusing on analyzing and understanding of elements of triangles. For example, in Wang (2011)'s study, it was found that prospective elementary teachers could form accurate logical reasoning and explanations about main elements of shapes such as angles and edges. However, they could not effectively reason using auxiliary elements. Also, Uygun (2016) and Gutierrez and Jaime (1999) focused on preservice teachers' understanding about altitudes of triangles as one of auxiliary elements of triangles. They stated that it was necessary for them to attain deep knowledge about altitudes. The researchers made suggestion to perform studies about other auxiliary elements of triangles for future research. In this respect, the necessity of making investigations about auxiliary elements of triangles is emphasized in the current study. Additionally, while Alatorre and Saiz(2010) investigated preservice and inservice teachers' understanding of altitudes of triangles; Gutierrez and Jaime (1999) examined students' learning of altitudes of triangles as a type of auxiliary element. In their study, they found that student learning was affected by their teachers' understanding, explanations and transferring of the knowledge. The researchers explained this finding by using quotations from a lesson designed by altitudes as a type of auxiliary element. Different from these studies, this study investigates the impacts of teachers' definitions, concept images,

- Selection and peer-review under responsibility of the Organizing Committee of the conference
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difficulties and errors about altitudes of triangles on their students. When the effects of teachers on student learning are considered, it is important to educate effective and knowledgeable teachers in preservice years. Moreover, many research in the literature have focused on the altitudes of triangles so it is necessary to pay attention on other types of auxiliary elements of triangles. Hence, preservice teachers should acquire deep knowledge and understanding of auxiliary elements of triangles. In this respect, it is important to examine preservice teachers' understanding of auxiliary elements of triangles. Therefore, in the present study, it was focused on to investigate the understanding of preservice middle school mathematics teachers' understanding of different types of auxiliary elements of triangles.

Method

In this study particularistic case study is used, as the case is determined based on the criteria of the researchers' interest and willingness. In a particularistic case study, the researcher identifies the phenomena that s/he wants to examine and understand the phenomena deeply and document it in detail (Merriam, 2009; Stake, 1995).

The sample of the current study included twenty three preservice middle school mathematics teachers (PMSMT). They were enrolled in the program of elementary mathematics education at a university in the northern part of Turkey. The participants were composed of twelve female and eleven male PMSMT. The participants were selected by using the criterion sampling strategy as a type of purposeful sampling strategy. The selection criteria for the present study were being familiar with the necessary knowledge of geometry related to the concept of triangles and being taken the undergraduate course of Geometry in their teacher education programs. The data were gathered by using the video recordings of whole class discussion, audio recordings of peer group discussions and artifact collection of their written documents of activity sheets.

The activity sheets were prepared in a way that PMSMT were asked to construct the altitude of triangles, prove the formation of altitudes and concurrence of them on triangles as orthocenter, determine the places of this point for different types of triangles and discuss their ideas and explanations about them.

The qualitative data analysis of the present study was performed based on the content analysis technique based on the steps explained by Creswell (2012). The themes were determined as the formation of auxiliary elements, concurrency of them, and naming the concurrency point. The strategies, justifications and explanations were determined as the codes of the data analysis process. In order to provide trustworthiness, the strategies of triangulation by data and investigator were used. The data were gathered from different sources including written documents, audio and video recordings. Also, the transcripts were also analyzed by two researchers independently. Moreover, member checking strategy was used.

Findings

In the process, the PMSMT focused on the formation of auxiliary elements of triangles. They constructed the angle bisector, altitude, perpendicular bisector and median by using compass and straight edge. They studied with their peers and participated in whole class discussions under the guidance of the instructor. The instructor initiated the discussion focusing on the errors of the PMSMT about the construction of auxiliary elements. Hence, their misconceptions and errors were removed and effective understanding was supported. For example, the PMSMT constructed the angle bisector of a triangle in two ways and justified the formation of an angle bisector was performed by two different strategies. In the first strategy, the angle bisector was constructed by the knowledge that the angle bisector of a triangle could be perpendicular bisector at the same time if it was an isosceles triangle. Therefore, they formed an isosceles triangle on the original triangle. Then, by constructing the perpendicular bisector, the angle bisector was formed. In this process, the justification of this construction process was also provided as in Figure 1as follows:

Instructor: Can you construct the angle bisector?
Ali: Firstly, I identify an isosceles triangle by drawing an arc. Then, I form the perpendicular bisector of the new edge…

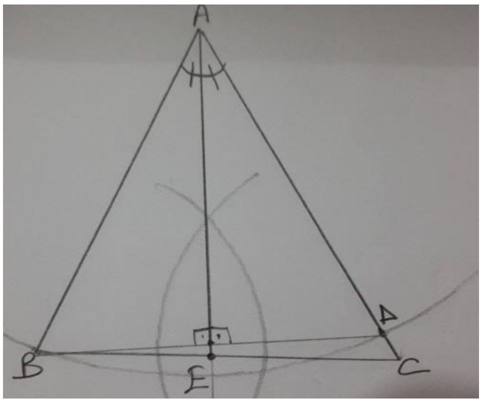
Figure 1. Construction of angle bisector by isosceles triangle

In the other strategy, the angle bisector was constructed using parallelogram. By the knowledge that the diagonal of a parallelogram formed two congruent triangles. They formed a parallelogram and two congruent triangles having a common side. By this way, an angle bisector was constructed in a different way and also it was justified by the knowledge related to parallelograms as in Figure 2 as follows:

Ayşe: I draw a parallelogram by using the sides of AB and BC. Then, by the instructions of finding midpoint of a line, I draw the diagonal of the parallelogram…

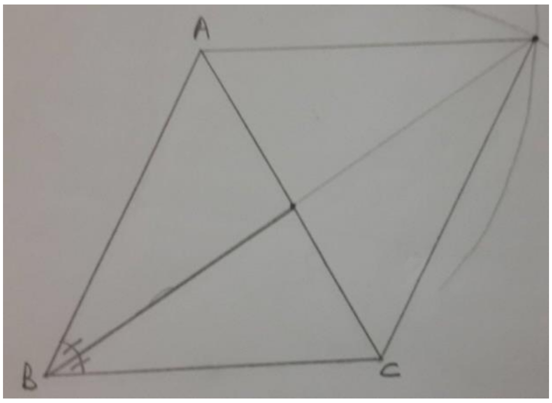

Figure 2. Construction of angle bisector by parallelogram

In the other part of the discussion process, the PMSMT focused on the concurrency of auxiliary elements of triangles. For example, in the activity sheet about angle bisectors, they showed the concurrency of them by the construction of all angle bisectors and justified the process by using the previous whole class discussion as explained above. Moreover, the PMSMT justified the concurrency of angle bisectors by Ceva Theorem. They explained that the angle bisector was a type of ceva and the concurrency of them could be showed by this theorem. Furthermore, they provided another justification using angle bisector theorem as in Figure 3 as follows:

Instructor: What can you say about the intersection of all angle bisectors of a triangle?
Ayşe: They are concurrent.
Instructor: How?
Ayşe: They all intersect each other at a point. I can show this by constructing all of them...
Instructor: What else?
Arzu: An angle bisector is a type of ceva so I can use Ceva Theorem.
Instructor: How?
Arzu: If I can apply the theorem for the related lengths of the sides, I can show…
Instructor: Is there another way?
Elif: Assume that there is a point as the intersection of the angle bisectors. Then, I draw the perpendicular lines from this point to the edges. Hence, congruent triangles such as BGO and KBO are formed… (see Figure 3)

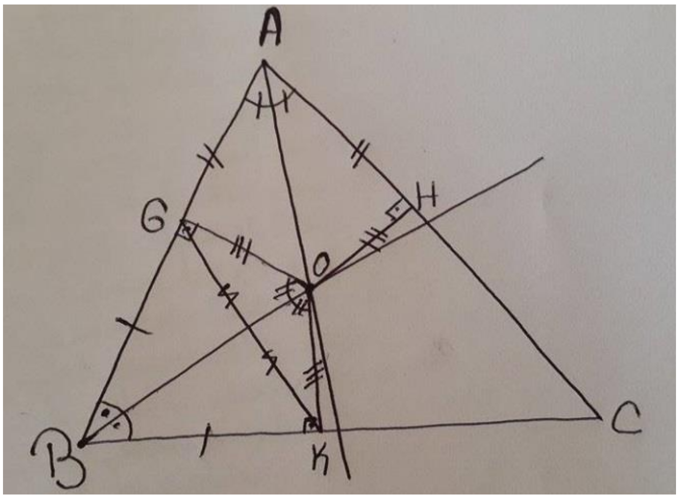

Figure 3. Concurrency of angle bisectors by angle bisector theorem

In the last part of the whole class discussion, the PMSMT talked about the names of the auxiliary elements of triangles. They discussed the incenter as the concurrency point of angle bisectors and the position of this point on the triangle. They provided the justification by using angle bisector theorem as in Figure 3. Also, a different justification was explained using the angles based on the arcs and the corners of the formed triangles by drawing arcs on Figure 3 and focusing on the measures of these arcs and angles of the figure. Then, they examined this situation focusing on the properties of these concurrency points. They also improved their understanding of these points. Afterwards, similar activities and discussion procedures were performed other auxiliary elements of triangles. They examined all auxiliary elements' properties.

Discussion and Conclusion

In the study, it was observed that geometric constructions facilitated the formation of auxiliary elements of triangles, relating with other concepts and justifying the formation of them. Through geometric constructions, the learners make these examinations by broadening their views, thinking and understanding of geometry (Cherowitzo, 2006). In this respect, it can be stated that geometric constructions can be useful in mathematics teacher education in order to help them acquire and develop their geometric thinking and knowledge and understanding about geometry concepts (Erduran & Yeşildere, 2010; Hoffer, 1981; Napitupulu, 2001). The present study was designed and conducted to examine preservice teachers' understanding about a particular geometry concept. This finding is parallel to the findings of some research in the literature since preservice middle school mathematics teachers' understanding of geometrical concepts can be improved by geometric constructions (Cheung, 2011; Napitupulu, 2001). It was also found that whole class discussions improved the PMSMT' understanding of auxiliary elements of triangles since they analyzed and criticized the concepts and their ideas about the solutions, formation of auxiliary elements, and justification of the ideas. This result is parallel to the study of Olkun and Toluk (2004). They stated that class discussions facilitated students' geometric thinking and understanding of geometrical concepts. Therefore, it is important to support PMSMT by providing an environment where they can have class discussions to understand geometric constructions. Also, the tasks and learning environments can be designed in this way in order to develop preservice teachers' knowledge and understanding of mathematical concepts especially the topics in geometry.

References

Alatorre, S., & Saiz, M. (2009). *Teachers and triangles*. Proceedings of Congress of Educational Research in Mathematics Education. 28 January- 1 February, Lyon; France.

Cherowitzo, B. (2006). *Geometric constructions*. [Online] Retrieved on 18-August-2012., at URL http://www-math.cudenver.edu/~wcherowi/courses/m3210/lecchap5.pdf.

Cheung, L. H. (2011). *Enhancing students' ability and interest in geometry learning through geometric constructions*. Unpublished master's thesis. The University of Hong Kong, China.

Creswell, J. W. (2012). *Educational research: planning, conducting, and evaluating quantitative and qualitative research* (4th ed.). Thousand Oaks, CA: SAGE Publications.

Damarin, S. K. (1981). What makes a triangle? *Arithmetic Teacher. 22*(1), 39-41.

Erduran, A. & Yeşildere, S. (2010). The use of a compass and straightedge to construct geometric structures. *Elementary Education Online, 9*(1), 331–345.

Gutierrez, A. & Jaime, A. (1999). Pre-service primary teachers' understanding of the concept of altitude of a triangle. *Journal of Mathematics Teacher of Education, 2*(3), 253-275.

Han, H. (2007). *Middle school students' quadrilateral learning: a comparison study*. Unpublished doctoral dissertation. University of Minnesota, Minnessota, USA.

Henningsen, M., & Stein, M. K. (1997). Mathematical tasks and student cognition: Classroom-based factors that support and inhibit high-level mathematical thinking and reasoning. *Journal for Research in Mathematics Education, 28*(5), 534-549.

Hoffer, A. (1981). Geometry more than proof. *Mathematics Teacher*, *74*(1), 11-18.

Merriam, S.B. (2009). *Qualitative research: a guide to design and implementation.* San Francisco: Jossey-Bass.

Napitupulu, B. (2001). *An exploration of students' understanding and van hiele levels of thinking on geometric constructions*. Unpublished master's thesis, Simon Fraser University, Indonesia.

Olkun, S. & Toluk, Z. (2004). Teacher questioning with an appropriate manipulative may make a big difference. *IUMPST: The Journal*, *2*, 1-11.

Uygun, T. (2016). *Preservice middle school mathematics teachers' understanding of altitudes of triangles*. Uluslararası Çağdaş Eğitim Araştırmaları Kongresi, 29 Eylül- 2 Ekim, Muğla, Türkiye.

Vinner, S., & Hershkowltz, R. (1980). Concept images and common cognitive paths in the development of some simple geometrical concepts. In Karplus (Ed.), *Proceedings of the Psychology of mathematics education* (pp. 177-184). PME.

Wang, S. (2011). *The van Hiele theory through the discursive lens: prospective teachers' geometric discourses.* Unpublished doctoral dissertation. Michigan State University, Michigan; ABD.

The Eurasia Proceedings of
Educational & Social Sciences (EPESS)
ISSN: 2587-1730

The Eurasia Proceedings of Educational & Social Sciences (EPESS), 2017

Volume 6, Pages 73-83

ICEMST 2017: International Conference on Education in Mathematics, Science & Technology

GENDERED TEACHER-STUDENT INTERACTIONS IN JUNIOR SECONDARY MATHEMATICS CLASSROOMS IN NIGERIA

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Abstract: Mathematics teachers do not remember how they interact with their students' in mathematics classrooms and also do not have ample time to reflect and analyse their pattern of interaction with the students; however, they continue interacting differently with females and males without knowing. This study aimed to investigate teacher-student interactions at junior secondary (JS3) mathematics classroom for gender bias. Mixed method research design was employed. Two instruments were used such as Interaction for Sex Equity in Classroom Teaching (INTERSECT) with a coding sheet and interviews. Six mathematics teachers, three males and three females were observed three times each. The researchers recorded 361 interactions of 180 male and 150 female students who were present in the observed classrooms. The findings revealed that males received significantly more acceptance-intellectual interactions than females did, the female learners receive significantly more remediation– intellectual interactions than males did.

Keywords: Gender bias, mathematics classrooms, teacher-student interactions

Introduction

There is a global rise in the consciousness of the impact of gender issues in education (Modo, 2011; UNICEF, 2014). All over the world, gender issues have become topical due to their ripple effects on all spears of human existence (Banks, 2005; British Council, 2012; Egbe-Okpengen & Orhungur, 2012; Miller et al., 2009; Sadker & Zittleman, 2009), Nigeria is no exception. The occurrence of gender bias in teacher-student interactions in mathematics classrooms in Nigeria is subtle in nature as such teachers are not aware that biases existence. This happens on the daily basis decisions on regarding the classroom interactions of teachers with their students; where teachers have no time to reflect or think back on their interactions with students in their respective classrooms. Despite that many studies have addressed gender bias on teacher - student interactions in the classrooms (Duffy et al., 2001; Hassaskhah & Zamir, 2013; Kokas, 2012) gender bias still exist. It suffices to say that presently, gender bias is persisting in Nigeria mathematics classroom as established by Farajimakin (2010), in which, male students are favoured in the classrooms in various subjects such as mathematics, physics, science and technology. Teachers give more attention to male students than female students (Salman et al., 2011). The bias is often subtle and unintentional, but its result is harmful. Adeyemi and Akpotu, (2004), Sadker and Zittleman, (2009, 2007) claimed that gender roles difference is prevalent in Nigeria and other parts of the world. Farajimakin (2010), Mustapha (2013), affirmed categorically that gender discrimination in classrooms is still prevailing.

Literature Review

In a study of teacher–student interactions a sample of one hundred fourth, sixth, and eighth grade classrooms, the findings showed that male students consistently out-talked and as well as out-participated female students (Sadker et al., 2007). Similarly, Becker (2001) also discovered that teachers began conversation with males more than females. However, these findings are similar to those of She (2000), who found that most of the teacher-

- Selection and peer-review under responsibility of the Organizing Committee of the conference

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initiated interactions involved more male students by using Brophy-Good Dyadic Child Interaction System, she (2000) found out that 355 teacher-initiated questions, male students responded 78.7% to the teacher questions in a mathematics classroom of 50:50 sex distribution. In another study, Kaily (2015) investigates gender bias in the mathematics classrooms in the South western British Columbia Canada Christian middle school whether boys and girls receive the same kind of attention from the teachers. Quantitative analysis of observation was conducted on different teachers. A sample of eight teachers of grades six, seven and eight was used. The findings revealed that boys received 13.58% more of teacher interactions and the girls received a less behavioural type of interaction from the teachers than boys and both girls and boys receive similar amount neutral interpretations from their teachers. Unfortunately, inferential statistics were not used in Kaily (2015) and Shel (2000) studies, it is not clear whether there is significant difference between female and male teachers' interactions patterns. Therefore, there is a need for inferential statistics to determine the significant different of the teacher interactions with both male and female students.

We reviewed the study of Einarsson and Granstrom (2002) that investigated the interactions of teachers and students in the high school aiming at the effects of the teacher gender and student gender in mathematics. A total of 597 students (294 males and 303 females) and 28 male and 8 female teachers were used in the study. The observation instrument used was Interaction for Sex Equity in Classroom teaching (INTERSECT). Their findings revealed that female and male teachers interacted with males more than females. But in contrast, Jones and Dindia (2004), findings suggested that teacher interacts more with female students. More recently, Bag et al., (2014) examined female and male teachers' interaction with female and male students in preparatory mathematics lesson at State University Turkey. The instrument used was video-recorded and observation Sinclair and Coulthard's Classroom Discourse analysis model was adopted. The findings of their study suggest that there is no equal distribution between the teachers' moves in both academic and non-academic directed to male and female students in classrooms. The findings of Bag et al (2014) are contradicted by the results of Leder et al., (2014) that examined teacher-interaction with high achievers' male and female students of grades 7 and 10 in Australia which shows that teacher gives greater attention to male students with high achiever than female students with higher achievement too. Most of the studies on gendered teacher-student interactions in mathematics classrooms have been conducted in western world (Howe & Abedin, 2013). It is repeatedly suggested to explore whether these results can be reproduced in other nations.

Studies by Kechen (2007), Khine and Fisher (2003) examined teacher and pupil interactions in mathematics classroom levels at each different stage of classes in Northeast England. A modified version of INTERESCT was used to record the classrooms interactions. The findings revealed that female learners received more positive feedback from the teachers than males. Secondly, male learners are active more in the morning lessons, while in contrast, female learners get attention more in the later period of the lesson than males. The results of Kechen (2007), Khine and Fisher (2003) are contradicted with the findings of Koca (2009), Sobel et al., (2004) that indicated female and male teachers interact more with male learner more than their female counterparts. It is interestingly to note that the results of the study would have pedagogical and psychological implications which require further studies. Many of these researches on gendered teacher-student interactions in mathematics classroom has generated inconsistent findings in various studies. That is negative feedback found in females than in males but it is still unclear which female students that account for these negative feedback increased (Howe & Abedin, 2013). Previous studies on teacher-student interactions in mathematics classrooms focused on secondary and university mathematics students. This present study extends to JS 3 mathematics classes in Nigeria.

Gul et al, (2012) in their study found that teachers interact with male students which are paralleled to the findings of Shomoossi et al., (2008). However, Staverman (2012) found that in grades 7 -9 of middle school mathematics, although male teachers interact more with male learners than females, but however, female teachers interact equally with female and male learners. The findings of Gul et al, (2012) study are interested simple because of the size of the sample of 155 teachers from 21 schools, the stratified random sampling and inferential statistics analysis were used in the study. However, there is difference between the studies of Gul et al, (2012) and Staverman (2012) whether the middle female teachers are equally interacting may be as a result of either (i) weak statistical effects which could be expecting to fluctuate from studies to studies or (ii) different population of participants in the study. In sum, the findings suggested that females sometimes are receiving messages that are subtle which can affect their academic negatively.

Problem Statement

Gender bias is manifested in teacher-student interactions in mathematics classroom have a negative implication for both male and female students which may affect them from reaching their full potential (McDonnell, 2007. The occurrence of gender bias in the mathematics classrooms is subtle in nature as such, teachers are not aware of its existence. Female students are continually treated differently in mathematics classrooms besides the fact that teachers give more attention to male students than female students. Improvement of gender equity of teachers' interaction in mathematics has been a concern of researchers. It is based on this issue that the researchers choose to ascertain the extent of gendered interactions of teachers in mathematics classrooms. In Nigeria, research on gendered teacher-student interactions in mathematics classrooms is scare, however, the small amount of studies focuses on teacher-student interactions in primary science and physics (Kalu, 2005; Oyebola, 2003). Therefore, there is a need to investigate teacher-students' interactions at junior secondary mathematics classrooms in Nigeria to proffer solutions to the differential treatment of male and female students at junior secondary school mathematics classrooms.

Purpose of the Study

This study examined teacher- student interactions patterns for any possible gender bias in junior secondary mathematics classrooms (JS3) in Abuja Nigeria. Observations of the junior secondary school mathematics classrooms are important since a lot of female students begin their first senior education experience at junior secondary (JS3) level. In addition, since these students choose their career at junior secondary school, the junior secondary school is a place to observe for any possible gender bias. Teachers' differential treatment of females in mathematics classrooms, may cause student to chance their career choice.

Research Questions

The study sought to find answers to the following research questions thus;

1.What is the proportion of the four evaluative types and two contents of interactions in mathematics classrooms?

2.Is there any significant gender bias difference between teacher-student interactions based on four evaluative types of interactions in mathematics classroom?

3. How do teachers perceive their interactions with students at junior secondary mathematics classroom?

Methodology

To achieve the purpose of the study, we adopted mixed method research design approaches. The quantitative data were subjected to descriptive and nonparametric Chi-Square test statistics. And for qualitative aspect, Miles and Huberman (1994) model was adapted for thematic analysis. A sample of (3) three males and three (3) females' mathematics were used making a total of six mathematics teachers in the three sampled schools. Two teachers are used in each sampled schools and each was observed three times for a period of two weeks, and each observation lasted 40 minutes. A total of 330 students were in these classes which comprised of females (n =150 (45.5%)) and males (n = 180 (54.5%)). The six mathematics teachers were purposively selected for the interviewed, and two research assistants were used for the data collection from the observed mathematics classrooms.

Data Collection

A modified Interaction for Sex Equity in Classroom Teaching (INTERSECT) and coding sheet form for teacher-student interactions were adapted from Duffy et al., (2001). Specifically, the current instrument involved coding teacher-student interactions, (a) evaluative type; criticism, acceptance, praise and remediation and (b) evaluative content; intellectual and conduct enable the observers to code for eight (8) potential types of interactions between the teacher and the students.

The inter-rater reliability for each category of interactions observed was calculated by using each data of observations from the two research assistants that were employed. The inter-rater reliability analyses indicated that the four areas of interactions reflected good inter-rater reliability with the kappa of 0.68 of praise, 0.72 for acceptance, 0.62 for remediation and 0.78 for criticism. The themes reliability was 0.70 using Cohen kappa which shows the overall agreement of four evaluation types of interactions during pilot testing of the study.

Data Analysis Procedure

The six (6) mathematics teachers were observed three times, and each observation lasted for 40 minutes over a period of two weeks. Descriptive statistics was employed in quantitative part for patterns of four evaluative types of interactions (remediation, praise, criticism and acceptance) in mathematics classrooms, which was computed based on two evaluative contents (intellectual and conduct) of interactions and also chi-square statistic test was used. For qualitative data, Thematic Analysis (TA) using Miles and Huberman (1994) model was adopted.

Results and Findings

Research Question 1

What is the proportion of the four evaluative types and two contents of interactions in the mathematics classrooms?

The analysis of the observational data focused on the nature of a teacher and student interactions patterns that emerged and the distribution of teacher interactions between male and female students in the mathematics classroom. In this section, Z-tests were carried out on all these interactions for teachers and students' gender in mathematics class, and a Bonferroni correction of alpha .01 was used because of the data were split by gender. This help to counteract the problem of multiple comparisons (Goldman, 2008). Female teachers ($z = 2.82$, $p < .05$) directed more of interactions toward males than females. When a teacher directed interactions to the whole classroom, Bonferroni correction for alpha .01) which indicated there was no significant student gender difference for responding to the male teacher of mathematics ($z = 2.32$, $p < .05$) female mathematics teachers ($z = 1.94$, $p < .05$). The overall sum of interactions of male teachers indicated a greater interaction toward male students than female teachers in mathematics ($Z = 4.22$, $p < .05$). Table 1 presents the values that represented the overall percentage of interactions which was directed toward females and males by both female and male mathematics teachers at JS 3 mathematics classrooms.

Table 1. Number of male and female mathematics teachers interactions toward male and female learners in mathematics classrooms

Interactions directed by Mathematics Teacher	Student	
	Male	Female
Male teacher	.74	.26
Female teacher	.63	.37

The total sum of the interactions includes four substantive interactions and two evaluative content on each of the category of interactions and definitions are given the areas of interaction in this study are; praise, acceptance, remediation and criticism with evaluative contents; intellectual and conduct. All interactions that took place between teachers and students in mathematics classrooms were analyzed (see Table 2)

Male teachers directed praise- intellectual to male students which accounted .78 and .03 to female students. There is no praise conduct to both female and male students from male mathematics teachers. Female mathematics teachers directed .32 intellectual praise- intellectual interactions to male students and .14 to female students. There is no praise-conduct interactions from female teachers to male and female students in mathematics classrooms. This also followed by acceptance-intellectual in which, male teachers directed a proportion of .32 and .36 to male and female students respectively. Male teachers only directed .03 of acceptance conduct to male students and non to female students, while female teachers directed acceptance- intellectual proportion .13 for male and .07 for female students. There is .03 acceptance conduct of interactions toward male and .02 to female students by the female mathematics teacher.

In remediation intellectual interactions, male teachers directed .12 and .23 to male and female students respectively, while .02 is directed to both male and female students on remediation conduct interactions by male teachers. And female teachers directed remediation intellectual interactions .23 and .18 to male and female students respectively and also directed remediation conduct interactions of .02 to males and .04 to female students. And on intellectual criticism interactions, male teachers directed .13 to male, .05 to female students, while .01 criticism-conduct was directed to male and non to female students. Female teachers directed intellectual criticism interactions of .34 and .25 to male and female students respectively, while .05 of conduct criticism was directed to male and .07 to female students. Overall the intellectual praise .78 is the greater proportion of interaction that was directed by male teachers to male students, and .03 was the lowest intellectual praise directed toward female students by male teachers. While .03 acceptance conduct was directed to both male and female students which are the greater conduct while the lowest praise conduct to both male and female students and also criticism conduct. The greater proportion of female teacher intellectual was acceptance .36 to male students and zero is the lowest conduct directed by the female teacher to female students at .00. These proportion of evaluative types of interactions are showed in Figure 1.

Table 2. Proportion of evaluative type interaction in mathematics by gender of student and gender of teacher

Interactions		Mathematics teacher	
		Male	Female
Praise towards			
Male students			
	intellectual	.78(100)	.32(18)
	conduct	.00(0)	00(0)
Female students			
	intellectual	.03(4)	.14(8)
	conduct	.00 (0)	00(0)
Acceptance toward			
Male students			
	intellectual	.32 (41)	.36(20)
	conduct	.03(4)	00(0)
Female students			
	intellectual	.13(16)	.07(4)
	conduct	.03 (4)	.02(1)
Remediation toward			
Male students			
	intellectual	.12(15)	.23(13)
	conduct	.02(2)	.02(1)
Female students			
	intellectual	.23(30)	.18(10)
	conduct	.02(3)	.04(2)
Criticism toward			
Male students			
	intellectual	.13(17)	.34(19)
	conduct	0.01(1)	.05(3)
Female students			
	intellectual	.05(7)	.25(14)
	conduct	.00(0)	.07(4)

Note. Proportions were calculated within each of the four groups in mathematics and gender of student. The values in the round brackets are observed frequencies. There are 180 males and 150 females in these observed classrooms.

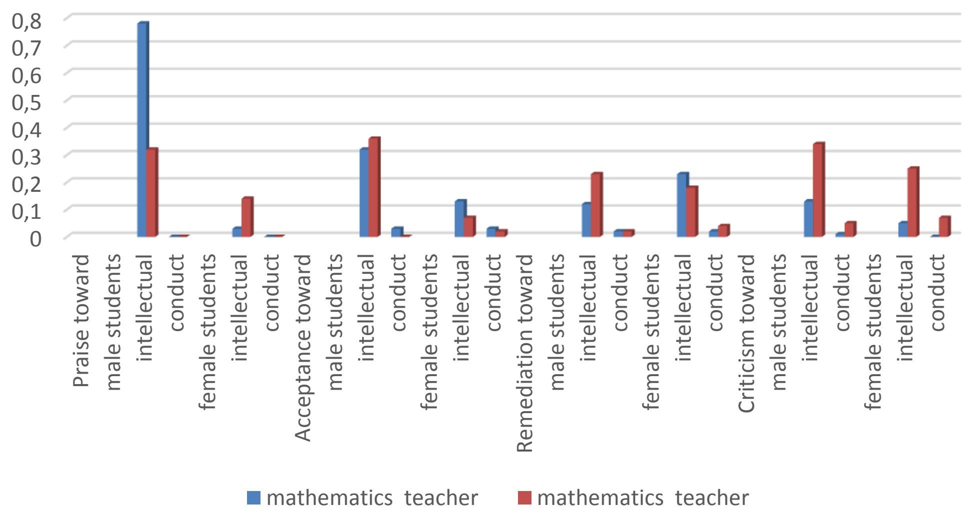

Figure 1. Proportion of evaluative type interaction in mathematics by gender of students and gender of teachers

Discriminant analysis was employed in order to see if teachers' gender, the gender of students and mathematics are differentiated the types of the evaluative teacher to student interactions of praise, remediation, acceptance, and criticism. Function one indicated a significant different between four evaluative types of interactions $\Lambda = .86$, $p < .05$. Therefore, function one is associated with students gender $r = .73$ and it accounts for 73% of the variance between types of interactions in mathematics classrooms observed. Females received more remediation than males, whereas males received praise, acceptance and criticism more than their female counterparts as showed in Figure 2.

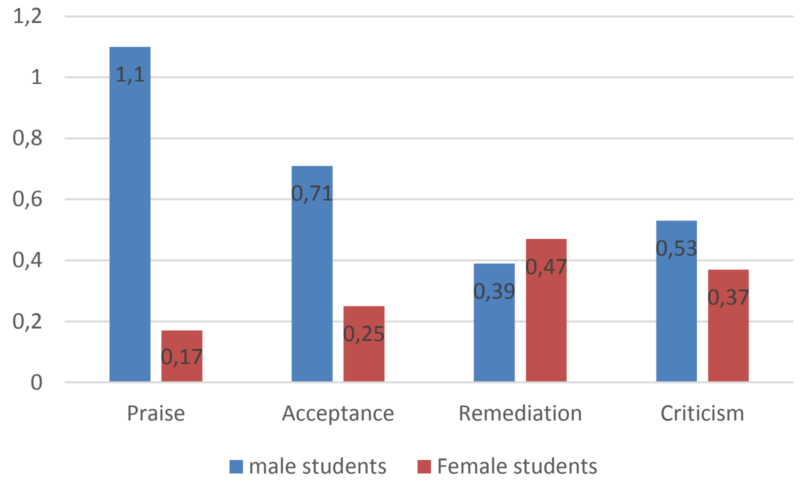

Figure 2. Proportion of teachers' evaluative type interaction in mathematics by gender of students

Research Question 2

Is there any significant gender bias difference between teacher-student interactions based on four evaluative types of interactions in mathematics classroom?

Discriminant function was used to determine the effect of teacher gender and mathematics on evaluative types of interactions. It was revealed that male teachers used more praise than female teachers $\chi2$ (1, N = 104) = 7.42; $p < .05$. Acceptance was used more by male teachers than female mathematics teacher $\chi2$ (1, N= 65) = 4.73; $p < .05$. In remediation, male teachers used more than their female counterparts $\chi2$ (1, N = 50) = 3.42; $p < .05$. On one hand, criticism was used more by female teachers than male teachers $\chi2$ (1, N = 40) =1.74; $p > .05$. It was found that praise was directed toward males significantly than females $\chi2$ (1, N = 118) = 8.12; $p < .05$. Acceptance was directed significantly more toward male students than directed toward their female students $\chi2$ (1, N =65) = 4.64; $p < .05$. Remediation was directed toward female students significantly more than male students $\chi2$ (1, N = 45) = 1.13; $p > .05$. Criticism was directed toward male student significantly more than toward female students $\chi2$ (1, N = 40) = 1.10; $p < .05$. It was found that 93% of the interaction were intellectual and 7% of the interaction was conducted which was based on four evaluative types of interactions such as praise, acceptance, remediation and criticism as shown in Figure 3.

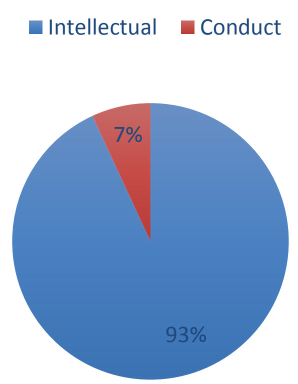

Figure 3. Frequency of evaluative content of interactions of teachers with gender

Discriminant analysis was also conducted in order to see if students' gender, teacher gender, and differentiated of evaluative content of teacher- student interactions. The function indicates a significant differentiation among four evaluative content of interactions, which, is $\Lambda = .96$, $p < .05$ and the function is associated with mathematics $r = .84$ and accounts for 84% of the variance between evaluative content of teacher -student interactions in which intellectual interactions 93% than 7% of conduct interactions in mathematics classes. Chi-square analysis was carried out to determine the differences in how 8 types of evaluative interactions were used. It was revealed that the type of interaction is depending on the gender of student $\chi 2$ (8, N= 361) = 11.72; $p < .05$. Males received significantly more acceptance-intellectual interactions than females, $z = 4.23$, $p < .05$. Female students receive significantly more remediation– intellectual interactions than male students did, $z = 5.46$, $p < .05$ and male students received more criticism- intellectual interactions than female students' $z = 4.92$, $p < .05$. Female students received significantly more acceptance-conduct interactions and remediation-conduct interactions than male students, $z = 3.48$, $p < .05$.

Research Question 3

How do teachers perceive their interactions with students at junior secondary mathematics classroom?

The categories are created from the interviewed data from teachers that participated in this study. The interview question was "do you feel that male and female students need to be treated differently in your mathematics classroom If yes why and how? The data from the interviews represented a coalescence of data into patterns of behaviours. These categories are grouped into two themes of mathematics classroom interactions. The themes are; Teacher academic attention and interactions and Gendered differential treatment by teachers include different types of interaction which is related to teacher and student roles in mathematics classrooms

Themes 1: Teacher Academic Attention and Interactions

Teacher- student interactions in mathematics classrooms are important factors in behavioural and academic outcomes for both male and female students. For effective teacher- student interactions are essential for promoting long time success in mathematics at junior secondary 3. This includes acceptance, remediation, praise and criticism intellectual from the teachers to male and female students in their mathematics classes. Either male or female student who received negative attention from teachers has increased the problem emotionally and disruptive behaviours. Male students received more attention from both male and female teachers than female students in which is in all cases is academic attention. Participants are of the view as showed that;

> *"I give attention to the most intelligent male students since the student always…questions and … in my class I do not see that to be bad after all the male are doing… than the female students in mathematics and…"* (Male teacher).

Another participant with the similar view to (male teacher), this is illustrated below;

> *"You see…if whether a male student is not doing well in your class you need to tell him to work harder… same when the student is good in mathematics I…that is very good of … keep it up. This will the student to encourage and strive to see he answer questions often in the class" (*Female teacher).

The data suggested that a need for given attention to those with difficulties in their work by encouraging and monitor them in the classrooms. Thus a participant pointed that female students seemed not to be doing well in the subject which likely is, as a result, less attention is given to them, thus a female participant has this to say;

> *"Hmmm…after the female student answer the questions incorrect… as a teacher I …the female student seems not to…serious which they need to work hard so as a teacher I need to give those female students attention and also using eye contact to female students in the class…" (*Male teacher*).*

The mathematics teachers reacted positively to only those students that are good in their classes irrespective of the student gender. It is also noted that the boys and girls behave differently in their classroom from what is expected from them by the teachers.

> *"I think you need to improve your answer Janet... we want to know how you got that solution unlike the answer Audu gave which is better understandable. In this case, one does not need to… them the same because …These are the things you will notice when you are teaching"* (Female teacher).

Theme 2: Gendered differential treatment by teachers

The audio tape recording of teachers' interviews in mathematics classrooms at junior secondary mathematics classrooms in Nigeria on differential treatment of male and female students was an appropriate tool to create awareness and reflection on gender bias treatment among male and female learners by their teachers. The intention of the interviewer was to determine the existence of gender bias in mathematics classrooms in terms of teacher-student interaction based on four evaluative types and two evaluative contents of interactions. Some teachers during the interview critically analysed their own behaviour and thought about using alternative approaches for the treatment of male and female students in their classrooms in the future. Here are some examples that were presented.

> *"In my class when a male student is good in mathematics I… the student to feel really happy with the answer he has given. You … really good in mathematics. The praising of the student should focus on the effort the students has accomplished. This will help the student to work more hard to prepare for the next class or examination. It also helps the student to see the link between the efforts he has invested in a task which has improved his academic performance in mathematic" (Male teacher)*

Another participant pointed that male students are found of disturbing and distracting the attention for those want to learn and therefore their treatment is different from that of female students. An example for differential treatment as;

> *"Ahaha… am…know the male student are found of disturbed the whole I thereby reprimand them more since the female students are always quietly and attentive. I do praise appreciate the female students for … Hmmm…hmm, the male students are always making noise and moving from… and I need to treat that student differently"* (Male teacher).

In additional, there are views from participants on teachers been harsh to female students simply because they are not able to answer questions in mathematics classroom.

> *"Wow! I'm... overreacting on female students that do not answer my…. In class. Some female students are saying that I'm harsh … which i think I am not but just because they seem not to like mathematics. I do tolerate them a lot. Well… with the boys, there is no need to be harsh to them they are good in mathematics. But I still appreciate any girl that is good in my class. I have to say to good female student "Mary you are making me proud … of doing well unlike the other girls"* (Male teacher)

Students are treated as an individual, not as girls or boys; the boys and the girls do not receive the same treatment on the basis of discipline, and boys received more punishment and detentions than girls, this was due to the facts that boys are more indiscipline in behaviour and as well inadequate in working pattern; This is an example from the interviewees;

> *"Yes, in fact, I treat them differently because I did that when John was disturbing mathematics class and not when Bola does the same... Its right, I think because John is found of doing that almost in every mathematics class, the male students are distracted more than the female students…there are some students that you always prefer. But you do not need them to know because all are equal before the school rules and regulations"* (Female teacher).

It is somewhat not surprising despite the perceptions of female students about the teacher's behaviours towards them, some teachers that were interviewed in junior secondary mathematics classrooms, reiterated that they do not treat both girls and boys equally in their mathematics classrooms. Some of the teachers were very clear that they give unequal treatment thus;

> *"Oh … there is difference in my teaching of males or females … I enjoy teaching mathematics and I have experience and skilled. Different treatment of girls and boys…yes, I know about it"* (Female teacher)

Some participants supported the different treatment of male and female students in mathematics classrooms which may be unintentional by teachers which they are not aware of. Thus,

> *"Am … not aware of treating females differently to males. Having …. said that, I do not … know if that happened without my knowing which is not intentional. So…am not aware … it, which it can be possible"* (Male teacher)

In the broader perspectives most teachers have the belief that they are giving equal treatment to both male and female students in the mathematics classroom in order to support the students learning, but it has been observed that it is very rarely to achieve. In most of our school's male students appear to dominate the classrooms interactions, and while the female students participate more in teacher-student interactions which are supporting learning. Mathematics teachers that participated in this study provided an insight into the different treatment of male and female students in mathematics classroom in Nigeria. The combination of the classroom observations and interviews reveal that the content of gender bias in teacher-student interactions exist in mathematics lessons, which the result may limit the female self-esteem and lower their achievement in mathematics.

Discussion of Findings

The results obtained from the classrooms observations on four evaluative types and two evaluative content of interactions in Table 3 shows that both male and female teachers at junior secondary mathematics classes in Nigeria directed praise intellectual (.78, .32), acceptance –intellectual (.32, .36), criticism-intellectual (.13, .34) and remediation intellectual (.12, .23) towards male students' more than female students in mathematics classrooms. These findings are commensurate with past literature which reveals that male students received all intellectual evaluative types of interactions than the female student from both male and female teachers (Duffy et al., 2001; Jones & Dindia 2004; Kaily 2015). The findings further reveal that female teachers directed more criticism –conduct (.07) and remediation–conduct (.04) towards female than male students in mathematics classrooms. The results are inconsistent with previous literature, which shows that female teachers directed less criticism –conduct and remediation-conduct to female students than male students in mathematics classroom (Einarsson & Granstrom, 2002; Eriba & Achor, 2010; MCDonnell, 2007). In this current study, female students received fewer interactions than male students from both male and female mathematics teachers which are commensurate with the study of (Hassaskhah & Zamir, 2013; Author, 2015). The finding shows there is a significant different between male and female teachers direct four evaluative types and two content of interactions more towards male students than female students.

Triangulation of the Findings of quantitative and qualitative

This section of the study used (classroom observations) quantitative statistical analyses to confirm or reject the existence of gender bias in teacher-student interaction based on four evaluative types and evaluative contents of interactions and mathematics textbooks. In addition, interview data based on these evaluative types and evaluative contents on gender bias (qualitative data analysis) was used to explore other gendered bias on teacher-student interactions in mathematics classrooms which has not been earlier theorised. Combining the classroom observations findings with the interviews results have conceptually stronger than using only single data for the existence of gender bias in teacher-student interactions in mathematics classrooms setting at junior secondary mathematics classroom in Nigeria.

Combining the quantitative and qualitative data represented one can conclude that is differential treatment occurring in teacher-students' interactions in mathematics classrooms based four evaluative types and two evaluative content of interactions. Although the two categories of teacher-students' interactions are interrelated in a consistent pattern of teacher-student interactions which male and female teachers, certainly treat them unequally. Teachers in the study treated the male and female student differently in all four evaluative type and evaluative contents of interaction in mathematics classroom (criticism, acceptance, remediation and praise). Generally, the difference in treatment is negative ways for male and female teacher give more attention to male students.

Conclusion

In sum, there is differential treatment of male and female students by both female and male teachers in mathematics classroom at junior secondary mathematics classroom in FCT Abuja Nigeria. The findings of the study revealed that the gender of the student affects their interaction with the mathematics teacher. Male and female mathematics teachers' interaction with more male students in the four categories of interactions than with female students at junior secondary school (JS3) mathematics classrooms. For male and female students to experience equal treatment by their teachers in mathematics classrooms, there must be gender equity in her educational system. Equal treatment can only be achieved the moment the notion of females is being inferior to males is eliminated. Female students should be given their own desire recognition to actualise their dreams and potential. Both new and old mathematics teachers need to go for training and retraining on the issue of gender equity on yearly basis in order to create awareness among mathematics teachers. The results of this study revealed that teachers at junior secondary three (JS3) mathematics classrooms are not aware of gender bias exhibited toward male and female students in their interaction.

The qualitative findings of research question 1a reveal that both male and female teachers give more interaction to the most intelligent students in mathematics irrespective of their sex, which is in line with the findings of Shomoossi et al., (2008) reports that only intelligent students received more interaction in the classroom. The findings are also consistent with previous studies Beam et al., (2006), Brandell and Staberg (2008), Cameron (2005) and Myhill (2002). These results suggested that male students do not generally monopolise mathematics classroom interactions. There is gender bias in mathematics classrooms as demonstrated through teacher to student interactions by observations and interviews. The reasons why female and male teachers are interacting with males more may be due to the fact that male students interact more in mathematics classrooms than female students. Secondly, it could be due to the notion that mathematics is a male domain, and the cultural belief of some part of Nigeria is that any female that is good in mathematics is termed "smarter" as such, no man will want to marry that lady. This study could be extended to senior secondary mathematics classroom to investigate the patterns of gender difference of interactions between teachers and their students.

Recommendations

Based on the findings of this study, future study is required to examine other factors that may likely cause teacher – student interactions in mathematics classrooms which may explain gender differences in teacher-student interactions patterns in mathematics.

References

Adeyemi, K., & Akpotu, N. (2004). Gender Analysis of Student enrolment in Nigeria Universities. Springer Higher Education Journal 48: 361-378.

Bag, E., Martu, L., & Bayyurt, Y. (2014). Gender and Classroom interaction: Examining a female and a male teacher's moves directed towards female and male students, University Journal of Education 31(1), 59-80.

Banks, S. R. (2005). Classroom Assessment: Issues and Practices. First Edition,

Boston: Pearson Education. 344 pages.

Beaman, R., Wheldall, K. & Kemp, C. (2006). Differential Teacher Attention to Boys and Girls in the Classroom, Educational Review, 58(3), 339–366.

Becker, J.R. (2001). Differential Treatment of Females and Males in Mathematics Classes. Journal for Research in Mathematics Education.12 (1), 40-53.

Brandell, G., & Staberg, E. M. (2008). Mathematics: a female, male or gender-neutral domain? A study of attitutes among students at secondary level, Gender and Education, 20 (5), 495-509, DOI: 10.1080/09540250701805771.

Cameron, D. (2005). Language, Gender and Sexuality: Current Issues and New Directions. Applied Linguistics, 26/4: 482-502.

Duffy, J., Warren, K., & Walsh, M. (2001). Classroom Interactions: Gender of teacher, Gender of Student, and Classroom Subject. Gender Roles, 45,579-593.

Einarsson, C. & Granstrom, K. (2002). Gender Biased Interaction in the Classroom: the influence of Gender and Age in the Relationship between Teachers and Pupils. Scandinavian Journal of Educational Research, .46(22).

Egbe-Okpengen, E. G., & Orhungur, M. M. (2012). Gender Issues in Entrepreneurial Development in Benue State (Nigeria) and Counselling Implications. Bulgarian Journal of Science and Education Policy (BJSEP), 6(2), 386-397.

Eriba, J. O., & Achor, E.E. (2010). Effects of School Type and Teacher Gender on Classroom Interaction Patterns in Integrated Science Classes. Brunei international Journal of Science and Mathematics Education 2(1) 48-58.

Farajimakin, I. O (2010). Gender issues: Students Performance in Senior Secondary School Mathematics Examination in Nigeria Retrieved from http://files.eric.ed.gov/fulltext/ED512116.pdf on 07/09/2015.

Goldman, M. (2008). Sta C141 Bioeng C141-Statistics for Bioinformatics Lecture Notes. Retrieved from www.sta.berkeley.edu/mgoldman/section 0402 pdfs on 16/08/2016.

Gul, S., Khah, M. B., Mughal, S., Rehmen, S. U., & Saif, N. (2012). Gender Stereotypes and Teachers Perceptions. (The Case of Pakistan) Information and Knowledge Management,

Hassaskhah, J., & Zamir, S. R. (2013). Gendered Teacher–Student Interactions in English Language Classrooms: A Case of Iranian College Context. SAGE Open DOI: 10.1177/2158244013502986.

Howe, C., & Abedin, M. (2013). Classroom dialogue: A systematic review across four decades of research. Cambridge Journal of Education, 43, 325-356.

Jones, S. M., & Dindia, K. (2004). A metal- Analysis perspective on Sex Equity in the Classroom. Review of Education Research 74 (4), 443-471.

Kaily, S. (2015). Gender Bias in Teacher-student interactions with students Master of Education Program Thesis paper 90. Retrieved from http://digitalcollections.dordt.edu/med_theses.

Kalu, I. (2005). Classroom Interaction Behaviour in Physics Lessons, relative to Students' Sex, African Journal of Research in Mathematics, Science and technology Education, 9(1), 55-66.

KeChen, (2007). A study of Primary Classroom Interactions: Is there still Gender imbalance in the Primary Classroom? www.research.nclac on 03/08/2015.

Khine, M. S., & Fisher, D. (2003). Teacher-Student Interactions in Science Classrooms in Brunei, Journal of Classroom Interaction, 38(2).

Koca, C (2009). Gender Interaction in COED Physical Education: A study in Turkey, Adolescence, .44(173), 165-185.

Kokas, K. E. (2012) The Gender Gap: the Effects of Gender Stereotyping on Students Achievement and where the Girls and Boys really are. Unpublished Master's Thesis Submitted to Penn State University.

Leder, G. C. Forgasz, H., & Jackson, G. (2014). Mathematics, English and Gender Issues: Do Teachers Count? Australian, Journal of Teacher Education; 39 (9).

McDonnell, L.M. (2007). Gender Bias in the College Algebra Classroom? PhD Thesis Submitted to University of Arizona. U.S.A.

Miles, M. B., & Huberman, A. M. (1994). Qualitative Data Analysis: An Expanded Source book second edition SAGE thousand Oaks London New Delhi.

Miller, C. F., Lurye, L. E., Zosuls, K. M., & Ruble, M. D. (2009). Accessibility of gender stereotypes domains: developmental and gender difference in children. Sex Roles 60, 870-881 doi: 10.1007/s11199-009-9584-x.

Modo, F. N. (2011). Gender Equity and Family Re-organisation: The Counsellor's View, Journal of International Gender Studies (JIGS), and No.7. An Annual Publication of the International Association for Gender Equity (IAFGE).

Mustapha, A. S. (2013). Gender and Language Education Research: A Review, Journal of Language Teaching and Research .4(3), 454-463.

Myhill, D. (2002). Bad Boys and Good Girls? Patterns of interaction and Response in whole Class Teaching, British Educational Research Journal, 28, 340-352.

Oyebola, O. (2003). Gender Issues in textbook development: a study of gender balance in illustrations of selected textbooks for upper primary Level. Retrieved from http://nigeria-education.org/content/gender-issues-textbook-development-study-gender-balance-illustrations-selected-textbooks.

Sadker, D., & Zittlman, K. (2007). Multicultural education: issues and perspectives, edited by James A. Banks and Cherry A, McGeeBanks. Hoboken, Gender bias from the Colonial America to today's classroom. 137-169. New Jessy: John Wiley and sons. Inc

Sadker, D., Zittleman, K., Earley, P., McCormick, T., Strawn, C., & Preston, J. (2007). The Treatment of Gender Equity in Teacher Education. In S. Klein (Ed.), The handbook for Achieving Gender Equity through Education (2nd ed.) (131–150). Hillsdale, NJ: Erlbaum.

Sadker,D. Sadker M., & Zittleman, K.R. (2009). Still failing at Fairness: How Gender Bias Cheats Girls and Boys in School and what we can do about it.1-361, New York: NY. A Division of Simon & Schuster, Inc.

Salman, M. F.,Yahaya, L. A., & Adewara, A. A. (2011). Mathematics Education in Nigeria: Gender and Spatial Dimensions of Enrollment. International Journal Education Science, 3(1) 15-20.

She, H. C. (2000). The interplay of a biology teacher is beliefs teaching practices and gender based student-teacher interaction, Education Research, 42, 100-111.

Shel, T. A. (2007) Gender and Inequity in Education literature review. "Paper commissioned for the EFA Global Monitoring Report 2008, Education for All.

Shomoossi, N., Amouzadeh, M., & Ketabi, S. (2008). Classroom Interaction Mediated by Gender and Technology: The Language Laboratory course, Novitas Royah Research on Youth and Language, 2(2), 176-184.

Sobel, S., Marconi, L., & Ellison, B. (2004). Find Gender in the Classroom. Human Nature Team Blaisdell/MCphail. Retrieved from www. Jrsciece.wup.muohio.edu on 3/8/15.

Staverman, K. (2012). Does Sex Matter? A Look at Middle and High School Science Classrooms. Thesis submitted to Eastern Kentucky University USA. Retrieved www://localhost/Users/tobybernert/Desktop/Sex%20Matter%20Thesis-21/4/15.

UNICEF, (2014). Basic Education and Gender Equality: Girls Education and Gender. Retrieved from https://www.unicef.org/education/index_44870.html.

The Eurasia Proceedings of
Educational & Social Sciences (EPESS)
ISSN: 2587-1730

The Eurasia Proceedings of Educational & Social Sciences (EPESS), 2017

Volume 6, Pages 84-86

ICEMST 2017: International Conference on Education in Mathematics, Science & Technology

DETERMINATION OF SECONDARY SCHOOL STUDENTS' ALTERNATIVE CONCEPTIONS ABOUT IONIZATION ENERGY

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Abstract: The topic of ionization energy is one of the important topics of the secondary school curriculum of many countries. In this study, it was aimed that to determine the secondary school students' alternative conceptions about ionization energy. For this purpose, a true/false diagnostic instrument was used to obtain data. The instrument which contains 20 questions was translated in Turkish firstly. After then to provide content validity, the instrument was examined by seven chemistry teachers. To provide reliability, the instrument was applied to 38 students twice. The final instrument was administered 956 students who are attending at 9th grade (269 students), 10th grades (253 students), 11th grade (236 students), and 12th grade (198 students) from nine different secondary schools in Balikesir, Turkey. At the end of the study, it was found that the students had two alternative frameworks that are the full outer shells explanatory principle and/or the conservation of force conception.

***Keywords*:** Secondary school, students, ionization energy.

Introduction

In many countries' secondary school curriculum contains the periodicity of atomic properties such as ionization energy, electronegativity, electron affinity and atomic radius. All of them are essential to interpret many chemical phenomena and concepts. Previous studies have indicated that students have the learning difficulty and the alternative conceptions in ionization energy topic. Taber (1999) developed an instrument to determine first-year A-level students' understanding of ionization energy in the UK. He found that a significant proportion of the students based their explanations of ionization energies on the full outer shells explanatory principle and/or the conservation of force conception rather than on Coulomb electrostatics. As Taber (1999) expressed that prerequisite knowledge needed by students to successfully understand ionization energy and patterns of ionization energies across a period/down a group of the Periodic Table includes the electronic structures of atoms and how they relate to the Periodic Table. Although this chemical knowledge is very important for explaining patterns in ionization energies, it is not sufficient. Students also need to apply basic electrostatic principles that they learned in physics to explain the interactions between an atomic nucleus and electrons (Taber, 1999). Although the students' conception concerning ionization energy in many countries such as UK, Singapore, China, New Zealand and Spain has been examined by researchers (Tan, Goh, Chia & Treagust, 2002; Tan, Taber, Liu, Coll & Lorenzo, 2008), there is no work concerning Turkish students. The topic of ionization energy is placed in both 9th and 11th-grade secondary chemistry curriculum in Turkey. From this departure point, the aim of the present study relate to following research question:

Do Turkish secondary school students base their explanations of ionization energies on the full shells explanatory principle and/or the conversation of force conception rather than on electrostatic principles?

- Selection and peer-review under responsibility of the Organizing Committee of the conference

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Methods

The Diagnostic Instrument

The original English language version of the diagnostic instrument "Truth about Ionisation Energy" by developed Taber (1999) which is a simple line diagram and 30 statements that were to be judged as true or false. The refined 20-item version of the instrument was used in the Turkish study reported here. The instrument was first translated into Turkish by author CN and was then checked by an English lecturer.

Content Validity and Reliability

To establish the content validity of the instrument, firstly both the secondary school chemistry curriculum and textbooks were examined by the authors. After then the instrument was validated by nine experienced chemistry teachers. To provide reliability, the instrument was re-administrated to 39 students after eight weeks. The correlation value obtained between the two measurements 0.4%. The final version of the instrument applied to 200 students and it was decided to provide establish of reliability.

Participants

The final instrument was administered 956 students who are attending at 9th grade (269 students), 10th grades (253 students), 11th grade (236 students), and 12th grade (198 students) from nine different secondary schools.

Results and Findings

The first question of the test is about the definition of ionization energy and it is a correct expression as "Energy is required to remove an electron from an atom." 97.80% of the students said that this is true. It is seen that a significant part of the students knows the definition of the ionization energy correctly. The second question is a question based on electrostatic interaction. 78.97% of the students answered correctly. In the third question, 37.45 % of the students gave the wrong answer. This question reflects octet thinking. It can be said that a significant proportion of the students have the alternative conception in this regard. The expression in question 4, "Only one electron can be removed from the atom, as it then has a stable electronic configuration.", only 39.54% of the students answered correctly. More than half of the students (56.49%) responded incorrectly. Another three questions concerning octet rule thinking are the questions 12, 18 and 20. %67.68 of the students answered the question 12 incorrectly. The question 18 is an incorrect expression as "The atom would be more stable if it 'lost' an electron". However, 80.23% of the students said that this is the true expression. The question 20 is an also an incorrect expression as "The atom would become stable if it either lost one electron or gained seven electrons." 80.02% of the students said that this is a true expression.

Conclusion

It was concluded that students had "electrostatic interaction thinking", which is expected to learn from them, in part. On the other hand, the students seem to understand the principles of electrostatic interaction at some point, they cannot fully apply it to their explanation of ionization energy. As explained by Taber (2003), this may be related to the fact that the electrostatic attraction law is the subject of both physics and chemistry. Electrostatic attraction law is taught by both physics and chemistry teachers separately for the same group of students in both chemistry and physics classes. In fact, this can be expected to be useful again. However, teachers 'different tendencies and approaches can confuse the students' minds. As you can see here, although the students use this law correctly in their explanations on ionizing energy, they have a very common alternative framework, octet framework.

Recommendations

The following suggestions can be made in line with the results obtained in the study. First of all, the students should be aware of the fact that it is not right to explain each event with the full shell stability. It will be more accurate and meaningful for the students to be given the reasons for the change of the periodical properties rather than the patterns. Finally, a special way for teaching subjects taught in both physics and chemistry lessons such as electrostatic interaction should be followed.

References

Taber, K. S. (1999). Ideas about ionisation energy: A diagnostic instrument. *School Science Review*, *81*(295) 97-104.

Taber, K.S. (2003). Understanding ionisation energy: Physical, chemical and alternative conceptions. Chemistry Education: Research and Practice, 4(2), 149-169.

Tan, K.C.D., Goh, N.K., Chia, L.S. & Treagust, D.F. (2002). Development and application of a two-tier multiple choice diagnostic instrument to assess high school students' understanding of inorganic chemistry qualitative analysis. *Journal of Research in Science Teaching*, *39*(4), 283-301.

Tan, K. C. D., Taber, K. S., Liu, X., Coll, R. K., Lorenzo, M., & Li, J., et al. (2008). Students' conceptions of ionisation energy: A cross-cultural study. *International Journal of Science Education*, *30*(2), 263–283.

The Eurasia Proceedings of
Educational & Social Sciences (EPESS)
ISSN: 2587-1730

The Eurasia Proceedings of Educational & Social Sciences (EPESS), 2017

Volume 6, Pages 87-98

ICEMST 2017: International Conference on Education in Mathematics, Science & Technology

THE EFFECT OF GENDER AND GDARE LEVEL ON RURAL SARAWAK INDIGENOUS SECONDARY SCHOOL STUDENTS' ATTITUDES TOWARDS CHEMISTRY LESSON TO ENHANCE LEARNING

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Abstract: The aim of this study is to investigate the interaction effects between gender and grade level among rural indigenous secondary school students' attitude towards chemistry of Sarawak, Malaysia. The students' attitudes were measured using Attitude towards Chemistry Lesson scale (ATCLS) form of a multidimensional questionnaire to provide the interaction effects between gender and grade levels. The subscales which are involved in ATCLS are liking for chemistry theory lessons, liking for chemistry laboratory work, evaluative beliefs about school chemistry and behavioural tendencies to learn chemistry. ATCLS was administered to 470 rural indigenous secondary school students between age 16-18 years old which involve 177 males and 293 female students. Only two grade levels were chosen in this study that is form 4(245) students and form 5 (225), students. The two-way MANOVA statistical analysis was used to identify the effects of gender and grade level on rural indigenous secondary school students' attitude towards chemistry. The finding show that gender (Wilks' lambda = 0.955, $F(4, 463) = 5.47$, $p < 0.001$) and grade level (Wilks' lambda = 0.969, $F(4, 463) = 3.68$, $p < 0.05$) have a significant effect on attitude towards chemistry. The finding also shows that no significant interaction effect on gender and grade level (Wilks' lambda = 0.983, $F(4, 463) = 2.03$, $p > 0.05$) on rural indigenous secondary school students' attitude towards chemistry.

Keywords: Attitude, gender, grade level, indigenous students, learning chemistry.

Introduction

Chemistry is an important area of Science. Chemistry is a subject that is unique and interesting. Chemistry is also important as it relates to our daily life activities. Other than that chemistry can help to develop many areas of knowledge to bring new technology in this modern world. However, the chemistry subject is considered to be one of the difficult subject among Malaysian students (Chu & Hong 2010; Abu Hassan Kassim 2003). Therefore, it is important to developing a positive attitude toward chemistry between the school students because the positive attitude will help them to change the perception and understanding of chemistry. According to Yunus & Ali (2013), most students lose interest in chemistry was due to the attitude of their own. The positive attitude is important to improve academic achievement in chemistry.

The main goal in developing chemistry curriculum are to understand students attitude while learning (Abrahams 2009). The attitude of the students in learning chemistry is a complex contract. A negative attitude towards chemistry is also due to the wrong approaches from using teaching materials by teachers and teachers weak in handling informal teaching in classroom (Najdi 2009). Good teaching can be carried out if the teacher can evaluate the curriculum that has been developed. The authorities designing curricula should provide a space for teachers to make evaluations of the curriculum (Fensham & Bellocchi 2013; Van Houtte, Demanet & Stevens, 2013). Chemistry teacher can conduct lessons more effectively if they can identify the weaknesses and strangeness of a curriculum (Cheung 2011).

- Selection and peer-review under responsibility of the Organizing Committee of the conference

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Learning outcomes of the curriculum of chemistry can be divided into three main domains of cognitive, psychomotor and affective. The focus of this study is to the affective domain which includes the outcomes of motivation, attitudes, values, self-esteem and self-efficacy. Affective domain is a domain that is important to the teaching of chemistry. Many teachers do not focus on this domain and they also are not familiar with how to assess students' attitudes (Cheung 2011). Although the behaviour, values and attitudes have been adopted in various curriculum in Malaysia but it did not become part of the formal assessment procedure (Yahaya & Hasan 2011; Nurzatulshima Kamarudin, Lilia Halim, Kamisah Osman, & Subahan T 2009). Many studies regarding attitudes to Malaysian secondary school students' towards science have been carried (Iksan, Halim, & Osman, 2006; Kamisah, zanaton, 2007; Kususanto, Fui, & Lan, 2012) but fewer studies were found about Malaysia secondary school students' attitudes towards chemistry (Fah, 2014). Other than that there are no study found about Sarawak indigenous students' attitude towards science or chemistry. Therefore the purpose of this study was to examine the interaction effect of gender and grade level with respect to indigenous secondary school students' attitudes toward chemistry lessons in Sarawak, Malaysia perspective.

Problems in Learning Chemistry

The main problem in learning chemistry are low students understanding about the content of chemistry curriculum. This can be seen from the students' achievement of chemistry in secondary schools is still at a low level (Edomwonyi-otu & Avaa, 2011). This is because many students still weak in mastering the basic concept of chemistry. This statement is supported by the results of chemistry SPM 2014 examination performance report. Students often have problems with science subjects due to students' response that science is too difficult, less efficient, less problem-solving skills, boring and too abstract (Asarudin Ashari, 1995; Mohd Nor & Tay, 2010; Taber, 2002). Most students have a low understanding of the basic concepts of Chemistry and this left them in the learning process of chemistry. Teachers should plan lessons based on the theory of constructivism to make sure the basic concepts of chemistry can be improved (Mohd Nor & Tay, 2010). Low basic understanding of chemistry will disrupt the learning process at a higher level. A basic understanding of chemistry is important so that teaching is not considered difficult, boring and too abstract. A chemistry teacher at the school should play a role by planning lessons using a variety of methods so that the basic and abstract knowledge of chemistry can be understood by all students.

Understanding abstract concepts in chemistry are important. Learning concepts and theories of chemistry at high levels is difficult if students cannot master an abstract concept (Sirhan, 2007). This abstract concept often combined with the mathematical concept of a chemical that causes students' understanding become more difficult which chemistry learns requires a set of skills at a high level (Peter Fensham, 1998; Zoller 1990; Taber, 2002). Other than that, chemistry also is considering a difficult subject because students having difficulty to understand the concept of problem-solving. In addition, students' sets in their mind that chemistry are considered irrelevant and less popular compare to other subjects. There is a space between the students' expectation and the way of teaching. Teachers are afraid to change according to the students' learning expectation. The learning can become more meaning full if teacher relates the teaching with the real word phenomena that students' always experiences it in their daily life. However teaching chemistry considered has no relevance to the real world and chemistry curriculum does not give impetus to promote chemical knowledge that is expected by students' (Holbrook, 2005). Students also building alternative ideas about science topics that can course the misconception. Teachers need to change an alternative idea of students to the right idea to avoid misconceptions. Existing information of students would interfere the information given by the teacher and the information provided will lead to misconceptions of the lesson (Taber, 2009).

Chemistry is a part of science knowledge that always involves teaching problem-solving and give the students' ability to obtain evidence and assess the evidence to make judgments, decisions or actions. One of the big challenges in chemistry is a continuous interaction between the two plates of the level of thinking that is macroscopic and microscopic. This challenge of the chemical interactions led the students' especially new students' think chemistry is a difficult subject to understand. (Bradley, J. D. & Brand, 1985). This information is supported by a study conducted by Johari (2007) which states that thinking microscopic level refers to the art world of atoms, molecules and ions that form a basic understanding of chemistry. This will explain the thought of macroscopic levels through the experience on the observation of an environment either in the laboratory activities or other activities in daily life. Examples of a macroscopic level of thinking are concerned with the discoloration and sediment in chemical reactions.

Student Attitudes Toward Chemistry

The meaning of attitude is a tendency to think, feel, or act positively or negatively toward objects of our environment (Eagly & Chaiken, 1993).The attitude object can be anything, such as chemistry, chemists, chemistry lessons, chemistry topics that taught in school, chemical education research, and industrial chemistry but the focus of this study is to evaluate the students attitude toward chemistry in a normal classroom of a secondary school. The normal classroom refers to learning theories and doing practical activities in a chemistry lab (Cheung 2009). The attitude towards chemistry is very important and this attitude will express interest or feelings towards studying chemistry. Other than that attitude will help to improve student academic performance and this is an important outcome of a science education in school. This attitude also will play a substantial role in students life to make a choice to choose the field of their future study. The students' attitude toward chemistry also will determine the capacity of human resources in the chemical field. The attitude of the students in learning chemistry is a complex contract and the negative attitude of students to learn chemistry is due to the teachers' teaching approaches (Najdi 2009).

National capacity of science and technology can only be achieved when countries have sufficient human resources for the specified period of time. To achieve that purpose various ways have been used by the government to create human capital that has self-esteem, values, knowledge, skills, critical thinking and creative thinking. Attitudes towards science will lead to the creating of good quality of human capital. The quality of human capital will determine the development of a country. Good quality of human capital is produced from schools. Students' quality is depending on anxiety and attitude of subjects that they learn in school. Research regarding the relationship between anxiety levels with attitude toward the chemistry shows that the anxiety level of the chemical science students' is moderately high but attitudes towards chemistry are high. The study also shows that there is a significant relationship between the level of anxiety and students' attitudes toward chemistry. This suggests that the high attitudes towards chemistry will reduce the anxiety level of students in chemistry (Fah 2014). The way of teaching of chemistry plays an important role in determining the attitude of students towards chemistry. The use of inquiry learning and the use of practical activities can increase students' positive attitude towards chemistry (Kar & Saleh 2012).

Chemical complexity levels also play an important role in assessing the attitudes of students in chemistry. This level of complexity is also one of the factors that influence the higher-order thinking skill (HOTS) among students (Van Houtte et al. 2013). Chemistry content complexity levels is based on curriculum designed. Besides that, the content and curriculum of chemistry itself have caused students to be negative. The majority of the negative attitude of students' towards learning chemistry can be changed if they carry out practical activities in the laboratory. However, some study shows that the practical work won't change the students' attitude towards chemistry and suggested that those involved in science education need to build a deeper understanding of the attitudes of students while building a curriculum (Abrahams, 2009).

Gender Differences in Student Attitudes toward Chemistry Lessons

Gender is probably the most significant variable related towards pupils' attitude to science'(Simon & Collins, 2003) but not many studies done to find the effect of gender to the students' attitude toward chemistry lesson. In the study conducted by Salta & Tzougraki (2004) found that no significant differences in attitudes towards chemistry between boys and girls but the girls showed the high negative attitude towards the level of content difficulty of chemistry. This is due to social norms of female students believe that the chemistry is not suitable for them because they think this field is cannot be chosen for their future studies. They think chemistry field is more suitable to male nature. This information is supported by many chemists and chemistry scientists are male. Other than that information from books, films, television programs and newspaper showed many men more prominent in the chemistry. Meta-analysis of the research literature from 1970 to 1990 concluded that more male students showed a positive attitude in all branches of science than girls. However academically high-performance girls in study show more positive attitudes compare to academically high-performance of boys (Weinburgh, 1995).

The study of Lang, Wong, & Fraser, (2005) among 497 tenth grade students from three independent schools in Singapore also found that high-performance girls in studies were more positive toward chemistry compares to boys. The study conducted on 437 students using a questionnaire is designed to get the students' perception of science or scientists, students' perception on activities outside of school that gives them the experience of science, students' perception of the importance of science, and the students' perception of characteristics of future works found that boys are more interested in the topic of science related to chemistry, while girls are more interested in the topics of science related to biology (Jones, Howe, & Rua, 2000). Quasi-experimental studies on 286 ((145 male and 141 female) students from Township schools in Oyo, Oyo State, Nigeria found that boys are a more positive attitude towards chemistry and show high ability in chemistry research (Adesoji & Raimi, 2004).

Changes in Student Attitudes toward Chemistry Lessons across Grade Levels

In Malaysia chemistry is taught when students are in form 4 and form 5. Students who choose science stream when they move from form 3 to form 4, chemistry is one of the subjects that should be taken. The age of students is in the range of 16 to 18 years old. There are not many studies on attitudes towards chemistry with changes in the level grade or age. In a study conducted by (Cheung, 2009) over 954 students from grade 4 to grade 7 of high school students ranging from the ages of 16 to 19 years found that there is a significant change in attitudes towards chemistry across the grade levels. In addition, there is a significant interaction effect between grade level and gender on attitudes towards chemistry. This shows that the level of age and grade of students will influence their attitudes toward chemistry. While the study of Hofstein, Ben-Zvi, Samuel, & Tamir, (1977) showed that there is a change in attitudes towards chemistry when they progress from grade 11 to grade 12. These findings show that a positive attitude towards chemistry decrease when student progress from grade 11 to grade 12. While the study of Menis (1989) showed that a positive attitude towards chemistry students is increasing as student progress from grade 11 to grade 12 in which the study was conducted on 3460 students from the USA. Both of these studies showed that is no significant interaction effect between gender and grade level on the students' attitudes toward chemistry.

The study from sample of 197 Turkey high school students from grade 9 to11 shows that grade level had a significant effect on the attitude toward chemistry as a school subject in terms of enjoyment and importance dimensions. Data from this study conclude that high school students' attitude towards chemistry lessons decreased significantly with increase in grade level (Can & Boz, 2012). Another study of (Belge Can, 2012) reported that high school students' attitude towards learning chemistry decreased significantly with increase in grade level and conclude that Turkey high school students do not achieve the educational objective of developing positive attitudes toward chemistry lesson.

Purpose of the Study

The purpose of this study was to measure the main effect and interaction effect of gender and grade level on rural Sarawak, Malaysia indigenous secondary school students' attitude towards chemistry lesson. This is following Kah Heng & Karpudewan, (2015) suggestion that research can be conducting involving students from different states in Malaysia so the outcomes could be generalised.

Methods

Instrument

The instrument used in this study was a questionnaire. The questionnaire that was used is 'Attitude Toward Chemistry Lessons Scale (ATCLS) developed by (Cheung 2009). This questionnaire was used to observe samples of indigenous high school students in the state of Sarawak. This questionnaire contained 12 items related to attitudes toward chemistry. The questionnaire has four subscales that is liking for chemistry theory lessons (3 items), liking for chemistry laboratory work (3 items), evaluative beliefs about school chemistry (3 items) and behavioral tendencies to learn chemistry (3 items). The 12 items used have been translated into Malay languages from English. ATCLS was used for studies in Hong Kong and Cronbach's alpha values of all four subscales are between 0.76 to 0.86 (Cheung, 2009) and in another studies conducted in Turkey recorded, the Cronbach's alpha reliability coefficient of ATCLS is 0.81 (Ayyildiz & Tarhan, 2009) and 0.93 (Belge Can, 2012). The internal consistency of the instrument is relatively high. Due to its high internal consistency it was decided to use the ATCLS in this study.

This questionnaire is modified to a five-point Likert scales with label scale 1 is strongly disagree, scale 2 is disagree, scale 3 is partly agree, the scale 4 is agree and scale 5 is strongly agree (Ayyildiz & Tarhan, 2009; Belge Can, 2012). To facilitate the students, the questionnaire was modified to bilingual that is English and Malay. Normally the combination of positive and negative items are often used to investigate attitudes to reduce the effects of acquiescence and bias responses but ATCLS is designed without negatively worded items (Cheung, 2009). This is because research found that negative item that is changed from positive item will cause a separate factor that allows measurements inappropriate (Spector, Van Katwyk, Brannick, & Chen, 1997; Burke, 1999; Gotlib & Meyer, 1986; Pilotte & Robert K. Gable, 1990; Miller & T. Anne Cleary, 1993; Schmitt & Stults, 1985).

Table 1. Attitude toward chemistry lessons scale

Subscale	Number of Item	Item
Liking for chemistry theory lessons	3	Q1: I like chemistry more than any other school subjects. Q5: Chemistry lessons are interesting Q9: Chemistry is one of my favorite subjects
Liking for chemistry laboratory work	3	Q2: I like to do chemistry experiments Q6: When I am working in the chemistry lab, I feel I am doing something important Q10: Doing chemistry experiments in school is fun
Evaluative beliefs about school chemistry	3	Q3: Chemistry is useful for solving everyday problems Q7: People must understand chemistry because it affects their lives Q11: Chemistry is one of the most important subjects for people to study
Behavioral tendencies to learn chemistry	3	Q4: I am willing to spend more time reading chemistry books Q8: I like trying to solve new problems in chemistry Q12: If I had a chance, I would do a project in chemistry

Sample

Secondary schools in Malaysia starting from grade 1 to grade 5. Students who are in grades 1 to 3 are categorised as lower secondary while grade 4 and 5 are in the upper secondary. Learning chemistry will only begin when students are in grades 4 and 5 that is in upper secondary. Students who are in the lower secondary will study science only. When students enter into grade 4, they were given the opportunity to choose courses according to their interest. The selection of courses in grade 4 also depends on PMR or PT3 result that was carried out during the grade 3. Students who choose to go into science courses will take chemistry as one of the compulsory subjects. Each session of school will start in January and ends in November. Usually, age of students in upper secondary education is around 16 to 18 years old.

This study was conducted at secondary schools in the district of Simunjan and Serian, state of Sarawak. Simunjan district has 5 schools while the Serian district has 6 schools. All schools in the area are categorized as rural schools and most of the students in these schools are indigenous students from Malay, Iban and Bidayuh ethnic. The students are from a different socio-economic background and different intellectual level. The number of boys and girls at every grade is almost the same. Chemistry teachers will administer the questionnaire during the session of classroom instruction. All participation is voluntary and no incentives were offered. A total of 470 students of grade 4 and grade 5 participated in this study. Table 2 show the distribution of students according gender and grade level.

Table 2. Distribution of students by gender and grade level

Gender	Male	177
	Female	293
Grade Level	Form 4	245
	Form 5	225
Total Responden (N)		470

Data Analysis

Data were analyzed using SPSS. Type of analysis was used is 'two-way multivariate analysis of variance (MANOVA) to determine the effect of the interaction between gender and grade level with a score of four categories surveyed. Two-way MANOVA is suitable because for all 4 categories are positively correlated (Cheung, 2007). If the two-way MANOVA analysis states a statistically significant relationship between gender and grade level, then further analysis will be conducted to determine where significant interaction effect was.

Results and Finding

To identify the reliability of the instrument for this study a pilot test was conducted. The Cronbach's Alpha value was compute is 0.86. This value of Cronbach's Alpha is acceptable and almost same with previous studies (Ayyildiz & Tarhan, 2009; Belge Can, 2012). The two-way MANOVA results showed that main effect independent variable gender (Wilks' lambda = 0.955, $F (4, 463) = 5.47$, $p < 0.001$) and main effect independent variable grade level (Wilks' lambda = 0.969, $F (4, 463) = 3.68$, $p < 0.05$) have a significant effect on attitude towards learning chemistry. Gender and grade level show no significant interaction effect (Wilks' lambda = 0.983, $F (4, 463) = 2.03$, $p > 0.05$) on secondary school students' attitudes towards chemistry for combine of all four dependent variables. Further analysis was performed to identify which subscales of the ATCLS show significant interactions. Analysis results show that only 1 out of 4 subscale [Evaluative beliefs about school chemistry $F(1, 466) = 13.80$, $p < 0.001$] exhibit significant interaction effect with main effect independent variable gender. Other dependent variables not exhibit significant effect with gender [Liking for chemistry theory lesson, $F (1,466)=0.38$, $p > 0.05$; Liking for chemistry laboratory , $F (1,466) = 0.01$, $p > 0.05$; Behavioral tendencies to learning chemistry, $F(1,466) = 0.76$ $p > 0.05$]. The analysis also show that only one subscale [Evaluative beliefs about school chemistry, $F(1,466)=7.01$, $p<0.05$] exhibit significant interaction effect with main effect independent variable grade level. Furthermore only 1 dependent variables [Evaluative beliefs about school chemistry $F(1,466)=6.11$, $p < 0.05$] exhibited significant interaction effects between gender and grade level.

The two-way MANOVA results indicated that subscale 'Evaluative beliefs about school chemistry' exhibit significant effect with gender. The further analysis was done to identify whether the results favored the male or female students. The mean score value for male is 4.20 and the mean score value for female is 4.41. This indicate that mean scores for female students are higher compared to their male counterparts in this particular subscale. Furthermore two-way MANOVA results also indicated that subscale 'Evaluative beliefs about school chemistry' exhibit significant effect with grade level. Further analysis was done and the results show that mean score for form 4 students is higher compare form 5 students which form 4 mean score is 4.39 and form 5 mean score is 4.23. Table 3 show the mean score of gender and grade level with 4 subscale of attitude towards chemistry. Other than that analysis of results also indicated the research population, gender and grade level contributed 50% of the changes in the dependent variable 'Evaluative belief about school chemistry ' and 11% of the changes in the dependent variable 'Liking for chemistry laboratory'. Figure 1 and figure 2 show the changes in students' mean score 'attitudes toward chemistry' by gender and grade level.

Table 3. Mean score of gender and grade level with four subscales

Dependent Variable	Gender	Grade Level	Mean	Std. Error	95% Confidence Interval	
					Lower Bound	Upper Bound
Liking for chemistry theory lessons	Male	Form 4	3.943	.072	3.801	4.084
		Form 5	3.989	.071	3.850	4.128
	Female	Form 4	3.911	.053	3.806	4.016
		Form 5	3.941	.058	3.827	4.054
Liking for chemistry laboratory work	Male	Form 4	4.437	.064	4.312	4.562
		Form 5	4.456	.063	4.333	4.578
	Female	Form 4	4.361	.047	4.268	4.453
		Form 5	4.519	.051	4.418	4.619
Evaluative beliefs about school chemistry	Male	Form 4	4.345	.066	4.215	4.474
		Form 5	4.044	.065	3.917	4.172
	Female	Form 4	4.418	.049	4.322	4.514
		Form 5	4.407	.053	4.303	4.511
Behavioral tendencies to learn chemistry	Male	Form 4	3.793	.072	3.653	3.934
		Form 5	3.744	.070	3.606	3.883
	Female	Form 4	3.703	.053	3.598	3.807
		Form 5	3.726	.057	3.613	3.839

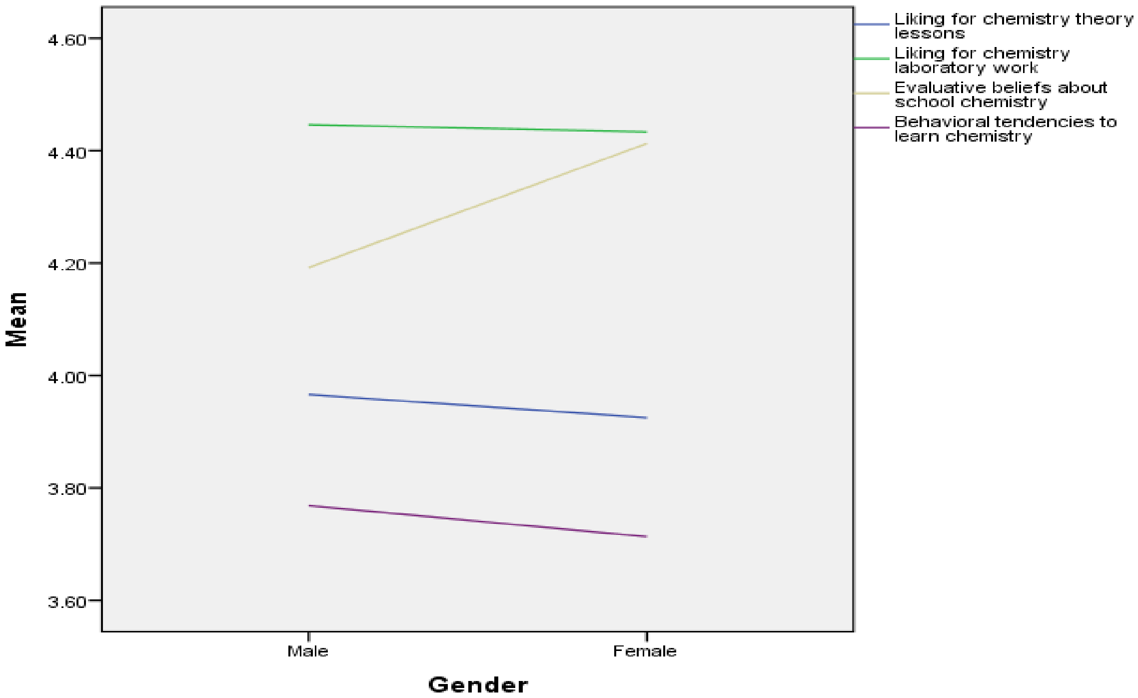

Figure 1. Changes in students' attitudes toward chemistry mean score by gender

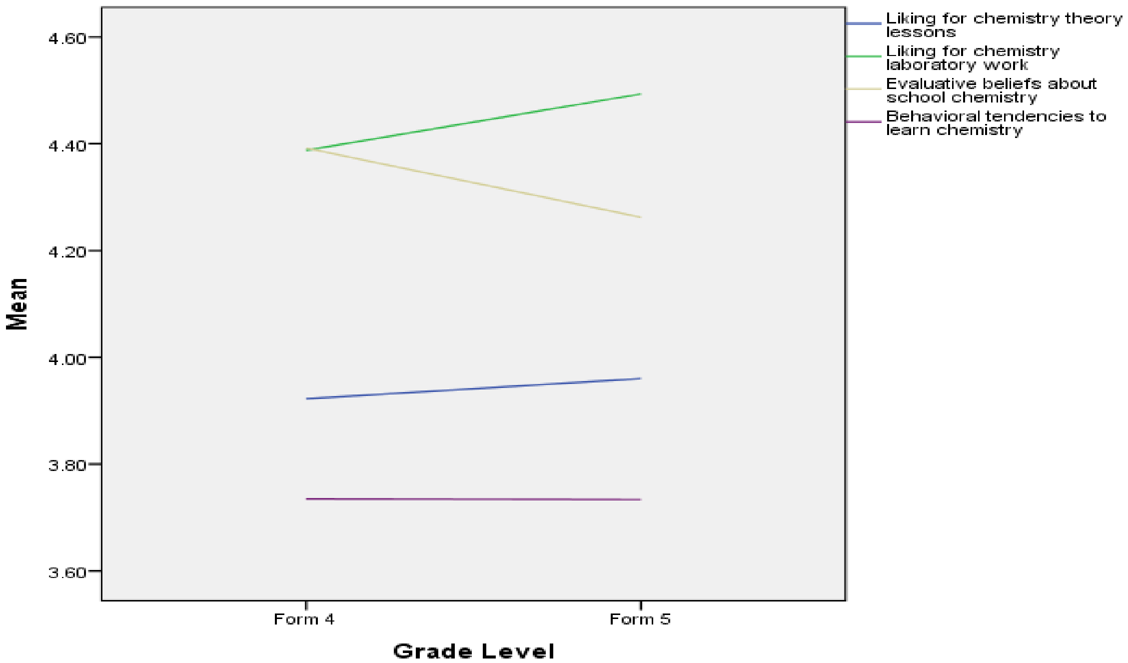

Figure 2. Changes in students' attitudes toward chemistry' mean score by grade levels

Discussions

Attitudes towards chemistry means students like or dislike to learning chemistry. Positive attitudes will help to improve the students achievements (Salta & Tzougraki, 2004a). Many previous research, result show that attitude is one of effective component that will influence students' learning (Kah Heng & Karpudewan, 2015). Improving students attitude become most important factors in teaching and learning. Various method was used to improve students attitude in particular subject. For instance, extra instruction and inquiry skills during experiment in physical lab was successfully improve students' attitude toward chemistry (Koksal & Berberoglu, 2012). Additionally, in a study conducted on 45 female and 45 male students from three secondary schools in Minna, Nigeria found learning using computer simulation can change the attitude of students to be motivated to learn chemistry (Gambari, 2016). Similarly, this study is made to evaluate the factors that will influences students' attitudes toward chemistry. Main focus of this study is to find interaction effects between gender and grade level on rural area indigenous secondary school students' attitude towards chemistry.

The two-way MANOVA outcomes can be summarized that is not significant differences were noticed among two grade levels (form 4 and form 5) for 'liking for chemistry theory lesson' subscales of dependent variables. Any way got slightly decrease in students mean score among grade level for this subscale. Meanwhile mean score male students (3.97) for subscale 'Liking for chemistry theory lesson' is slightly higher compare to female students mean score (3.93) and mean score increasing trend was noticed with the grade level (form 4 to form 5) for female and decreasing trend for male. This finding is quite similar with previously studies (Cheung, 2009; Barnes, McInerney, & Marsh, 2005) and these findings also contradict with the finding from Kah Heng & Karpudewan,(2015) and Salta & Tzougraki, (2004b) research.

The finding for subscale 'liking chemistry laboratory work' got slightly increase in students mean score among grade level (form 4= 4.40, form 5= 4.49). Mean score male students (4.45) is slightly higher than mean score female students (4.44) for this particular subscale. Other than that gender never show a significant effect with the subscale 'liking chemistry laboratory work' with the attitude of male more favourable to chemistry laboratory work. Meanwhile the interest of male students in laboratory work is increase from form 4 (4.44) to form 5 (4.47) and mean score for female students also is increase from form 4 (4.36) to form 5 (4.52). Increasing trend was noticed for this subscale with the grade level (form 4 to form 5) for male and female. This finding is quite different with the study among 312 boys and 185 girls in 18 secondary 4 independent school students from Singapore which reported that females students preferred to using more laboratory learning environment compare to male students (Quek, Wong, & Fraser, 2002).

For the subscale of evaluative beliefs about school chemistry, mean score female students (4.41) is higher than mean score male students (4.20) and also found that, the students mean score of grade level decrease from form 4 (4.39) to form 5 (4.23). Meanwhile male and female students showed more stable and positive attitude towards chemistry from the perspective of evaluative beliefs which the female students mean score slightly decrease from form 4 (4.42) to form 5 (4.41) and mean score for male also decrease from form 4 (4.35) to form 5 (4.04). This finding is similar with the finding of Kah Heng & Karpudewan, (2015). The analysis also show that there is significant different change in attitude across gender and grade level for subscale evaluative beliefs. This finding is similar with finding of Can & Boz, (2012) and Belge Can, (2012) where gender and grade level had significant effects on high school students' attitudes toward chemistry.

Other than that for subscale behavioural tendencies to learn chemistry, mean score male students (3.78) is higher than female students (3.71) and the students mean score of grade level is almost same for form 4 and form 5. The analysis also show that there is no significant different change in attitude across gender and grade level for behavioural tendencies but mean score for male is decrease from form 4 (3.79) to form 5 (3.74) and for female is increase from form 4 (3.70) to form 5 (3.73). Male and female for this subscale experienced slightly positive attitude towards chemistry. This finding also similar and consistent with the finding of Cheung, (2009) were no significant different in change of attitude across the gender and grade level for behavioural tendencies.

The planning in teaching is important to develop positive attitude toward science subjects. The development of positive attitude will prepare students to make decisions for the problems in science (Koballa & Crawley, 1985). The students' achievement for the subjects of chemistry in secondary schools is still at a low level (Edomwonyi-otu & Avaa, 2011). Learning difficulties and low achievement in chemistry is due to the negative attitude of students towards the subject (Yunus & Ali, 2013). The attitude of students' is so much related with teaching strategies of teacher in classroom (Najdi, 2009). From the data obtained, mean score for male and female is different for each subscales. Figure 1 show that male mean score is higher than female mean score in 3 subscale that is liking chemistry theory lesson, liking chemistry laboratory work and behavioural tendencies to learn chemistry. Meanwhile female mean score is higher than male mean only in one subscale that is evaluative beliefs about school chemistry. Even though the male students score mean is higher in 3 subscale but the difference is not significant. It show that the attitude differences among this 3 subscale is very small and no gap between male and female students' attitude in learning chemistry in early stage across this 3 subscale compare to subscale evaluative beliefs about chemistry where there was a gap between male and female with statistically show a significant different. This outcome suggests that all students generally has same prior attitudes towards chemistry in early stage of learning and teacher need to plan a teaching strategies according to their attitudes. Female students more understand that chemistry is useful, affect their lives and important subjects compare to male students.

Male students liking for chemistry laboratory work is increasing from form 4 to form 5. This may be due to teacher teaching strategic in grade 4 where by teacher used cookbook style of doing experiment work (Kassim, 2014). This is because teacher assumed that students' are not familiar with laboratory equipment and environment. Meanwhile when students are in grade 5, teacher understand that they become more efficient with laboratory environment and equipment, so teachers change to inquiry strategic in teaching experiment. Other than that the experiment presented in textbook are needed the students to follow procedures in a cookbook style and students do not have opportunities to explore themselves. Normally male students expect a more challenging nature in learning compare to female students (Kah Heng & Karpudewan, 2015). Male students more active and show more positive attitude in inquiry base chemistry laboratory work compare to female students (Wolf & Fraser, 2008).

Female students felt that chemistry is very useful for solving everyday problems. They understand the important of chemistry in their daily life. Chemistry more important and useful for female across the grade level. This finding also similar and consistent with the finding of Kah Heng & Karpudewan (2015). Chemistry teacher should play an important role to reduce the gap between male and female about understanding the important and usefulness of chemistry. Teacher are suggested using laboratory method to ensure the improvement of the students attitude towards chemistry (Adesoji & Raimi, 2004). Chemistry teachers should carry out activities based on gender differences so that every student has an opportunity to change their attitudes towards chemistry. Female students understand the benefits, uses and importance of chemistry but they still think that chemistry is a difficult subject. This is because the natural attitude of female students who think that boys are better than girls in chemistry. This results suggest that teacher should plan lessons based on constructivism theory to improve the basic concepts of chemistry. Low basic understanding of chemistry will disrupt the attitude of students. A basic understanding of chemistry is important because chemistry is considered difficult, bored and too abstract subject (Mohd Nor & Tay, 2010). Teacher at school need to use a variety teaching methods, appropriate teaching material, better approaches and different pedagogical skills to improve the basic knowledge and attitude of chemistry within the gender framework. Learning chemistry also must related with our real world to motivate students to learn chemistry and develop students ability to solve real problem based their knowledge and skills (Cheung, 2009).

Male students showed a decreased trend in attitude of majoriti subscale from form 4 to form 5 while the female showed an increased trend in most subscale except subscale evaluative beliefs about school chemistry with very marginal reduction that is only 0.01. This finding is similar with (Can & Boz, 2012) that have claimed that female students attitude increased compare to male students in form 4 and form 5. This is probably due the nature of female students that always put their hard work in study compare male students (Cotton, Joyner, George, & Cotton, 2015). The hard work in study make their attitude towards chemistry improve when across the grade. Other than that, this changes also because at end of form 5, students have to sit for public examinations with the results will determine their further studies in tertiary education (Kah Heng & Karpudewan, 2015).

Recommendations

The results from this study cannot be generalized because the data was used is cross-sectional and size sample is too small and other than the above conclusion need to verified with a representative sample using a longitudinal research design (Cheung, 2009). Further research is recommended to identify the underlying reasons for gender differences across the grade level in attitude towards chemistry among indigenous rural area student in Sarawak, Malaysia. Further study also is needed to understand why indigenous rural area male students' attitude is decreasing when across a grade level compare to indigenous rural area female students. It is also suggested that research can be conducted involving indigenous students from the different rural area in Malaysia so that the outcomes can be generalized.

Conclusion

The aim of this study is to investigate the interaction effects between gender and grade level among rural indigenous secondary school students' attitude towards chemistry in Sarawak, Malaysia. The students' attitudes were measured using ATCLS survey form with multidimensional questionnaire to provide the interaction effects between gender and grade levels. For this purpose, the two-way MANOVA statistical analysis was used. This analysis is more trustworthy compare to other statistical analyses because two-way MANOVA will avoid any type 1 error in research. This study is comparing the attitude towards chemistry lessons among male and female students and also find the information about attitude towards chemistry for male and female changes of grade level from form 4 to form 5.

There was a significant effect between gender and attitude toward chemistry lesson. Mean score from research was showed that male students have more positive attitude towards chemistry compared to female students in majority subscales expect 1 subscale that is evaluative beliefs about school chemistry. Other than that female students attitude toward chemistry lesson become more positive across grade level from form 4 to form 5 meanwhile male students attitude toward chemistry lesson become less positive across the grade level (Can & Boz, 2012). The result shows that female students put more hard work to get good result in public examination at form 5. This will improve their attitude towards chemistry and this outcomes needs further exploration (Cotton et al., 2015; Kah Heng & Karpudewan, 2015).

Overall the result show that students attitude towards chemistry lesson is positive in the range 3.71 to 4.45 based on scale 1 to 5. This shows that attitude among indigenous students towards chemistry is positive in line with nation's education objectives to reduce the education gap in urban and rural areas. Positive attitude among students will help Malaysia's to become develop country in year 2020. The outcomes showed that gender and grade level will influence the level of chemistry attitude and teachers need to take into account these two factors in teaching and learning among indigenous rural area students.

References

Abrahams, I. Z. (2009). Does practical work really motivate? : A study of the affective value of practical work in secondary school science. *International Journal of Science Education*, *31*(17), 2335–2353. http://doi.org/10.1080/09500690802342836

Adesoji, F. A., & Raimi, S. M. (2004). Effects of Enhanced Laboratory Instructional Technique on Senior Secondary Student's Attitude toward Chemistry in Oyo Township, Oyo State, Nigeria. *Journal of Science Education and Technology*, *13*(3), 377–385. http://doi.org/10.1023/B:JOST.0000045465.81437.3b

Asarudin Ashari. (1995). Strategi peningkatan minat pelajar Bumiputera dalam bidang sains dan teknologi. In *Seminar Kebangsaan ke Arah Peningkatan Bilangan Pelajar Bumiputera Berkualiti Tinggi Dalam Bidang Sains dan Teknologi*. Kuala Lumpur: Universiti Teknologi Malaysia.

Ayyildiz, Y., & Tarhan, L. (2009). Effect of Case Studies on Primary School Teaching Students â€™ Attitudes Toward Chemistry Lesson. *H. U. Journal of Education*, *43*, 62–70.

Barnes, G., McInerney, D. M., & Marsh, H. W. (2005). Exploring sex differences in science enrolment intentions: An application of the General Model of Academic Choice. *The Australian Educational Researcher*, *32*(2), 1–23. http://doi.org/10.1007/BF03216817

Belge Can, H. (2012). Students' attitudes toward school chemistry: The effect of interaction between gender and grade level. *Asia-Pacific Forum on Science Learning and Teaching*, *13*(1), 1–16.

Bradley, J. D. & Brand, M. (1985). Stamping Out Misconceptions. *Journal of Chemical Education*, *62*(4), 318.

Burke, B. G. (1999). Item Reversals and Response Validity In The Job Diagnostic Survey. *Psychological Reports*, (85), 213–219. Retrieved from http://journals.sagepub.com/doi/pdf/10.2466/pr0.1999.85.1.213

Can, H. B., & Boz, Y. (2012). A Cross-Age Study on High School Students ' Attitudes Toward Chemistry. *International Journal on New Trends in Education and Their Implications*, *3*(3), 82–89.

Cheung, D. (2007). Confirmatory Factor Analysis of the Attitude toward Chemistry Lessons Scale. *Proceeding of the 2nd NICE Symposium July*, *1990*.

Cheung, D. (2009). Students' attitudes toward chemistry lessons: The interaction effect between grade level and gender. *Research in Science Education*, *39*(1), 75–91. http://doi.org/10.1007/s11165-007-9075-4

Cheung, D. (2011). Evaluating student attitudes toward chemistry lessons to enhance teaching in the secondary school. *Educacion Quimica*, *22*(2), 117–122.

Cotton, D. R. E., Joyner, M., George, R., & Cotton, P. A. (2015). Understanding the gender and ethnicity attainment gap in UK higher education. *Innovations in Education and Teaching International*, *3297*(February), 1–12. http://doi.org/10.1080/14703297.2015.1013145

Eagly, A. H., & Chaiken, S. (1993). The Nature of Attitudes. *The Psychology of Attitudes*, 1–21.

Edomwonyi-otu, L., & Avaa, A. (2011). The Challenge of Effective Teaching of Chemistry A Case Study. *Leonardo Electronic Journal of Practices and Technologies*, (18), 1–8. Retrieved from http://193.226.7.140/lejpt/A18/001_008.pdf

Fah, A. L. S. Y. & L. Y. (2014). SIKAP DAN KEBIMBANGAN KIMIA DALAM KALANGAN PELAJAR ALIRAN SAINS: SATU PENDEKATAN PEMODELAN PERSAMAAN STRUKTURAL (SEM). *Jurnal Pemikir Pendidikan (Journal for Educational Thinkers)*, *5*, 99–117.

Fensham, P. J., & Bellocchi, A. (2013). Higher order thinking in chemistry curriculum and its assessment. *Thinking Skills and Creativity*, *10*, 250–264. http://doi.org/10.1016/j.tsc.2013.06.003

Gambari, I. A. (2016). Promoting Intrinsic and Extrinsic Motivation among Chemistry Students using Computer-Assisted Instruction. *Contemporary Educational Technology*, *7*(1), 25–46.

Gotlib, I. H., & Meyer, J. P. (1986). Factor analysis of the Multiple Affect Adjective Check List: A separation of positive and negative affect. *Journal of Personality and Social Psychology*, *50*(6), 1161–1165. http://doi.org/10.1037/0022-3514.50.6.1161

Hofstein, A., Ben???Zvi, R., Samuel, D., & Tamir, P. (1977). Attitudes of israeli high???school students toward Chemistry and Physics: A comparative study. *Science Education*, *61*(2), 259–268.

http://doi.org/10.1002/sce.3730610217

Holbrook, J. (2005). Making chemistry teaching relevant. *Chemical Education International*, *6*(1), 3–8.

Iksan, Z. I., Halim, L., & Osman, K. (2006). Sikap Terhadap Sains dalam Kalangan Pelajar Sains di Peringkat Menengah dan Matrikulasi. *Pertanika J. Soc. Sci. & Hum*, *14*(2), 131–147.

Johari, I. N. H. dan A. M. Y. S. (2007). Visualisasi Dalam Pendidikan Sains: Ke arah Pengajaran dan Pembelajaran Berkesan. *Jurnal Pendidikan Universiti Teknologi Malaysia.*, *12*, 26–40.

Jones, M. G., Howe, A., & Rua, M. J. (2000). Gender Differences in Students' Experiences, Interests, and Attitudes toward Science and Scientists. *Science Education*, *84*, 180–192. http://doi.org/10.1002/(SICI)1098-237X(200003)84:2<180::AID-SCE3>3.0.CO;2-X

Kah Heng, C., & Karpudewan, M. (2015). The Interaction Effects of Gender and Grade Level on Secondary School Students' Attitude towards Learning Chemistry. *Eurasia Journal of Mathematics Science & Technology Education*, *11*(4), 889–898. http://doi.org/10.12973/eurasia.2015.1446a

Kamisah, zanaton, L. (2007). Sikap terhadap Sains dan Sikap Saintifik di kalangan Pelajar Sains. *Jurnal Pendidikan*, *32*, 39–60.

Kar, N. Z. N., & Saleh, S. (2012). THE EFFECT OF INQUIRY DISCOVERY APPROACH TOWARDS STUDENT ACHIEVEMENT IN THE SUBJECT OF CHEMISTRY. *Asia Pacific Journal of Educators and Education*, *27*, 159–174.

Kassim, A. H. (2014). Perlaksanaan Kurikulum Sains KBSM Sekolah Menengah di Negeri Perak : Ke manakah arah tujunya ? (Implementation of KBSM Science Curriculum in the State of Perak : Where to ?). *Journal of Applied Research in Education*, *18*, 67–85. Retrieved from http://www.ubd.edu.bn/Resources/docs/jaRE jOURNAL/2014/TK_Abu Hassan-Asmayati.pdf

Koballa, T. R., & Crawley, F. E. (1985). The Influence of Attitude on Science Teaching and Learning. *School Science and Mathematics*, *85*(March), 222–232. http://doi.org/10.1111/j.1949-8594.1985.tb09615.x

Koksal, E. A., & Berberoglu, G. (2012). The Effect of Guided-Inquiry Instruction on 6th Grade Turkish Students' Achievement, Science Process Skills, and Attitudes Toward Science. *International Journal of Science Education*, *693*(January 2015), 1–13. http://doi.org/10.1080/09500693.2012.721942

Kususanto, P., Fui, C. S., & Lan, L. H. (2012). Teachers ' Expectancy and Students ' Attitude towards Science. *Journal Of Education and Learning*, *6*(2), 87–98.

Lang, Q. C., Wong, A. F. L., & Fraser, B. J. (2005). Teacher-student interaction and gifted students' attitudes toward chemistry in laboratory classrooms in Singapore. *The Journal of Classroom Interaction*, *40*(1), 18. Retrieved from http://proquest.umi.com.dbgw.lis.curtin.edu.au/pqdweb?did=897763511&Fmt=7&clientId=22212&RQT=309&VName=PQD

Menis, J. (1989). Attitudes towards School, Chemistry and Science among Upper Secondary Chemistry Students in the United States. *Research in Science & Technological Education*, *7*(2), 183–190. http://doi.org/10.1080/0263514890070206

Miller, T. R., & T. Anne Cleary. (1993). Direction of wording effects in balanced scales. *Educational and Psychological Measurement*, (53), 51–60. http://doi.org/0803973233

Mohd Nor, B., & Tay, C. (2010). Masalah Pembelajaran Pelajar Tingkatan Empat Dalam Mata Pelajaran Kimia Khususnya Tajuk Elektrokimia. *... Pelajar Tingkatan Empat Dalam Mata Pelajaran ...*. Retrieved from http://eprints.utm.my/11624/

Najdi, D. S. (2009). Students Attitude Toward Learning Chemistry, *diambil pa*. Retrieved from http://www.qou.edu/arabic/magazine/journal_Edu/issued1_1/research12.pdf

Nurzatulshima Kamarudin, Lilia Halim, Kamisah Osman, & Subahan T. (2009). Pengurusan Penglibatan Pelajar dalam Amali Sains. *Jurnal Pendidikan Malaysia*, *34*, 205–217.

Peter Fensham. (1998). *Development and Dilemmas in Science EducationNo Title*. (P. Taylor, Ed.) (5th ed.). London: The Falmer Press. Retrieved from http://files.eric.ed.gov/fulltext/ED309081.pdf

Pilotte, W. J., & Robert K. Gable. (1990). The impact of positive and negative item stems on the validity of a computer anxiety scale. *Educational and Psychological Measurement*, (50), 603–610.

Quek, C. L., Wong, A. F. L., & Fraser, B. J. (2002). Gender differences in the perceptions of chemistry laboratory classroom environments. *Queensland Journal of Educational Research*, *18*, 164–182.

Salta, K., & Tzougraki, C. (2004a). Attitudes toward chemistry among 11th grade students in high schools in Greece. *Science Education*, *88*(4), 535–547. http://doi.org/10.1002/sce.10134

Salta, K., & Tzougraki, C. (2004b). Attitudes toward chemistry among 11th grade students in high schools in Greece. *Science Education*, *88*, 535–547. http://doi.org/10.1002/sce.10134

Schmitt, N., & Stults, D. M. (1985). Factors defined by negatively keyed items: the result of careless respondents? *Applied Psychological Measurement*, *9*(4), 367–373. http://doi.org/10.1177/014662168500900405

Simon, S., & Collins, S. (2003). Attitudes towards science: a review of the literature and its implications. *International Journal of Science Education*, *25*(9), 1049–1079. http://doi.org/10.1080/0950069032000032199

Sirhan, G. (2007). Learning Difficulties in Chemistry: An Overview. *Turkish Science Education*, *4*(2), 2–20.

Spector, P. E., Van Katwyk, P. T., Brannick, M. T., & Chen, P. Y. (1997). When Two Factors Don't Reflect

Two Constructs: How Item Characteristics Can Produce Artifactual Factors. *Journal of Management*, *23*(5), 659–677. http://doi.org/10.1177/014920639702300503

Taber, K. S. (2002). Alternative conceptions in chemistry teaching. *Chemical Misconceptions - Prevention, Diagnosis and Cure. Volume I: Theoretical Background*, *1*, 180. Retrieved from www.rsc.org/learn-chemistry/resource/.../pdf

Taber, K. S. (2009). Challenging Misconceptions in the Chemistry Classroom: Resources to Support Teachers. *Educació Química EduQ*, *4*, 13–20. http://doi.org/10.2346/20.2003.02.27

Van Houtte, M., Demanet, J., & Stevens, P. A. J. (2013). Curriculum tracking and teacher evaluations of individual students: Selection, adjustment or labeling? *Social Psychology of Education*, *16*(3), 329–352. http://doi.org/10.1007/s11218-013-9216-8

Weinburgh, M. (1995). Gender differences in student attitudes toward science: A meta???analysis of the literature from 1970 to 1991. *Journal of Research in Science Teaching*, *32*(4), 387–398. http://doi.org/10.1002/tea.3660320407

Wolf, S. J., & Fraser, B. J. (2008). Learning environment, attitudes and achievement among middle-school science students using Inquiry-based laboratory activities. *Research in Science Education*, *38*(3), 321–341. http://doi.org/10.1007/s11165-007-9052-y

Yahaya, A., & Hasan, J. M. (2011). Pelaksanaan kurikulum kimia KBSM di kalangan guru-guru pelatih jurusan kimia Di UTM. *Journal of Science and Mathematics Educational*, *2*, 18–38. Retrieved from http://eprints.utm.my/13426/

Yunus, F. W., & Ali, Z. M. (2013). Attitude towards Learning Chemistry among Secondary School Students in Malaysia. *Journal Of Asian Behavioural Studies*, *3*(11), 1–11.

Zoller, U. (1990). Students' misunderstandings and misconceptions in college freshman chemistry (general and organic). *Journal of Research in Science Teaching*, *27*(10), 1053–1065. http://doi.org/10.1002/tea.3660271011

The Eurasia Proceedings of
Educational & Social Sciences (EPESS)
ISSN: 2587-1730

The Eurasia Proceedings of Educational & Social Sciences (EPESS), 2017

Volume 6, Pages 99-101

ICEMST 2017: International Conference on Education in Mathematics, Science & Technology

EXAMINATION OF SECONDARY SCHOOL STUDENTS' CONCEPTIONS ABOUT METALLIC BONDING AND PROPERTIES OF METALS

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Abstract: This study examines secondary school students' conceptions about metallic bonding and properties of metals by using a diagnostic instrument. The diagnostic instrument titled "iron" was designed to test out student understanding of the basic notion of metallic bonding and the relation between the properties of particles and bulk properties by Taber (2002). In the present study, a translated version of the true/false diagnostic instrument which contains 20 questions was administered to 942 students who are attending at 10th grades (374 students), 11th grade (333 students), and 12th grade (235 students) from different secondary schools. At the end of the study, it was found that the students had the octet rule alternative framework. They apply the full outer shells explanatory principle to explain metallic structure. It was concluded that students have alternative conceptions about the relationship between the properties of metal atoms and the properties of the metallic structure. For example, most of the students think "iron conducts electricity because iron atoms are electrical conductors" and "the reason iron rusts is that iron atoms will rust if exposed to damp air".

***Keywords*:** Metallic bonding, secondary school students, metallic properties

Introduction

Understanding chemical bonding and the particulate nature of structures are fundamental to success in chemistry. Although a number of alternative conceptions related to covalent and ionic bonding have been described in the literature, there are very few studies investigate students' understanding metallic bonding. 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. In Taber's study, some of the students suggested there would be ionic or covalent bonding in metals or metallic bonds existed between two metals. 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.

Besides, understanding of chemical bonding needs to understand the particulate nature of matter meaningfully. On the other hand, students often have considerable difficulty in using atomic/molecular level models of matter to explain the properties of substances. A review of several studies by Nakhleh (1992) indicates that students' understanding of the model of matter is relatively limited. The most prevalent student conceptions are that matter is continuous and that the macroscopic properties of matter may be extrapolated to its particles (Ben-Zvi, Eylon and Silberstein 1986). Krnel, Watson and Glazar (1998) proposed that students regard particles as small pieces of an object with all its properties. A similar situation is seen between metallic structures and metal atoms. Metallic bonding and properties of metals place in the secondary school curriculum of many countries. To investigate high school students' conceptions about metallic bonding and properties of metals is important. In this connection, the research question is the following:

- Selection and peer-review under responsibility of the Organizing Committee of the conference

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Do students have alternative conceptions about the relationship between the properties of metal atoms and the properties of the metallic structure?

Methods

Context of the study

The topic of metallic bonding is placed in 9th grade secondary chemistry curriculum in Turkey. The sea of electrons metaphor for the metallic bond is used in teaching metallic bonding commonly in 9th grade.

Research Participants

The participants consisted of 942 students who are attending at 10th grades (374 students), 11th grade (333 students), and 12th grade (235 students) from different secondary schools in Balıkesir. The sample can be considered to be representative of the wider population of secondary school students.

Data Collection

In the present study, a translated version of the true/false diagnostic instrument which contains 20 questions was used. The original English language version of the diagnostic instrument titled "iron" was designed to test out student understanding of the basic notion of metallic bonding and the relation between the properties of particles and bulk properties by Taber (2002). The instrument was first translated into Turkish by the author, and was then checked by an English lecturer.

Data Analysis

The overall facility of the instrument in terms of the percentage of correct responses on each item and across the instrument was considered. Firstly the number of students selecting the correct response, the number of students selecting an unambiguous (True or False) response, the number of 'I do not know' responses, and the number of non-responses (no response given for item) were determined for data analysis. After then, the correct responses as percentage of total number of students completing the instrument was calculated.
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

It is seen that the results of the percentage of correct answers to each item in three grades were very close to each other. It can be seen from the students' responses to Q1, they know that iron is metal and all metals have a type of bonding called metallic bonding (90%/78%/89%). Almost half of the students know that the iron atoms are packed together and the structure is held together by metallic bonding (54%/61%/54%). Taber (2001) has cited that some of the students find way to understand the metallic bond as a variation on the ionic or covalent case. In this study it was found that most of the students assumed that metals were molecular (%17/21/18) as seen from Q17. On the other hand, there are no molecules in a metal. Almost half of the students thought that the atoms in a metal were held together by ionic bonds. Another important point that most of the students used the full outer shell/octet stability while explaining the bonding. This was called octet alternative framework by Taber (1998, 1999). According to analysis of second item, it was found that most of the students (24%, 22%, 26%) had octet alternative framework thinking.

Conclusion

At the end of the study, it was concluded that the students had the octet rule alternative framework and they applied the full outer shells explanatory principle to explain metallic structure. It was also found that students had alternative conceptions about the relationship between the properties of metal atoms and the properties of the metallic structure. For example, most of the students think "iron conducts electricity because iron atoms are electrical conductors" and "the reason iron rusts is that iron atoms will rust if exposed to damp air". Another important conclusion is that most of the students assume that metals are molecular.

Recommendations

First of all, the students should be presented fundamental conditions of the bond occasion 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 the simple explanations of bonding such as electron sharing or transferring. If different models are used to explain metallic bonding, why these different models used should be clarified.

Acknowledgments

Research reported in this publication was supported by Balikesir University BAP with the project number 2016/63.

References

Ben-Zyi, R., Eylon, B.-S., & Silberstein, J. (1986). Is an atom of copper malleable? *Journal of Chemical Education, 63,* 64–66.

Cheng, M.M.W., & Gilbert, J. K. (2014). Students' visualization of metallic bonding and the malleability of metals*. International Journal of Science Education, 36(8)*, 1373-1407.

Coll, R.K., & Taylor, N. (2002). Mental models in chemistry: Senior chemistry students' mental models of chemical bonding. *Chemistry Education: Research and Practice in Europe, 3(2),* 175-184.

Coll, R.K., & Treagust, D.F. (2003). Learners' mental models of metallic bonding: A cross-Age study. *Science Education*, *87,* 685-707.

Coll, R.K. (2008). Chemistry learners' preferred mental models for chemical bonding. *Journal of Turkish Science Education, 5(1),* 22-47.

Gay L. R., & Airasion P. (2000). *Educational research: competencies for analysis and application.* Prentice-Hall, New Jersey.

Krnel, D., Watson, R., & Glazar, S. A. (1998). Survey of research related to the development of the concept of 'matter'. *International Journal of Science Education, 20*(3), 257–289.

Nakhleh, M. B. (1992). Why some students don't learn chemistry: Chemical misconceptions. *Journal of Chemical Education*, *69*(3), 191–196.

Taber, K. S. (2002). *Chemical misconceptions- prevention, diagnosis and cure, Volume II: classroom resources.* London: The Royal Society of Chemistry.

Taber, K.S. (2003). Mediating mental models of metals: Acknowledging the priority of the learners' Prior learning. *Science Education, 87*, 732-758.

The Eurasia Proceedings of
Educational & Social Sciences (EPESS)
ISSN: 2587-1730

The Eurasia Proceedings of Educational & Social Sciences (EPESS), 2017

Volume 6, Pages 102-104

ICEMST 2017: International Conference on Education in Mathematics, Science & Technology

SURGERY: TEXTBOOK FOR STUDENTS OF HIGHER MEDICAL EDUCATIONAL INSTITUTIONS

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Abstract: At the same time, the fact is obvious that if these capabilities are not peculiar to everyone but only to some doctors, it becomes an indicator not for mass professional thinking but personal qualities of a definite person. Broad medical activity, which includes a significant amount of both patients and medical personnel, frequency of main diseases (socially significant in many respects) and requirements on rendering high quality medical care demand mass training of clinical thinking. First of all, it is demanded by the training of the diagnosis recognition process. How is the training performed now? Nowadays, the nosological principle of training dominates. A student studies one or another disease using textbooks and lectures. Thus, the student learns symptoms of the given disease in general, without relation to one or another concrete patient. Later at a lecture, a teacher presents a patient with the disease under study to the group of students, explains specific symptoms using patient's example and checks how students acquired the particular nosological form. Thereby conclusions are made about a young doctor's ability to recognize diseases and to treat patients who have the given disease. Both teachers and students are sure that a fund of knowledge about many diseases is formed in this way and the doctor will be able to do his job professionally by accumulation of this knowledge.

Keywords**:** Surgery, textbook, students.

Introduction

For the quality of treatment of patients, doctors need to learn and master the stages of diagnosis.
Methods of diagnostics:

Analogy method, which is possible in case of typical (classical) manifestation of a disease (in uncomplicated external abdominal hernias and acute purulent surgical infection of soft tissues).
Inductive method, which is based on the initial hypothetical generalization with the findings validation.
Substantiated diagnosis, based on the doctor's mentally synthetically activity, who sequentially analyses all the present symptoms and verifies their compliance with the disease
Method of differential diagnosis (most reliable), which excludes all signs of other similar diseases.
The most important thing in education is the development of future doctor is ***method of preliminary diagnosis*** of any disease, including surgical.

The previously used textbooks on surgery has been described mainly the clinical manifestations of diseases and their treatment techniques, without clarifying the principles and preliminary diagnosis capabilities for students.
After medical education the doctors of the general medical practice tasks determinates basic requirements of scope of knowledge and practical skills for graduating student of institute of higher education of IV level of accreditation: goal-directed methodic algorithm of questioning of the patient (getting anamnesis), physical examination, substantiation of provisional diagnosis, determinate algorithm of additional methods of investigations with analysis of received results, differential diagnosis, forming clinical diagnosis, substantiation of treatment program and it's realization.

- Selection and peer-review under responsibility of the Organizing Committee of the conference
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In the future the young doctor can work not only the doctor of family medicine, but also the expert of other directions, for example - the surgeon. For preparation to practical workies application textbook “Surgery” for students and including information on methods and principles of forming of preliminary diagnosis (Bereznytskyy, Zakharash, & Mishalov, 2016).

Methods

For education of medical students in textbook “Surgery” including information about methodology of the forming preliminary diagnosis.
After the thorough questioning and physical examination of the patient the doctor has to make sampling of pathological symptoms in their both subjective and objective manifestations. Preliminary diagnosis is substantiated by referring to the complaints of the patient, using their successive presentation, starting with the most evident ones. Each complaint must include all various subjective shades of the pain manifestation in this patient (for example, localization of pain, its displacement, intensity, character, irradiation, and ways of the pain relief). After the sequential referring to each complaint, in order to justify the preliminary diagnosis, the anamnesis (history) disease and life of patients is used that shows the time when the disease arose, the nature of its course and the patient’s subjective evaluation of possible factors that led to occurrence of the disease.
Method of physical examination for forming preliminary diagnosis including of special methodic: visual inspection of body patients, palpation of body patients (abdomen and other parts), percussion of body patients (chest and abdomen), auscultation of body patients (chest and abdomen) for information about of pathological manifestation any surgical diseases.

Correctly of results of method questioning and method physical examination may be application for effective forming of preliminary diagnosis. All stages of the method of forming the preliminary diagnosis are very detailed in the textbook “Surgery” and allow medical students effectively develop discipline Surgery under primary diagnosis. To implement the system of planning, monitoring and evaluation of the education quality for a real degree of assimilation of students with specific components of the program during the academic year of surgery training and discipline for module “Abdominal surgery” in general based on the cumulative number of ranking points for the European Credit Transfer System (ECTS) (The European higher education area, 1999; Magna Charta Universitatum, 1988).

This will improve the quality of learning discipline among the four-six years students of enrolled this year, and develop common indicators for professionally-oriented exam after 6 year of study to get a general level of theoretical and practical knowledge and skills of physicians interns of surgery. The Department of Surgery № 1 of the Dnipro Medical Academy was conduct structured, multiple planning of the study process and the use of different forms of the staging control. Taking into account the Standard program of the discipline, Curriculum, Working program for the department was create the specific actions by teachers, students and interns of surgery to achieve theoretical and practical knowledge, necessary resources and sequence of technological operations with the use of credit-modular system.

Thus, the substantial module “Surgical Gastroenterology and Proctology” includes “Syndrome of chronic pain in the upper region of abdominal cavity”, “Syndrome of mechanical jaundice”, “Syndrome of an acute pain in perianal area”, “Syndrome of rectal prolepses" and “Diarrheic-inflammatory syndrome”, combining similar diseases or their complications in the form of so-called educational elements, where, for example, a practice training for “Syndrome acute pain in perianal region” contains "Acute hemorrhoids”, “Acute anal fissures", “Acute paraproctitis” and “Inflammation of the epithelial coccygeal passage”.

This approach is appropriate to expediently use the time of practical training, examine patients according to pathological syndrome, mastering the skills in classes with medical simulators, and perform preliminary and differential diagnosis with the definition of a rational treatment program.

To support the learning process developed by the principles of credit-modular system using multimedia lectures, the textbook "Surgery", methodological guide of development for students and interns, methodological guide of development for teachers, hand book and individual plans for students and interns, journal of the teacher.

Results and Findings

Textbook “Surgery” for medical students including all educational information about methods diagnostic of surgical diseases, and preliminary diagnosis, in particularly.

Education of students 4-6 courses of medical university using the proposed textbook increased their interest and motivation. With this tutorial, students preparation not only clinical manifestations of disease and surgical techniques and their medicaments therapy.
This tutorial helps students learn different methods and stages of diagnostics of surgical diseases, starting with a preliminary diagnosis.

Experience of using this textbook “Surgery” and credit-modular system in teaching and measuring knowledge of surgery since 2016 suggests that this approach is effective. Received results underscore the increased objectivity in the control of knowledge on the part of teachers' interest and increasing students and medical interns’ interest to master a subject, that allowed to prepare a general practitioner in surgery and surgeons, and integrate in the future in practical public health in Ukraine and worldwide.

Conclusion

Given, that the level of qualification of the doctor is in the first place in various gradational systems of educational societies it’s understood the necessity to improve the quality of the doctor in institutes of higher education, in which directed implementation of the credit module system to the educational process.
The doctors of the general medical practice tasks determinates basic requirements of scope of knowledge and practical skills for graduating of student of institute of higher education of IV level of accreditation: goal-directed methodic algorithm of questioning of the patient (getting complains, anamnesis), physical examination (visual inspection, palpation, percussion, auscultation), substantiation of provisional diagnosis on the basis of the revealed syndromes, determinate algorithm of additional methods of investigations with analysis of received results, differential diagnosis between similar diseases, forming clinical diagnosis taking into account the International Classification of Diseases in Edition #10, substantiation of treatment program (place of treatment: home, ambulatory or clinic; time beginning of treatment: urgent or plan; methods of treatment: medicaments or surgical intervention; rehabilitation and prevention of recurrent after treatment) and its implementation.

Recommendations

New textbook “Surgery” may be used for effective preparation of students and young doctors for forming preliminary diagnosis, as the first stage of diagnosis of diseases.

References

Bereznytskyy Ya., Zakharash M., Mishalov V. (2016). *Surgery: textbook for students.* Vinnitsa (Ukraine): Nova knyga.

The European higher education area. (1999). Joint Declaration of the European Ministers of Education. Bologna, June 19, 1999.

Magna Charta Universitatum. (1988). Bologna, Italy, September 18, 1988.

The Eurasia Proceedings of
Educational & Social Sciences (EPESS)
ISSN: 2587-1730

The Eurasia Proceedings of Educational & Social Sciences (EPESS), 2017

Volume 6, Pages 105-108

ICEMST 2017: International Conference on Education in Mathematics, Science & Technology

TEACHING EVOLUTION SELF-EFFICACY SCALE: THE DEVELOPMENT, VALIDATION AND RELIABILITY STUDY

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Abstract: The purpose of this study is to develop a valid and reliable instrument for measuring prospective biology teachers' self-efficacy beliefs about teaching evolution. The research was conducted on a study group consisted of 212 prospective biology teachers. Content validity was established through review of related literature and expert opinions. Exploratory Factor Analysis and Confirmatory Factor Analysis are performed in order to establish the scale's construct validity. The scale's reliability coefficient and item-total correlations are calculated. Cronbach alpha coefficient of the scale is 0,87. Internal consistency coefficients for the sub-scales varied between 0,81 and 0,83 and found to be within admissible limits. In light of these results, it could be argued that the scale is reliable and valid instrument and can be used in identifiying prospective biology teachers' self-efficacy beliefs about teaching evolution.

Keywords: Teaching evolution, self-efficacy beliefs, reliability, validity

Introduction

The theory of evolution is one of the best substantiated theories in the history of science, supported by evidence from a wide variety of scientific disciplines, including paleontology, geology, genetics and developmental biology. Its role and importance in understanding life on earth have been emphasized many times by important international scientific communities (National Research Council, 1998). Without a doubt, one of the important actors in the teaching of the theory of evolution in school science is biology teachers. In order for effective teaching of the theory, biology teachers should have a substantial content knowledge regarding the theory of evolution and positive attitudes towards teaching of it in the schools. On the other hand, one of the important factors influencing effective teaching of the theory of evolution is the self-efficacy beliefs of biology teachers about the teaching of the theory. Self-efficacy is defined as people's beliefs about their capabilities to produce designated levels of performance that exercise influence over events that affect their lives (Bandura, 1986, cited in Senemoglu, 2012). Tschannen- Moran and Woolfolk-Hoy (2001) describe teacher's self-efficacy belief as a judgment of his or her capabilities to bring about desired outcomes of student engagement and learning. One of the important features of self-efficacy beliefs is its domain-specific nature (Lin & Tsai, 2013). Therefore, general trend in the literature has been to develop domain-specific instruments to measure students' and teachers' self-efficacy beliefs in various domains. Considering the importance of the theory of evolution in learning about biology and life, it is crucial to develop an instrument that measures self-efficacy beliefs of teachers regarding the teaching of the theory of evolution. To this end, this study reports on the results of the development and validity study of an instrument which aims to measure prospective biology teachers' self-efficacy beliefs regarding teaching the theory of evolution.

- Selection and peer-review under responsibility of the Organizing Committee of the conference

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Method

Study was conducted at Marmara University in 2015-2016 academic year. Data was gathered from 212 prospective biology teachers. Participants were seniors who were enrolled in biology education program and graduate students who were enrolled in teaching certification program at the same university. Having been completed the subject area courses was the criterion for inclusion in the study. An item pool consisting of 34 statements was prepared and sent to the five experts for consultation about wording and content validity. Items and content were revised according to five experts' opinions and recommendation following Lawshe technique (Lawshe, 1975).

SPSS 20.0 and LISREL 8.80 were used for data analysis. In order to conduct construct validity study, Exploratory Factor Analysis (EFA) was carried out. Data was examined with Kaiser-Meyer Olkin (KMO) parameter and the Bartlett sphericity test before the factor analysis. After exploratory factor analysis, Confirmatory Factor Analysis (CFA) was carried out and the model established in EFA is tested. Cronbach's alpha coefficient was calculated for the scale's reliability.

Results and Discussion

Content validity is examined via Lawshe technique. After receiving feedbacks from five experts, for each item, Content Validity Ratios (CVR) were calculated, as a result 12 items with negative ratios were eliminated from the item pool. Content validity index of the scale (CVI) was calculated as well. After the first revision 5-point Likert type scale with 22 items, 14 positive and 8 negative statements, was attained. In order to study the construct validity of the scale EFA is conducted. For sampling adequacy the KMO value was found to be .867, and for normality the Bartlett sphericity test was significant with values of $\chi2=955.049$ and $p<0.01$). These parameters were considered to be appropriate for conducting factor analysis (Field, 2005). A principal component analysis was used, and the calculations were made by taking the eigenvalue as 1. The criterion was designated that significant factor loadings should be greater than .45, items with less loadings were eliminated from the scale. After reviewing the scree plot, two-factor scale with 11 items is identified (Table 1). The total explained variance is 57.9%, the first factor explains 29.1% of the total variance while the second factor explains 28.8% of the total variance. The factors were named by analyzing the content of items in each factor in light of the related literature. Accordingly, the first factor was named as "self-efficacy about evolution content knowledge" and the second factor was named as "self-efficacy about teaching evolution".

Table 1: Factor structure of self efficacy about evolution teaching scale

Item No		Common factor variance	Factor-1 Loading	Factor loadings after Varimax rotation	
				1	2
4		0,575	0,723	0,675	
8		0,512	0,560	0,711	
10		0,643	0,657	0,790	
12		0,527	0,722	0,567	
15		0,611	0,669	0,760	
22		0,605	0,729	0,708	
	Explained variance %			**29.1**	
	Factor 1 Cronbach alpha			**0.83**	
3		0,508	0,627		0,682
6		0,535	0,632		0,706
7		0,612	0,723		0,721
11		0,546	0,607		0,726
13		0,704	0,698		0,822
	Explained variance %			**28.8**	
	Factor 2 Cronbach alpha			**0.81**	
	Total variance explained %			**57.9**	
	Cronbach alpha of the scale			**0.87**	

Using LISREL 8.80, CFA was carried out in order to test the validity of the two-factor structure of the scale (Table 2). The relationships between the factors' items are as follows; item-factor loadings for "self-efficacy about evolution content knowledge" vary between $.57 \leq \lambda \leq .71$; item-factor loadings for "self-efficacy about teaching evolution" vary between $.62 \leq \lambda \leq .77$. Additionally, the general adaptability parameters for the model are χ^2/sd = 3.14, CFI = .95, NFI = .93, RMR=.061; RMSEA = .80; SRMR =.061; TLI =.93.

Table 2: Self efficacy about teaching evolution fit indices from CFA

Fit indices	**Perfect fit values**	**Acceptable fit values**	**Fit indices from CFA**	**Result**
χ 2 /sd	$0 \leq \chi$ 2 /sd ≤ 2	$2 \leq \chi$ 2 /sd ≤ 5	3.14	Acceptable
CFI	.95 ≤ CFI ≤ 1.00	90 ≤ CFI ≤ .95	.95	Perfect
NFI	0.95≤NFI≤1.00	0.90≤NFI≤0.95	.93	Acceptable
RMR	.00 ≤ RMR ≤ .05	.05 ≤ RMR ≤ .10	.061	Acceptable
RMSEA	.00 ≤ RMSEA ≤ .05	.05 ≤ RMSEA ≤ .08	.80	Acceptable
SRMR	.00 ≤ RMR ≤ .05	.05 ≤ RMR ≤ .10	.061	Acceptable
TLI (NNFI)	.95 ≤ TLI ≤ 1.00	.90 ≤ TLI ≤ .95	.93	Acceptable

(Kline, 2011)

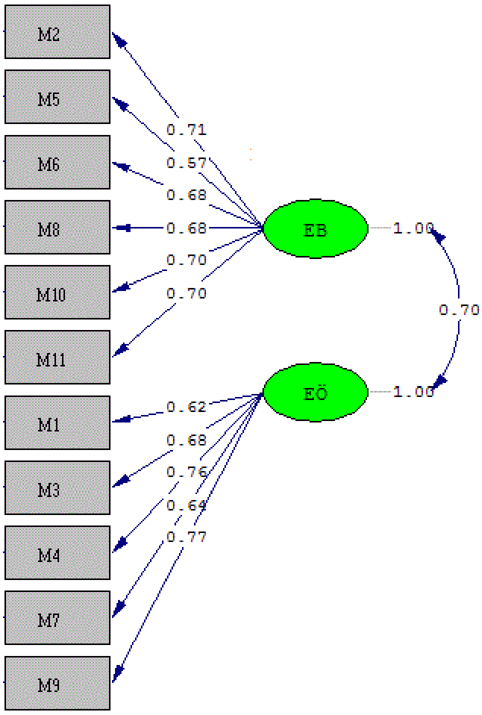

Figure 1: Pathway and factor loadings

The obtained indices confirm that model fit is acceptable. The scale's reliability coefficient and item-total correlations are calculated. Cronbach alpha coefficient of the scale is .87. Internal consistency coefficients for the sub-scales varied between .81 and .83 and found to be within admissible limits. In light of these results, it could be argued that the scale is reliable and valid instrument and can be used in identifying prospective biology teachers' self-efficacy beliefs about teaching evolution.

References

Kline, R.B. (2011). *Principles and practice of structural equation modeling.* New York: The Guilford Press.

Lawshe, C. H. (1975). A quantitative approach to content validity1. *Personnel Psychology*, *28*(4), 563-575.

Lin, T. J., & Tsai, C. C. (2013). A multi-dimensional instrument for evaluating Taiwanese high school students'science learning self-efficacy in relation to their approaches to learning science. *International Journal of Science and Mathematics Education*, *11*(6), 1275-1301.

NRC (National Research Council).(1998). *Teaching about evolution and the nature of science*. Washington, DC: National Academy Press.

Senemoğlu, N. (2012). *Gelişim öğrenme ve öğretim kuramdan uygulamaya* (21. Baskı). Ankara: Pegem Akademi.

Tschannen-Moran, M., & Hoy, A. W. (2001). Teacher efficacy: capturing an elusive construct. *Teaching and Teacher Education*, *17*(7), 783-805.

ISRES Publishing

The Eurasia Proceedings of
Educational & Social Sciences (EPESS)
ISSN: 2587-1730

The Eurasia Proceedings of Educational & Social Sciences (EPESS), 2017

Volume 6, Pages 109-113

ICEMST 2017: International Conference on Education in Mathematics, Science & Technology

COMPARISON OF STUDENTS' LEARNING AND ATTITUDES IN TECHNOLOGY SUPPORTED AND LABORATORY BASED ENVIRONMENTS

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Abstract: This research study aimed to compare students' conceptual knowledge and attitudes towards physics lesson who were separately taught with three different methods. The main research question was as follows: Are there significance differences among technology supported teaching, laboratory-based teaching, and curriculum-based teaching in terms of students' learning and attitudes? True experimental design was carried out for this research. The participants of this study were 144 9th grade students studying in an all-boys state high school. The students who were in the technology supported classroom constituted the first experimental group while the students in the laboratory based classroom comprised the second experimental group. There was also one control group whose students were taught based on the curriculum. Each group had 48 students. The teacher of three groups was the same. Data were collected in the physics lessons. The students' conceptual learning was assessed with the help of "Force and Motion Achievement Test". This test was applied before and after the treatment with an eight-week time difference. In order to determine any change in the students' attitudes towards physics lesson, "Physics Lesson Attitude Scale" was used. Effect sizes were calculated for the changes in students' knowledge and attitudes. Findings showed significant differences between the experimental groups and control group. In other words, when technology or laboratory approach was embedded in the instruction, the students became better learners and their attitudes increased. Results also presented no significant differences between the experimental groups.

***Keywords*: ** Learning, attitude, technology, laboratory, science.

Introduction and Purpose of the Research

Each passing day we encounter a new technological development and the use of technology has become an indispensable habit for people. Researchers have stressed the importance of effective use of technology in science teaching and learning because through the use of technology, students' scientific investigations and reasoning can be constructively developed and help students connect constructed knowledge to practical work (McFarlane & Sakellariou, 2002). Technology simultaneously ushers the tasks of creating, evaluating, analyzing, and applying through collaboration into the classroom while generating greater enthusiasm for learning (Cicconi, 2014), which is related to attitude. Ranging from drawings on a blackboard or interactive multimedia simulations to etchings on a clay tablet or Web-based hypertexts to the pump metaphor of the heart or the computer metaphor of the brain, technologies have constrained and afforded a range of representations, analogies, examples, explanations, and demonstrations that can help make subject matter more accessible to the learner (Koehler & Mishra, 2006).

Improving learning experiences for all students is the ultimate goal of research in technology use in education; however, there is well-placed concern that even when good technologies are available, they are not being used to their full potential to support students' learning (Forssell, 2011). Therefore, research has focused on the impact of using technology on students' cognitive and affective skills. Marty (1985), for example, investigated the

- Selection and peer-review under responsibility of the Organizing Committee of the conference

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effects of interaction with computerized simulation game on high school students' achievement and attitudes. Analysis revealed a significant difference in change of class means on achievement favoring use of the computer game and very little difference in the change of class means on attitudes. Grimm (1995) examined the effect of technology rich educational environments on student academic achievement and attitude by comparing type of school (technology-rich school (TRS) and traditional school (TS)). The overall findings indicated that TRS environments contributed to increased academic achievement of 4^{th}-grade, 6^{th}-grade, and llth-grade students and contributed to students' overall attitude for 6^{th}-grade and llth-grade students. Jimoyiannis and Komis (2001) investigated the effect of using computer simulations in learning of speed and acceleration concepts. At the end of the application, the experiment group in which the simulations were used among the students was found to be more successful academically. Saka and Yilmaz (2005) aimed to develop instructional materials based on computer-aided study sheets and to determine the effect on the achievement level of the concepts that students have difficulty in understanding about electrostatics in the 9th grade physics course. Results indicated that study sheets for computer-aided physics teaching had an efficacious effect in teaching the electrostatic concepts. Additionally, students stated that they liked physics but they had difficulty in understanding some of the topics in abstract concepts in physics. They said that the prepared material was interesting, practical and easy to use.

On the other hand, hands-on approach in science education provides the student with engaging activities during the learning process and allows students to fully participate in the learning process because students should learn science by experiencing it (Wiggins, 2006). Research implies that use of the laboratory and hands-on activities are effective instructional techniques to increase achievement in science knowledge and when properly designed, they can influence attitudes toward science in a positive way (Freedman, 1995).

Some research investigated the benefits of laboratory instruction on students' attitudes towards science. For instance, Norton (1985) compared college students in the experimental group who were told to work independently and did not get any instructional help with the students in the control group who continued with step-by-step verification laboratory exercises, working in pairs with direct supervision and instruction. Results indicated that the treatment of the independent laboratory investigation did not have a significantly different effect on the dependent measures of critical thinking ability and/or scientific attitude when compared to the effect of the performance of verification laboratory exercises by a control group. Freedman (1997) investigated the use of a hands-on laboratory program as a means of improving student attitude toward science and increasing student achievement levels in science knowledge. It was concluded that laboratory instruction influenced, in a positive direction, the students' attitudes toward science, and influenced their achievement in science knowledge. Demirtas-Yilmaz (2014) examined 30 studies regarding the achievement of students compared to the traditional and laboratory based methods in science education in Turkey between 2000 and 2012 by using meta-analysis. Results showed that the laboratory based teaching method was much more effective in increasing the academic achievement of the students than the traditional teaching method.

Some research compared the impact of technology with effects of laboratory on learning (Akpan, 2002; Bozkurt & Sarikoc, 2008; Coramik, 2012; Darrah et al., 2014; Finkelstein et al., 2005; Zacharia & Anderson, 2003). Akpan (2002) revealed that teaching with simulation support was as effective as teaching with real laboratory experiments in his work on anatomy and organisms with high school students. He suggested that simulations might be an alternative to real laboratory experiments. The work of Bozkurt and Sarikoc (2008) was carried out with university students where the concept of circuit in alternating current was studied. For the study, a virtual lab group using computer simulations and a traditional lab group using real experimental materials were created. At the end, the virtual laboratory group was found to be quite successful compared to the traditional laboratory group. Finally, Coramik (2012) explored the outcomes of using computers and experiment-assisted activities in the teaching of the magnetism unit in the 11th grade physics course to the students' academic achievement and attitudes towards the physics course. It was seen that the academic achievement and attitudes scores of the students in the experiment-supported teaching group were higher than the scores of the students in the computer-assisted teaching group.

Results of the studies can change based on the subject, discipline and how the technology and laboratory activities are implemented. More research is needed to compare using technology with laboratory usage in terms of students' learning and attitudes. Hence, the following research question put a light on this research: Are there significance differences among technology supported teaching, laboratory-based teaching, and curriculum-based teaching in terms of students' learning of dynamics and their attitudes towards physics lesson.

Methodology

True experimental design was used for this research (Krathwohl, 1997). There were two experimental groups and one control group. The first experimental group was instructed with technology supported teaching and the second experimental group was instructed with laboratory based teaching. The control group followed the curriculum and was exposed to curriculum based teaching. The participants of the study were 144 9th grade male students. Each group had 48 students. The research was conducted in a physics class in an all-boys state high school. The teacher of all groups was the same person. The students were taking the class two hours a week. The instruction continued in the dynamics unit and lasted 8 weeks. Simulations, video recordings, smart board, tablets and z-book were used as the technology in the first experimental group. The second experimental group did hands on science by using experiment sets.

Quantitative research methods were used to collect data. In order to measure the changes in the participants' learning of dynamics, Force and Motion Achievement Instrument developed by Gokalp (2011) was administered as pre-test and post-test. The instrument had 30 questions including 16 multiple-choice, 12 open-ended, and 2 true-false questions. The scoring was between 0-54. The students' attitudes towards physics class were assessed by applying Physics Class Attitude Scale developed by Geban et al. (1994) before and after the treatment. This instrument consisted of 15 items with 5-point Likert scale. The scoring was between 15-75. Descriptive statistics and t-tests were performed to analyze the data. Effect sizes were calculated for the changes in the groups. Reliability measurements were made with the help of Cronbach alpha test.

Results and Discussion

Results for Learning

With regard to Force and Motion Achievement Test, Cronbach Alpha value for the pre-test was found as .40 whereas this value was calculated as .67 for the post-test. Due to the fact that this instrument measured student learning, the low reliability can be expected for the first application where the students were not familiar with the concepts asked in the instrument. To better identify which approach had the most positive effect on the students learning, the groups' pre-tests and post-tests were compared with each other by implementing independent t-tests. No significant differences were found among the groups' pre-test results considering learning. However, significance differences were found between the post-tests of the technology group and curriculum-based group as well as between the laboratory group and curriculum group as presented in Table 1. The mean value of the technology group ($\bar{x}$ = 27.56) was significantly higher than the mean value of the curriculum-based group ($\bar{x}$ = 20.13, p = 0.00). Similarly, the laboratory group's mean value ($\bar{x}$ = 27.20) was significantly higher than the curriculum-based group's mean value ($\bar{x}$ = 20.13, p = 0.00). The effect size between the technology and curriculum based groups was .58 and the effect size between the laboratory and curriculum based groups was .61. These values were not found to exceed Cohen's (1988) convention for a large effect (d = .80) but they were in medium level. In addition, there was not any significant difference between the post-tests of the technology group and laboratory group.

Table 1. Independent t-test results of the groups' post-tests regarding learning

Groups	**n**	$\bar{x}$	**ss**	**t**	**sd**	**p**
Technology	45	27.56	5.81			
Laboratory	44	27.20	4.81	.310	87	.757
Total	89					
Technology	45	27.56	5.81			
Curriculum-based	39	20.13	4.38	6.537	82	.000
Total	84					
Laboratory	44	27.20	4.81			
Curriculum-based	39	20.13	4.38	6.979	81	.000
Total	83					

Findings indicated that the students in all groups improved their learning of dynamics concepts after the instruction; however, the increase in the curriculum-based group was less than the increase in technology and laboratory groups. Although high school physics curriculum has been revised recently, it needs to support more activities based on technology and laboratory.

Technology group developed more knowledge than the curriculum based group. This result is consistent with the results presented by Jimoyiannis & Komis (2001). Laboratory group performed more learning progression than the curriculum based group. This finding is in line with the results that emerged from the research by Freedman (1997) and Wiggins, (2006). At the end of the instruction, there was not any significant difference in the students' learning who studied either in the technology group or in the laboratory group. This result supports what Akpan (2002) and Darrah et al. (2014) found in their research.

Results for Attitudes

The application of Physics Class Attitude Scale had high reliability where Cronbach Alpha value for the pre-test was .90 and it was .93 for the post-test. No significant differences were found among the groups' pre-test results when the attitude took into account. Nonetheless, significance differences were found between the post-tests of the technology group and curriculum-based group as well as between the laboratory group and curriculum group as presented in Table 2. The mean value of the technology group ($\bar{x}$ = 54.72) was significantly higher than the mean value of the curriculum-based group ($\bar{x}$ = 45.38, p = 0.02). Likewise, the laboratory group's mean value ($\bar{x}$ = 56.45) was significantly higher than the curriculum-based group's mean value ($\bar{x}$ = 45.38, p = 0.00). The effect size between the technology and curriculum based groups was .35 and the effect size between the laboratory and curriculum based groups was .42. In addition, there was not any significant difference between the post-tests of the technology group and laboratory group. When the students involved with more activities including technology and laboratory, their attitudes towards physics class enhanced.

Table 2. Independent t-test results of the groups' post-tests regarding attitudes

Groups	n	$\bar{x}$	ss	t	sd	p
Technology	43	54.72	8.57			
Laboratory	47	56.45	7.80	-1.000	88	.320
Total	90					
Technology	43	54.72	8.57			
Curriculum-based	37	45.38	15.10	3.331	55.090	.002
Total	80					
Laboratory	47	56.45	7.80			
Curriculum-based	37	45.38	15.10	4.054	50.975	.000
Total	84					

Technology group developed more attitude towards physics class than the curriculum based group. This result is consistent with the results presented by Marty (1985) and Grimm (1995). Laboratory group performed more progression in their attitudes than the curriculum based group. This finding is in line with the results that emerged from the research by Freedman (1997).

Attitude change takes time and needs having experiences. Since there was not any change in terms of instruction in the curriculum-based group, any change in attitudes of the students' in curriculum-based group was not expected. Since the participants were ninth grade students and studied physics discipline for the first time, eight-week duration was enough for the students in the technology and laboratory groups to change their attitudes.

Conclusions and Suggestions

Two conclusions can be drawn from the study. First, when students are given a chance to engage with technology and laboratory environments, they reach higher level of scientific understanding and tend to develop more positive attitudes toward physics class. And second, there is no difference between the technology supported instruction and laboratory based instruction in terms of their impact on students' learning of dynamics concepts and attitude towards physics class.

According to the results of the research, the following suggestions can be made for the instructors:

a) Technology would be used during the instruction where there is a lack of laboratory materials or in situations where experiments cannot be conducted in the school environment to facilitate learning and attitude.

b) Students should be taught how to use technology for the right purposes at the right time.

References

Akpan, J. P. (2002). Which comes first: Computer simulation of dissection or a traditional laboratory practical method of dissection. *Electronic Journal of Science Education, 6*(4): http://wolfweb.unr.edu/homepage/crowther/ejse/akpan2.pdf

Bozkurt, E., & Sarikoc, A. (2008). Fizik eğitiminde sanal laboratuvar geleneksel laboratuvarın yerini tutabilir mi? *Ahmet Keleşoğlu Eğitim Fakültesi Dergisi, 25*, 89-100.

Cicconi, M., (2014). Vygotsky meets technology a reinvention of collaboration in the early childhood mathematics classroom. *Early Childhood Education Journal, 42*, 57-65.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale: Lawrence Earlbaum Associates.

Coramik, M. (2012). *The effect of teaching magnetism unit with computer-aided and experiment-aided activities on 11th grade students? self-efficacy, metacognition, attitude, motivation and conceptual understanding.* Unpublished Master Thesis. Balıkesir University, Balikesir.

Darrah, M., Humbert, R., Finstein, J., Simon, M., & Hopkins, J. (2014). Are virtual labs as effective as hands-on labs for undergraduate physics? A comparative study at two major universities. *Journal of Science Education and Technology*, 23(6), 803-814.

Demirtas-Yilmaz, F. (2014). *A Meta-Analysis Of The Effects Of Laboratory Based Teaching On Students' Success*. Unpublished master thesis. Yuzuncu Yil University, Van, Turkiye

Finkelstein, N. D., Adams, W. K., Keller, C. J., Kohl, P. B., Perkins, K. K., Podolefsky, N. S., . . . LeMaster, R. (2005). When learning about the real world is better done virtually: A study of substituting computer simulations for laboratory equipment. *Physics Review Special Topics Physics Education Research 1*, 1-8.

Forssell, K. S. (2011). *Technological pedagogical content knowledge: Relationships to learning ecologies and social learning networks*. Unpublished doctoral dissertation. Stanford University, Stanford, CA.

Freedman, M P. (1995). *The relationship between laboratory instruction, attitude toward science, and physical science achievement among diverse ninth grade students.* Unpublished doctoral dissertation. Temple University, Philadelphia, PA

Freedman, M. (1997). Relationship Among Laboratory Instruction, Attitude Toward Science and Achievement in Science Knowledge. *Journal of Research in Science Teaching, 34*(4), 343-357.

Geban, Ö., Ertepınar, H., Yılmaz, G., Atlan, A., & Şahpaz, Ö. (1994). *Bilgisayar destekli eğitimin öğrencilerin fen bilgisi başarılarına ve fen bilgisi ilgilerine etkisi.* I. Ulusal Fen Bilimleri Eğitimi Sempozyumu. Dokuz Eylül Üniversitesi, İzmir.

Gokalp, M. S. (2011). *The effect of webquest based instruction on ninth grade students' achievement in and attitude towards force and motion.* Unpublished Doctoral Dissertation. Middle East Technical University, Ankara, Turkiye.

Grimm, C. R. (1995). *The effect of technology-rich school environments on academic achievement and attitudes of urban school students*. Unpublished doctoral dissertation. Old Dominion University, Norfolk, VA.

Jimoyiannis, A., & Komis, V. (2001). Computer simulations in physics teaching and learning: A case study on students' understanding of trajectory motion. *Computer & Education*, *36*(2), 183-204.

Koehler, M.J., & Mishra, P. (2008). Introducing TPCK. AACTE Committee on Innovation and Technology (Ed.), *The handbook of technological pedagogical content knowledge (TPCK) for educators* (pp. 3-29). Mahwah, NJ: Lawrence Erlbaum Associates.

Krathwohl, D. R. (1997). *Methods of educational and social science research: An integrated approach*. Reading, UK: Addison-Wesley.

Marty, J. F. (1985). *Selected effects of a computer game on achievement, attitude, and graphing ability in seconday shool algebra*. Unpublished doctoral dissertation. Oregon State University, Corvallis, OR.

McFarlane, A. E., & Sakellariou, S. (2002). The role of ICT in science education. *Cambridge Journal of Education*, *32* (2), 219 – 232

Norton, S. W. (1985). *The Effects of an independent laboratory investigation on the critical thinking ability and scientific attitude of students in a general microbiology class*. Unpublished doctoral dissertation. Auburn University, Auburn, AL.

Saka, A., & Yılmaz, M. (2005). Bilgisayar destekli fizik öğretiminde çalışma yapraklarına dayalı materyal geliştirme ve uygulama. *The Turkish Online Journal of Educational Technology,* 4, 120-131.

Wiggins, F. (2006). *The effects of hands-on science instruction on the science achievement of middle school students.* Unpublished doctoral dissertation. Texas Southern University, Houston, TX.

Zacharia, Z., & Anderson, O. R. (2003). The effects of an interactive computer-based simulation prior to performing a laboratory inquiry-based experiment on students' conceptual understanding of physics. *American Journal of Physics*, *71*(6), 618-629.

The Eurasia Proceedings of
Educational & Social Sciences (EPESS)
ISSN: 2587-1730

The Eurasia Proceedings of Educational & Social Sciences (EPESS), 2017

Volume 6, Pages 114-120

ICEMST 2017: International Conference on Education in Mathematics, Science & Technology

A DIGITAL TO ANALOG VOLTAGE CONVERTER EXPERIMENT FOR MICROCONTROLLER COURSE

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Abstract: Teaching modules and programming of a microcontroller through experiments is a very efficient method. Microcontroller programming usually also requires practical electronics knowledge. Variable analog voltage outputs are usually not available in common microcontrollers, but this type of signal is required for many applications. This experiment is proposed to teach digital to analog voltage conversion (DAC) using pulse width modulation (PWM) by a microcontroller. In the experimental procedure students should generate the PWM signal, develop digital to analog voltage regulator circuit, design a ripple filter, review the experimental results and answer the questions. Students are expected to observe and interpret the code writing, the digital to analog converter and ripple filter effect. This paper describes, the experimental procedure, the materials and methods used in the experiment and the main theoretical concepts, and determine the evaluation methods for the benefits of the experiment. This experiment will be applied to biomedical engineering undergraduates. Their performances will be evaluated through surrey questions and their grades.

***Keywords*:** Digital to analog conversion, pulse width modulation, microcontroller, ripple filter, laboratory experiment.

Introduction

A microcontroller is a chip that combines all the components of a microprocessor-based system with an integrated circuit. Microcontrollers are used as digital to analog to converter and analog to digital converter. Although analog to digital conversion (ADC) applications are very common, digital to analog conversion (DAC) applications are not so common but DAC is used in driving various electronic devices, sensor circuits and LED driving circuits. The aim of this experiment is to teach and let practice the students; generation of PWM signal, filter design and the regulation process of DAC.

In Başkent University, Biomedical Engineering undergraduates take electronic circuit design and programming lessons until the third grade. Microcontroller courses are thought to third-year students and it is continuation of theoretical and practical knowledge of the programming courses and circuit design courses which they took before. This experiment was prepared because theoretical knowledge would be more effective if supported by laboratory studies(Gibbins & Perkin, n.d.). This study concerns an implementation of DAC for Microcontroller Course.

This experiment aims to teach PWM signal generation, digital analog conversion and filter design in the direction of programming and electronic information that the student learns. The student is expected to generate the PWM signal by a microcontroller, convert this signal to analog using a filter, and design the required ripple filter circuit. Combining microcontroller programming with analog circuit design is expected to improve student's expertise and motivation.

- Selection and peer-review under responsibility of the Organizing Committee of the conference

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In literature, there exist several laboratory experiments that involve the design and the programming of microcontroller. Dias et all(de A Dias, da Silva, Kitani, Lagana, & Justo, 2016) describe an undergraduate course to teach microcontroller using automotive electronic systems. The course aims to improve students' hardware knowledge and software programming skills. Authors report that increasing complexity of laboratory projects make students more independent and develop their skills in project management and system integration.
Nurnberg et all (Nürnberg, Beuth, Becker, & Puente León, 2016) designed a laboratory course on microcontroller programming by processing digital signal. The aim of this course, to gain a perspective on information technology and to prepare students for more complex exercises in their later work. The students gained experiences in programming the microcontroller by solving simple tasks.

Ajao et all (Ajao, Olaniyi, Kolo, & Ajao, 2015) aim to solve the problems of developing students' understanding and skills in embedded system design by using microcontroller with applied laboratory experiments. According to this paper, this design has better conveniences over other similar works and it will lead students to build different simple systems with complex hardware circuit for research applications and industrial works.

This article explains the experiment plan and it gives the theoretical information about the components of the experiment set up. At first, it is explained how to generate PWM signal by using microcontroller. Then, technical information was given about the required filter designs and the signal values converted to digital were shown on the liquid crystal display (LCD). The success of the student on the experiment will be evaluated in three parts: preliminary work, experiment performance of the student and report. The impact of the experiment on student's motivation and understanding will be interpreted by survey questions to be asked before and after the experiment.

Materials and Methods

Pulse Width Modulation (PWM)

PWM is a technique for obtaining the analog signal desired to be produced at the output by controlling the widths of the pulses. The application of PWM technology is becoming increasingly widespread. PWM method is widely used in areas such as switching Mode power supplies, telecommunication, PIC applications and power circuits. In this experiment, the PWM signal generated by the microcontroller is used as digital data. When PWM signal is generated, two components are considered: duty cycle and frequency.

The duty cycle determines the ratio of time while the PWM signal is high to the period of the signal. Frequency is simple the frequency of the signal.

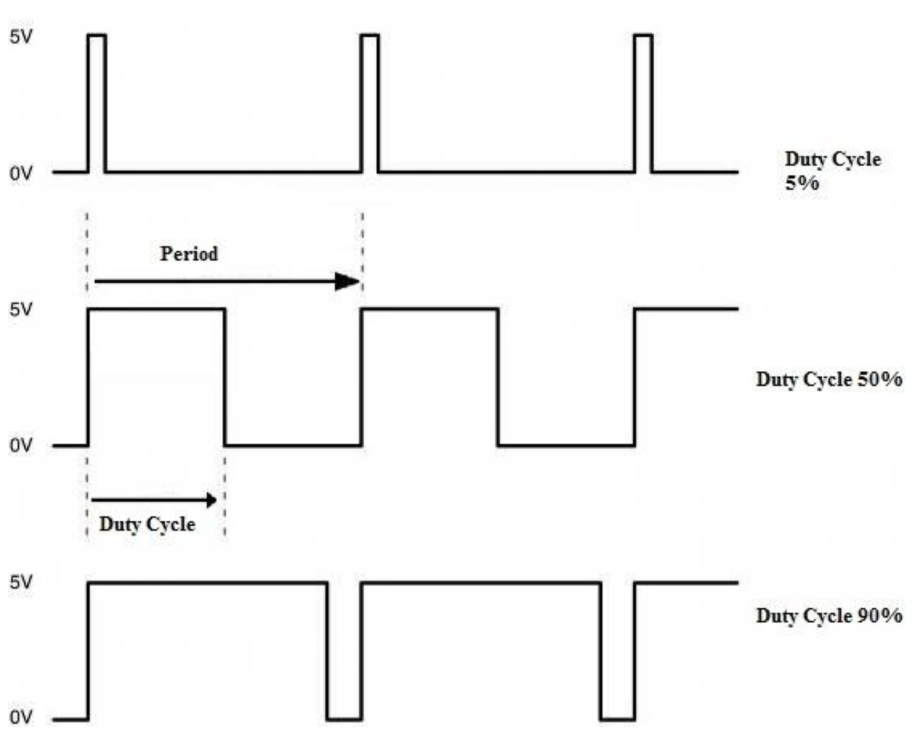

Figure 1. Duty cycle examples

In the experiment, PIC Clicker was used as microcontroller demo board for PWM generation. PIC clicker is a compact starter development kit. The duty cycle and the frequency of the PWM signal generated by the PIC clicker are adjusted through the code written by a microcontroller program According to the code, the duty cycle is increased or decreased depending on whether or not the buttons on the microcontroller are pressed.

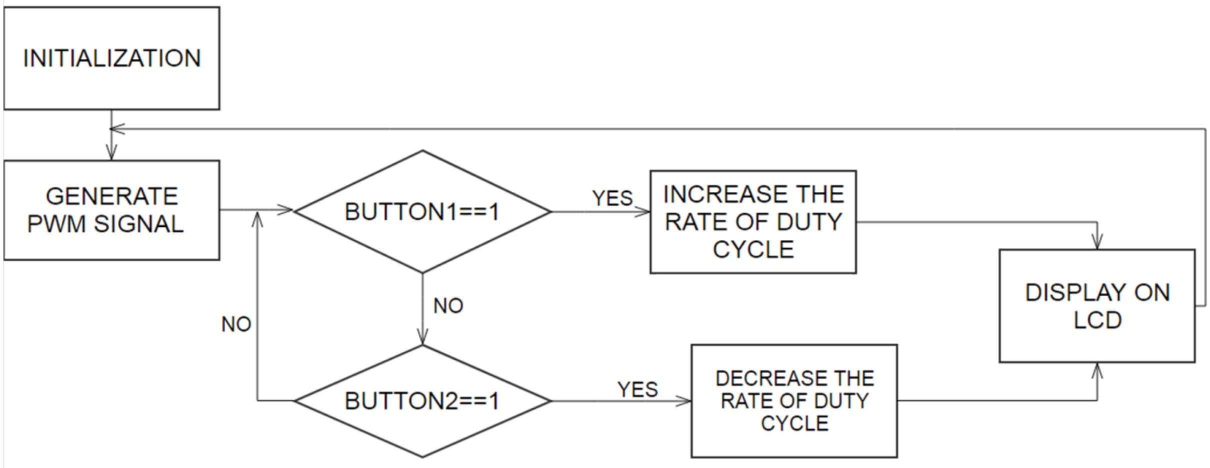

Figure 2. Microcontroller diagram

Low-pass and Ripple Filter Design

An electrical filter is a circuit that can be designed to reshape or reject all undesired frequencies of an electrical signal to transmit signals sought by the circuit designer. In this experiment design a low pass filter and a ripple filter were used .The low pass filter consisting of diode, capacitor and internal resistance of the system is used to find the DC signal corresponding to the PWM signal generated by the microcontroller. In this way, high frequency signals are blocked while low frequency signals pass. The signal obtained by suppressing the high frequency signals becomes smoother. When the PWM signal we have produced is high, the capacitor is charged. We used the diode to prevent the capacitor from discharging when the signal is low. Ripples are observed in the PWM signal passing through the low-pass filter. A ripple filter designed with using inductance and capacitor. And the ripple filter is used to eliminate these fluctuations.

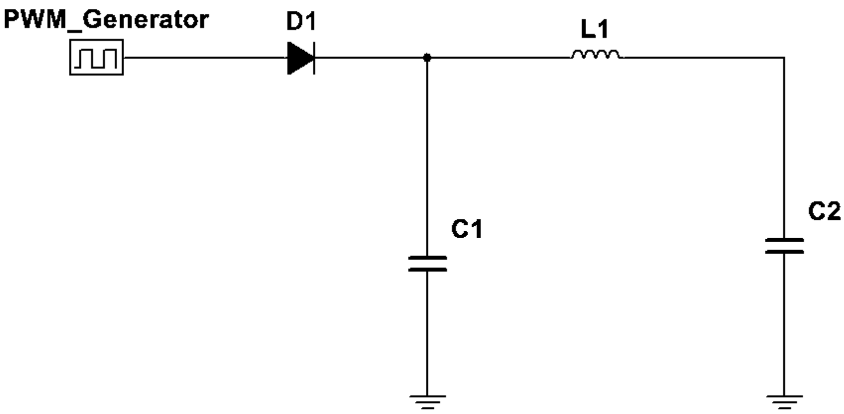

Figure 3. Filter circuits

Digital to Analog Conversion

Digital information such as 1 and 0 is referred to as digital analog conversions in circuits or integrated circuits that produce currents or voltages at different values according to the change in input values at the input and output, and this conversion is also called digital to analog conversion.

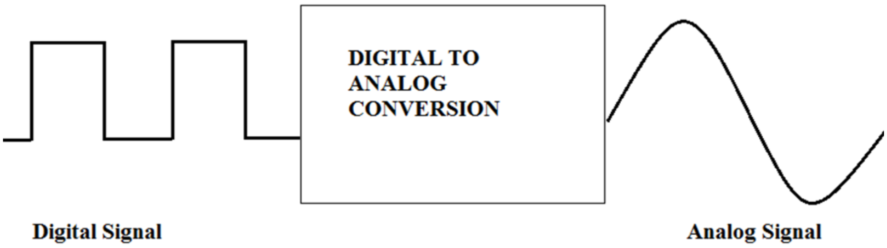

Figure 4. Digital to analog conversion

In this experiment, a microcontroller generates digital signals using pulse width modulation (PWM). The PWM signal produced to convert to analog signal has two important components; duty cycle and frequency. There is a direct proportion between the output voltage and the duty cycle. The output voltage is controlled by changing the duty cycle in the experimental setup. The PWM signals whose duty cycle was changed were observed with an oscilloscope.

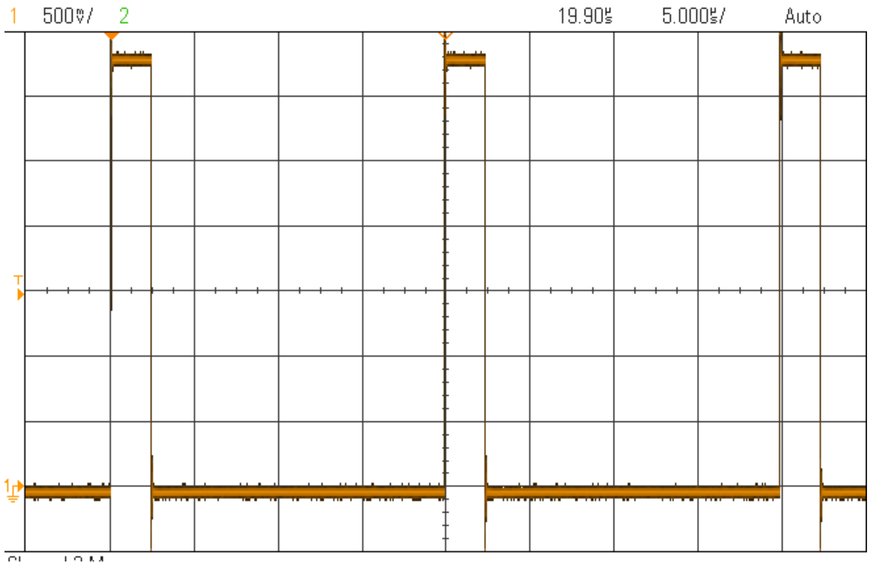

Figure 5. Image of PWM signal with 12.5% duty cycle

Experiment Design

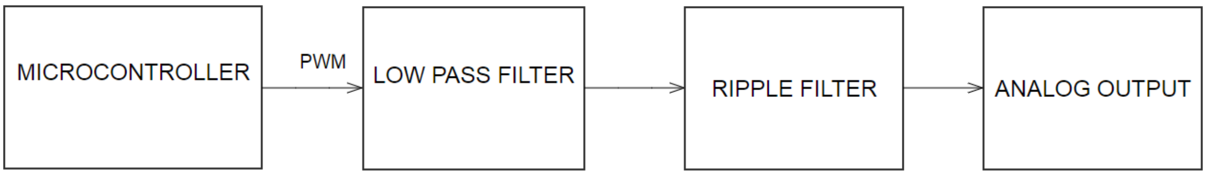

Figure 6. Experiment design block diagram

The students use the microcontroller to generate the PWM signal. First of all, students use the MicroC program to write the microcontroller code to be used in generating the appropriate PWM signal. When writing the code, the student is expected to know how to start the PWM module in the PIC Clicker demo board, set up the correct pin connections and adjust the duty cycle and make the LCD connections to display duty cycle.

After generating the PWM signal, students design the circuit that will make the necessary adjustments that will convert this signal to digital. They set up a low-pass filter circuit using a diode and a capacitor. This filter blocks the passage of high frequencies in the signal and makes the signal smoother. But this correction is not enough to create a complete digital signal. They set up a ripple filter circuit using an inductance and a capacitor to eliminate the ripples observed on the signal. In this way, a nearly flat digital signal is obtained. After that digital to analog conversion is completed. They observe the filter output through an oscilloscope and record their observations.

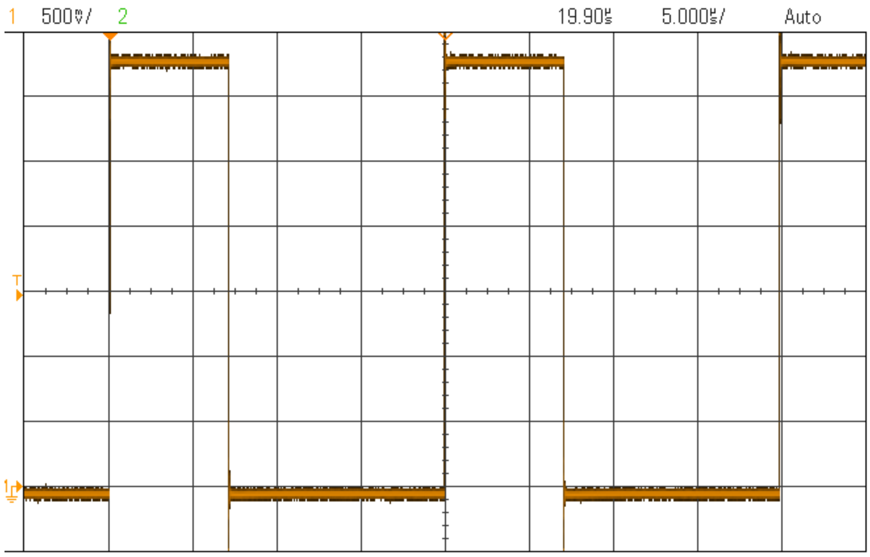

Figure 7. PWM signal

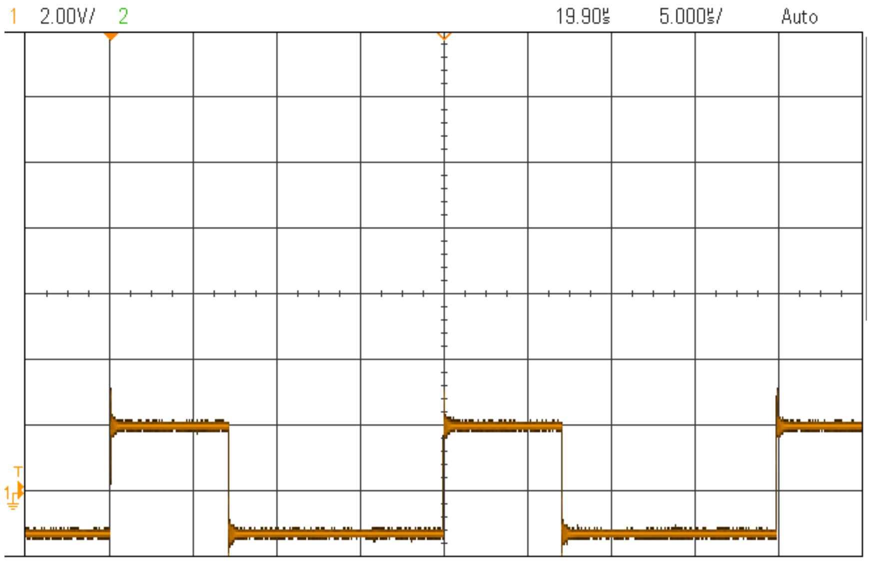

Figure 8. Effect of low-pass filter on PWM signal

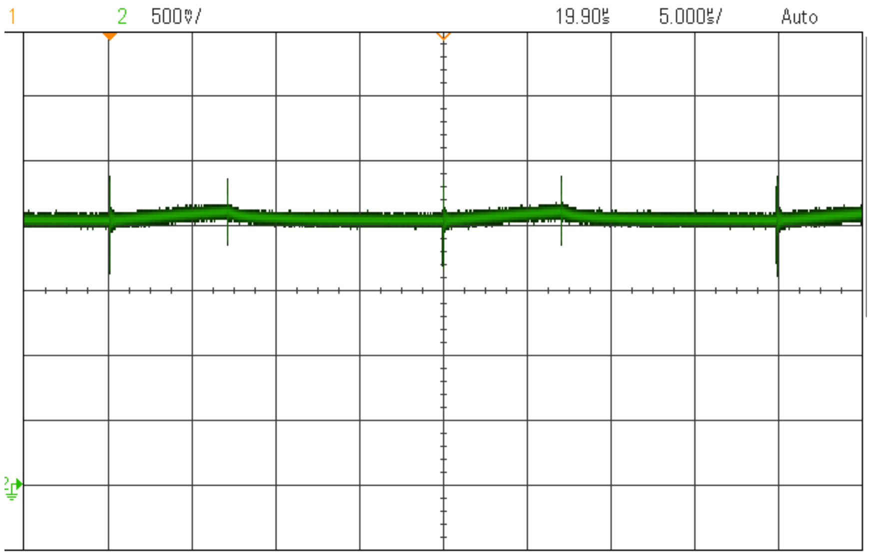

Figure 9. Effect of ripple filter on PWM signal

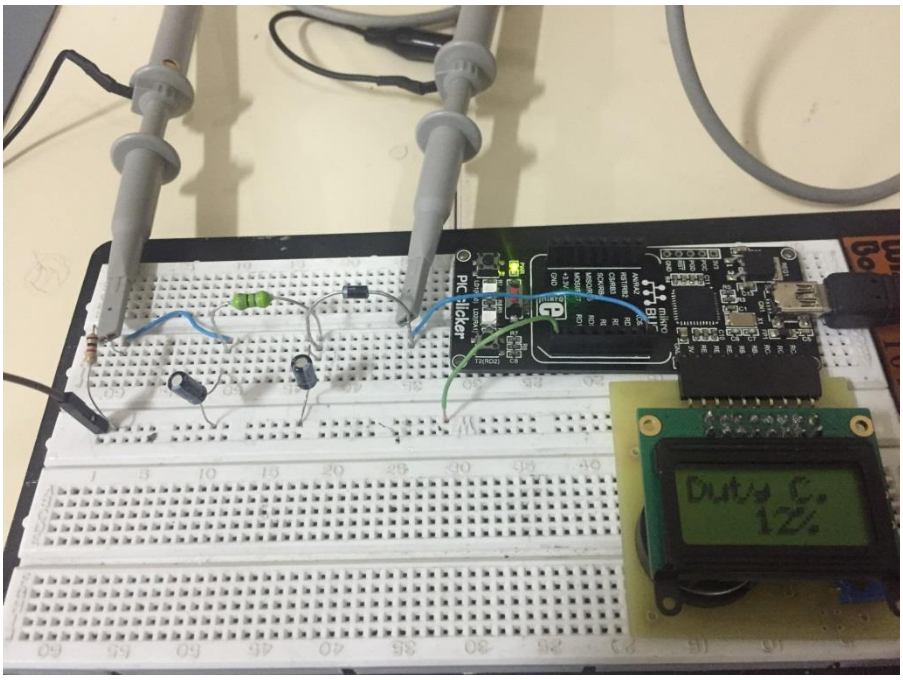

Figure 10. Experiment design

Evaluatıon Method

Questionnaires which will be applied before and after the experiment and grades will be used to evaluate the performance of the experiment. Similar studies related to the subject have been reviewed and questions in Table.1 and Table.2 are defined.(Chen et al., 2016) (Ibrahim, 2015)(Subudhi, 2016)

Table 1. Survey questions applied before the experiment

Questions	On a scale of 1 to 5 rate: (1=very poor, 2=poor, 3=satisfactory, 4=strong, 5=very strong)
Q1	Do laboratories increase your motivation about biomedical engineering?
Q2	What are the difficulty levels of laboratories?
Q3	Do you think the laboratories help you to improve your theoretical knowledge?
Q4	Are you having trouble designing in experiments?
Q5	Do you think laboratories are complementary to the course content?

Table 2. Survey questions applied after the experiment

Questions	On a scale of 1 to 5 rate: (1=very poor, 2=poor, 3=satisfactory, 4=strong, 5=very strong)
Q1	Did this laboratory increase your motivation about biomedical engineering?
Q2	What is the difficulty level of this laboratory?
Q3	Do you think this laboratory helped you to improve your theoretical knowledge?
Q4	Did you have trouble designing in experiments?
Q5	Do you think this laboratory is complementary to the course content?

The students' laboratory success will be graded according to the preliminary work, performance during the experiment and the report they delivered at the end of the experiment.(Ogrutan & Aciu, 2017) The papers prepared for the preliminary work contain the theoretical information required for the experiment and the study questions related to the subject for the student. The performance of the students during the experiment is assessed by the course teachers and their assistants. The report that students record observations at the time of experiment and write their inferences is graded at the end of the experiment.

Conclusion

Laboratory works including electronics design could be tough for the students. For Biomedical Engineering students it is even tougher because they should both use electronics and medical concepts. Laboratory design experiments are mandatory because they should practice theoretical knowledge. Since design is hard, general trend for students is to memorize and save the day.

In this study we offer a well-planned experiment in order to motivate students to make a design and test it. Our aim is to teach to students that generation of PWM signal, filter design, regulation process of DAC, programming microcontroller. The experiment described in this article is designed for biomedical engineering students in the third year for microcontroller laboratory at Başkent University. During the design process, students are taught how to produce the PWM signal used in many electronic applications, design the necessary filters, and program microcontrollers. The experiment design has a microcontroller for generating PWM, a low pass filter and ripple filter to regulate the generated signal, and an LCD to display the determined duty cycle.

Literature was searched for this experiment which was prepared to increase the motivation of the students and their interest in lessons. And the experiment was planned considering of researches made. Experiment will be evaluated according to the methods described in the paper.

References

Ajao, L. A., Olaniyi, O. M., Kolo, J. G., & Ajao, A. O. (2015). Project-Based Microcontroller System Laboratory Using Bk300 Development Board With Pic16F887, *5*(3), 15–28. https://doi.org/DOI : 10.5121/ijesa.2015.5302

Chen, H. Y., Nieh, H. M., Yang, M. F., Chou, Y. K., Chung, J. H., & Liou, J. W. (2016). Implementation of a Low-Cost Automated LED Photometer for Enzymatic Reaction Detection to Teach Basic Bioelectronics Technologies in Vocational High Schools. *IEEE Transactions on Education*, *59*(3), 194–201. https://doi.org/10.1109/TE.2015.2503337

de A Dias, B. M., da Silva, C. T., Kitani, E. C., Lagana, A. A. M., & Justo, J. F. (2016). Teaching microcontrollers using automotive electronic systems. *International Journal of Electrical Engineering Education*, *53*(1), 23–36. https://doi.org/10.1177/0020720915596750

Gibbins, L., & Perkin, G. (n.d.). Laboratories for the 21st Century in STEM Higher Education.

Ibrahim, D. (2015). Development of a low-cost educational liquid-level sensor circuit. *International Journal of Electrical Engineering Education*, *52*(2), 168–181. https://doi.org/10.1177/0020720915575926

Nürnberg, T., Beuth, T., Becker, J., & Puente León, F. (2016). An introductory microcontroller programming laboratory course for first-year students. *International Journal of Electrical Engineering Education*, *53*(2), 99–113. https://doi.org/10.1177/0020720915611439

Ogrutan, P., & Aciu, L. E. (2017). Laboratory Works Designed for Developing Student Motivation in Computer Architecture, *6*(1), 3–10. https://doi.org/10.18421/TEM61-01

Subudhi, B. (2016). A flexible robotic control experiment for teaching nonlinear adaptive control. https://doi.org/10.1177/0020720916631159

The Eurasia Proceedings of
Educational & Social Sciences (EPESS)
ISSN: 2587-1730

The Eurasia Proceedings of Educational & Social Sciences (EPESS), 2017

Volume 6, Pages 121-127

ICEMST 2017: International Conference on Education in Mathematics, Science & Technology

A TURBIDIMETER DESIGN EXPERIMENT FOR BIOMEDICAL ENGINEERING UNDERGRADUATES

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Abstract: This article describes a laboratory experiment to teach phototransistor and LED driver circuits and analog to digital conversion using a microcontroller through a turbidimeter design for biomedical engineering undergraduates. Teaching electrical circuits and concepts using a real design helps students to use the theoretical knowledge practically and apply it. This type of real application motivates students. The purpose of this design is to drive an LED by BJT transistor and to get a voltage value related to the absorbed light from the LED by phototransistor and to convert the voltage signal of the absorbed light into digital by using microcontroller. The test of turbidimeter in the experiment is applied by measuring the added soil to water in cuvettes. In this paper, similar experiments are reviewed, the experimental procedures are explained, the methods for evaluation the success of the experiment are determined. As a further work experiment will be applied to biomedical engineering undergraduates and evaluation of their success and motivation will be reviewed.

Keywords: Turbidimeter, transistor, microcontroller, laboratory experiment.

Introduction

Student motivation is an important influence on learning. Working with practical application can increase the motivation and enthusiasm of the students according to the results observed in laboratory studies. This laboratory experiment aims to increase the motivation of students by designing an electronic measurement device name Turbidimeter that can be used in biomedical applications.

In Başkent University Biomedical Engineering Department, Biomedical Engineering undergraduates take circuit theory, electromagnetics, electronics and digital logic lessons until the third grade. In the curriculum for biomedical engineering, Medical Electronics and microcontroller courses are thought to third-year students and those courses are a combination of theoretical and practical knowledge of the other courses which they took. This study concerns a Turbidimeter design laboratory experiment for Medical Electronic Course.

The experiment aims to test the student's knowledge about light emitting diode (LED) driving circuits, transistor and phototransistor circuits, microcontroller programming. During the experiment, the student, sets up the BJT controlled Infrared LED driver circuit, obtains a voltage value for the light absorbed from the LED by a phototransistor, and converts this voltage value from analog to digital using microcontroller.

There are several similar laboratory experiments reported in the literature. Doğan (Ibrahim, 2015), designed and report a laboratory experiment of a low-cost educational liquid-level sensor circuit. The author report a survey that was conducted among 15 students completing the laboratory experiment where students were asked to comment on the system and most of the students (80%) had good results and found the experiment very informative.

- Selection and peer-review under responsibility of the Organizing Committee of the conference

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Chen, et. all (Chen et al., 2016) describe the development of a home-assembled, low-cost blue light-emitting diode (LED) photometer. This photometer measure the contents of substances in biochemical samples such as protein, amino acids. It can enable students to develop well-rounded professional knowledge and skill in bio detection electronics. According to this paper, this photometer is cheaper than existing systems. It has significant advantages and ease of use.

Kim et. all (Kim & Schubert, 2015) explored a simple laboratory exercise that would allow students to determine transistor model. In the experiment, the aim is to carry out a meaningful laboratory study on the amplifier frequency response to find the actual capacitor values. The course teachers evaluated whether this experiment increased student knowledge about modeling high-frequency transistors.

This paper describes the laboratory experiment plan and the theoretical knowledge that it requires. In the first section the turbidimeter is explained. Than in the materials and methods section theoretical information of circuit elements, microcontroller setup is described step by step. In the evaluation methods section, the experiment performed by the student and the success of the experiment on the student education will be evaluated according to the pre-determined survey questions.

Turbidimeter

Turbidity is the cloudiness of a fluid medium. Turbidimetry is the measurement method by measuring the absorbed light passing through the sample where the particle is located. Turbidimeter is a device that measures turbidity. Most turbidimeters have a cuvette to hold the fluid, a light source directed to the cuvette, and one or more photo detectors to measure light passing through the fluid. Turbidimeter can be used in microbiology analyzers and coagulation analyzers. It is also used to determine the protein content in biological fluids such as urine and body fluids. (Duggal, 2007)

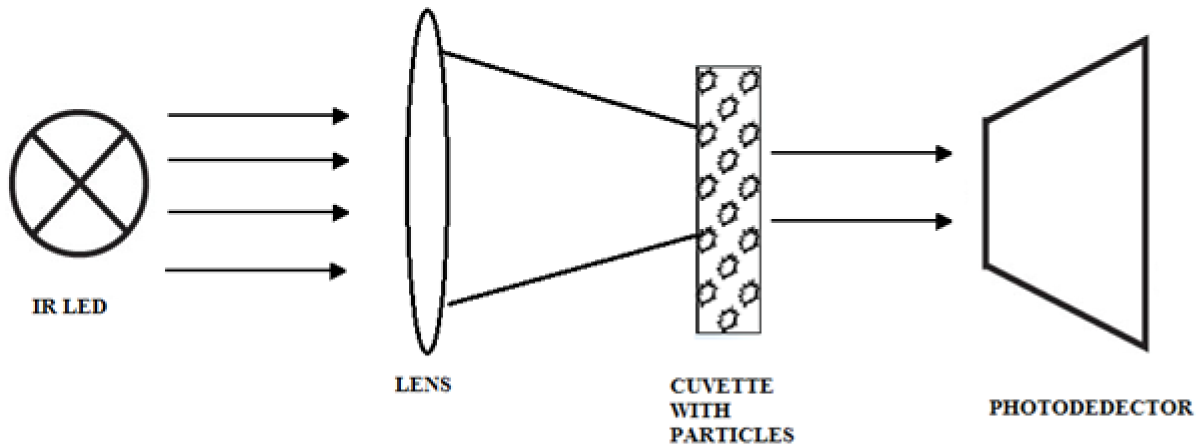

Figure 1. Turbidimeter diagram

Material and Methods

LED Driver Circuit

In the LED driver circuits (Figure 1), the received electrical signals are transformed to light. The light emitter is a 5mm Infrared LED (Everlight, IR533C) with peak wavelength of 940 nm. Its spectral bandwidth is 45 nm (Free & Diode, n.d.). One of the main components of the LED driver circuit is the transistor.

The transistor is an NPN Silicon amplifier transistor (On Semiconductor, BC337) with maximum collector current of 800 mA (Ratings, Characteristics, & Diagram, 2013).

The infrared light emitter is driven by the collector current of the transistor. The collector current value is controlled by a variable resistor and the current passing through the LED is changed according to that. This change affects the brightness of the LED.

LED driver circuit is used as variable intensity light source for Turdimeter design.

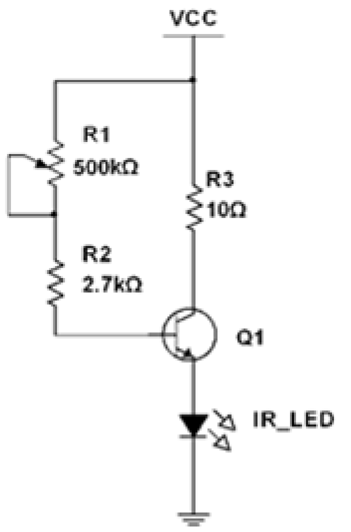

Figure 2. The LED driver circuit

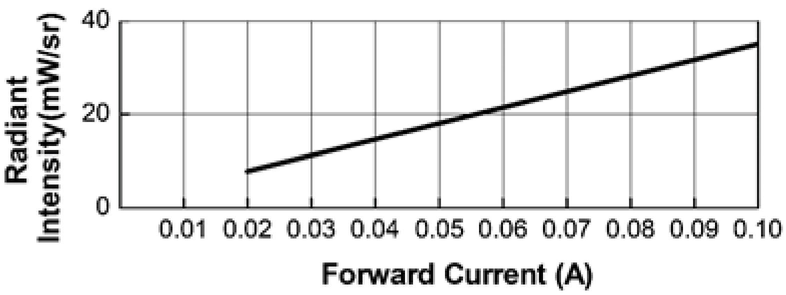

Figure 3. The LED's intensity/forward current graph

Phototransistor Circuit

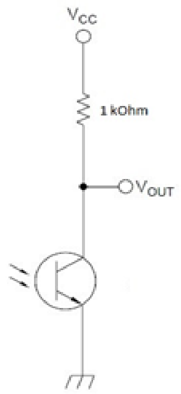

Figure 4, Phototransistor circuit

Phototransistor uses light rather than electricity to control an electrical current to flow from its collector to emitter. Silicon NPN Phototransistor (Siemens, SFH303-FA) operates at wavelengths between 450 nm and 880 nm (Merkmale & Group, n.d.). This working range is suitable for the wavelength range of the LED used in the experiment. The light from the LED is received by the phototransistor and converted into base current. The current flow from collector of phototransistor is proportional to the absorbed light. By using a resistor on the collector input of phototransistor the current change can be monitored as a voltage value as shown in Fig 3.

Microcontroller Circuit

In order to display the measured light intensity a turbidimeter should have a display. In the designed experimented a microcontroller demo board with a built in Liquid Crystal Display (LCD) is used for monitoring the output voltage of phototransistor circuit. Microcontroller is an element that combines all parts of a microprocessor based system into a single integrated circuit. In this experimental setup, a microcontroller with an A/D is used to convert received analog voltage value to digital. Voltage values converted from analog to digital by the microcontroller are displayed using LCD.

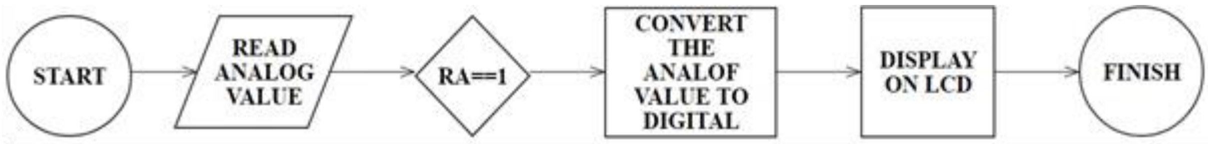

Figure 5. Microcontroller diagram

The output voltage of phototransistor circuit is an analog value. This value should be converted to digital to be displayed on LCD. To apply this conversion to ADC channels of PIC Clicker was used. The PIC Clicker which be used in the experimental design has 12-bit ADC. It has been shown how the ADC unit apply this conversion in Fig.4 With the A-D control register ADCON1, which ports and bits are to be used as analog inputs, is selected. The analog input channel (AN0, AN1, etc.) is also selected with channel control register ADCON0.

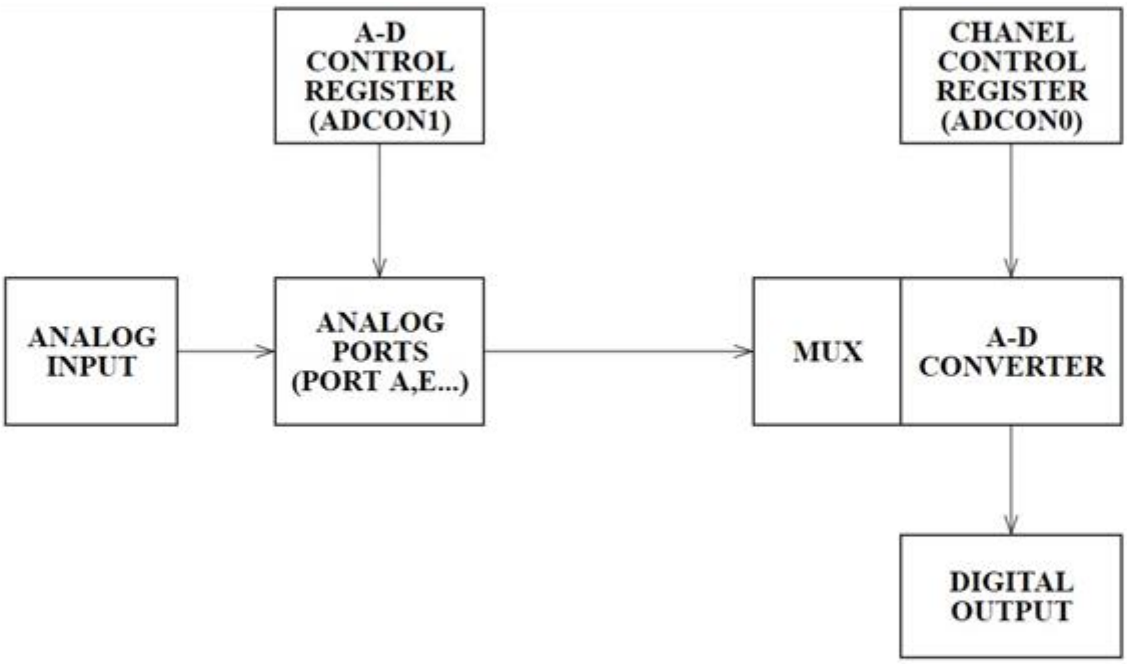

Figure 6. Analog digital converter (ADC) algorithm

Experiment Design

First of all, the student sets up the led driver circuit with the BJT transistor, changes the current through the LED by controlling the variable resistor in the circuit and records the result. Then establishes a circuit with the phototransistor to receive the light that the Led has been emitting and measures the voltage value of the phototransistor from the collector. This value, which is measured without putting a sample with particle between LED and phototransistor, is accepted as default. The student makes a comparison between the other measurements taking into account this value. The student uses water samples with different levels of particles prepared in advance to observe the working principle of the turbidimeter. Five different levels of water samples with soil are prepared by students. The five levels at which the measured voltage variation on the phototransistor is best observed are provided by 50 mg to 250 mg of soil. The student records the measured voltage values by placing the samples at each level between the LED and the phototransistor.

In the next step of the experiment, the student converts the voltage values measured from the collector into digital with the microcontroller and displays on the LCD. To be able to do this process, the student must program the microcontroller. At the end of the experiment, the students are expected to fill in a report in the direction of their observations.

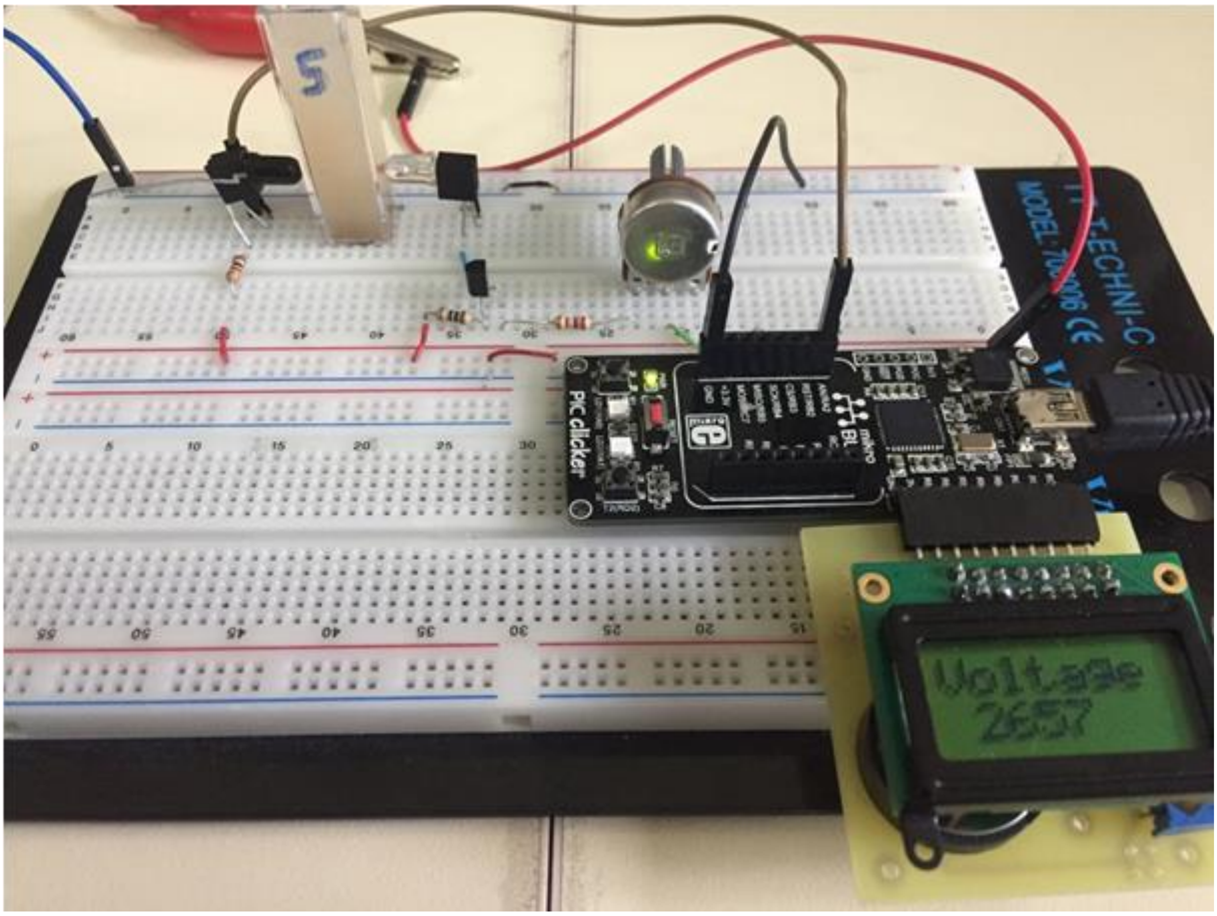

Figure 7. Experiment design

Evaluation Method

In order to evaluate the performance of the experiment, survey before and after experiment and grading will be used.(Subudhi, 2016) For the survey questions, similar applications are reviewed and questions in Table.1 and Table.2 defined.(de A Dias, da Silva, Kitani, Lagana, & Justo, 2016)

Table 1. Questionnaire used to evaluate students general approach about laboratory experiments on medical electronics

Questions	**On a scale of 1 to 5 rate: (1=very poor, 2=poor, 3=satisfactory, 4=strong, 5=very strong)**
Q1	Do laboratories attract your interest?
Q2	What is the difficulty level of laboratories?
Q3	Do you think the laboratories are instructive?
Q4	Do you think projects, related to a real application, enhance your skills in hardware and software?
Q5	Did laboratory experiments increase your understanding of the course?

Preliminary work, student performance and prepared test report are considered and graded. In the preliminary study, basic theoretical information is given about the experimental subjects and it is requested to answer the preparation questions for the experiment. The assistants assess students' performance by observing them during the experiment. The report delivered by the students is graded at the end of the experiment.

Table 2. Questionnaire used to evaluate students general approach about this laboratory experiment on medical electronics

Questions	On a scale of 1 to 5 rate: (1=very poor, 2=poor, 3=satisfactory, 4=strong, 5=very strong)
Q1	Did this laboratory experiment attract your interest?
Q2	What is the difficulty level of this laboratory?
Q3	Do you think this laboratory experiment was instructive?
Q4	Do you think this project, enhance your skills in hardware and software?
Q5	Did this laboratory experiment increased your understanding of the course?

Conclusion

In engineering education, laboratory experiments are mandatory for practicing theoretical knowledge. It is hard for the students to design something they did not before. Most of the students try to pass the experiment by memorizing it. And also students’ motivation about what they learn at school is very important. Laboratory experiment should increase their interest about the lessons.

In this experiment, a basic turbidimeter circuit designed to measure students' knowledge of the courses which they take and to increase their motivation. If the experimental process is carried out as intended, the theoretical and practical knowledge and skills of the students develop. The designed turbidimeter circuit will be practically tested by the students and the results will be evaluated by the teachers. The designed test plan increases the skill and motivation of the student as it is a real device application.

The experiment designed in this paper will be used at Başkent University in third year medical electronic laboratory by students of the biomedical engineering department. Here, students designs LED driver circuit and photo detector circuit for basic turbidimeter design. The system includes a light source, a photo detector to receive the light, and water samples with soil to test the design. The microcontroller used in the turbidimeter design is used as the analog to digital converter. A survey will be conducted among the students before and after the laboratory experiment. A literature survey of similar studies was done. In the results of the research, the experiment described in the article was planned. Experiment will be evaluated according to the methods described in the paper.

References

Chen, H. Y., Nieh, H. M., Yang, M. F., Chou, Y. K., Chung, J. H., & Liou, J. W. (2016). Implementation of a Low-Cost Automated LED Photometer for Enzymatic Reaction Detection to Teach Basic Bioelectronics Technologies in Vocational High Schools. IEEE Transactions on Education, 59(3), 194–201. https://doi.org/10.1109/TE.2015.2503337

de A Dias, B. M., da Silva, C. T., Kitani, E. C., Lagana, A. A. M., & Justo, J. F. (2016). Teaching microcontrollers using automotive electronic systems. International Journal of Electrical Engineering Education, 53(1), 23–36. https://doi.org/10.1177/0020720915596750

Duggal, K. N. (2007). Elements of Environmental Engineering. Ram Nagar,New Delhi: S. Chand&Co.,2007.

Free, P., & Diode, I. E. (n.d.). 5mm Infrared LED.

Ibrahim, D. (2015). Development of a low-cost educational liquid-level sensor circuit. International Journal of Electrical Engineering Education, 52(2), 168–181. https://doi.org/10.1177/0020720915575926

Kim, E. M., & Schubert, T. F. (2015). A laboratory exercise to improve student understanding of dominant pole analysis and high-frequency modeling of Field Effect Transistors. International Journal of Electrical Engineering Education, 52(2), 155–167. https://doi.org/10.1177/0020720915575924

Merkmale, W., & Group, S. (n.d.). SFH 303 SFH 303 FA Silicon NPN Phototransistor SFH 303 SFH 303 FA SFH 303 SFH 303 FA, 1–6.

Ratings, M., Characteristics, T., & Diagram, M. (2013). BC337-40 Amplifier Transistors, 1–5.
Subudhi, B. (2016). A flexible robotic control experiment for teaching nonlinear adaptive control. https://doi.org/10.1177/0020720916631159

The Eurasia Proceedings of
Educational & Social Sciences (EPESS)
ISSN: 2587-1730

The Eurasia Proceedings of Educational & Social Sciences (EPESS), 2017

Volume 6, Pages 128-141

ICEMST 2017: International Conference on Education in Mathematics, Science & Technology

INTEGRATING STEM IN AN ENGINEERING DESIGN PROCESS: THE LEARNING EXPERIENCE OF RURAL SECONDARY SCHOOL STUDENTS IN AN OUTREACH CHALLENGE PROGRAM

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Abstract: This research was conducted to evaluate the learning experience of Grade Ten students from two Malaysian rural secondary schools that adopted the integration of STEM in an Engineering Design Process (STEM-EDP) approach vis-á-vis an outreach challenge program. A total of 89 students undertook a ten hour program which engaged them in designing and building three different prototypes as well as answering higher order thinking questions. Data on students' learning experience were captured through teachers' field notes, and participants' responses to open-ended questions. The STEM-EDP outreach challenge program brought awareness to rural school students of their potential as problem solvers, thinkers, creators, and collaborators. Students were able to simultaneously broaden their boundaries in knowledge and competency even though they experienced difficulties in tackling challenges associated with STEM activities. Findings suggested that the STEM-EDP approach can be applied as a means for fostering creativity, problem solving skills, and thinking skills among rural secondary school students.

***Keywords*:** Engineering design process, higher order thinking, outreach challenge program, rural schools, STEM.

Introduction

The demand for a science, technology, engineering and mathematics (STEM) driven workforce in Malaysia has become a burgeoning need as the economy has evolved from a production-based economy to a knowledge-based economy. By the year 2020, it has been estimated that Malaysia will be in need of 500,000 skilled STEM workers (Academy of Sciences Malaysia, 2015). Undeniably the supply of STEM related workforce is highly dependent on new entrants into STEM related programmes in upper secondary as well as tertiary level. However, research has shown that only a total of 45% of students have enrolled in science stream, and technical and vocational secondary school classes in 2014, which is still far from the ideal ratio of 60:40 Science/Technical: Arts Policy set in 1970 (Yong & Phang, 2015; Ministry of Education Malaysia, 2014).

The challenge of achieving the 60:40 Science/Technical: Arts Policy is even tougher for the vast rural areas of Malaysia due to its limited infrastructure, lack of good schools and small population (Ling, Mahdib, Mohamadin & Manaf, 2015). Sabah, an East Malaysian state with a relatively high proportion of students in rural schools is facing a more challenging situation with respect to its efforts to reform rural schools. Many rural primary and secondary schools are located in wide and isolated areas with unique topography (Malaysian Digest, 2011). Some schools, for example, are located in areas with limited road access and as is often the case, water transport such as boats is used. According to the Sabah Economic Development and Investment Authority Blueprint (SDC, 2011), 72% of Sabah's schools were located in rural areas. In terms of infrastructure and basic utilities, most rural primary and secondary schools in Sabah lack supplies of 24-hour electrical connection and clean water, access to good teaching and learning resources, computers, and science laboratories. It is apparent that these limited opportunities and facilities have somewhat created a gap in education attainment between rural and urban schools in Sabah and in Malaysia as a whole.

In its report about Malaysian rural schools, the World Bank (2010, p. 92) noted that: "Potentially as a result of less favourable conditions in rural schools, students from rural and remote schools perform significantly worse

- Selection and peer-review under responsibility of the Organizing Committee of the conference

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on tests than their peers in urban areas. Disparities within states between rural and urban areas are most prevalent in poorer states like Sabah". Specifically, the World Bank (2010) reports a disparity between urban and rural secondary schools' achievement in Mathematics among Malaysian students at Grade 9 (15 years of age). It is clear that many rural school students have lagged behind their peers from urban schools in academic performance due to inadequate infrastructures, utilities and learning resources.

As a consequence, despite many new initiatives aimed at transforming rural schools, it is a difficult task to achieve in the near future (Malaysian Digest, 2011). Similarly demanding is the revitalizing of Malaysian rural secondary schools in STEM education. Undeniably, information about the best practices from new initiatives or programs in rural secondary schools can be used as a reference to revitalize rural schools in the Malaysian context. As long as the right approach is put in place, the quality of Malaysian rural secondary schools can certainly be improved and in the intervening time, the gap between rural schools and their urban counterparts can be minimized or possibly closed.

In countries such as Colombia and the United States of America, an outreach program is usually designed to help and encourage disadvantaged students of rural schools to increase their science, technology, engineering, and mathematics literacy and enthusiasm. This afterschool program aims to improve the quality and reach of STEM education at all levels. These initiatives raise the questions, "How would an outreach program help less privileged students in Malaysian rural secondary schools learn about STEM?". Tackling questions like this, particularly in rural settings often requires innovative solutions. There is also a need to propose an integrated program which allows science teachers to seamlessly examine what rural school students would learn and difficulties faced during the outreach program.

Theoretical Background

Engineering Design Process and Problems

Many researchers propose engineering design process as a means of solving challenges in STEM fields (Farmer, Allen, Berland, Crawford, & Guerra, 2012; Householder & Hailey, 2012; Hynes, Portsmore, Dare, Milto, Rogers, & Hammer, 2011). The Massachusetts Department of Education (2006, p. 84) proposed eight steps of engineering design process which provide a guide for teachers and curriculum coordinators regarding learning, teaching, and assessment in science and technology/engineering specific content from Pre-Kindergarten to Grades 6-8 and throughout high school. Those eight steps of engineering design process include identifying the need or problem, research the need or problem, develop possible solution(s), select the best possible solution, construct a prototype, test and evaluate the solution, communicate the solution, and redesign. Wendell, Wright, and Paugh (2015) found evidence that specific instructional support built upon student resources could create more pathways to success and learning during the different phases of engineering design. Additionally, students could create and communicate design ideas to each other while engaging in practices. The use of the engineering design process as an instructional framework is intended to ensure that all pedagogical practices are contextualized within the engineering design process so that students research, calculate, test, brainstorm, build and perform activities to fulfil STEM-design challenges (Berland, Steingut & Ko, 2014; Farmer *et al.*, 2012).

Farmer *et al.* (2012), and Householder and Hailey (2012) have demonstrated how engineering design problems embedded in the context of an engineering design process in secondary school science classrooms could scaffold in building engineering skills and habits. As outlined by Khandani (2005), and Mentzer, Huffman and Thayer (2014), engineering design problems in practice tend to be structurally open-ended and highly complex. An open-ended problem may have various acceptable solution paths and be limited by rigid and negotiable constraints which are not always presented with the problem. Engineering design problems are also designed to be 'ill-defined'. Greenwald (2000) characterized an ill-defined problem as being: ''unclear and raises questions about what is known, what needs to be known, and how the answer can be found. Because the problem is unclear, there are many ways to solve it, and the solutions are influenced by one's vantage point and experience'' (p. 28). King and Kitchener (1994) claims that an effective technique for developing problem-solving and critical-thinking skills is to expose students to "ill-defined" problems in their field.

Many researchers claim that STEM curricula can be integrated in an engineering design process to provide a mechanism through which students learn relevant STEM content (Hmelo, Holton, & Kolodner, 2000; Mehalik, Doppelt, & Schunn, 2008; Schunn, 2009). This mechanism encourages students to make connections, helps connect design failure or next steps to real world engineering and technology (Lottero-Perdue, 2015). Students learn important scientific concepts and their application in engineering and technology, as well as their relationship and application in daily life or real world context. Students could look for connections by engaging with activities or material in 'real-world' contexts to establish relevance. This approach can attract students' interest in science lessons and provide them with a deep understanding of concepts and meaningful learning. A research by Neo, Neo and Tan (2012) found that activities that students carry out in the real world were effective in teaching and engaging students in the classroom as well as increasing their understanding of the subject matter.

Hynes *et al.* (2011) noted that engineering design process that focus on solutions and construction of prototypes impel students to encounter the process of creative and critical thinking as well as problem solving skills. Hence, engineering design process would offer an effective route as an instructional framework for teaching STEM subjects among rural secondary school students.

Purpose of Research

Relatively few organized efforts have been directed to the integration of secondary school STEM subjects in engineering design process experiences. This research was therefore undertaken to investigate the learning experience of rural secondary school students (16 years old) on the integration of STEM in an engineering design process (STEM-EDP) outreach challenge program. It was also conducted to address some of the concerns how and whether the students could benefit in the aspects of creative and critical thinking, problem solving skills and applying relevant STEM concepts. Implementing a STEM-EDP approach in an outreach challenge program may provide the platform to address the numerous challenges that are fundamental to the STEM education of rural school students.

Research Questions

The research questions guiding this research are:

1. What have students learned through engaging with the program?
3. How did STEM-EDP activities aid the students in their creative and critical thinking, and problem solving skills?
4. What difficulties did the students face as they engaged with the program? What suggestions would students offer to overcome those difficulties?

Methodology of Research

Research Design and Participants

A single group with intervening STEM-EDP challenge program design was used in this research. The outreach program was conducted in two secondary rural schools in April and May 2015. The two selected schools are located in a rural area on the West Coast of Sabah, Malaysia. School A was about 215 km whereas school B was 160 km from Kota Kinabalu. The participants consisted of 89 Grade Ten Science Stream students, with each 49 and 40 respectively from school A and school B. Participants comprised 53 females (59.6%) and 36 males (40.4%) aged 16 years old. In the Malaysian context, students from the age of 16 have the opportunity to pursue two years of study in the upper secondary upon completion of the lower secondary education. Students who are academically inclined can choose between two main streams: the Science or Arts Stream. Seemingly, the Science Stream students are perceived to be more adept at performing in mathematics and science related subjects. Thus, purposive sampling was employed in the selection of the participants. According to Fraenkel and Wallen (2000) purposive sampling minimizes experimental contamination. Selection of Grade Ten Science Stream students who possessed knowledge, ideas or experiences of STEM relevant to the research would best help the researcher understand the research question (Creswell, 2003).

Students gathered into heterogeneous groups of four to five members on the basis of random selection in accordance with gender and ethnicity (diversity). The groups were assigned by the teacher so that there would be inclusion of students of high-, medium- and low competency levels based on their individual scores achieved in the end-of-semester examination. To ensure active and equal participation within a group, each student was assigned to perform a specific role: a reporter, recorder, runner, checker, and sketcher. All groups were given identical materials. At the start of the program, students were presented a letter of consent detailing the nature of their involvement in the program and the need to give their consent on the sheet provided indicating their full understanding. Code names were used for the data to ensure the confidentiality of the schools and individual identities.

A total of 22 science teachers from School A and 19 science teachers from School B participated as assessors and facilitators. They were trained to carry out the facilitation and assessment prior to the program. They stood of qualified science teachers with degrees in Science Education. They obtained a passing grade in the Research Methodology course (qualitative and quantitative) in their Masters course which they were undertaking at the time. A total of 18 of them helped the researcher develop the STEM activities and testing procedures. The researcher guided the science teachers on how to facilitate students through the seven steps of engineering design process in order to ensure the consistency and reliability in the implementation of the STEM activities across students and schools.

Data Collection

Research Data were collected through qualitative means: participant's responses to open-ended questions; and teacher's field notes. Teachers wrote their field notes based on the observation made during the STEM activities, and the focus group interviews with students. A total of 19 semi-structured focus group interviews were carried out after the completion of each STEM activity. The questions of the interviews were open ended (Table 1) and the students were encouraged to draw explicitly from their learning experiences of working on the STEM activities. Each focus group interview was conducted in groups consisting of 4-5 students. Table 1 shows the tools that were being used to address the corresponding research questions.

Table 1. Data capturing tools.

Research Questions	**Data Capturing Tools**
What have students learned through engaging with the program?	Teacher's field notes based on focus group interview and observation.
Question: What were some of the things about this program that students learned?	Open-ended questions. *"Something new students have learned today was…"*
How did STEM-EDP activities aid the students in their creative and critical thinking, and problem solving skills?	Teacher's field notes based on focus group interviews and observation.
i. What difficulties did the students face as they engaged with the program? ii. What suggestions would students offer to overcome those difficulties?	Teacher's field notes based on focus group interviews and observation.

Data Analysis

The qualitative data were analysed through thematic analysis. Thematic analysis is a form of a pattern recognition technique by searching through the data for emerging themes (Fereday & Muir-Cochrane, 2006). Two researchers independently reviewed teachers' field notes and students' responses to open-ended questions. They read the data line by line and identified recurring patterns in the data. The patterns identified by each researcher were compared to ensure validity of the codes. They dealt with codes which had no consensus by sharing their perspectives and concerns to reach common codes. Through multiple reviews and an iterative process, categories and codes were refined and grouped into themes.

Learning through STEM-EDP Outreach Challenge Program

The STEM-EDP outreach challenge program was designed with a focus on encouraging rural school students to solve an ill-defined problem utilizing the engineering design process to design, build, and test their creations. In the challenge, students would be asked to consider the constraints of the materials and time, identify the problem, think about what they already know, design, plan, construct, test and evaluate a physical prototype of their design.

The STEM-EDP program consisted of Six STEM activities (Appendix A) lasting about three hours and 20 minutes each. Three activities were introduced in each school with specific context to enhance learning and understanding of the STEM concepts. Students also needed to answer the Higher-Order Thinking (HOT) questions that stood of questions that were not strictly in their curriculum. In a way, answering HOT questions inspired students to acquire new found competences. Anderson and Krathwohl (2001)'s Taxonomy was used as a guide to develop a blueprint for the HOT questions, which belonged to the Analysis and Evaluation category of the cognitive domain. Some samples of HOT questions used were: 'In your opinion, if buildings were constructed identical to this prototype, is it safe to be inhabited? If yes/no, please explain why?'(Evaluation); 'How can your prototype be modified in order to improve its results in the future?'(Analysis); and 'Explain why there is a difference of the submarines' speeds between the two bottles? (Analysis)'. The HOT questions were specially designed to evaluate students' analysis, evaluation and communication skills in connecting STEM activities with their daily life.

Previous research (Siew, Amir & Chong, 2015) found that science teachers noted several potential challenges while implementing a STEM-Project-based learning approach in their rural school classrooms. These included inadequate materials, limited facilities and limited allocation of classroom time. Accordingly, the engineering design process employed in this program (Figure 1) removed the 'redesign' step proposed by the Massachusetts Department of Education (2006, p. 84). This modification was made to ensure that students could produce workable prototypes that made best use of the materials and time provided.

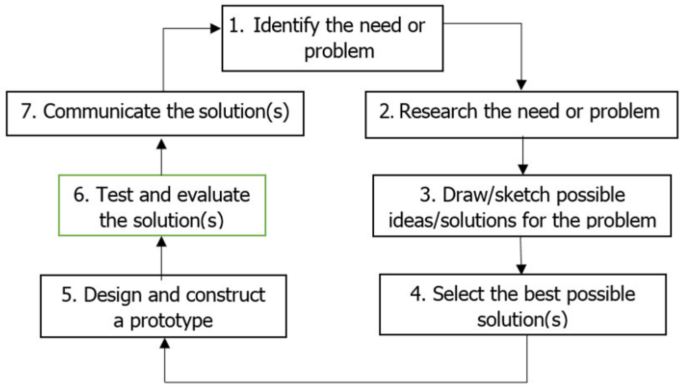

Figure 1. The seven steps of engineering design process (Adapted from Massachusetts Department of Education, 2006).

The advantages of the engineering design process in the teaching of STEM is that it focuses on solutions by constructing prototypes that drive students to encounter the process of creative and critical thinking, and problem solving skills. It allows students to realise that there are many ways to find solutions, as they engage in brainstorming to identify problems and propose solutions. The process of finding the optimal solution based on constraints requires participants to engage both in critical thinking and problem solving skills. Through the seven stages of engineering design process, learners are intended to develop creative and critical thinking, and problem solving skills while carrying out the STEM activities.

Prior to the program, students worked in teams to solve an ill-defined problem by designing and building workable solutions in forms of prototypes, which could be tested and fulfilled the criteria set in the problem. In this research an ill-defined problem was introduced to students within the context of their daily life. Thus, ill-defined problems become better defined and more contextualized as they were worked on and hence the solving and learning was through doing.

Students worked collaboratively to plan, design, construct, and test a prototype based on their prior and new knowledge; and demonstrated and tested their prototype to their peers and facilitators. The students were expected to be able to identify and discuss the science and mathematical concepts exhibited in their designs or prototypes. The STEM-EDP outreach challenge program promoted out-of-the-box creative thinking and discussions. Students were encouraged to find multiple, imaginative, intuitive and common sense solutions and not "one right answer" to a problem. The goal of this program was to enhance innovative and inventive thinking abilities of rural school students resulting in skills that can be applied in the Science, Mathematics, Engineering, and Technology fields.

Results of Research

Qualitative Analysis on Participants' Response

Science teachers' field notes and students' responses to open-ended questions were analysed using thematic analysis. A number of different themes in relation to STEM-EDP approach emerged from the data. The abbreviations used for the analysis are: "S" represents Student, "T represents Teacher, "SA" represents School A, "SB" represents School B and 'G' represents Group. The main findings are discussed below:

Students' acquisitions through engagement with the program

Application of Science, Technology, Engineering and Mathematics knowledge in solving daily life problems. Almost every participant (98%) noted that they benefitted from the STEM activities as they were exposed to real-life situations where Science, Technological, Engineering and Mathematical knowledge were applied for solving daily life problems. More importantly, STEM activities succeeded in providing a platform for them to apply scientific knowledge. Among the scientific concepts the students noted were related to water and air pressure, equilibrium of force, base area, balanced force, surface tension, stability, water density and the buoyancy force in a submarine. Students also pointed out that they were working like engineers. Related responses to open questions were:

"The activity integrates many of the STEM concepts such as water pressure (science), boat structure (engineering) and measuring length (mathematics)"(S39, S43);*"I could apply physics concepts in solving problems and thinking outside the box such as designing of floating needles and paper clips on the water's surface using the concept of water's surface tension"* (S31, S39); *and "We learned how to build balancing toys as if we were engineers"* (S78, S91).

T21, T30, and T36 (SB) confirmed that interviews with students revealed that they found the need to apply the concept of impulse in order to create an innovation to help absorb the impact of an egg being thrown from a high place. Furthermore, students were also able to explain that the concept of impulse was also applied in producing car air bags.

Application of scientific knowledge in designing and producing daily life products and answering HOT questions. A significant number of science teachers (88%) observed that a profound comprehension of scientific knowledge was needed in order for students to answer HOT questions every time a STEM session ended. Scientific knowledge did not only help participants answer high level questions but also helped them to be creative in reapplying knowledge learnt in the designing and producing of prototypes. For example, T5 and T10 (SA), and T6 and T19 (SB) observed that HOT questions gave students an opportunity to posit answers according to their thinking and make connections with scientific concepts they have learnt in class. Some of the evidences that showed students realised the importance of using scientific concepts in designing and producing daily life products include:

"I learnt that the Sink and Swim activity that involve the concept of weight and air pressure is very important in building a submarine" (S44); *"Scientific concept has always been applied in every creation"* (S7); *"It involves making daily life products through the applications of scientific concepts"* (S11, S37, S61).

T2 and T13 (SA) added that during the activity of creating a straw submarine, they observed that students discovered that the submarine needed to be designed with some air space inside it. When the plastic bottle was being pressed, it created pressure against the water in the bottle. Indirectly, the water in the bottle exerted pressure towards the air space in the submarine. Based on this understanding, students started to create different designs of submarines using straws. Students also discovered the different speeds of the submarine, moving up and down in two different solutions. Facilitators were even more satisfied that the students could answer the HOT questions correctly.

Connecting STEM activities with daily lives and scientific concepts learned. A large percentage (93%) of the science teachers noted in their field notes that participants learned how to make connection of the STEM activities with their daily life phenomenon. For example, T2, T18, T13 and T14 observed that students could relate how ships or boats function and why they could float on the surface of water by making comparisons with their boat models. Another example is when answering the HOT questions, participants could affiliate the floating needle and paper clip activity with the water strider bug, a floating log, water lilies, floating ants and others. T6 and T19 supported these claims by noting that "*Scientific knowledge is not only for answering exam papers but also useful in helping students create connections and explain situations faced in their daily lives. In* *this case, it is observed that students applied scientific concepts they learned during Physics lessons in problems given to them. Students not only applied the science principles and laws they learnt but also used them in practical forms*".

Designing and building something new and practical. A large percentage (96%) of the participants expressed in the open questions that STEM activities gave them an opportunity to create many new, interesting and practical science products using everyday materials. They stated that the balloon powered car made from plastic bottles was a new experience for them. They were fascinated with finding ways to make a highly powered car moved by air using ever ready materials such as glue, bottles, pencils and others. Another activity was making a boat. The students said they realised that play dough can float when shaped into a boat. Others noted that finding gravity centre through making the balancing toys was a new activity. Meanwhile, a few students commented that they discovered how to float the needles and paper clips while some noted their success in floating the objects.

According to T24 and T28, when participants were asked why they were excited with the STEM activity, they answered that: "*because we got the chance to design and build a new model which we only see in textbooks*". As for T20, T23, and T34, they observed that the students could design egg protection tools and that every group member worked together the whole time by contributing ideas and carrying out the projects as they had planned. Other than that, T13 and T14 also said that students showed interest in STEM 3 activity because they could become 'designers' of their own boat in the future. One of the members in the group shared her opinion by saying that, *"This activity gives me an idea of creating a modern boat that can give a great impact to the means of transportation"* (G6, S3). Thus, STEM activity, according to T13 and T14, seems to provide a very good start to stimulate the interest of students in learning Science.

Ways in which STEM activities have aided the students in their creative and critical thinking, and problem solving skills.

In their field notes, science teachers reported that all the participants agreed the activities they were engaged in had aided either in their creativity, critical thinking or problem solving skills through measures as discussed below.

HOT questions sparked critical thinking. A large percentage (93%) of the participants expressed through the open questions that they were challenged to think critically when answering the demanding questions in the STEM program. According to T4 and T11, students were capable of giving rational answers to the HOT questions. For example, one of the group members gave an excellent answer and showed that he/she understood the concept and was able to give a suggestion to improve the existing prototype if given the chance to design it with the aid of extra materials. From T4 and T11's observation, the HOT questions challenged the participants even in their groups. The sharing of answers added knowledge collectively to the group besides increasing their critical thinking skills.

Besides that, other teachers like T27, T31, and T39 (SB) also thought that the student's critical thinking was enhanced since each activity required students to answer HOT questions. The students felt that the HOT questions were difficult but they tried their best to answer and associate them with their prior knowledge. According to T24 and T28 (SB), two members from their group stated that STEM activities tested and challenged them to think outside the box using higher thinking skills.

Ill-defined problems inspired creativity and thinking. A significant number of science teachers (83%) reported that students faced complexities posed by ill-defined problems in the program. These ill-defined problems demanded from them effective response to the challenging tasks which in turn inspired creativity and thinking. For example, T26 and T33 stated that participants from groups Two and Seven admitted that STEM 3 activity was the most challenging because it demanded high thinking skills to solve problems and tested the students' creativity levels in creating a bottle car that was powered by a balloon. Participants had to figure out ways to move a car by using only air within a balloon. Participants also had to think of a method of reducing the car's weight and decrease its tire resistance. Besides that, T29 and T35 (SB) also declared that students found the STEM 2 activity challenging particularly when building a slide made of satay sticks tied together that needed high creativity skills.

T20, T23 and T34 (SB) also asserted that interview results showed that each student admitted that the problems posed in three activities were challenging. One of the male participants in their group admitted that he never knew that he could solve the challenge of building a slide using satay sticks in a short amount of time. On the other hand, participants in T25 and T40's group (SB) also claimed that STEM program encouraged them to think creatively as well as critically. This was because each activity had its own challenges.

For STEM 1 activity, which was the 'egg-astronaut', students were being hurried and struggled with having no ideas in using the materials given because *"slow to act as ideas came late*' (G4, S92). Nevertheless, discussions done from time to time enabled them to think creatively and they eventually made a sellotaped basket tied with three balloons. This idea came from their own group member and the inspiration for it came from their observation of the hot air balloon. Their own knowledge about hot air balloons helped them in this activity. Moreover, according to participants in T9 and T12's group (SA), *"The thing we like the most with this activity is that it challenges our mind to create something more creative that is to think of ways to produce balancing toys in a more stable way. This activity also tests patience"* (S3, G2).

Besides that, the problem of limited materials forced them to think creatively. Below is another example of an interview with student groups:

Students (SA; S4): I have to recombine other materials to make up a good raft.
Students (SA; S1): There is no glue, we need glue, teacher. No glue, so we have to think a bit critically to tie the straws together and minimize leakages.
Students (SA; S6): We redo the raft, well; it floats and still carries 18 marbles. I guess we managed to learn how to solve the problem. (Laughs)

Along with that, T5 and T10 noted that most respondents responded that STEM activities challenged them and their creativity for the sake of creating a working product that fulfilled the criteria needed in the specified rubric. As an example, the "Sink or Swim" activity needed students to identify methods or steps and design needed to make the paper clips and needles float on the surface of water.

Sketching, designing and constructing models fostered creative thinking and problem solving skills. A considerably large percentage (78%) of the science teachers noted in their field notes that participants stated that the activities of sketching, designing and constructing models helped to increase their creative thinking and problem solving skills. For example, T27, T31, and T39 (SB) noted that students expressed opinions that each activity encouraged creative thinking and also problem solving skills. This was because each activity needed students to sketch and design models according to the creativity of each group. Students noted that they had to think of a way to design models that worked and at the same time possessed creative elements. By observing the sketches in the three activities, T27, T31, and T39 (SB) found that there was improvement particularly in STEM activity 3. Besides that, students also said that their problem solving skills were highly stimulated because they had to solve problems in the stipulated time as well as create a working model out of the materials prepared.

Apart from that, T2 and T14 noted that participants became inventive when given the chance to design and produce their own functional straw submarine. One of them even stated that *"I liked this activity. Maybe, who knows, in the future, I can create my own submarine, because I already know the concepts of how to make it!" (G6, S2.).* T7, T15 and T17 (SA) also found that the 'Straw Submarine' activity challenged student's thinking skills as they noted: *"We can see that everybody was trying really hard to build the submarine. It can obviously be seen on their faces. All of them also stated that to build submarine is very hard compared to the previous activity".*

In addition, T2 and T14 stated that 'balancing toys' successfully induced creativity within students as almost every one of them were able to build a balancing toy with different designs. By using their creativity and imagination, students in group Six were able to create nine balancing toys with different designs. Furthermore, this activity also enhanced student's thinking skills. Students gained ideas on how to create their own toy design. Hence, it encouraged them to think more profoundly. What's more, from the interviews, students shared that this activity motivated their creative thinking. This was supported by observations made by T9 and T12 (SA) who noted that: *"Besides creating one 'balancing toy', students can think of ways to merge a few 'balancing toys' in a stable condition".* Moreover, T2 and T13 (SA) stated that the balancing toys activity successfully encouraged the creativity and imagination of the students as almost every one of them was able to build a balancing toy with different designs.

Another example was a boat making activity. From the provided materials, students designed two different kinds of boats, one from play dough and another from straws. This increased the number of marbles carried by the boat as long as the boat was stable enough to carry them. Brainstorming within the group produced new ideas and boosted the confidence of individuals, hence allowing them to do their best work in order to find optimal solutions.

Working cooperatively instilled thinking. In a statement by T4 and T11 (SA), students were in opinion that "Sink or Swim", the first STEM activity, challenged them to think of ideas and make many attempts without giving up in order for a needle and paper clip float. Suggestions from their friends in the groups helped them to increase their critical and creative thinking when making attempts to cooperate as a group to solve the problems. T6 and T19 (SA) also observed the mutual understanding shared among the group members while doing the activities and the cooperation in contributing ideas. T7, T15 and T17 (SA) reinforced that participants tried to solve and help each other to find the centre of gravity in order to create stable 'balancing toys'.

The challenge faced by the students during the program

Time Constraint. A major concern during the program was time constraint. T29 and T35 (SB) said that some students assented that it was tough to design the slide model in activity STEM 2. According to them, models built from sticks needed time but the time given was not enough. Time constraints caused them not to complete their model according to plan. Another pair who stated a similar problem was T26 and T33 of SB. They said that students in STEM 2 faced lack of time. T20, T23 and T34 (SB) also agreed that time was short and not enough for students to complete the STEM 2 activity. Similarly, T24 and T28 (SB) said that students from Group 1 complained that they did not have enough time to build a strong runway. Finally, T32 and T38 (SB) posited that participants from Group 3 found that the STEM 2 activity (slide invention) was the most arduous because the time given was too brief (S4, G3) and too many materials had to be assembled (S3, G3).

Students equipped with limited scientific concepts. T24 and T28 (SB) noted in their observation and interviews that students experienced difficulty in applying scientific concepts and knowledge in the implementation of the STEM-EDP program. The students were weak in mastering physics concepts, hence they needed to put in extra effort to relate physics principles in designing and building activities. For example, according to the students of group Four, their prior knowledge of scientific concepts was limited. This led them to be less creative in creating something unique for the STEM 1 activity. T7, T15 and T17 (SA) affirmed this:

"We found out that most of the students under our care cannot get the science concepts quickly, except the leader of group One. The main difficulty that the students faced was weak basic concepts in science. The next problem that we observed was, they did not know how to explain the concept, which can be seen in their answers for Higher Order Thinking (HOT) questions. For example, they only got one mark for question 2.3.2 because of insufficient explanation of the process involved when they pressed the bottle. This was the main reason why they got last placed in this program.

T6 and T19 (SA) noted that students encountered the difficulty of relating scientific concepts they have learnt in the classroom to the activity. For example in activity 1A, students were unable to link the scientific concepts such as buoyancy force and density to the design. Hence, a discussion among the students in determining the exact scientific concepts taught them to think using higher level thinking skills. They had to assess in detail the exact scientific concepts used to solve the problem in this activity. Additionally, T4 and T11 stated that students faced hardship in stating and explaining the concept of buoyancy connected with large ships made out of steel. In this matter, students could only give unfocused answers that did not match the suggested answers. This was seen when students tried to solve the problem of making boat models. Other facilitators responded:

"Students appeared to be unable to perform the activity, even after they understood what they have to do. This may be due to lack of ideas to create something that they are not accustomed to." (T1, SA).

"We have to give them hints such as 'force related to water' and giving them time to recall what they have learnt in the classroom. Fortunately, they remembered! Even though they knew the concept, they were not able to relate it with the activity." (T7, T15 & T17, SA).

Activities were too challenging. T20, T23, T24, T32, T34 and T38 (SB) remarked that participants experienced higher level thinking challenges in STEM activities As for T2 and T18's group, in the STEM 3 activity, students experienced obstacles in balancing the marbles on the raft. The dilemma was most felt when they had to choose a raft shape that could hold the most number of marbles. T7's group also found the same activity challenging. The interview finding was as follows:

: We faced so much problems with testing the raft on the water.
Students (SA; S1, S5) : ..... The leaks really cracked our brains. (Laughs)
: We tried many times to fix the raft but it was still leaking. Our brains are tired, (Smiles cheekily)

According to T2, T9, T12 and T18 (SA), students encountered hardship in balancing the 'balancing toys' even though there were several efforts done to tie them up. Students faced difficulty in finding the centre of gravity of the 'balancing toys' in order to create stable 'balancing toys. Even though the balance was the same, students found different designs had different centres of gravity. Nevertheless, after improvisation was done, each group was seen to be able to balance their 'balancing toys'.

T9, T12, T30, T21, and T36 reinforced that students were of the opinion that STEM activities were demanding especially when they tried to make a submarine float and sink. This was supported by their remarks: *"We found it extremely difficult to make the submarine float and sink. We tried many methods but we still could not manage. The activity undoubtedly tested our knowledge and skills*". This was also supported by the remarks made by T7, TT15 and T17:*"We found out that students were really engaged in 'Straw Submarine' compared to 'Sink or Swim' activity. This is because, according to students, 'Straw Submarine' is a more challenging and interesting activity because they must know the concept of buoyancy and how submarines work in order for them to build a straw submarine."*

Besides that, other teachers like T27, T31, and T39 (SB) revealed that all the students admitted that the STEM activities were challenging and that they needed to take high risks in making decisions in order for their models and designs to be built and function well using related scientific concepts and appropriate materials.

Students' suggestion for overcoming the identified source of problem

Extending the time. Time was a big issue in STEM 2 activity for school B in this program. According to T38 (SB), students suggested that time should be increased for STEM 2 activity which needed more time to construct the structure (G3, S1). T26 and T33 (SB) also noted the same suggestion for STEM 2 activities. Tuina, a student, stated that if time were increased, she and her friends would have been able to make better creations and do more trials so that weaknesses could be overcome. T24 and T28 repeated the same suggestion from participants for STEM 2 activity.

Discussion

The STEM subjects which were integrated into engineering design process provided a mechanism through which students learn to make connections by engaging in 'real-world' problems and contexts (Lottero-Perdue, 2015; Neo, Neo & Tan, 2012). In this present research, findings show that students were able to apply STEM knowledge in solving daily life problems, designing and producing daily life products and answering HOT questions. Students were also able to connect the STEM activities with daily lives and scientific concepts learned in the classroom, and to create new and practical products using everyday materials. This research makes clear that the execution of the proposed STEM-EDP program can help students in relating STEM knowledge to their real-world problems and contexts.

The STEM-EDP outreach challenge program not only allowed students to gain and integrate STEM knowledge but also provided an avenue to boost their creativity, critical thinking, and problem solving skills. Students' creative and critical thinking was sparked through solving HOT questions and ill-defined problems posed in the STEM activities. Students could respond effectively even with limited materials and time in organizing their thoughts to choose the best possible solution for their prototype using related scientific concepts. Lewis (2009) asserts that imposing some structure to open-ended design problems may assist in encouraging more creative thinking. Hynes *et al.* (2011) also noted that engineering design process provides students an opportunity to practice critical thinking skills as well as creative and outside-the-box thinking. King and Kitchener (1994) have also written about exposure to ill-defined problems that mimic those solved by real-world practitioners help students develop problem-solving and critical-thinking skills. This research demonstrates that STEM-EDP approach allows students to focus on solutions to ill-defined problems and construction of prototypes that could encounter them in the process of creative and critical thinking, and problem solving skills.

In addition, the research showed that activities such as sketching, designing and constructing a prototype have helped students to foster their creative thinking and problem solving skills. Students described how the engineering design process encouraged them to come up with sketches for possible solutions. The process also taught them how to solve the given problems in the stipulated time as well as design and create a working model out of the materials prepared. Students said that brainstorming within the group produced new ideas, and mutual understanding and cooperation boosted the confidence of each individual to do his/her best work in order to construct a functional prototype. For example, a group of five from group Six were able to create nine balancing toys with different designs.

A number of the earlier researches have noted that learning in cooperative learning groups fosters creativity and problem solving skills and social competences. For example, Siew, Chong and Lee (2015) reported that sketching science and sharing ideas in cooperative learning groups in problem-based learning fostered students' scientific creativity. Similarly, Stanford University Newsletter (2001) noted that students who brainstorm in a collaborative situations while solving a problem develop both domain knowledge and problem solving skills. Notably, the program had a significant impact on students' understanding about themselves as potential problem solvers, thinkers, creators, and collaborators. Students were made aware of their potential to become inventors. They also felt a sense of empowerment to make an impact to the world.

For most students, STEM-EDP outreach challenge program provided a fun and enjoyable learning experience, enabling them to incorporate their own ideas from daily life experiences and creative thinking to create new products. Overall, the program scaffold the students' critical thinking, problem solving, team work, creativity, and thinking. They learnt skills and competences that were otherwise tough to teach in a normal classroom setting.

While the students described many positive learning experiences gained in this program, they also pointed out several challenges. The two most commonly mentioned challenges were the limited amount of time needed to construct optimal prototypes, and limited knowledge of scientific concepts. Straw, MacLeod, and Hart (2012), and Siew, Amir and Chong (2015) also note that time is a critical constraint; this is especially obvious when the conducted STEM activities involved the use of a wide range of cognitive abilities. Siew *et al.* (2015) have also written about limited knowledge of scientific concepts being a challenge that influences success in STEM activities.

This research makes clear that reducing the time pressure by negotiating or extending the execution time would clearly help some students complete the activities. This research also highlighted that students who are equipped with sufficient knowledge of scientific concepts would be able to answer HOT questions elaborately, and thus adequate classroom opportunities to practice thinking skills are crucially needed. In addition, this research makes clear that consolidating students' understanding of scientific concepts would help them in adopting a STEM-EDP approach in their design and build activities. The research finding not only confirms the results of previous research studies reviewed, but also supports new research examining a number of potential ways to support STEM students with complex design tasks in time-limited situations.

Although the research findings suggest that rural secondary school students benefited from the learning experience through STEM-EDP outreach challenge program, its limitation must also be acknowledged. This research involved only 89 Grade Ten students, and may not be representative of the Malaysian rural secondary school students' population as a whole. This research is a one-day snapshot of students' learning experiences. Future research will therefore need to be carried out with a larger sample size and longer period with extra ill-defined problems compared to the current research to assess extensively the learning effects of integrating STEM in an engineering design process. Further comparison between rural and urban schools would shed light on the extent to which locality influences students' learning experiences in the STEM-EDP program.

Conclusions

This research investigated and elaborated how Grade Ten rural school students (16 years old) benefited from a day long implementation of the STEM-EDP outreach challenge program. It concludes that the proposed program is an extremely rewarding and influential process of teaching and learning both for the educators and the students. Vis-à-vis the program, students were able to expand their boundaries of knowledge and competencies to become problem solvers, innovators, creators, and collaborators even though they experienced difficulties in tackling challenges associated with STEM activities. The STEM-EDP outreach challenge program opened the eyes of many rural secondary school students of their potential to fill in the critical pipeline of engineers, scientists, and innovators so essential to the future of Malaysia. Findings suggest that the STEM-EDP outreach challenge program offered a means for developing creativity, problem solving skills, and thinking skills among rural secondary school students. This research has therefore highlighted the pivotal role of applying integrated approaches such as STEM-EDP to the teaching and learning process of science related subjects which cater to the needs and challenges faced by rural school children in the country.

Acknowledgements

The research was supported by the University of Malaysia Sabah (UMS), Malaysia under Grant No. GPP0004. Any opinions, viewpoints, findings, conclusions, suggests, or recommendations expressed are the authors and do not necessarily reflect the views of the University of Malaysia Sabah, Malaysia.

References

Academy of Sciences Malaysia (2015). *Science Outlook: Action towards vision. Report to the Ministry of Science, Technology and Innovation*. Kuala Lumpur: Academy of Sciences Malaysia. Retrieved June 24, 2016 from http://www.mastic.mosti.gov.my/.../10156/2d66a776-277e-4816-bce1-53a89 afda5e.

Anderson, L. W., Krathwohl, D. R., (2001). *A taxonomy for learning, teaching, and assessing: A revision of bloom's taxonomy of educational objectives*. New York: Longman.

Berland, L., Steingut, R., & Ko, P. (2014). High school student perceptions of the utility of the engineering design process: Creating opportunities to engage in engineering practices and apply math and science content. *Journal of Science Education and Technology*, *23*, 705–720.

Creswell, J. W. (2003). *Research design: Qualitative, quantitative and mixed approaches*. 2nd ed., Los Angeles: Sage Publication.

Creswell, J. W. (2012). Educational research: Planning, conducting, and evaluating *quantitative and qualitative research*. 4th Ed., Boston: Pearson.

Farmer, C., Allen, D. T., Berland, L. K., Crawford, R. H., & Guerra, L. (2012). *Engineer your world: An innovative approach to developing a high school engineering design course*. Paper presented at the meeting of the American Society for Engineering Education, San Antonio, TX.

Fereday, J., & Muir-Cochrane, E. (2006). Demonstrating rigor using thematic analysis: A hybrid approach of inductive and deductive coding and theme development. *International Journal of Qualitative Methods, 5* (1), 80-92.

Fraenkel, J. R., & Wallen, N. E. (2000). *How to design and evaluate research in education*. New York. NY: Macmillan.

Greenwald, N. L. (2000). Learning from problems. *The Science Teacher*, *67* (4), 28–32.

Hmelo, C. E., Holton, D. L., & Kolodner, J. L. (2000). Designing to learn about complex systems. *Journal of the Learning Sciences, 9* (3), 247-298.

Householder, D. L., & Hailey, C. E. (2012). Incorporating engineering design challenges into STEM courses. Retrieved Feb 13, 2016 from http://ncete.org/flash/pdfs/NCETECaucusReport.pdf

Hynes, M., Portsmore, M., Dare, E., Milto, E., Rogers, C., & Hammer, D. (2011). *Infusing engineering design into high school STEM courses*. Retrieved Feb 13, 2016 from http://ncete.org/flash/pdfs/Infusing%20Engineering% 20 Hynes.pdf

Illinois Valley Community College. (2011). *STEM activities for middle school students***.** Oglesby: IL 61348.

Khandani, S. (2005). *Engineering design process: Education transfer plan*. Retrieved Feb 06, 2016 from http://www.iisme.org/etpexemplary.cfm

King, P.M., & Kitchener, K.S. (1994). *Developing Reflective Judgment: Understanding and Promoting Intellectual Growth and Critical Thinking in Adolescents and Adults.* San Francisco: Jossey-Bass.

Lewis, T. (2005). Creativity: A framework for the design/problem solving discourse in technology education. *Journal of Technology Education, 17* (1), 35-52.

Ling, S. E., Mahdib, R., Mohamadin, M. I., & Manaf, B. A. (2015). Second chance science education for school leavers. *Procedia - Social and Behavioral Sciences*, *167*, 288 – 292

Lottero-Perdue, P. S. (2015). *Running Head: The engineering design process, responses to failure*, Towson University. Presented at NARST 2015.

Malaysian Digest. (2011). *Bringing 'Transformation' to Sarawak Rural Schools*. Retrieved Jan 9, 2016 from http://www.malaysiandigest.com/features/18061-bringingtransformation-to-sarawak-rural-schools.html

Massachusetts Department of Education. (2006). *Massachusetts science and technology/engineering curriculum framework.* Malden, MA: Author. Retrieved Dec 23, 2015 from http://www.doe.mass.edu/frameworks/scitech/1006.pdf

Mehalik, M., Doppelt, Y., & Schunn, C. (2008). Middle-school science through design-based learning versus scripted inquiry: better overall science concept learning and equity gap reduction. *Journal of Engineering Education, 97* (1), 71-85.

Mentzer, N., Huffman, T., & Thayer, H. (2014). High school student modeling in the engineering design process. *International Journal of Technology and Design Education*, *24*, 293–316.

Ministry of Education Malaysia. (2014). *STEM education: policies and prospects toward achieving international standard and meeting national development needs*. Retrieved March 8, 2016 from www.akademisains.gov.my/.../STEM%20Education_Dr%20Azian.pdf

Neo, M., Neo, K.T.K. & Tan, H.Y.J. (2012). Applying authentic learning strategies in a multimedia and web learning environment (MWLE): Malaysian students' perspective. *TOJET: The Turkish Online Journal of Educational Technology*, *11* (3), 50-60.

Schunn, C. D. (2009). How kids learn engineering: The cognitive science perspective. *The Bridge: Linking Engineering and Society, 39* (3), 32-37.

SDC (2011). Sabah Economic Development and Investment Authority Blueprint. Retrieve 21 June 2016 from http://www.sedia.com.my

Siew, N. M., Amir, N., & Chong, C. L. (2015). The perceptions of pre-service and in-service teachers regarding a project-based STEM approach to teaching science. *SpringerPlu*s, *4(*8), 1-20.

Siew, N. M., Chong, C. L., & Lee, B. N. (2015). Fostering fifth graders' scientific creativity through problem-based learning. *Journal of Baltic Science Education*, *4(5), 655–669*.

Stanford University Newsletter on Teaching. (2001). Problem-Based Learning. *Speaking of Teaching, 11* (1), 1-8.

Straw, S, MacLeod, S., & Hart, R. (2012). *Evaluation of the Welcome Trust Camden STEM initiative*. NFER: Slough.

Wendell, K., Wright, C., & Paugh, P. (2015). Engineering design as disciplinary discourse: An exploration of language demands and resources among urban elementary students. Presented at the NARST, Chicago, IL. Retrieved March 23, 2016 from http://www.eie.org/engineering-elementary/research/ articles.

World Bank. (2010). *Malaysia Economic Monitor, Inclusive Growth*. World Bank: Bangkok, Thailand. Retrieved April 12, 2016 from http://siteresources.worldbank.org/INTMALAYSIA/Resources/324392-1288897994959/mem_ nov2010_fullreport.pdf

Yong, X. H., & Phang, F. A. (2015). Science and arts streams students' scientific epistemological beliefs. *International Education Studies*, *8* (13), 88-92.

Appendix A

STEM activities in School A and School B

	SCHOOL A	SCHOOL B
STEM 1	1 (a) How would you produce an object using paper clips and needles that can float on the water surface? 1 (b) How would you produce a submarine that may arise and submerge in a closed water bottle?	How would you produce a protective egg device in order to protect a raw egg as it falls to the ground from a height of a 2-storey building?
STEM 2	How would you produce a balancing toy that can stand upright and stable on your finger, like a bird perched on a tree branch?	How would you produce a sliding model that is able to withstand the load of and encourage the acceleration of a tennis ball?
STEM 3	How would you design and build a model boat that can accommodate as many boxes of biscuits for your company to be transported from Labuan to Kota Kinabalu? Suppose that marbles are the boxes of biscuits that need to be brought to Kota Kinabalu.	How would you produce a balloon-powered car that can go the fastest and furthest away from the starting line?

The Eurasia Proceedings of
Educational & Social Sciences (EPESS)
ISSN: 2587-1730

The Eurasia Proceedings of Educational & Social Sciences (EPESS), 2017

Volume 6, Pages 142-152

ICEMST 2017: International Conference on Education in Mathematics, Science & Technology

THE PREDICTIVE EFFECTS OF ENGAGEMENT IN SCIENCE LESSONS AND ATTITUDES TOWARD SCIENCE ON SOUTHEAST ASIAN GRADE 8 STUDENTS' SCIENCE ACHIEVEMENT IN TIMSS 2015

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Abstract: This study explored the predictive effects of students' engagement in science lessons and attitudes toward science on science achievement among Southeast Asian eighth graders in TIMSS 2015. In this study, students' views on engaging teaching in science lessons, students' interest in and liking of learning science, understanding about the importance of and the usefulness of the subjects (attainment value and utility value), and self-confidence or self-concept in their ability to learn science were measured. Data were obtained from 9,726 Malaysian students, 6,116 Singaporean students, and 6,482 Thai students who participated in TIMSS 2015. The results of the present study indicated that Southeast Asian eighth graders' views on engaging teaching in science lessons, liking, valuing, and confidence in learning science were positively and significantly associated with their science achievement in TIMSS 2015 except for the relationship between students confidence in science with science achievement for Malaysian samples. Southeast Asian eighth graders' liking, valuing, and confidence in science also showed significant predictive effects on their science achievement except for Malaysian grade 8 students' confidence in science which showed an inverse contribution to science achievement. On the other hand, Malaysian and Thai female students scored significantly higher than their male counterparts on the TIMSS 2015 science assessment. This study provides information on prerequisites of Southeast Asian students' science learning. Implications of the findings for educational policy and practice are discussed.

Keywords**:** Engagement in science lessons, attitudes toward science, science achievement; TIMSS

Introduction

TIMSS is an international comparative study that has been implemented by the International Association for the Evaluation of Educational Achievement (IEA) since 1995. It was designed to assess the quality of the teaching and learning of science and mathematics among Grades 4 and 8 students across participating countries (Martin, Mullis, Foy, & Stanco, 2012). The findings of the recent cycle of TIMSS reveal that Singapore and Korea are the top achievers in science at the fourth grade whereas Japan, Russian Federation, and Hong Kong SAR are listed in the top five. At the eighth grade, Singapore is the top achiever in science whereas Japan, Chinese Taipei, Korea, and Slovenia are listed in the top five. East Asian countries like Singapore, Hong Kong SAR, Korea, Chinese Taipei, and Japan are also the top achievers in mathematics at the fourth grade and eighth grade. On the other hand, Southeast Asian countries like Malaysia and Thailand was ranked 24th and 28th in TIMSS 2015 science assessment at the eighth grade. Malaysia and Thailand was also ranked 22nd and 30th ^{i}n TIMSS 2015 mathematics assessment at the eighth grade.

Even though the curricular policies and the school resources often set the tone for accomplishment as well as teaching effectiveness, what students experience in the classroom are more likely to have a considerable direct impact on their science learning. It can be concluded that classroom instruction is at the core of student learning. In relation to this, the concept of student content engagement has been highlighted by McLaughlin, McGrath, Burian-Fitzgerald, Lanahan, Scotchmer, Enyeart, and Salganik (2005) in an effort to build a better linkage between curriculum and instruction.

- Selection and peer-review under responsibility of the Organizing Committee of the conference

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It is undeniable that factors which might have contributed to the outstanding science performance in TIMSS are multi-faceted, and such factors have been widely researched recently, including cognitive, affective (i.e., interest, attitude, and motivation), as well as psycho/sociological aspects (see Ong & Gonzalez, 2012; Ong, Gonzalez, & Shanmugam, 2013). Research about students' learning has studied the complex phenomenon of motivation (Nolen, 2003; Pintrich, 2003; Singh, Granville, & Dika, 2002). For example, students' motivation to learn can be affected by whether or not they find the subject enjoyable and place value on the subject. In addition, students' motivation can be affected by their self-confidence in learning the subject (Linnenbrink & Pintrich, 2003). Hence, TIMSS 2011 included scales about three motivational constructs: intrinsic value (interest), utility value, and ability beliefs (Martin, Mullis, Foy, & Stanco, 2012).
There are 11 SEAMEO countries in the Southeast-Asian region. Three out of the 11 SEAMEO member countries, Malaysia, Singapore, and Thailand, participated in TIMSS 2015. Singapore joined the TIMSS since 1995 at both the fourth and eighth grade levels. However, Malaysia joined the programme in 1999 only at the eighth grade level. Thailand joined the programme in 1999 at both the fourth and eighth grade levels. A summary of the Grade 8 science and mathematics performance of these three Southeast Asian countries from TIMSS 1995 to TIMSS 2015 is provided in Table 1.

Table 1: TIMSS (Grade 8) science scores for Malaysia, Singapore, and Thailand (1995 – 2015)

		TIMSS Science Scores of Grade 8 Students		
Year	**No. of Participatin g Countries**	**Malaysia**	**Singapore**	**Thailand**
1995	45	-	580	-
1999	38	492	568	482
2003	46	510	578	-
2007	59	471	567	471
2011	63	426	590	451
2015	46	471	597	456

The purpose of the present study is to examine the predictive effects of students' views on engaging teaching in science lessons and attitudes toward science on science achievement among eighth grade students in Southeast Asian countries who participated in the TIMSS 2015 assessment. The research question that underpinned this study was: Using the TIMSS 2015 data, how well do Grade 8 Southeast Asian students' views on engaging teaching in science lessons and attitudes toward *science predict their science achievement?*

Review Of Literature

Effective Pedagogical Practices and Students' Engagement in Science Learning

Engagement or sometimes being referred to as participation or involvement is a type of commitment to appear at a certain time and place, in educational contexts, should be the school or various learning environment, be it in or out-of-school or home. Research showed that students' attitude towards learning will be better reinforced if teachers use a plethora of diverse strategies that include innovative pedagogical approaches and interesting instructional materials to engage or involve students' learning. For example, teachers could arouse students' curiosity and interest towards science learning by relating the lessons to the environmental phenomena and their daily lives. Moreover, viewing from constructivist perspective emphasizing on students' prior knowledge, teachers should be prepared and consider the initial ideas of students to develop further. Students should also be given more explanatory power so that their ideas can be developed into useful concepts (Martin, Sexton, Wagner, & Gerlovich, 1994).

Science is a constantly evolving field. Students will become more effective citizens by being able to locate, analyse, and critique information to form their own opinions since everyday people are required to make decisions in unfamiliar contexts (Tytler, 2007). Hence, science curriculum should not be presented with too many superficial ideas, leaving students with disconnected ideas that cannot be used to solve problems and explain phenomena they encounter in their everyday world (Krajcik & Merritt, 2012). Educators are also encouraged to use effective questioning techniques to elicit students' prior knowledge as well as to promote their communication, thinking, and reasoning skills. For example, Treffers (1987) suggested that students should be given the opportunity to reflect on their own science related experiences by asking them critical questions in related context. In fact, according to researchers, interactive questioning provides the context for modifications of the schema and the building of new schemas. Through the process of accommodation as an alternative, there will also be the breaking up of the present schema into subschemas to facilitate teaching and learning (Treffers, 1987 in Aida Suraya, 1997).

Feedback is one of the most powerful influences on learning and achievement (Hattie & Timperley, 2007). Students will hence be more engaged in learning if teachers are able to provide useful feedback with praise for their good effort completed for given tasks and summary on what the students should have learned from each lesson. Students should also be encouraged to improve their performance from time to time by engaging in various types of learning environment, be it within or out-of-school and home.

Psychological Factors and Students' Engagement in a Learning Environment

Literature revealed that 'learning' occurs if the learners communicate and interact with their learning environment. Learners must be engaged actively and individually to discover, transform, and 'own' complex information (Martin, et al., 1994). Students' engagement in learning is found to be affected by a number of cognitive and socio-psychological factors such as values, attitudes, interest, motivation and expectation. Numerous researches were conducted on students' engagement in science including areas of cognitive development [e.g., by Piaget (1964)] and problem-solving behaviour [e.g., by Garton (2004)]. There is also research on academic learning time spent among students, e.g., the study on 'time on task behaviors' (Brophy, 1998 in Chapman, 2005).

A big challenge to science teaching is in the affective domain (Quick & Anderson, 2005). Hence, apart from the cognitive domains of learning as proposed by Bloom's taxonomy, the planning of science lessons should also consider the affective domains as suggested in the Krathwohl's taxonomy of educational objectives. These include the levels of receiving, responding, valuing, organization, and characterization by value (Krathwohl, Bloom & Masia, 1956). These indicators may serve as guidelines for any evaluative studies on students' active engagement in science learning as a result of their attitude, interest, or motivation levels. For example, students with high 'self-esteem' (i.e., the general feelings of self-worth or self-value) will be more engaged on certain tasks such as science activities as they have of themselves towards their own capacity to succeed at the tasks given. Those with personal interest on particular topics will be more likely to be engaged in that topics and develop long-term interest to pursue further.

Students who believe they have the ability and confidence to succeed in the learning tasks (i.e., with expectancy and self-efficacy beliefs) would likely to be more engaged in the given tasks such as science activities. Those who have intrinsic motivation will find the task inherently enjoyable and be more engaged in the activities (Atkinson, Atkinson, Smith & Bem, 1993; Lefton, 1991; Weiner, 1979). When the learners are motivated and involved or engaged actively (Darling-Hammond, 1997) in the subject taught such as mathematics, they are willing to pursue the assigned intellectual activities even when these become difficult (Finn, Pannozzo, & Voekl, 1995; Natriello, 1984; Reeve, 2005; Schlechty, 2001).

Self-Efficacy Beliefs and Achievement in Science

Constructivist and motivation theories recognize that motivation is influenced by how interesting and relevant the learners perceive the activities and information. According to educational psychologists, student's motivation is influenced by a number of beliefs, values, interests, and attitudes that can be positive or negative in their effects. The construct about 'self' was grounded on the 'self-determination' theory (stating that students may do activities for interest or enjoyment, i.e., intrinsic motivation), and/or the 'self-belief' theory (including self-efficacy which stated when self-confidence is high, students will be more motivated to persist in a task until it is completed). The construct 'belief on own coping ability' (intrinsic motivation) is based on the Expectancy-Value theory explaining that beliefs about one's ability to succeed are expectancy beliefs, beliefs about the extent to which the task is useful, enjoyable, or relates to one's self-image as value beliefs (Glynn, Taasoobshirazi, & Brickman, 2007; Palmer, 2007; Phillips, 2007; Weiner, 1979). It is believed that students are motivated to learn when they value either the outcome or process of learning and they expect that they will be successful. As explained from psychological theories, students believe that the task is of value (value beliefs) and they believe he/she has the ability and confidence to succeed in the learning task (expectancy and self-efficacy beliefs) (Lefton, 1991; Phillips, 2007).

Self-efficacy is a very specific form of self-concept theory that refers to people's beliefs about their mastery or capabilities to perform a task successfully at designated levels with convictions about their own effectiveness that can determine the types of behavior they will engage in or the amount of risk they will undertake. It is their belief about whether or not they can successfully engage in and execute a specific behavior or their confidence in their ability to behave in such a way to produce a desirable outcome (Bandura, 1977, 1997; Lefton, 1991). Self-efficacy determines and flows from the feelings of self-beliefs and self-worth. In other words, the people with self-efficacy consider themselves to be capable and worthy. A strong sense of self-efficacy allows people to feel free to select the influence, construct their own desirable lives, and even effect changes in themselves and persevere in tough times. Self-efficacy or self-beliefs make a difference to how people feel, think, and act, such as in science-related learning or activities. If people feel themselves to be able to control a situation, this increases their perceived self-efficacy or self-beliefs to manage it. In fact, people with a high level of self-efficacy are more likely to attribute success to variables within themselves rather than to chance factors and are more likely to pursue a task (Bandura & Wood, 1989 in Lefton, 1991), subsequently striving towards accomplishing the task with commendable achievement.

Methodology

Data for the study were drawn from the TIMSS 2015 database (http://timssandpirls.bc.edu/timss2015/international-database/). A total of 22,324 Grade 8 students from Malaysia (N =9,726), Singapore (N = 6,116), Thailand (N = 6,482) participated in the TIMSS 2015 assessment.

Science Achievement

The TIMSS 2015 science achievement scale was based on items involving content (in Biology, Chemistry, Physics, Earth Science) and cognitive (Knowing, Applying, Reasoning) domains in science. TIMSS uses an imputation methodology, involving plausible values, to report student performance. Plausible values consisting of an approach developed by Mislevy and Sheehan (1987, 1989) and based on the imputation theory of Rubin (1987), are random elements from the set of scores (i.e., random draws from the marginal posterior of the latent distribution used as a measure of science achievement. The IEA's International Database (IDB) Analyzer for TIMSS, a plug-in for SPSS, was used to combine the five plausible values as well as to produce their average values and corrected standard errors.

Students' Views on Engaging Teaching in Science Lessons

The Students' Views on Engaging Teaching in Science Lessons Scale was developed to measure students' views on engaging teaching in science lessons. The scale was based on ten items (BSBS22A to BSBS22J). All items were rated on a 4-point Likert-type scale, ranging from '1' (*Disagree a lot*) to '4' (*Agree a lot*).The Cronbach's alpha reliability coefficients for the scale were 0.930, 0.935, 0.921 for Malaysia, Singapore, and Thailand, respectively.

Students Liking for Learning Science

The Students Like Learning Science Scale was developed to measure students' interest in and liking for learning science. The scale was based on nine items (BSBS21A to BSBS21I). All items were rated on a 4-point Likert-type scale, ranging from '1' (*Disagree a lot*) to '4' (*Agree a lot*). The Cronbach's alpha reliability coefficients for the scale were 0.897, 0.923, and 0.860 for Malaysia, Singapore, and Thailand, respectively.

Students Value Science

The TIMSS 2011 Students Value Science Scale addresses students' attitudes about the importance and usefulness of the subject, sometimes called attainment value and utility value (Wigfield & Eccles, 2000). The scale was based on nine items (BSBS24A to BSBS24I). All items were rated on a 4-point Likert type scale, ranging from '1' (*Disagree a lot*) to '4' (*Agree a lot*). The Cronbach's alpha reliability coefficients for the scale were 0.890, 0.902, and 0.914 for Malaysia, Singapore, and Thailand, respectively.

Students Confident in Science

The Student Confident in Science Scale assesses students' self-confidence or self-concept in their ability to learn science. The scale was based on eight items (BSBS23A to BSBS23H). All items were rated on a 4-point Likert type scale, ranging from '1' (*Disagree a lot*) to '4' (*Agree a lot*). The Cronbach's alpha reliability coefficients for the scale were 0.715, 0.908, and 0.747 for Malaysia, Singapore, and Thailand, respectively.
In addition to these measures, student demographic characteristic such as gender (dummy coded as 0 = 'female', 1 = 'male') was also included in the study as a control variable.

Results and Findings

Table 2: Descriptive statistics (weighted) with average scale scores for students' views on engaging teaching in science lessons, students like learning science, students value science, and students' confidence in science

Statement Code	Statement	Malaysia		Singapore		Thailand	
		M	SD	M	SD	M	SD
Students' Views on Engaging Teaching in Science Lessons							
BSBS22A	I know what my teacher expects me to do.	1.67	.679	1.76	.670	1.92	.761
BSBS22B	My teacher is easy to understand.	1.63	.703	1.84	.786	1.65	.713
BSBS22C	I am interested in what my teacher says.	1.63	.700	1.85	.798	1.65	.714
BSBS22D	My teacher gives me interesting things to do.	1.68	.730	1.90	.803	1.69	.740
BSBS22E	My teacher has clear answers to my questions.	1.55	.685	1.78	.753	1.69	.746
BSBS22F	My teacher is good at explaining science.	1.50	.653	1.71	.742	1.58	.711
BSBS22G	My teacher lets me show what I have learned.	1.75	.725	1.93	.771	1.75	.748
BSBS22H	My teacher does a variety of things to help us learn.	1.44	.637	1.81	.754	1.56	.702
BSBS22I	My teacher tells me how to do better when I make a mistake.	1.50	.658	1.80	.742	1.58	.704
BSBS22J	My teacher listens to what I have to say	1.72	.744	1.84	.756	1.71	.750
	Average scale score	10.21 (0.05)		9.78 (0.04)		10.20 (0.04)	
Students Like Learning Science							
BSBS21A	I enjoy learning science.	1.46	.644	1.76	.802	1.62	.701
BSBS21B	I wish I did not have to study science.*	3.48	.739	2.98	.964	3.06	.983
BSBS21C	Science is boring.*	3.40	.769	3.03	.909	2.91	.980
BSBS21D	I learn many interesting things in science.	1.39	.613	1.54	.701	1.46	.646
BSBS21E	I like science.	1.52	.692	1.82	.847	1.76	.747
BSBS21F	I look forward to learning science in school.	1.81	.792	1.94	.871	2.03	.816
BSBS21G	Science teaches me how things in the world work.	1.34	.578	1.59	.687	1.54	.675
BSBS21H	I like to conduct science experiments.	1.50	.685	1.63	.804	1.54	.726
BSBS21I	Science is one of my favourite subjects.	1.65	.774	2.00	.967	1.80	.813
	Average scale score	10.85 (0.06)		10.29 (0.04)		10.34 (0.05)	
Students Value Science							
BSBS24A	I think learning science will help me in my daily life.	1.54	.660	1.63	.700	1.41	.605

BSBS24B	I need science to learn other school subjects.	1.69	.782	2.05	.845	1.68	.724
BSBS24C	I need to do well in science to get into the university of my choice.	1.68	.696	1.73	.780	1.54	.690
BSBS24D	I need to do well in science to get the job I want	1.70	.716	1.88	.863	1.57	.715
BSBS24E	I would like a job that involves using science.	1.88	.849	2.20	.978	1.86	.848
BSBS24F	It is important to learn about science to get ahead in the world.	1.64	.647	1.66	.719	1.55	.692
BSBS24G	Learning science will give me job opportunities when I am an adult.	1.68	.700	1.69	.751	1.57	.695
BSBS24H	My parents think that it is important that I do well in science.	1.69	.710	1.65	.721	1.64	.719
BSBS24I	It is important to do well in science.	1.65	.666	1.50	.649	1.54	.687
	Average scale score	10.37 (0.04)		10.24 (0.03)		10.75 (0.04)	
Students Confident in Science							
BSBS23A	I usually do well in science.	2.82	1.204	2.14	.855	2.01	.703
BSBS23B	Science is more difficult for me than for many of my classmates.*	2.31	1.182	2.75	.891	2.33	.896
BSBS23C	Science is not one of my strengths.*	2.36	1.185	2.62	.985	2.40	.939
BSBS23D	I learn quickly in science.	2.94	1.110	2.20	.838	2.15	.765
BSBS23E	I am good at working out difficult science problems.	2.63	1.241	2.43	.868	2.26	.789
BSBS23F	My teacher tells me I am good at science.	2.46	1.236	2.57	.870	2.52	.859
BSBS23G	Science is harder for me than any other subject.*	2.20	1.151	2.82	.924	2.39	.930
BSBS23H	Science makes me confused.*	2.21	1.164	2.68	.946	2.46	.958
	Average scale score	8.66 (0.03)		9.66 (0.04)		9.32 (0.03)	

Note: 1 = Disagree A Lot, 4 = Agree A Lot; Standard errors appear in parentheses; * negatively-worded item

Based on the average scale scores as shown in Table 2, Malaysian and Thai students engaged in the science lessons the most as compared to Singaporean students. Malaysian students liked learning science the most as compared to Singaporean and Thai students. On the other hand, Thai students valued science the most whereas Singaporean students expressed their confidence in their science ability the most.

Tables 3 to 6 show the percentage of Southeast Asian students who engaged in science lessons, liked learning science, valued science, confident in science with their average science achievement, respectively.

Students' Views on Engaging Teaching in Science Lessons

Table 3: Students' views on engaging teaching in science lessons

Country	N	Very Engaging Teaching		Engaging Teaching		Less than Engaging Teaching		Average Scale Score
		%	Average Achievement	%	Average Achievement	%	Average Achievement	
Malaysia	9581	48.69 (1.39)	489.30 (3.55)	42.25 (.98)	467.01 (4.83)	9.07 (.84)	407.69 (10.41)	10.21 (0.05)
Singapore	6086	35.04 (.92)	606.47 (4.06)	51.78 (.74)	594.96 (3.28)	13.19 (.84)	577.77 (5.23)	9.78 (0.04)
Thailand	6451	49.51 (1.23)	460.83 (4.14)	42.25 (.89)	451.59 (4.78)	8.24 (.65)	450.94 (8.16)	10.20 (0.04)

Average		44.41 (.69)	518.87 (2.27)	45.42 (.51)	504.52 (2.51)	10.17 (.45)	478.80 (4.74)	10.06 (0.03)

Note: Standard errors in parentheses

On average, 49% of the Malaysian eighth grade students reported being very engaged during their science lessons. 42% reported being engaged and another 9% reported being less than engaged in science lessons. Very engaged students had higher science achievement than their counterparts who reported being engaged and students who were less than engaged (489 vs. 467 and 408, respectively). In contrast, only 35% of the Singaporean eighth grade students reported being very engaged during their science lessons, 52% reported being engaged, and another 13% reported being less than engaged. Engaged students had higher science achievement than their counterparts who reported being engaged and less than engaged (606 vs. 595 and 578, respectively). Almost 50% of the Thai eighth grade students reported being very engaged during their science lessons. 42% reported being engaged and another 8% reported being less than engaged in science lessons. Very engaged students had higher science achievement than their counterparts who reported being engaged and students who were less than engaged (461 vs. 452 and 451, respectively).

Students Like Learning Science

Table 4: Students like learning science

Country	N	Very Much Like Learning Science		Like Learning Science		Do Not Like Learning Science		Average Scale Score
		%	Average Achievement	%	Average Achievement	%	Average Achievement	
Malaysia	9615	51.48 (1.33)	498.45 (3.17)	41.52 (1.00)	453.59 (5.03)	7.00 (0.66)	389.27 (10.34)	10.85 (0.06)
Singapore	6084	38.01 (.84)	622.25 (3.84)	47.47 (.76)	588.30 (3.26)	14.52 (.62)	558.06 (4.49)	10.29 (0.04)
Thailand	6421	37.19 (1.29)	477.48 (4.45)	54.67 (1.09)	445.10 (4.32)	8.14 (.60)	433.72 (6.79)	10.34 (0.05)
Average		42.23 (.68)	532.73 (2.23)	47.88 (.56)	495.66 (2.46)	9.89 (.36)	460.35 (4.39)	10.49 (0.03)

Note: Standard errors in parentheses

Table 4 presents the Grade 8 students' results for the Students Like Learning Science Scale in TIMSS 2015. On average, 51% of the Malaysian students like learning science very much and only 7% do not like learning science as compared to 38% of the Singaporean students who like learning science very much and 15% do not like learning science and 37% of the Thai students who like learning science very much and only 8% do not like learning science. Accompanying the decrease in liking learning science is a widening achievement gap between students who like learning science very much and those who do not like learning science: Malaysian students (498 vs. 389), Singaporean students (622 vs. 558), Thai students (477 vs. 433), respectively. It can be concluded that students who liked learning science very much had higher average science achievement than those who liked or did not like learning science.

Students Value Science

Table 5: Students value science

Country	N	Strongly Value Science		Value Science		Do Not Value Science		Average Scale Score
		%	Average Achievement	%	Average Achievement	%	Average Achievement	
Malaysia	9455	37.90 (.96)	482.65 (3.36)	53.52 (.83)	481.45 (4.30)	8.58 (.80)	386.58 (8.88)	10.37 (0.04)
Singapore	6077	37.37 (.75)	621.01 (3.38)	53.07 (.73)	588.51 (3.37)	9.56 (.51)	547.81 (4.67)	10.24 (0.03)
Thailand	6446	49.35 (1.15)	472.22 (4.61)	44.81 (1.06)	442.48 (4.25)	5.85 (.40)	426.86 (7.15)	10.75 (0.04)
Average		41.54 (.56)	525.29 (2.21)	50.46 (.51)	504.15 (2.31)	8.00 (.35)	453.75 (4.11)	10.45 (0.02)

Note: Standard errors in parentheses

Table 5 presents the results for the TIMSS 2015 Students Value Science Scale for Grade 8 students. On average, 38% of the Malaysian students strongly value science and only 9% do not value science as compared to 37% of the Singaporean students who strongly value science and 10% who do not value science, and 49% of the Thai students strongly value science and only 6% who do not value science. Accompanying the decrease in valuing science is a widening achievement gap between students who strongly value science and those who do not value science: Malaysian students (483 vs. 387), Singaporean students (621 vs. 548), and Thai students (472 vs. 427). Hence, across Grade 8, students who said they strongly valued science typically had higher achievement than students who valued it, and those students, in turn, had higher achievement than students who did not value science.

Students' Confidence in Science

Table 6: Students' confidence in science

Country	N	Very Confident in Science		Confident in Science		Not Confident in Science		Average Scale Score
		%	Average Achievement	%	Average Achievement	%	Average Achievement	
Malaysia	9503	5.57 (.33)	511.99 (5.26)	25.25 (.64)	455.34 (4.80)	69.18 (.70)	476.78 (4.22)	8.66 (0.03)
Singapore	6083	16.93 (.65)	633.02 (4.74)	39.53 (.65)	608.30 (3.46)	43.54 (.86)	572.10 (3.50)	9.66 (0.04)
Thailand	6440	6.82 (.46)	512.75 (6.34)	36.57 (.95)	467.35 (4.58)	56.61 (1.14)	442.09 (4.18)	9.32 (0.03)
Average		9.77 (.29)	552.59 (3.17)	33.78 (.44)	510.33 (2.49)	56.44 (.53)	496.99 (2.30)	9.21 (0.02)

Note: Standard errors in parentheses

Table 6 presents the Grade 8 students' results for the TIMSS 2015 Students' Confidence in Science Scale. On average, only 6% of the Grade 8 students in Malaysia expressed confidence in their science ability, with 25% confident in science, and 69% not confident in science. On the other hand, 17% of Singaporean students, on average, expressed confidence in their science ability, with 40% confident in science, and 44% not confident in science. 7% of the Grade 8 students in Thailand expressed confidence in their science ability, with 37% confident, and 57% not confident in science. Accompanying the decrease in confidence in science is a widening achievement gap between students who are very confident in science and those who are not confident in science: Malaysian students (512 vs. 477), Singaporean students (633 vs. 572), and Thai students (513 vs. 442), respectively. Hence, across Grade 8, students who expressed confidence in their science ability typically had higher achievement than students who were confident, and those students, in turn, had higher achievement than students who were not confident in science.
Correlation and simultaneous multiple regression analyses were conducted separately for each education system to determine whether or not students' views on engaging teaching in science lessons and attitudes toward science were predictive of their science achievement (see Table 7 and Table 8).

Table 7: Correlations between students' views on engaging teaching in science lessons, students liking science, students value science, students' confidence in science with science achievement

	Malaysia									
	ESL		SLS		SVS		SCS		Science	
	r	SE	*r*	SE	*r*	SE	*r*	SE	*r*	SE
ESL	1.00	.00	.70*	.01	.41*	.03	-.14*	.02	.23*	.03
SLS			1.00	.00	.37*	.02	-.25*	.01	.35*	.03
SVS					1.00	.00	-.01	.01	.20*	.03
SCS							1.00	.00	-.16*	.02
Science									1.00	.00
	Singapore									
	ESL		SLS		SVS		SCS		Science	
	r	SE	*r*	SE	*r*	SE	*r*	SE	*r*	SE
ESL	1.00	.00	.63*	.01	.50*	.01	.50*	.01	.08*	.02
SLS			1.00	.00	.62*	.01	.71*	.01	.27*	.02

	ESL		SLS		SVS		SCS		Science	
SVS					1.00	.00	.48*	.01	.25*	.02
SCS							1.00	.00	.24*	.02
Science									1.00	.00
	Thailand									
	ESL		**SLS**		**SVS**		**SCS**		**Science**	
	r	**SE**	***r***	**SE**	***r***	**SE**	***r***	**SE**	***r***	**SE**
ESL	1.00	.00	.66*	.01	.61*	.01	.41*	.01	.07*	.03
SLS			1.00	.00	.57*	.01	.58*	.01	.22*	.02
SVS					1.00	.00	.35*	.01	.21*	.02
SCS							1.00	.00	.17*	.02
Science									1.00	.00

*$p < 0.05$; ESL- Engaging Science Lessons; SLS – Students Liking Science; SVS – Students Value Science; SCS – Students' Confidence in Science

The results in Table 7 indicated that Grade 8 students' views on engaging teaching in science lessons, liking, valuing, and confidence of learning science were significantly associated with science achievement (r = 0.16 to 0.35 for Malaysia; r = 0.08 to 0.27 for Singapore, r = 0.07 to 0.22 for Thailand). However, Malaysian students' confidence in science was negatively correlated with their science achievement. Southeast Asian students' views on engaging teaching in science lessons, liking, valuing, and confidence of learning science were also moderately and significantly correlated among each other (r = 0.14 to 0.70 for Malaysia, r = 0.48 to 0.71 for Singapore, and r = 0.35 to 0.66 for Thailand).

Table 8: Grade 8 students' views on engaging teaching in science lessons and attitudes towards science in predicting their science achievement

	Malaysia		**Singapore**		**Thailand**	
	β	***SE***	***β***	***SE***	***β***	***SE***
Constant	308.52*	25.22	469.79*	10.98	333.23*	15.88
Gender	-6.10*	3.01	-5.95	3.40	-15.36*	4.55
Engaging in Science Lessons	-2.55	1.31	-9.19*	1.18	-11.07*	1.90
Students like science	16.12*	1.32	9.76*	1.11	9.44*	1.29
Students value science	5.47*	1.19	7.95*	.98	9.09*	1.54
Students confident in science	-4.33*	.82	3.95*	.89	5.14*	1.36
Adjusted R^2	.13		.11		.09	

*$p < 0.05$

Based on Table 8, the largest β value (16.12 and 9.76, respectively) of students like science suggests that this variable makes the strongest unique significant contribution to explaining science achievement for the Malaysian and Singaporean samples, when the variance explained by all the other variables in the model is controlled for. The significant β values (4.33, 3.95, and 5.14) of students confident in science for Malaysian, Singaporean, and Thai samples were the lowest indicating that students confident in science made the least contribution to their science achievement. Malaysian grade 8 students' confidence in science showed an inverse contribution to science achievement. On the other hand, Malaysian and Thai female students scored significantly higher than their male counterparts on the TIMSS 2015 science assessment.

Conclusion

The results of the present study indicated that Southeast Asian eighth graders' views on engaging teaching in science lessons, liking, valuing, and confidence in learning science were positively and significantly associated with their science achievement in TIMSS 2015 except for the relationship between students confidence in science with science achievement for Malaysian samples. Southeast Asian eighth graders' liking, valuing, and confidence in science also showed significant predictive effects on their science achievement except for Malaysian grade 8 students' confidence in science which showed an inverse contribution to science achievement. On the other hand, Malaysian and Thai female students scored significantly higher than their male counterparts on the TIMSS 2015 science assessment. It is noteworthy to understand that the relationship between positive attitudes and high achievement is bidirectional, with attitudes and achievement mutually influencing each other, e.g., students who are good at science also are more likely to enjoy learning science. Due to the fact that this study was a non-experimental survey research using secondary data drawn from the TIMSS 2015 database, it is highly recommended that an experimental research design should be adopted to further investigate the predictive effects of students' views on engaging teaching in science lessons and attitudes toward science on students' science achievement in future researches.

References

Aida Suraya, M.Y. (1997). *Creating constructivist environment in the teaching of decimals*. Paper presented and compiled in the proceedings of International Conference on Cooperative Learning and Constructivism (CLAC) in Science and Mathematics Education, 1 to 4 April at SEAMEO RECSAM.

Atkinson, R. L., Atkinson, R. C., Smith, E. E. & Bem, D .J. (1993). *Introduction to Psych*ology. 11th Edition.

Fort Worth, TX: Harcourt Brace Jovanich, Inc.

Bandura, A. (1977). *Social learning theory*. Englewood Cliffs, NJ: Prentice-Hall.

Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York: W.H. Freeman.

Chapman, E. (2005). Assessing student engagement rates. *Eric Digest Online*. Retrieved 5 March 2006 from http://www.ericdigests.org/2005-2/engagement.html

Darling-Hammond, L. (1997). *The right to learn: A blueprint for creating schools that work*. San Francisco: Jossey-Bass.

Finn, J.D., Pannozzo, G.M. & Voekl, K.E. (1995). Disruptive and inattentive-withdrawn behaviour and achievement among fourth graders. *Elementary School Journal*, *95*, 421-454.

Garton, A.F. (2004). *Exploring cognitive development: The child as problem solver*. Victoria, Australia: Blackwell Publishing.

Glynn, S.M., Taasoobshirazi, G., & Brickman, P. (2007). Nonscience majors learning science: A theoretical model of motivation. *Journal of Research in Science Teaching*, *44*(8), 1088-1107.

Hattie, J. & Timperley, H. (2007). The power of feedback. *Review of Educational Research*. March 2007, 77(1), 81-112.

Krajcik, J, & Merritt, J. (2012). *Engaging student in scientific practices: What does constructing and revising models look like in the science classroom?* March 2012 issues of NSTA's K-12 journals. Retrieved June 25, 2015 from http://nstahosted.org/pdfs/ngss/resources/201203_framework-krajcikandmerritt.pdf

Krathwohl, D., Bloom, B., & Masia, B. (1956). Taxonomy of Educational Objectives. *Handbook II: Affective Domain*. New York: David McKay.

Lefton, L. A. (1991). *Psychology*. Fourth edition. Boston, MA: Allyn and Bacon.

Linnenbrink, E. A., & Pintrich, P. R. (2003). The role of self-efficacy beliefs in student engagement and learning in the classroom. *Reading & Writing Quarterly: Overcoming Learning Difficulties*, *19*(2), 119-137.

McLaughlin, M., McGrath, D.J., Burian-Fitzgerald, A., Lanahan, L., Scotchmer, M., Enyeart, C., & Salganik, L. (2005). *Student content engagement as a construct for the measurement of effective classroom instruction and teacher knowledge*. Retrieved from http://www.air.org/files/AERA2005 Student_Content_Engagement11.pdf.

Martin, M. O., Mullis, I. V., Foy, P., & Stanco, G. M. (2012). *TIMSS 2011 International Results in Science*. Amsterdam, The Netherlands: International Association for the Evaluation of Educational Achievement.

Martin, R.E., Sexton, C., Wagner, K. & Gerlovich, J. (1994). *Teaching science for all children*. Boston: Allyn and Bacon.

Mislevy, R. J., & Sheehan, K. M. (1987). Marginal estimation procedures. In A. E. Beaton (Ed.), *The NAEP 1983/84 Technical Report* (NAEP Report 15-TR-20, pp. 121–211) Princeton, NJ: Educational Testing Service.

Mislevy, R. J., & Sheehan, K. M. (1989). Information matrices in latent-variable models. *Journal of Educational and Behavioral Statistics*, *14*(4), 335-350.

Natriello, G. (1984). Problems in the evaluation of students and student disengagement from secondary schools. *Journal of research and development in education*, *17*, 14-24.

Nolen, S. B. (2003). Learning environment, motivation, and achievement in high school science. *Journal of Research in Science Teaching*, *40*(4), 347-368.

Ong, S. L., & Gonzalez, E. J. (2012). *TIMSS 2007: What can we learn?* (Eds.). Penang: SEAMEO-RECSAM.

Ong, S. L., Gonzalez, E. J., & Shanmugam, S.K.S. (2013). *TIMSS 2011: What can we learn together in reaching greater heights?* (Eds.). Penang: SEAMEO-RECSAM.

Palmer, D. (2007). What is the best way to motivate students in science? *Teaching Science: The Journal of the Australian Science Teachers Association*. *53*(1), 38-42.

Phillips, J. A. (2007). *HMEF 5043: Psychology of learning and instruction*. Kuala Lumpur, Malaysia: UNITEM Sdn. Bhd.

Piaget, J. (1964). *Judgment and reasoning in child*. Paterson N.J.: Litlefield Adams.

Pintrich, P. R. (2003). A motivational science perspective on the role of student motivation in learning and teaching contexts. *Journal of educational Psychology*, *95*(4), 667.

Quick, M. & Anderson, L. (2005). Engaging students in the learning of science. USC College. Retrieved June 25, 2015 from http://cet.usc.edu/resources/teaching_learning/docs/learningscience_oct05.pdf

Reeve, J.M. (2005). *Understanding motivation and emotion*. 4th edition. Iowa: John Wiley & Sons, Inc.

Rubin, D. B. (1987).*Multiple imputation for nonresponse in surveys*. New York: Wiley.

Schlechty, P. C. (2001). *Shaking up the schoolhouse*. San Francisco: Jossey-Bass

Singh, K., Granville, M., & Dika, S. (2002). Mathematics and science achievement: Effects of motivation, interest, and academic engagement. *The Journal of Educational Research*, *95*(6), 323-332.

Tytler, R. (2007). *Re-imagining science education: Engaging students in science for Australia's future*. Victoria, Australia: Australia Council for Educational Research. Retrieved June 25, 2015 from http://research.acer.edu.au/cgi/viewcontent.cgi?article=1002&context=aer

Weiner, B. (1979). A theory of motivation for some classroom experiences. *Journal of Educational Psychology*, *71*(1), 3-25.

Wigfield, A., & Eccles, J. S. (2000). Expectancy-value theory of achievement motivation. *Contemporary Educational Psychology*, *25*, 68-81.

The Eurasia Proceedings of
Educational & Social Sciences (EPESS)
ISSN: 2587-1730

The Eurasia Proceedings of Educational & Social Sciences (EPESS), 2017

Volume 6, Pages 153-159

ICEMST 2017: International Conference on Education in Mathematics, Science & Technology

BEYOND CLASSROOM BOUNDARIES, ENHANCING MARGINALIZED CHILDREN'S SELF-CONCEPT THROUGH LEARNING OUTSIDE CLASSROOM APPROACH

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Abstract: Workplace expectations and scenarios in this 21st century require human capitals who are equipped with competencies to embark in the STEM related careers. Therefore, marginalized children need to be prepared and upgrade themselves. Analytical scrutiny of marginalized children talent development often found low self-concept as the most important factor which inhibit their learning development. It is argued that effort to enhance self-concept among marginalized learners must be revolved around their surroundings. Conducive and meaningful learning environment need to be crafty designed to suit their needs and tendencies. In this study, self-concept covers evaluative appraisal of oneself in both the academic and non-academic aspects. This study is aimed to determine the effect of Learning Outside the Classroom (LOC) primary science module towards enhancing self-concept among marginalized learners' in Malaysia. By employing a quasi-experimental with pre-test post-test, nonequivalent control group research design, a total of some 73 primary school marginalized learners were involved in the study. The treatment group used LOC primary science module while the control group experienced learning using conventional module prepared by the Ministry of Education. In the treatment group, teaching and learning processes occurred outside the classroom using particularly flora and fauna within their surroundings. Self-concept was evaluated using Self Descriptive Questionnaire (SDQ). Data obtained were analyzed using MANOVA repeated measures. Analysis of findings lead to inference that there was a significant main effect of group in shaping the children's self-concept. This study concludes that LOC modules, which carry in itself meaningful and fun science learning experiences has successfully developed marginalized children self-concept. It is then suggested that similar learning modules as developed in this study, be developed across other themes as envisaged in the science primary curriculum for marginalized children.

Keywords: Learning outside classroom, marginalized children, primary science, self-concept, module

Introduction

In a knowledge-based society in the 21st century where information is rapidly changed, education plays a very important and crucial role in meeting the demands for large scale of human capital workforce which based on scientific knowledge. Workplace expectations and scenarios in this 21st century require human capitals who are equipped with competencies to embark in the STEM related careers. This situation also applies to marginalized communities. Therefore, marginalized learners need to upgrade themselves through school education in order to prepare for new era society. Besides reducing individual's gap, the level of competence among every learner should be increased too and this according to Min & Mi (2015) can be done through education in schools. This is because marginalized learners often associated with lower academic achievement and self-concept when compared with learners in the mainstream flow. Such situation is not only happening in Malaysia, but also occurs in other countries such as United States, Canada, New Zealand and Australia (Anderson, 2014; Arens et al., 2014; Bishop, 2010; Bodkin-Andrews, Dillon & Craven, 2010; Chigeza, 2011; McEwan & Trowbridge, 2007; Prout & Hill, 2012). This is consistent with Prout & Hill (2012) which states that there are differences exist globally between the education level of native learners and non-native learners in their respective countries.

- Selection and peer-review under responsibility of the Organizing Committee of the conference

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Malaysia, a developing country in the 21st century is constantly working to improve the level of education among its people. Therefore, marginalized learners should strive to improve themselves through education in order not to be left behind in this development when compared with other communities. Through education, marginalized learners can and will be able to move forward and adapt themselves in this new era society. In addition, it also provides the learners for a future that requires knowledge and application skills in a highly competitive job (Trilling & Fadel, 2009)

Efforts to raise the level of education among marginalized learners in Malaysia have always been given serious consideration. Therefore, factors that affect science academic achievement should be identified and studied so that a nation of high competence and high achievers can be realized. Analytical scrutiny of marginalized children talent development often found low self-concept as the most important factor which inhibit their learning development. In recent years, many previous studies showed a positive relationship between self-concept and academic achievement (Craven & Marsh, 2008; Guay, Marsh & Boivin, 2003; Leibham 2005). According to Guay, Marsh & Boivin (2003) and Stipek (2002), self-concept is an important factor in influencing behavior and academic achievement in school as a child will behave in a manner consistent with self-confidence. In addition, OECD (2003) found that many policy documents to support that positive self-concept as an important outcome of education. This is in line with Craven et al. (2008) stating that learners with higher self-concept in academic are more likely to show a better attitude, psychological well-being and showed a good performance in achievement tests.

In addition, conducive and simulative learning environment are very important factors in ensuring effective learning process and that will lead to the enactment of meaningful learning among marginalized learners. Conducive and meaningful learning environment need to be crafty designed to suit their needs and tendencies. Hence, Learning Outside Classroom (LOC) module produced by researchers with the application and implementation of activities based on the environment in the process of the teaching and learning (T&L). Intervention or modules that can determine and enhance the level of self-concept among marginalized learners in primary schools in needed. Therefore, LOC module aims to determine it’s effect on self-concept of marginalized learners in Malaysia. Malaysia's desire to become a modern and developed country would be achieved if all communities have a high level of education.

Theoretical Framework of Loc Module

The instructional design model used in LOC module is based on the Morrison, Ross, Kalman and Kemp Model (MRKK) (Morrison et al., 2013). This model became the basis for the development of the module prepared by the researchers in this study. It has nine major elements arranged in an oval shaped cycle and is not linear. This means that the instruction can start anywhere deemed appropriate. The cycle has no starting point or ending point. The process of review and evaluation will take place as an ongoing basis to improve instruction.

LOC module applied several learning theories, namely Behaviorist Learning Theory, Cognitivist Learning Theory, Constructivist Learning Theory and Contextual approach. Behaviorist Learning Theory emphasizes behavioral changes that can be observed and measured by the teacher. Meanwhile, the Cognitivist Learning Theory which emphasizes information processing in the mind also included in this module. Contextual approach that stimulates a person’s mind to find meaning in context by making meaningful and relevant relationship to their environment also be applied. The sequence of information presentation during the T&L process is based on Needham’s Five Phase Constructivist Learning Theory (Needham, 1987) which involves the orientation phase, eliciting ideas, restructuring of ideas, application of ideas and reflection. With these, it is able to create learning environment that stimulates and increase self-concept among marginalized learners.

LOC module requires teacher to bring marginalized learners out of the classroom for T&L science. This approach is different from the inquiry method practiced by teachers in remote areas where the T&L process always occurs in the classroom. It will give the marginalized learners a more comfortable feeling and a feeling of being close to the environment. This is due to the environment is an important element in their daily lives. Therefore, learning activities involving the environment will be of interest to them (Ma’rof & Sarjit, 2008) and also create a conducive learning atmosphere for marginalized learners.

Although LOC approach can help to build a dynamic knowledge and explore the skills and abilities of learners (Smith & Sobel, 2010), it is not emphasized in the existing module for marginalized learners in Malaysia (CCD, 2013). Therefore, its application in remote schools can be narrowed down to zero. This LOC approach can be used as an alternative to the T&L method that implemented in schools. With this, hopefully marginalized learners will find science to be interesting to learn. Thus, it will create positive impact on self-concept toward learning science. The conceptual framework discussed can be visualized as shown in Figure 1 below.

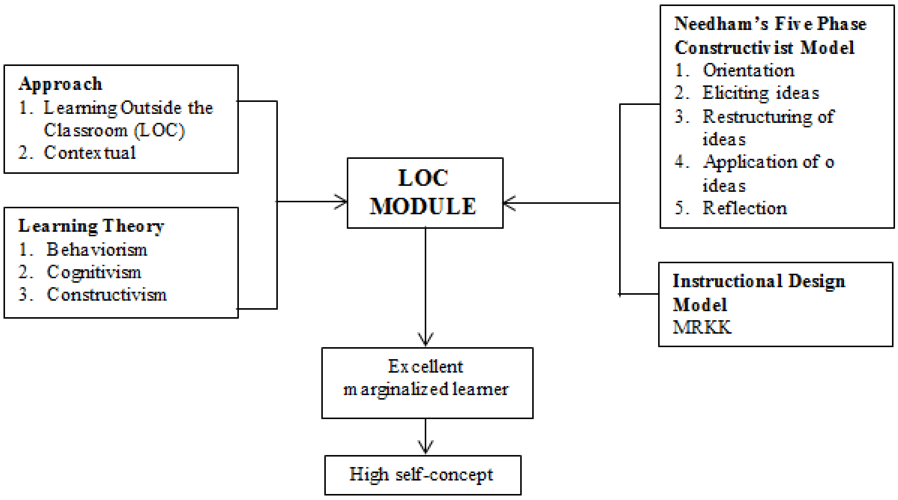

Figure 1. Theoretical framework

Objectives

This study aimed to determine the effects of LOC science module toward enhancing self-concept of Year Two marginalized learners in remote area in Sarawak, Malaysia. It is believed that with the use of this module, it will give opportunity to teachers to implement alternative approach beside the conventional teaching uses inquiry strategies practiced in remote schools in Malaysia.

Methodology

Research Design

This study employed quasi-experimental of the type pre-test post-test, non-equivalent control group design. Both the experimental and control group were tested with pre-test and post-test before and after the intervention implemented as shown in Table 1.

Table 1. Pre-test post-test, non-equivalent control group design

Group	Test	Intervention	Test
Control	Pre-test	Inquiry	Post-test
Experimental	Pre-test	LOC science module	Post-test

This study was conducted in four schools in the remote part in the state of Sarawak, Malaysia. Two schools served as experimental group using LOC science module and two other schools as control group using inquiry module during T&L. The independent variable in this study is the study group, namely control and experimental group. While dependent variable is self-concept. In this study, the topic of 'Plant' has been selected based on a preliminary analysis of the difficulty level of topics in Year Two science subject that was administered to four science teachers teaching Year Two science and 59 Year Three learners in marginalized schools. Both teachers and learners gave the same view that they rated 'Plant' as the one of the most difficult topic in Year Two science subject.

Respondent

The respondents comprised of Year Two learners (8 years old) from four marginalized primary schools in remote part of Sarawak, Malaysia. Since each school has a low number of Year Two learners, each of the control group and the experimental group need to be covered by a combination of two schools in order to make sure that the number of respondents are more than 30 for each group. Thus, a total of 73 respondents participated in this study in which the control group consisted of 35 Year Two learners and the experimental group consisted of 38 Year Two learners. Schools are selected based on criteria such as the level of learners' competency (based on the results of the Primary School Achievement Test) and school band category.

Instrument

Instrument used in this study is Self-Concept Questionnaire (SCQ). SCQ was taken from Leibham (2005), which adapted from Self Descriptive Questionnaire - I (SDQ - I) in Marsh (1990). However, only three categories in SDQ - I were selected for this study, namely general construct, science construct and social construct. After the verification process by experts and pilot test conducted, SCQ contain 18 items which consists of 6 items from general construct, 5 items from science construct and 7 items from social construct in the form of a 3-point Likert scale of "1 = Not True", "2 = Not Sure" and "3 = True". The reliability of SCQ is high with alpha Cronbach coefficient value more than 0.70.

Procedure

After pilot test, correction and improvements was done to the module and instrument before administered them in the actual study. SCQ was administered to respondents in both groups before the T&L on plants as pre-test to determine the homogeneity level of self-concept between the control and experimental groups. Control group used inquiry module while experimental group used LOC module during T&L session. A five-week period is required to complete the 'Plants' topic. At the end of the T&L session, SCQ administered again to the same respondents in both groups as post-test. SCQ administered by the provisions of the same time taken before and after the T&L session on 'Plant' topic in both control and experimental groups.

Analysis

Quantitative data obtained through SCQ before and after the T&L session in both the control and experimental groups were analyzed using descriptive statistics and inferential statistics. All data compiled and summarized in table form for easy analysis reports and presentations made.

Independent samples T-test conducted on the data collected during the pre-test to determine the level of homogeneity of the self-concept between the two groups involved. MANOVA 2x2x3 repeated measures analysis was used to determine the effect of LOC science module in enhancing self-concept. Repeated measures involves two study groups (control and experimental), two time (pre-test and post-test) and three constructs of self-concept (general, science and social).

Research Findings

Homogeneity Of Self-Concept

Homogeneity analysis of the level of self-concept between the control and experimental groups using T-test Independent samples at the 0.05 significant level found that there was no significant difference between control and experimental groups with pre-test mean score of self-concept, $t = 1.940$ and $df = 71$, $p > 0.05$. The findings show the control and experimental groups were homogeneous in terms of self-concept before the study was conducted. The homogeneity between the two groups allows comparison to be performed on the effects of LOC science module in the learning of 'Plant' topic among marginalized learners. Table 2 shows the analysis of the Independent-samples T-test of pre-test mean score for self-concept according to groups.

Table 2. Independent t-test pre-test mean score of self-concept according to groups

Dependent variable	t	df	p	Mean Difference
Pre-test self-concept	1.940	71	.056	.109

Self-Concept

MANOVA repeated measures 2x2x3 analysis was used to determine the effect of LOC science module in enhancing self-concept. The findings showed that there was significant main effect of group on self-concept [F (3, 69) = 4.618, p> 0.025] with an effect size of 0.167. Data showed that there was no significant main effect of time on self-concept [F (3, 69) = 2.016, p> 0.025] with effect size of 0.081. The effect of the interaction between time with the group is also not significant to the self-concept [F (3, 69) = 0.766, p <0.025] with effect size of 0.032. Results are shown in Table 3 below.

Table 3. Multivariate test

Effect	Pillai's Trace Value	F	df1	df2	p	Partial Eta Squared
Group	0.167	4.618	3	69	0.005	0.167
Time	0.081	2.016	3	69	0.12	0.081
Group * Time	0.032	0.766	3	69	0.517	0.032

Significance level = 0.025

However, further analyses as shown in Table 4 found that there is no significant main effect of group on all the three constructs of self-concept, namely general construct [F (2, 69) = 1.675, p <0.025] with an effect size of 0.023, science construct [F (2, 69) = 3.016, p <0.025] with an effect size of 0.041 and social construct [F (2, 69) = 2.143, p <0.025] with an effect size of 0.029. This means that the level of self-concept among marginalized learners generally has not been increased significantly.

Table 4. Effect within subjects test

Effects	Dependent Variable	Squared Total	df	Mean Squared	F	p	Partial Eta
Group	General	0.341	1	0.341	1.675	0.200	0.023
	Science	0.484	1	0.484	3.016	0.087	0.041
	Social	0.295	1	0.295	2.143	0.148	0.029

Significance level = 0.025

Discussion

The findings indicate that the LOC science module is not effective in enhancing self-concept among marginalized learners as a whole. Although result showed significant main effects of group, but further analyses indicate no significant main effect on all the three constructs of self-concept. This concluded that LOC science module did not give significant positive impact toward self-concept of marginalized learners in this study. But for descriptive comparison purposes, it can be said that LOC science module is better than the inquiry module. This is because marginalized learners in the control group showed decreased in the level of self-concept whereas it increased in the experimental group. But the level of increment of self-concept among marginalized learners in the experimental group is not significant.

Failure to increase the level of self-concept among marginalized learners did not necessarily represent that the LOC science module is not good. Such insignificant increase may likely due to the change of strategy or approach of T&L used by teachers in the experimental schools that creates negative impact on self-concept of marginalized learners. A drastic change from the inquiry approach to the implementation of activities that are more learner-centered in LOC module has brought something unusual and uneasy for these marginalized learners. This resulted in negative impact which Ayla (2016) also reported in the study that carried out in Turkey.

Another reason may be related to the existing level of marginalized learners' self-concept for learning as a whole. Many studies reported that these marginalized learners have lower cognitive level compared with mainstream learners. This directly affects the self-concept of marginalized learners where the level is still considered low and is at an unsatisfactory level. Abdull Shukor Shaari et al. (2011) and Asnarulkhadi Abu Samah et al. (2007) also reported that marginalized learners in Malaysia do not show enthusiasm in the learning process. The learning process only occurred when they are in school and not at home. Moreover, marginalized parents were less attentive and less concerned with their children's education.

Conclusion

LOC module used in this study found no significant positive impact towards improving the self-concept among marginalized learners in Malaysia toward the topic of 'Plant'. The self-concept among marginalized learners still remain at unsatisfactory level despite various initiatives have been undertaken by the Ministry of Education. Continuous low level of self-concept among marginalized learners will bring them at risk of being left behind in the aspect of education. This is taken seriously especially by educators because it will lead to increase dropout rates and science academic achievement degradation if not managed properly. Therefore, drastic measures and more practical intensive programs such as curriculum that integrates the environment and culture of marginalized people must be created so that marginalized learners can see the relevance of science learned at school in their daily lives. As reported by Ayla (2016), a review of the science curriculum that is more focused on matters relating to life directly affect the environment in the classroom and in turn have a positive impact on learners learning in Turkey. In addition, the new curriculum for marginalized learners need more focus on aspects of psychomotor and affective than cognitive as practiced by mainstream learners. This is because marginalized learners are poor in cognitive aspect when compared with mainstream learners. The aim is to produce human capital among marginalized communities in the 21st century for a future that requires knowledge and skills in a job application that is highly competitive.

References

Abdull Shukor Shaari, Nuraini Yusoff, Mohd Izam Ghazali, & Mohd Hasani Dali. (2011). Kanak-kanak minoriti orang asli di Malaysia: menggapai literasi bahasa melayu (Aboriginal minority children in Malaysia: achieve malay language literacy). *Jurnal Pendidikan Bahasa Melayu*, *1*(2), 59-70.

Anderson, R. (2014). Grade repetition risk for indigenous students in early schooling in Queensland, Australia. *Procedia Social and Behavioral Sciences*, *114*, 744-748.

Arens, A. K., Andrews, G. B., Craven, R. G., & Yeung, A. S. (2014). Self-concept of indigenous and non-indigenous Australian students: Competence and affect components and relations to achievement. *Learning and Individual Differences*, *32*, 93-103.

Asnarulkhadi Abu Samah, Maria Mansor, Zahid Emby, Mariani Mansor, & Hanina Hallimatusaadiah Hamsan. (2007). Kurikulum Bersepadu Orang Asli/Penan (KAP) – Satu Pendekatan Baru dalam pembangunan Pendidikan Komuniti Orang Asli/Penan (Integrated Curriculum for Aboriginal / Penan (KAP) - A New Approach in the Development of Aboriginal Community Education / Penan). In Seminar Kebangsaan Sains Sosial: Sains Sosial Teras Pembangunan Modal Insan (National Seminar on Social Sciences: Social Science Core Human Capital Development), 20-21 Mei 2007, Kuala Lumpur.

Ayla, C. (2016). Student motivation in constructivist learning environment. *Eurasia Journal of Mathematics, Science & Technology Education*, *12*(2), 233-247.

Bishop, R. (2010). Effective teaching for indigenous and minoritized students. *Procedia Social and Behavioral Sciences*, *7*(C), 57-62.

Bodkin-Andrews, G. H., Dillon, A., & Craven, R. G. (2010). Bangawarra'gumada strengthening the spirit: causal modelling of academic self-concept and patterns of disengagement for indigenous and non-indigenous Australian students. *Australian Journal of Indigenous Education*, *39*, 24–39.

Chigeza, P. (2011). Cultural resources of minority and marginalised students should be included in the school science curriculum. *Cultural Studies of Science Education*, *6*, 401–412.

Craven, R. G., & Marsh, H. W. (2008). The centrality of self-concept construct for psychological wellbeing and unlocking human potential: Implications for child and educational psychologists. *Educational and Child Psychology*, *25*,104-118.

Craven, R. G., Yeung, A. S., McInerney, D. M., & Liem, G. A. (2008). *International best practice in effective educational interventions: why self-concept matters and examples from bullying, peer support, and reading research*. Teaching and Learning: International Best Practice. Information Age Publishing Inc.

Curriculum Development Devision, CCD. (2013). *Kurikulum Standard Sekolah Rendah Murid Orang Asli dan Penan (KAP). Modul Pengajaran: Dunia Sains dan Teknologi Tahun Dua* (Primary School Standard Curriculum Students Aboriginal and Penan (KAP). Teaching modules: The World of Science and Technology Year Two). Putrajaya: Bahagian Pembangunan Kurikulum.

Guay, F., Marsh, H. W., & Boivin, M. (2003). Academic self-concept and academic achievement: Developmental perspectives on their causal ordering. *Journal of Educational Psychology*, *95*, 124-136.

Leibham, M. E. (2005). The impact of interest on elementary school children's self-concepts, intrinsic motivation, academic achievement, and willingness to broaden knowledge. (Unpublished doctoral dissertation). Indiana State University.

Ma'rof, R., & Sarjit, S. (2008). *Orang asli: isu, transformasi dan cabaran*. Selangor: Penerbit Universiti Putra Malaysia.

Marsh, H. W. (1990). A multidimensional, hierarchical self-concept: Theoretical and empirical justification. *Educational Psychology Review*, *2*, 77-172.

McEwan, P. J., & Trowbridge, M. (2007). The achievement of indigenous students in Guatemalan primary schools. *International Journal of Educational Development*, *27*, 61-76.

Min, K. K., & Mi, K. C. (2015). Design and implementation of integrated instruction of mathematics and science in Korea. *Eurasia Journal of Mathematics, Science & Technology Education*, *11*(1), 3-15.

Morrison, G. R., Ross, S. M., Kalman, H. K., & Kemp, J. E. (2013). *Designing effective instruction*. 7th Eds. NJ: John Wiley & Sons, Inc.

Needham, R. (1987). *CLIS in the classroom: Teaching strategies for developing understanding in science*. Leeds: University of Leeds.

Organization for Economic Cooperation and Development, OECD. (2003). *Student engagement at school: A sense of belonging and participation*. Paris: Organization for Economic Cooperation and Development.

Prout, S., & Hill, A. (2012). Situating indigenous student mobility within the global education research agenda. *International Journal of Educational Research*, *54,* 60–68.

Smith, G., & Sobel, D. (2010). *Place and community based education in school*. United Kingdon: Routledge: Taylor & Francis.

Stipek, D. (2002). *Motivation to learn: Integrating theory and practice*. 4th Edition. Boston: Allyn and Bacon.

Trilling, B., & Fadel, C. (2009). *21st century skills: learning for life in our times*. San Francisco, CA: Jossey-Bass.

The Eurasia Proceedings of
Educational & Social Sciences (EPESS)
ISSN: 2587-1730

The Eurasia Proceedings of Educational & Social Sciences (EPESS), 2017

Volume 6, Pages 160-166

ICEMST 2017: International Conference on Education in Mathematics, Science & Technology

EFFECT OF STEM-5E LEARNING CYCLE (AM-STEM KIDS MODULE) IN FOSTERING NOBLE VALUES AMONG ELEMENTARY SCHOOL CHILDREN

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Abstract: The purpose of this study is to investigate the effect of STEM-5E learning cycle intervention (AM-STEM Kids module) in fostering noble values among elementary school children. The element of noble values consists of: (i) being thankful to God, (ii) being cooperative, (iii) thinking rationally, (iv) appreciating the contribution of science and technology, and (v) being fair and just. This study employed a quasi-experiment with non-equivalent pretest and posttest control group design. A total of 116 fifth-grade children from two schools were selected as respondents and each of the school was treated as treatment and control group. The treatment group using AM-STEM Kids module while the control group experienced conventional inquiry teaching approach. Questionnaires were used to examine the perception of noble values by the children before and after the designed learning activities. MANOVA repeated measure and paired sample t-test were used to identify the effect and the existence of significant changes in the children's noble values between treatment and control group. The finding of the study revealed that there was a significant change in the mean score for treatment and control group in term of appreciating the contribution of science and technology, and being fair and just. Data also shows the effect size of the treatment group is higher as compared to the control group. The result of this study concludes that, AM-STEM Kids module is effective in fostering children's noble values and hence could be used as teaching resources in fostering noble values in the science classroom.

Keywords**:** Noble values, STEM, 5E learning cycle, inquiry based learning

Introduction

Value education is not new in the education system. History related to the value education in western countries such as in the United States indicate, it has begun since the 16^{th} century. The aim of the value education at that time is to produce children with moral, diligent and can contribute to the development of state and society (Mabary, 2017). In addition, value education arises formally in the education system and implemented across disciplines particularly in science. For instance, in Australia, value education was introduced and applied in school after the intensive study featuring a variety of best practices and approaches to apply values in the teaching and learning process ((Australian Goverment Department of Education 2005)).

In Malaysia, the development of value education begins when the Ministry of Education (MOE) makes a comprehensive reform starting 1980s. Through the reform, in 1983 the elements of noble values were emphasized in the New Curriculum of Primary Schools (KBSR). The element of noble value continues to be emphasized in the new curriculum transformation called a Primary School Standard Curriculum (KSSR) in 2011. This curriculum applied the skills and values that are relevant to the children to prepare them with the needs as the 21st century learner (MOE, 2011).

- Selection and peer-review under responsibility of the Organizing Committee of the conference

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Preservation of noble value practice in curriculum demonstrated the application of noble values in teaching and learning is an important agenda in the national education system (Hasan, Hamzah, & Awang, 2014). In fact, it helps children to develop a good character value not only for themselves and family, but to the environment and the society. This is based on the aspiration of the Malaysian National Philosophy of Education that aims towards "developing the potential of individuals in a holistic and integrated manner, so as to produce individuals who are intellectually, spiritually, emotionally and physically balanced and harmonious" (MOE, 2012).

There are many definitions regarding the 'value' term depends on the usage (Seah & Bishop, 2000). According to Clement (2013), value of inner belief of an individual is associated with social value that will guide to the social actions and practices. The term of noble values can be defined as a practice or conduct of human life consisting of positive and civilized attributes which lead to a high culture in the lives (Hasan et al., 2014)). However, the value practice should not surpass the religious boundary and must follow the norm and spiritual value. In Malaysia context which has the multiracial society, the value is universal and accepted by all religion.

Although the cultivation of noble value was emphasized in the education system, however the inculcation of noble values implemented by teachers is still in moderate level (Ismail et al., 2007; Şahinkayasi & Kelleci, 2013). The possibility reason why it take place because cognitive domain are more emphasized compared to affective domain (Main, 1992; Pa & Tapsir, 2013; Seah & Bishop, 2000). This is due to the lack of evaluation or assessment regarding affective domain particularly values aspect either is formative or summative test (Ismail et al., 2007). In addition, previous research also found, the cultivation of values was mostly less implemented in science subject compared to others disciplines (Nik Yaacob, 2007)). Conjecture of this absence maybe because of lack of experience by science teachers to develop and plan the instructional systematically (Hasan et al., 2014; Şahinkayasi & Kelleci, 2013).

It is indicated that, a systematic instructional to cultivate the noble values in science teaching and learning should be developed especially in a elementary school setting. Since in the early age, the development of cognitive and affective aspect among children is growing (Hurlock, 1990). At this stage, children simply accepted what is being delivered and infuse for them in interactive learning environment.

Methods

Quasi-experimental design with Non-equivalent Pretest and Posttest Control Group type was used in this study. Based on this type of design, both groups (control and treatment) were given a pre-test and post-test. The study was conducted in the field for four weeks according the teachers schedule teaching plan on the energy's topic. Before the implementation, teachers in the treatment group were briefed and trained how to use AM-STEM Kids module.

Participants

A total of 116 5th grade children from two elementary schools in Selangor districted, Malaysia were selected as respondents. Each of the school was treated as treatment (N = 56) and control group (N = 58). The treatment group used AM-STEM Kids module while the control group experienced conventional inquiry teaching approach.

Instruments and Procedures

The instrument used in this research is a set of questionnaire of noble values which employed the 5-point agreement of Likert type response (1= strongly not agree to 5= strongly agree). The instrument was adapted from Abu Saad, (2007) and Nik Yaacob (2007) which takes into consideration the noble values's elements of the Malaysian science curriculum, namely (i) be thankful to God, (ii) cooperative, (iii) rational, (iv) Appreciation to nature and the contribution of science and technology, and (v) fair and just. This instrument has been verified by experts in term of construct and content validation. The reliability of the instrument indicates Cronbach's Alpha value for all constructs were between 0.5-0.7. Although it was not considered good internal consistency (George & Mallery, 2003) however, it is still acceptable since the number of the items in each construct is very small and it is no less than 0.4 the critical value (Nunnally & Bernstein, 1994). Table 1 shows the example of the items.

Table 1. Example of items for noble values elements

Elements	Items	Number of item
Be thankful to God	I am thankful to be able to realize the nature of God's creation through science.	3
Cooperative	I solved science tasks through discussion in the group.	3
Rational	I will think good or bad of a science solution before make a decision.	3
Appreciating to nature and the contribution of science and technology	I will turn off the electric device (e.g. television) if I find no one using it. I feel guilty if I accidentally destruction the plant.	4
Fair and just	I agree that students scored in science through their own efforts not because of their good relationships with teachers.	3

Development of AM-STEM Kids Module

Research procedure in developing instructional design of AM-STEM Kids module was based on ADDIE model. This model has a structured and systematic process and convenient for a novice designer. ADDIE model consist of five phases, namely need analysis, design, development, implementation and assessment. During need analysis phase, problems and gap were identified to ensure the development of intervention was a neccesity for the target group and able to solve the problem as well fill in the identified gap. From need analysis, energy topic was selected and the instruction was designed with the systematic planning on inculcation of noble value. In designing and developing of AM-STEM Kids module, STEM approach was used involved the integration of content and skills of STEM disciplines. Strategy regarding inculcate of noble values in the module imply the interaction of God-nature-human. These approaches and strategy were used in compliance with 5E learning cycle. Activities of each phase in the 5E learning cycle (Baybee et al., 2006) as describe below:

Engagement Phase (Observe)

Children do the simple activity to generate their interest and curiosity about the new concept of energy. The activity will help children to promote them to stimulate their thinking and access prior knowledge. The main processes in this activity involve children to make the observation, develop meaning from their observation and make a pre-hypothesis. First stage to inculcate the noble value is promotes children to recognize the God creation through the observation of nature in the activity and making a reflection.
Interaction activity:

- God – Children recognize the god creation through the source of energy that has been created.
- Nature – Children observe surroundings and develop appreciation to nature.
- Human – Children will make the observation in a pair to generate pre-hypothesis regarding the definition of energy and record the data. The teacher will raise questions on the topic related to energy and encourage children to responses rationally.

Exploration Phase (Investigate & Create)

In this phase, children involved with the investigation activity and creation of product. Through exploration experienced, children can identify and challenge their prior knowledge, including misconception if any, and pre-hypothesis they have make. The investigation activity required children to verify their pre-hypothesis by search the source of energy around their surroundings and investigate the transformation of energy form. Meanwhile, creation of a product activities involved children to create a product to solve society issues using engineering design process steps. Second stage to inculcate the noble values in this phase is making children to understand of God creation. Children will be assisted to realize the existence of God based on the certain phenomenon through the exploration activity.
Interaction activity:

- God – Children understand the God creation through the creation of the sun as a main of energy source. Phenomenon from the sun shines is it can be used as a solar energy to generate electricity.

- Nature – Children appreciate of nature, science and technology through the relationship of science and engineering in design activity. They need to think rationally to solve the given problems.
- Human – Children work in a team to do the investigation and communicate effectively to solve the problem.

Explanation Phase (Present & Rectify)

Children will present their finding of exploration activity in a group or individually. Through the presentation, children will show their knowledge and communication skills. In this phase teacher guided children to explain about the concept and definition of energy in their own words. In the same time the misconception raised by the children will rectifying by the teacher through the questioning session. Second stage to inculcate the noble values is making children to believe in God through the application of knowledge.
Interaction activity:

- God – thankful to God and reflect what happen if there is no source of energy.
- Nature –appreciate of nature, science and technology
- Human – work in a team.

Elaboration Phase

Children making an improvement of their finding and design activity regarding the definitions and scientific concepts of energy and energy model that they have been created.

Evaluation Phase

Evaluation was applied in each of learning cycle phase. The teacher will assess child's knowledge and understanding through this phase. Evaluation activities involved formative test, for example, working task, activities score using a rubric such as in producing a product, reflection journal and test of each sub-topic of energy. Summative test to assess children practices of noble values using a set of questionnaire (pre-test and post-test).

Data Analysis

The data gathered from the instrument are quantitative data and were analysed using SPSS 21.0 at the significant level of .05. Analysis data involve descriptive statistic and inferential analysis employ MANOVA repeated measure and paired sample t-test. These analyses were used to identify the significant changes between the control and treatment group.

Research Question

The main purpose of this study is to develop a systematic teaching and learning activities for the topic of energy in 5th grade elementary school children called 'AM-STEM kids module'. The module developed according to the characteristics of STEM 5E learning cycle and focusing on embedded with the noble values. The aim of this study also is to investigate the effectiveness of the module in fostering the noble values among children. The research questions are as follows:
1) What is the noble value level among children?
2) Is there any difference between control and treatment group?

Results and Findings

Findings from the pre and post-tests were used to answer the research questions, as well examine the effects of STEM 5E learning cycle used in AM-STEM kids module in fostering the noble values among elementary school children. The results and findings as below:

What is the noble value level among children?

Descriptive statistic involved means score were used for the first research question to determine the level of noble values among children. Figure 1 showed the finding of the descriptive analysis. From the result, the noble value mean score for both groups and achiever level were increased across time period (pre-test and post-test). These result indicate, children will foster their noble value when they involve in the learning process. The finding also presented the children had a high level of noble values since the mean score level was above 3.68 (Wiersma, 1995).

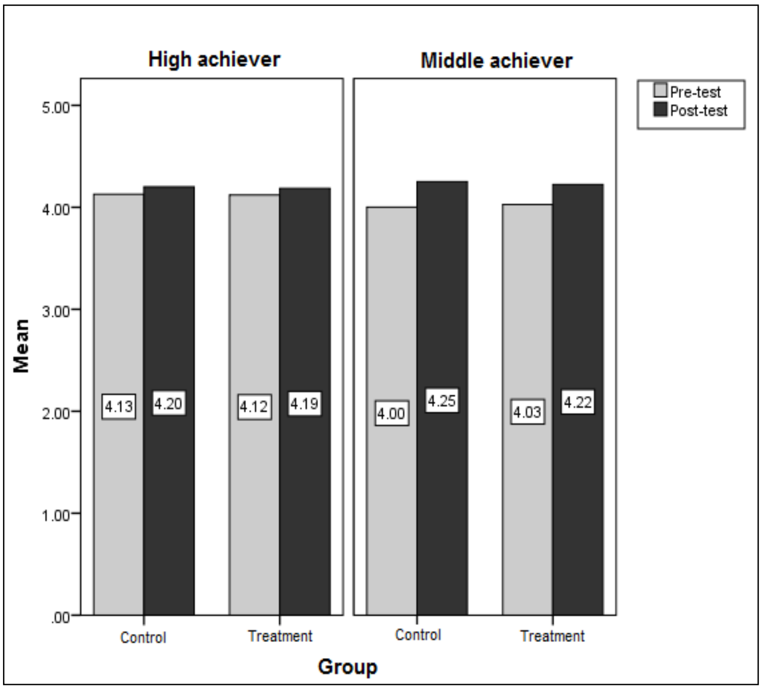

Figure 1. Descriptive analysis

Is there any difference between control and treatment group?

For this second research question, analysis using MANOVA repeated measure (2×2×2×5) was implemented. It was analysis repeatedly towards two groups (control and treatment), two category of achiever's level (high achiever and middle achiever), two times measurement (pre-test and post-test) and five elements of noble values. The main effects and the interaction effects as shown in Table 2 which was obtain from multivariate test.

Table 2. Multivariate test

Effect	Nilai Pillai's trace	F	df1	df2	Sig.	Partial Eta Squared
Group	0.08	1.80	5	108	0.12	0.08
Level	0.10	2.52	5	108	**0.03**	0.10
Group*Level	0.07	1.60	5	108	0.17	0.07
Time	0.19	4.92	5	108	**0.00**	0.19
Time*Group	0.14	3.66	5	108	**0.00**	0.14
Time*Level	0.05	1.03	5	108	0.41	0.05
Time*Group*Level	0.03	0.72	5	108	0.61	0.03

Significant level = 0.05

Based on the multivariate test in Table 2, the impact of the intervention (conventional inquiry and AM-STEM Kids module) on children's mean score on the noble values questionnaire, across two time periods (pre-test and post-test) was assess. There was no significant main effect comparing the two types of intervention, F (5,108) = 1.80, p = 0.12, partial eta squared 0.08. Meanwhile, there was a significant main effect comparing two types of achiever [F(5,108) = 2.52, p = 0.03, partial eta squared 0.10] and across two time period [F (5,108) = 4.92, p = 0.00, partial eta squared 0.19]. These main effects shows, an increasing of noble values across the types of achiever and time period if measured separately. The interaction between the intervention and achiever, time periods and achiever and time period, intervention and achiever shows no significant interaction. However, there was significant interaction between the time period and the intervention, F (5,108) = 3.66, p = 0.00, partial eta squared 0.14. This finding indicated there was a different in the effectiveness of two group interventions in fostering the noble values.

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According to above result, further analysis was employed using a paired sample t-test. This analysis was used to compare the mean score of both groups from pre-tests with the mean score from post-tests. Five elements of noble value were tested namely: (i) be thankful to God, (ii) cooperative, (iii) rational, (iv) appreciation to nature and the contribution of science and technology, and (v) fair and just. Table 3 shows the comparison of mean score and the effect size (r) for both groups across time period.

Table 3. Paired sample t-test

Elements	Group	Time	μ	σ	t	df	Sig.	r
Thankful	Control	Pre-post	-0.10	0.49	-1.50	56	0.14	-0.10
	Treatment	Pre-post	0.05	0.41	0.95	58	0.35	0.05
Cooperative	Control	Pre-post	-0.25	0.51	-3.75	56	**0.00**	0.52
	Treatment	Pre-post	-0.12	0.65	-1.43	58	0.16	0.19
Rational	Control	Pre-post	-0.18	0.86	-1.61	56	0.11	-0.18
	Treatment	Pre-post	0.00	0.96	0.00	58	1.00	0.00
Appretiation	Control	Pre-post	-0.22	0.60	-2.80	56	**0.01**	0.38
	Treatment	Pre-post	-0.33	0.72	-3.58	58	**0.00**	0.49
Fair and just	Control	Pre-post	0.00	0.81	0.00	56	1.00	0.00
	Treatment	Pre-post	-0.25	0.81	-2.42	58	**0.02**	0.32

Significant level = 0.05

Based on Table 3, both group shows significant value on appreciation element [(control group: t=-2.80, dk = 56, P < 0.05) (treatment group: t=-3.58, dk = 58, P < 0.05)]. However, compared the effect size of this elements, treatment group shows the larger effect size (r = 0.49) than control group (r = 0.38). Meanwhile, there was significant difference for element cooperative in control group instead of treatment group [(control group: t=-3.75, dk = 56, P < 0.05) (treatment group: t=-1.43, dk = 58, P > 0.05)]. Element fair and just shows a significant value for treatment group (t=-2.42, dk = 58, P < 0.05)] with large effect size (r = 0.32). This can be concluded, the treatment group using AM-STEM Kids module was effective than conventional inquiry teaching approach in fostering the appreciation to nature and the contribution of science and technology and the element of fair and just. However, control group was more effective in fostering cooperative element among children.

Discussion and Conclusion

The intervention called AM-STEM Kids module that compliance with STEM 5E learning cycle was developed to the 5th grade elementary school children to investigate the impact of the module in fostering children noble value. This research was applied a quasi-experimental study with involved two groups (conventional inquiry approach and AM-STEM Kids module) and two group achiever (high and low achiever). It is found that, the noble value practiced by children in both groups had a high mean score before and after the treatment. In addition, after the treatments were given for both groups it shows improvement of the noble value practice. Statistically, teaching approach between using a module and conventional inquiry gave a same impact in term of fostering noble values among children. The resulted from this finding parallel with the study conducted by Nik Yaacob (2007). This condition indicate, affective component such as value needs an adequate time and continues stimulation if we want to see the changes take effect.

One of the goals in science education is to develop children with the character of Noble value (MOE, 2013). Selected elements in noble values were used to compare the differences between control and treatment group. The result shows, elements appreciation to nature and the contribution of science and technology demonstrated a large effect size than a control group. The effectiveness of the module, due to the fact that the opportunity given to the child to interact with nature. Aktepe (2015) found, through the observation and making children love to the environment can develop them to appreciate the nature. Fair and just element also shows the larger effect size when using a module compared to conventional inquiry. This result was consistent with the study by Vaughn, Schumm, Niarhos, and Gordon (1993), that is students prefered teacher who give the same favor and task among them.

İn conclution, eventhough the module less impresive to foster all aspects of noble values with regards of time factor, despite of that AM-STEM Kids module is still effective in fostering children's noble values. Hence, it could be used as teaching resources in fostering noble values in the science classroom.

References

Aktepe, V. (2015). Implementation of a Performance Task for Developing the Value of Love of Nature. *Educational Sciences: Theory & Practice, 15*(3), 771-786.

Australian Goverment Department of Education, Science and Training. (2005). *National Framework for Values Education in Australian School*. Canberra: Commonwealth of Australia.

Baybee, R.W, Taylor, J.A., Gardner, A., Scotter, P.V., Powell, J.C., Westbrook, A., & Landes, N. (2006). *The BSCS 5E Instructional Model: Origins, Effectiveness and Applications* Colorado Springs: BSCS.

Clement, P. (2013). Values in Science and in Science Education. *Journal INEDP, 1*(1), 1-26.

George, D, & Mallery, P. (2003). *SPSS for Windows Step by Step: A Simple guide and reference*. Boston: Allyn & Bacon.

Abu Saad, H. (2007). *Perkaitan penghayatan akhlak, sikap terhadap sains, pencapaian dan pemilihan kerjaya di kalangan pelajar dalam konteks pembangunan modal insan bersepadu dalam bidang sains dan teknologi di SMKA.* (PhD), Universiti Kebangsaan Malaysia, Bangi.

Hasan, A.A., Hamzah, M.I., & Awang, M.M. (2014). Inculcating Noble Values for Pre-Service Teachers. *International Education Studies, 7*(11), 111-119.

Hurlock, E.B. (1990). *Developmental Psychology: A Lifespan Approach*.

Ismail, H., Hamzah, R.Y., Aida, S.M., Nawawi, H., Abu, R., & Wan Ali, W.Z. (2007). Teachers' Belief Towards the Principles Underlying the National Philosophy of Education in Malaysia. *International Journal of Learning, 13*(9), 93-104.

MOE. (2012). *Kurikulum Bersepadu Sekolah Rendah: Spesifikasi Kurikulum Sains Tahun Lima*. Putrajaya: Bahagian Pembangunan Kurikulum.

MOE. (2011). Kurikulum Standard Sekolah Rendah (KSSR). Retrieved from http://web.moe.gov.my/bpk/v2/kssr/index.php/pengenalan/latar_belakang

MOE. (2013). *Kurikulum Standard Sekolah: Dokumen Standard Kurikulum dan Pentaksiran*. Putrajaya: Bahagian Pembangunan Kurikulum.

Mabary, T.G. (2017). *Values, Moral, and Character Education in Colonial America Through the Nineteenth Century: A Qualitative Historical Study.* (PhD), Southwest Baptist University. Retrieved from http://search.proquest.com.www.ezplib.ukm.my/pqdtglobal/pagepdf/1897041207/fulltextPDF/93187EE5C9754978PQ/15?accountid=27931

Main, R.G. (1992). *Integrating the affective domain into the instructional design process*. California State University, College of Communications. Brooks AFB, TX: Air Force Systems Command.

Nik Yaacob, N.K. (2007). *Kajian Penerapan nilai murni menerusi pengajaran bermodul.* (PhD), Universiti Kebangsaan Malaysia, Bangi.

Nunnally, J.C, & Bernstein, I.H. (1994). *Psychometric Theory* (3rd ed.). USA: McGraw-Hill, Inc.

Pa, N.A.M., & Tapsir, R. (2013). Analysis of instruments measuring values of mathematics education. *Procedia - Social and Behavioral Sciences, 90*(2013), 449-457.

Şahinkayasi, Y., & Kelleci, Ö. (2013). Elementary School Teachers' Views on Values Education. *Procedia - Social and Behavioral Sciences, 93*(2013), 116-120.

Seah, W.T., & Bishop, A.J. (2000). *Values in mathematics textbooks: A view through two Australasian regions*. Paper presented at the Paper presented at the 81st Annual Meeting of the American Educational Research Association, New Orleans, LA.

Vaughn, S., Schumm, J.S., Niarhos, F.J., & Gordon, J. (1993). Students' Perceptions of Two Hypothetical Teachers' Instructional Adaptations for Low Achievers. *The Elementary School Journal, 94*(1), 87-102

Wiersma, W. (1995). *Research Method in Education: An Introduction*. Boston: Allyn & Bacon.

ISRES Publishing

The Eurasia Proceedings of
Educational & Social Sciences (EPESS)
ISSN: 2587-1730

The Eurasia Proceedings of Educational & Social Sciences (EPESS), 2017

Volume 6, Pages 167-172

ICEMST 2017: International Conference on Education in Mathematics, Science & Technology

THE INVESTIGATION OF THE EFFECTS OF ROBOTIC-ASSISTED PRACTICES IN TEACHING RENEWABLE ENERGY SOURCES TO SEVENTH-GRADE STUDENTS IN SECONDARY SCHOOL

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Abstract: The purpose of the study is to teach the robotics-assisted lego training sets and renewable energy sources to 7th grade students in secondary school and examine the effects of practices on academic achievement and scientific process skills of students. The research was carried out with 20 students which study in the 7th grade of secondary school. A single group pre-test-post test model which is one of the pre-test designs, was used in the study. In the research, it was tried to be taught the renewable energy sources to students by using the Lego® Mindstorms EV3 Training Kit and the Lego® Renewable Energy Kit. The practice lasted total for 20 hours as 3 stages. At the first stage, Lego® Mindstorms EV3 Training Kit and Lego® Renewable Energy Kit were introduced to the students. At the second stage of the practice solar energy related materials and at the final stage wind energy materials of the practice were ensured to be designed by students, and it was made them do activities. In the research, as a mean of collecting data, "Alternative Energy Resources Achievement Test" developed by Mercan Höbek (2014) in order to measure the success of students on the topic of renewable and non-renewable energy sources, "Scientific Process Skill Test" developed by Okey, Wise and Burns (1985) and translated and adapted to Turkish by by Geban, Aşkar and Özkan (1992) in order to determine whether there is any change in the scientific process skills of the students and "Semi-structured interview form" in order to evaluate the perspectives of students on the use of legos as a course material, were used. The data obtained in the study were evaluated through the SPSS package program. In the light of this study, it was determined how students perceive education with legos as a method oriented the subject of renewable energy sources.

***Keywords*:** Robotic, renewable energy resources, lego® mindstorms EV3 educatin kit, lego® renewable energy kit

Introduction

It is now clear that science and technology education plays an important role in the future of societies, as scientific knowledge grows, technological innovations progress rapidly, and the effects of science and technology are clearly visible in all areas of our lives (Mercan Höbek, 2014). Recently, many innovative approach-based applications have been implemented in the field of education. A number of innovation activities have been carried out in which the learning environment is enriched, in which remedial materials for conceptual misconceptions about a specific topic are used, in which the students are responsible for their own learning in the process and they work in cooperation with their peers and using social communication skills, and also, teachers working as guides in the process. One of the innovative works used in these activities is the Lego-Logo supported learning environment (Silik, 2016).

Students trained in the learning environment created with Lego robot kits have fulfilled the stages of thinking, analysing, formulating the results, reaching the knowledge and searching for the answers (Özdoğru, 2013). According to Costa and Fernandes (2004), learning environments provided by Robotics contribute to the development of many skills that students already have.Robotics activities in Science and Technology education have shown that students have acquired many abilities such as problem-solving, finding practical solutions to problems, critical thinking, awareness of their own abilities, learning by doing living, increasing the level of using technology and being more willing to use technology (Silik, 2016).

- Selection and peer-review under responsibility of the Organizing Committee of the conference

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When the studies in which the robotics are used in the literature are examined; In a study conducted by Özdoğru (2013), it was found that the use of Lego Mindstorms NXT 2.0 has a positive effect on students' scientific process skills, academic achievement, attitudes towards science and technology.In the studies conducted by Koç Şenol and Böyük (2015), experiments carried out with robotic support, examines the effects of students on scientific process skills and motivation for science and technology lessons in the Science and Technology lesson "Force and Movement"s unit, it was found that robotics significantly influenced students' motivation for scientific process skills and science and technology lessons. In the study of Payne (2008), as a result of the study of robotic courses investigating effects on primary school students, emphasised that sense of responsibility, creativity, analysis and synthesis skills, collaborative learning and independent working skills, communication and problem-solving skills improved in the students Ma, Lai, Prejean, Ford and Williams (2007) found that robotic activities helped middle school students learn better about physical knowledge. In their study, Lindh and Holgersson (2007) also found that the success of students who love problem-solving activities, increased and the students who received lego training, were more successful the next year.
In this context, this research aims to teach renewable energy sources to the 7th-grade students of midle school with robotically supported lego training sets and to examine the impact of their application on academic achievement and scientific process skills of students.

Methods

This research is a study aimed to teach renewable energy sources to the 7th-grade students of midle school with robotically supported lego training sets and to examine the impact of their application on academic achievement and scientific process skills of students. In the study, one group pre-test-post test model was used from pre-test designs.Students in the study were tried to be taught renewable energy sources by using Lego® Mindstorms EV3 Training Kit and Lego® Renewable Energy Kit.The set includes solar energy panel, wind turbine propellers, LED lights, motor, energy meter to measure energy produced and 6 different production guides.The application lasted for 3 stages in total for 20 hours In the first stage, students were introduced Lego® Mindstorms EV3 Training Kit and Lego® Renewable Energy Kit.In the second stage of the application, solar energy related materials and in the last stage of the application, materials related to wind energy were designed and activities were done.

Data Collection Tools

The Alternative Energy Sources Achievement Test developed by Mercan Höbek (2014) ,in order to measure the success of the students as a means of collecting data in the research in terms of renewable and non-renewable energy sources; Science Process Skills Test (SPST) which was developed by Okey, Wise and Burns (1985) and translated and adapted by Geban, Aşkar and Özkan (1992) to determine whether there is any change in the scientific process skills of the students, "Robotic Preliminary Questionnaire" developed by Riberio (2006) and translated into Turkish by Koç Şenol (2012), Robotic Satisfaction Test developed by Silva (2008) and Gibbon (2007) and translated into Turkish by Koç Şenol (2012) and a semi-structured interview form to assess students' views of the use of legos as lesson material and to determine their views and recommendations on implementation, were used as data collection tools in the research.

Results and Findings

A total of 20 middle school 7th grade students including 10 girls and 10 boys participated in the research. Alternative Energy Resources Achievement Test consisting of 19 multiple choice and 3 open ended questions in order to measure the success of students on the topic of renewable and non-renewable energy sources, Scientific Process Skill Test, "Robotic Preliminary Questionnaire", "Robotic Satisfaction Test" for students to determine whether there is any change in scientific process skills and a semi-structured interview form to assess students' views of the use of legos as lesson material and to determine their views and recommendations on implementation, were used as data collection tools in the research.Multiple-choice questions and open-ended questions on alternative energy sources achievement test were evaluated separately. The 19 multiple choice questions were each rated 1 point and the highest score was 19 points. The data obtained from the study were evaluated by means of the SPSS package program and the data obtained are presented below.

Table 1. SPST pretest-posttest scores of the students

	N	$\overline{X}$	*SS*	*t*	*df*	*p*
Pre-test	20	0,55	0,16	3,37	19	0,03
Post-test	20	0,67	0,11			

When Table 1 is examined, it is seen that students' scientific process skills test have a pre-test score average 0.55; And the posttest score average is 0.67.As the t-test result ($t_{19} = 0.03$; $p <0.05$) on these values, it is seen that there is a statistically significant difference between students average of pre-test-post test scores in scientific process ability test.Therefore, it can be said that the robotic activities contributed positively to the students' scientific process skills.

Table 2. Results of AERAT pretest-posttest scores of students

	N	$\overline{X}$	*SS*	*t*	*df*	*p*
Pre-test	20	0,62	0,22	4,54	19	0,00
Post-test	20	0,78	0,14			

When Table 1 is examined, it is seen that students' scientific process skills test have a pre-test score average 0.55; And the posttest score average is 0.67.As the t-test result ($t_{19} = 0.03$; $p <0.05$) on these values, it is seen that there is a statistically significant difference between students average of pre-test-post test scores in scientific process ability test.Therefore, it can be said that the robotic activities contributed positively to the students' scientific process skills.

Table 3. Frequency and percentage distributions of answers given by students to AERAT open-ended questions

	Very good				Good				Middle				Developable				Not good			
	Pre-test		Post-test		Pre-test		Post-test		Pre-test		Post-test		Pre-test		Post-test		Pre-test		Post-test	
	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%
What are the most commonly used energy sources in our country, why?	1	5	4	20	4	20	7	35	8	40	8	40	3	15	1	5	4	20	0	0
What do you understand from renewable energy sources?	0	0	4	20	10	50	13	65	3	15	3	15	1	5	0	0	6	30	0	0
What are the contributions of renewable energy sources to my country?	0	0	6	30	8	40	6	30	4	20	5	25	0	0	1	5	8	40	2	10

In the study, students were asked question,"What are the most commonly used energy sources in our country and why?", the number of students who answered "good" and "very good", increased from 5 in the pre-test to 11 in the post-test and no change in the middle response. In evaluating the answers to the questions, answers such as the fossil fuels (coal, natural gas, oil), hydroelectric power plants, wind power plants and thermal power plants have been evaluated as a very good.

Students were asked question, "What do you understand from renewable energy sources", the number of students who answered "good" and "very good", increased from 10 in the pre-test to 17 in the post-test and no change in the middle response. In evaluating the answers to the questions, answers such as self-renewable, environmentally friendly, non-reducing energy sources in nature have been evaluated as a very good.

Students were asked question, "What are the contributions of renewable energy sources to my country?", the number of students who answered "good" and "very good" increased from 10 in the pre-test to 17 in the post-test and the medium answer increased 1 point. In evaluating the answers to the questions, answers such contributing to the country's budget, improving the economy and reducing its dependency on the environment by reducing environmental pollution have been evaluated as a very good.

Table 4. Frequency and percentage distributions of questions 1 and 2 of the robotic preliminary questionnaire

	Yes		**No**	
	f	**%**	**f**	**%**
Have you ever used Lego parts before?	16	80	4	20
Do you have information about the Lego Mindstorms Robotic System?	4	20	16	80

As seen in Table 4, "Have you ever used Lego parts before?" to the question, 80% of middle school students participating in the survey answered yes, 20% of the students answered no. 20% of the middle school students who participated in the survey said they had knowledge about the Lego Mindstorms Robotic System, 80% of middle school students stated that they did not have any information.

Table 5. Frequency and percentage distributions of question 3 of the robotic preliminary questionnaire

	Yes		**Undecided**		**Easy**	
	f	**%**	**f**	**%**	**f**	**%**
Do you think you can learn about renewable energy sources with Lego?	16	80	4	20	0	0

As seen in Table 5, "Do you have information about the Lego Mindstorms Robotic System?" to the question, 80% of middle school students participating in the survey answered yes, 20% of the students answered no.

Table 6. Frequency and percentage distributions of question 4 of the robotic preliminary questionnaire

	Partly Difficult				**Undecided**				**Easy**			
	Pre-test		**Post-test**		**Pre-test**		**Post-test**		**Pre-test**		**Post-test**	
	f	**%**	**f**	**%**	**f**	**%**	**f**	**%**	**f**	**%**	**f**	**%**
What do you think about the use of legos in activities you performed/will perform?	0	0	4	20	5	25	0	0	15	75	16	80

“What do you think about the use of legos in activities you performed/will perform?” to the question, 25% of middle school students participating in pre-test stated that they were undecided for the use of legos in the activities they will perform and 75% stated that the use of legos will be easy. In the post-test, 20% of middle school students were found to be partly difficult and 80% stated it was easy.

Also on post-test, students were asked the question, "Are you satisfied with the activities you have done?", they stated that 15% of middle school students were satisfied, and 85% were very satisfied.

"Have you been interested in using Legos in renewable energy activities?" to the question, 100% of of middle school students answered yes.

Students participating in a survey were asked "Does the Lego® Renewable Energy Set benefit from learning Renewable Energy Resources?", 100% of the students answered yes and stated it was beneficial. Some of the answers given by students are as follows:

Ö-1: "Yes it was. I also had fun. "
Ö-2: "Yes it was and I had a lot of fun."

Students participating in a survey were asked "What are the advantages of lesson processing with legos?" Some of the answers given by students are as follows:

Ö-1: "I think it will be more fun and more memorable as it will be applied "
Ö-2: "We learn by having more fun."
Ö-3: "It can stay faster and clearer in people's minds."
Ö-4: "I think it will make it easier to learn and increase the interest in the lesson."
Ö-5: "Enables student-centered lesson for applied."
Ö-6: "The lesson can be more memorable when it is applied."
Ö-7: "Lessons become more fun and educational."

Students participating in a survey were asked "What do you think about the processing of the lessons with legos?" Do you want to? Why?" Some of the answers given by students are as follows:

Ö-1: "I think it will be more fun and more memorable and more productive learning because it will be applied."
Ö-2: "I think that our learning will be more fun, more memorable and more productive for students by learning away from the memorization system, experimenting and practicing."
Ö-3: "It ensures that children (we) are not bored from the lessons and understand the lesson better."

Students participating in a survey were asked "What are the disadvantages of lectures with legos?" Some of the answers given by students are as follows:

Ö-1: "So I do not think it would be but maybe some of our friends can use it to play games instead of education. "
Ö-2: "There may be a time problem when the lesson is being processed."
Ö-3: "I was pleased to learn with renewable energy set, but it was expensive when I asked teacher the price. In my opinion, If it is at a cheaper price, all children will be learned using it."

Conclusion

In this study, which examines the effects of teaching robotics-supported lego training sets and renewable energy sources on students' academic achievement and scientific process skills to seventh grade students in midle school, it was determined that the activities of renewable energy sources made with robotically supported lego training kits influenced the students' scientific process skills positively by analyzing the obtained data (t_{19}=0.03; $p<0.05$). While this result is in parallel with the results of the studies in the literature (Sullivan, (2008); Çayır, (2010); Çavaş et al., (2012); Koç Şenol (2012); Koç Senol and Büyük, (2015); Özdoğru (2013)), it also contradicts the result of the study by Ma, Lai, Prejean, Ford and Williams (2007).

From the analysis of the data obtained in the research and the responses of the students to the open-ended questions in the success tests of alternative energy sources, we can say that teaching robotics-supported lego training sets and renewable energy sources increases the knowledge of renewable energy sources.This result is parallel to the results of the study by Marulcu and Mercan Höbek (2014).

According to the results of the survey conducted before the application to determine the opinions of students related to robotics in the research, 80% of the students stated that they used Lego parts in advance, whereas 80% of the students did not know about the Lego Mindstorms Robotic System. As seen here, most of the students who participated in the research have no knowledge of robotics, even though they use the parts of the lego.

"Do you think you can learn about renewable energy sources with Lego?", 80% of the middle school students who participated in the survey had answered yes, and 20% answered no.

What do you think about the use of legos in activities you performed/will perform?" to the question, 25% of middle school students participating in pre-test stated that they were undecided for the use of legos in the activities they will perform and 75% stated that the use of legos will be easy. In the post-test, 20% of middle school students were found to be partly difficult and 80% stated it was easy.

Also on post-test, students were asked the question, "Are you satisfied with the activities you have done?", they stated that 15% of middle school students were satisfied, and 85% were very satisfied. "Have you been interested in using Legos in renewable energy activities?" to the question, 100% of of middle school students answered yes.

Students participating in a survey were asked "Does the Lego® Renewable Energy Set benefit from learning Renewable Energy Resources?", 100% of the students answered yes and stated it was beneficial.

Recommendations

In this study, which examines the effects of teaching robotics-supported lego training sets and renewable energy sources on students' academic achievement and scientific process skills in midle school students, the obtained data and moving from the results; In the study, considering that junior high school students are very satisfied with the robotics that they have been doing, that they have learned to have fun, and that their motivation for learning is increasing, various courses and activities should be organized for students and teachers on robotics which is the technology of our day.

References

Çavaş, B., Holbrook, J., Rannikmae, M., Kesercioglu, T., Özdoğru, E., Gökler, F. (2012). The Effects of Robotics Club on the Students' Performance on Science Process & Scientific Creativity Skills and Perceptions on Robots, Human and Society. 3rd International Workshop *"Teaching Robotics, Teaching with Robotics" 2012 Integrating Robotics in School Curriculum Riva del Garda(TN*), İtalya.

Çayır, E. (2010). Assignment the effect of learning environment supported by lego-logo on science process skill and self concept. Master's Thesis, Sakarya University, Sakarya.

Geban, Ö., Aşkar, P. & Özkan, İ. (1992) Effects of Computer Similation and Problem Solving Approaches on High School. *Journal of Educational Research. 86* (1), 5-10.

Koç Şenol, A. (2012). Science and technology laboratory applications supported by robotic: ROBOLAB. *Master Thesis, Erciyes University, Graduate School of Education Sciences.*

Koç Şenol, A., & Büyük, U. (2015). Robotik Destekli Fen Ve Teknoloji Laboratuvar Uygulamaları: ROBOLAB. *Electronic Turkish Studies*, *10*(3).

Lindh, J. and Holgersson, T. (2007). Does lego training stimulate pupils' ability to solve logical problems? *Computers & Education*, *49*(4), 1097–1111.

Ma, Y., Lai, G., Prejean, L., Ford, M. J., and Williams, D. (2007, March). Acquisition of Physics content knowledge and scientific inquiry skills in a robotics summer camp. In Society for Information Technology & Teacher Education International Conference, Department of Curriculum.

Mercan Höbek, K. (2014). Analysıs of the 6th, 7th, and 8th Grade Scıence and Technology Currıcula for Identifying Subjects that can be Taught by Engıneering-Design Method: Preparing Teaching Materials for Alternate Energy Reseources. Master's Thesis, Erciyes University, Kayseri.

Özdoğru, E. (2013). The Effect of Lego Programme Based Science and Technology Education on the Students' Academic Achievement, Science Process Skills and Their Attitudes Toward Science and Technology Course for Physical Facts Learning Field. Master's Thesis, Dokuz Eylül University, İzmir.

Payne, A. (2008), *Integrating Math, Science and Technology: Teaching Problem- Solving Skills Through Robotics,* Dept. of Curriculum & Teaching Hofstra University, Hempstead.

Silik, Y. (2016). Effect of Educational Robotics Applications on Problem Solving Skills of Science Teacher Candidates. Master's Thesis, Karadeniz Technical University, Trabzon.

Sullivan, F. R. (2008). Robotics and science literacy: Thinking skills, science process skills and systems understanding. Journal of Research in Science Teaching, 45(3), 373-394.

ISRES Publishing

The Eurasia Proceedings of Educational & Social Sciences (EPESS)
ISSN: 2587-1730

The Eurasia Proceedings of Educational & Social Sciences (EPESS), 2017

Volume 6, Pages 173-176

ICEMST 2017: International Conference on Education in Mathematics, Science & Technology

EXAMINATION OF PRE-SERVICE TEACHERS' TECHNOLOGY INTEGRATION AND THEIR TECHNOLOGICAL PEDAGOGICAL CONTENT KNOWLEDGE

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Abstract: How technology is integrated to the lessons is important because what is meant by teachers' use of technology varies widely. Therefore, the purposes of this study were to determine pre-service physics teachers' TPCK and to examine their technology integration skills during their practices. Technological pedagogical content knowledge frames this research. The participants of the study were senior pre-service physics. In order to measure the participants' true knowledge, ability, and practice about TPCK, data were collected by using mixed-methods including observations, lesson plans, and interviews. Results of this study conclude that pre-service physics teachers can reflect technology integration to their practices more successfully than to their lesson plans. They can behave like an expert while using CBL technology in their teaching. Although they know how to use technology effectively, some of them need to improve their knowledge and realize that technology is not a vitamin whose mere presence catalyzes better educational outcomes. In addition, pre-service physics teachers have high level TPCK; hence, they have tendency to use technology and have a coherent knowledge about technology, pedagogy and content. This study suggests that various technologies should be introduced in teacher education programs and teacher candidates should use these technologies as tools to gain progress in advancing their TPCK.

Keywords: Pre-service teachers, TPCK, technology integration.

Introduction

Technology has begun to take a crucial role in education; therefore, there has been substantial investment on technological tools in order to integrate technology to the science teaching. However, how technology is integrated to the lessons is important because what is meant by teachers' use of technology varies widely (Bebell, Russell & O'Dwyer, 2004). Therefore, the purposes of this study were to determine pre-service physics teachers' TPCK and to examine their technology integration skills during their practices.

Theoretical Framework

Technological pedagogical content knowledge frames this research. Teachers should need to have a coherent knowledge about technology, pedagogy and content. Technological Pedagogical Content Knowledge, known as TPCK or TPACK, has become theoretical framework of teacher knowledge for technology integration. TPCK framework allows us to make sense of the complex web of relationships that exist when teachers attempt to apply technology to the teaching of subject matter (Mishra & Koehler, 2006). In recent years, researchers described TPCK within Schulman's (1987, 1986) framework description of Pedagogical Content Knowledge (PCK). TPCK is an extension of PCK and is achieved when a teacher knows (Graham and others, 2004);

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1) How technological tools transform pedagogical strategies and content representations for teaching particular topics,
2) How technology tools and representations impact a student's understanding of these topics.

According to Koehler and Mishra (2008), TPCK has three components: PCK, TPK (Technological Pedagogical Knowledge) and TCK (Technological Content Knowledge). PCK is the connection and relation of pedagogy and content knowledge. TPK represents the integration of technology with general pedagogical strategies. It is related to engage students with technology effectively in the learning process. TCK represents knowledge of technological tools that are used by teachers within content. Consequently, TPCK, that is center of the model, represents the usage of technology to provide content and pedagogical strategies.

Literature Review On Tpck And Technology Integration

Teachers must not focus on the technology itself, but rather on the learning outcome that is supported by technology (Millen, 2015). Teachers' knowledge to integrate content, pedagogy and technology has become important. As a result, a quite number of studies have been focused on to examine how teachers and teacher candidates integrate technology into their teaching and to determine their TPCK. Due to the fact that self-report instruments were generally used to discover teachers' TPCK in the studies (Archambault & Crippen, 2009; Forssell, 2011; Liang, Chai, Koh, Yang, & Tsai, 2013; Jang & Tsai, 2013), the results might not reflect what TPCK these teachers actually would perform during their practices.

Because confidence in TPCK is different from confidence in using technology more generally, it is important to create opportunities for teachers to learn how new technologies support their specific goals in the grade, subject area, and school context in which they teach (Forssell, 2011). Therefore, Koh and Divaharan (2013); Lowder (2013); Mudzimiri (2012) and Sabo (2013) developed teacher education courses and studied the participants' TPCK. Some research investigated teachers' technology integration (Inan & Lowther, 2010; Stoilescu, 2011). The review of research on TPCK suggests that more research is needed to explore how science teachers integrate specific technology in their teaching practices by collecting data from various methods including observing and interviewing.

Purposes of the Study

Assessing TPCK requires focus on a specific technology using in a particular context and in support of a clear set of curricular objectives, and it will require some measure of teachers' PCK as well (Forssell, 2011). Thus, the research questions put a light on this study are as follows:

1. What is pre-service physics teachers' technological pedagogical content knowledge?
2. How do pre-service physics teachers integrate calculator based laboratory (CBL) technology into their practices?

Methodology

Case study design (Stake, 1995) was guided to the research. The participants of the study were 10 senior pre-service physics teachers, three of whom were male. Science teachers could develop their TPCK through using technological tools in science teaching (Jang & Tsai, 2013). Therefore, the participants enrolled in a course titled as "Technology Integration in Physics Teaching". One of the researchers was the instructor of the course. Since teaching with technology requires complex skills and understandings, the participants had opportunity to learn and integrate Calculator-Based Laboratory (CBL) technology into teaching of various physics subjects in this course. Then, they designed and implemented a lesson plan about the physics concepts. Before starting to implementation, the participants' CBL knowledge and skills were measured to make sure that all the participants learned this technology. In order to measure the participants' true knowledge, ability, and practice about TPCK, data were collected by using mixed-methods including observations, lesson plans, and interviews.

The pre-service physics teachers' skills while they were integrating the CBL technology into their teaching were observed by two researchers. Science Classroom Observation Rubric (SCOR) developed by Burry-Stock and Oxford (1994) was filled out by the researchers separately for each participant. Another data source was the pre-service physics teachers' lesson plans they prepared in detail. Moreover, interviews were conducted with the participants just after their practices to understand their thoughts about technology integration and to evaluate their practices. Five point scoring rubrics were created by the researchers to analyze the participants' lesson plans transcripts gathered from the interviews.

Conclusions and Suggestions

Results of this study conclude that pre-service physics teachers can reflect technology integration to their practices more successfully than to their lesson plans. They can behave like an expert while using CBL technology in their teaching. Although they know how to use technology effectively, some of them need to improve their knowledge and realize that technology is not a 'vitamin' whose mere presence catalyzes better educational outcomes (Dede, 2001). In addition, pre-service physics teachers have high level TPCK; hence, they have tendency to use technology and have a coherent knowledge about technology, pedagogy and content.

Using technology might stimulate teachers' confidence and self-efficacy, so that they become more successful in their teaching. Future research must expand on this possibility. This study suggests that various technologies should be introduced in teacher education programs and teacher candidates should use these technologies as tools to gain progress in advancing their TPCK.

References

Archambault, L., & Crippen, K. (2009). Examining TPACK among K-12 online distance educators in the United States. *Contemporary Issues in Technology and Teacher Education*, *9*(1), 71-88.

Bebel, D., Russell, M., & O'Dwyer, L. (2004). Measuring teachers' technology uses: Why multiple-measures are more revealing. *International Society for Technology in Education*, *37*(1), 45-63

Burry-Stock, J. A., & Oxford, R.L. (1994). Expert Science Teaching Education Evaluation Model (ESTEEM): Measuring Excellence in Science Teaching for Professional Development. *Journal of Personal Evaluation in Education*, *8*, 267-297.

Dede, C. (2001). Creating research centers to enhance the effective use of learning technologies. *Testimony to the Research Subcommittee, Science Committee, US House of Representatives.* Committee on Science. Harvard University, Cambridge, MA.

Forssell, K. S. (2011). *Technological pedagogical content knowledge: Relationships to learning ecologies and social learning networks*. Unpublished doctoral dissertation. Stanford University, Stanford, CA.

Graham, C. R., Burgoyne, N., Cantrell, P., Smith, L., St. Clair, L. & Harris, R. (2009). TPACK development in science teaching: Measuring the TPACK confidence of inservice science teachers. *TechTrends*, *53*(5), 70-79.

Inan, F. A., & Lowther, D. L. (2010). Factors affecting technology integration in K-12 classrooms: A path model. *Educational Technology Research Development*, *58*(2), 137–154

Jang, S. J., & Tsai, M. F. (2013). Exploring the TPACK of Taiwanese secondary school science teachers using a new contextualized TPACK model. *Australasian Journal of Educational Technology, 29*(4), 566-580.

Koehler, M.J., & Mishra, P. (2008). Introducing TPCK. AACTE Committee on Innovation and Technology (Ed.), *The handbook of technological pedagogical content knowledge (TPCK) for educators* (pp. 3-29). Mahwah, NJ: Lawrence Erlbaum Associates.

Koh, J. H. L., & Divaharan, S. (2013). Towards a TPACK-fostering ICT instructional process for teachers: Lessons from the implementation of interactive whiteboard instruction. *Australasian Journal of Educational Technology*, *29*(2), 233-247

Liang, J. C., Chai, C. S., Koh, J. H. L., Yang, C. J., & Tsai, C. C. (2013). Surveying in-service preschool teachers' technological pedagogical content knowledge. *Australasian Journal of Educational Technology*, *29*(4), 581-594.

Lowder, L. S. (2013). *Building technological pedagogical content knowledge (TPACK) among pre-service teachers in a science methods course using action research*. Unpublished doctoral dissertation. University of Florida, Gainesville, FL.

Millen, R. A., & Gable, R. (2016). Closing the gap between technological and best practice innovations: TPACK and DI. *K-12 Education*, Paper 33.

Mishra, P., & Koehler, M.J. (2006). Technological pedagogical content knowledge: A framework for integrating technology in teacher knowledge. *Teachers College Record*, *108*(6), 1017-1054.

Mudzimiri, R. (2012). *A study of the development of technological pedagogical content knowledge (TPACK) in pre-service secondary mathematics teachers*. Unpublished doctoral dissertation. Montana State University, Bozeman, MT.

Sabo, K. (2013). *A mixed-methods examination of influences on the shape and malleability of technological pedagogical content knowledge (TPACK) in graduate teacher education students.* Unpublished doctoral dissertation. Arizona State University, Phoenix, AZ

Shulman, L. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher, 15*(2), 4-14.

Shulman, L. S. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review, 57*(1), 1-22.

Stake, R. (1995). *The art of case-study research*. Thousand Oaks, CA: Sage

Stoilescu , D. (2011). *Technological pedagogical content knowledge: Secondary school mathematics teachers' use of technology*. Unpublished doctoral dissertation, University of Toronto, Canada.

The Eurasia Proceedings of
Educational & Social Sciences (EPESS)
ISSN: 2587-1730

The Eurasia Proceedings of Educational & Social Sciences (EPESS), 2017

Volume 6, Pages 177-188

ICEMST 2017: International Conference on Education in Mathematics, Science & Technology

SELF EFFICACY AS MEDIATOR BETWEEN LEARNING AND BEHAVIOUR AMONG IN-SERVICE SCIENCE TEACHERS TRAINING PROGRAMME OF HIGHER ORDER THINKING SKILLS

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Abstract: The aim of this study is to explore the relationship between learning and behaviour among Malaysian science teachers after attending the In-Service Teachers Training Programme of Higher Order Thinking Skills (HOTS) which was mediated by their self-efficacy. The four-level model of Kirkpatrick was applied to evaluate training effectiveness at two levels, learning and behaviour based on the application of Bandura's social cognitive theory. Multiple regression analyses indicate that self-efficacy mediated the relationship between learning (Knowledge, Skills, Attitude change) and behaviour. One of the practical implications emerging from this study is the importance of promoting and encouraging teacher participation in hand-on and HOTS-oriented activities. Such activities not only develop their self-confidence, but enhance their self-efficacy when implementing teaching and learning innovations related to HOTs. In terms of modification of the four-level model, the school organiser of the HOTS Programme should also include "self-efficacy" in the evaluation process in order to improve its effectiveness.

Keywords: Learning, self-efficacy, behaviour, training, higher order thinking skills.

Introduction

Training can be an effective way to equip workers with the skills, knowledge and capabilities to ensure they can deal with global challenges (Bhatti, Ali, Mohd Isa, & Battour 2014). In order to meet these goals, the organization has allocated a substantial amount of funds to improve the knowledge and skills of workers (Aguinis & Kraiger, 2009). This effort pays off only when employees actually transfer the contents learned into practice (Hutchins et al., 2010). Training transfer which are knowledge and skills applied to the workplace is important and indicates the effectiveness of training. Hence, it is important to evaluate learning, behaviour and transfer of training associated with the effectiveness of the training.

In the context of education, training can enhance the quality of education as it exposes educators to innovation aimed for professional development. Studies indicate the low impact of creative and critical thinking training programme on teacher practice despite having it disseminated among teachers since two decades ago as evident in the low standard of teacher and student thinking skill (Ministry of Education 2012). Conversely, teachers are expected to nurture students' higher order thinking skills (Kong, 2006; Loving & Wilson, 2000; Wang, Johansson, Bjorkstrom, & Nordstrom, 2010) if they have it in their pre-service or in-service training (Kong, 2006). The In-Service Teachers Training Programme of Higher Order Thinking Skills (HOTS) were designed to prepare teachers for instruction of higher order thinking skills in the context of science modules, prepared as part of a large-scale educational reform. It is therefore important to examine the extent to which knowledge and skills acquired from the training are transferred in the workplace or transfer of training.

In the implementation of such training programme, stakeholders have invested millions for teacher professional knowledge and new skills. In the Malaysian context, the Education Ministry allocated RM 500 million to train

- Selection and peer-review under responsibility of the Organizing Committee of the conference
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teachers implement higher order thinking skills in their teaching and learning process (Ministry of Education 2013). Hence it is deemed necessary to carry out a study to investigate to which extent the knowledge and skills gained from such training being applied at the workplace or training transfer.

Transfer of training is a critical aspect and a core issue for human resource development (Burke, 2007). To ensure transfer of training “learned behavior must be generalized to the job context and maintained over a period of time on the job” (Baldwin & Ford, 1988, p. 63). Unfortunately, in the context of the evaluation of higher order thinking skills (HOTs) training, evaluation only focused on the first and second levels which are reactions and learning (Ministry of Education, 2013). Further studies are necessary to evaluate the third level which is behaviour and the extent to which learning is transferred to the job context. According to adult education theory by Michael Knowles (1984), the five factors influencing knowledge and skill transfer from training to workplace are self-efficacy, experience, readiness to learn, learning orientation and intrinsic motivation. As adults, teachers are expected to apply the knowledge and skill learnt from the training to their workplace but any behavioural change depends on many factors. Hence this study aims to identify self-efficacy factor as the moderator in the relationship between learning and behaviour at workplace.

Background of Study

Education reforms abroad (National Research Council (NRC) 1996, 2000; National Science Teachers Association (NSTA) 2003) and the Standards for Professional Development in Schools (NCATE 2001), require teachers to apply constructivist learning and higher order thinking skills in teaching (Barak et al. 2007; Dori and Herscovitz 2005 Tobin et al. 1990). In Malaysia, teachers are given in-service trainings related to creative and higher-order thinking skills besides being exposed to various thinking tools, learning and teaching strategies aimed at enhancing learners' thinking skills (Poh 2005).

Despite its introduction for more than two decades, the Critical and Creative Thinking Skills Programme has yet proven to be effective as research findings indicate that the standard of thinking skills among students and teachers is still relatively low (Ministry of Education 2012). Results from TIMSS 2011 and PISA 2009 show Malaysian students lack skills in interpreting complex information and identifying suitable strategies for solving problems that require higher order thinking skills. This serves as a wake-up call to step up efforts towards improving learner performance in science and mathematics. The findings from TIMSS and PISA have provided input for the Malaysia Education Blueprint (MEB) 2013-2025 of which the key performance indicator to be achieved is improved average scores in 2015 TIMSS and PISA which can rank Malaysia in the top quarter tier in 2025. Hence the Higher-order Thinking Skills Training Programme (HOTs) has been implemented through which teachers are equipped with knowledge, skills, teaching strategies and thinking tools to help them improve learners' critical thinking skills.

Problem Statement

Training facilitates an organisation to equip the workers with skills, knowledge and capabilities in facing the global challenges (Bhatti, Ali, Mohd Isa, & Battour 2014;). To attain the objective, organisations allocate a large fund for the upgrading of their workers' knowledge and skills (Aguinis & Kraiger, 2009). The efforts yield promising returns if the workers are able to apply to workplace what has been learnt from the training programme (Hutchins et al., 2010). It nevertheless remains questionable to what extent teachers innovatively apply what has been learnt to their workplace. Hence it is vital to evaluate the effectiveness of such training by identifying the extent to which teachers' behavioural changes are evident based on the knowledge and skill transfer at workplace.

In the corporate sector, training evaluation or effectiveness is a common practice to ensure returns of human capital investment for evaluating investment returns (Neo, 2010; McGuire & Jorgensen, 2011; Werner & DeSimone 2012). However in the field of education, training evaluation has been in focus only recently (Guskey 2000). In regard to evaluation of training in higher order thinking skill training (HOTs), it involves only the first and second level of evaluation which are the reaction and learning before and after training (Ministry of Education 2013). Hence it is deemed necessary to explore in-depth the next level of evaluation which is the behaviour.

According to Kirkpatrick (1959), behavioural evaluation refers to what extent participants apply knowledge and skills learnt at the training to their workplace. Based on the social cognitive theory, Zimmerman (1990) discovered that learning was a significant factor for enhancing self-efficacy. Bandura social cognitive theory by

Bandura (1986) posits that self-efficacy is individual belief of what he or she can achieve despite all the challenges. In this study, if the participants of the higher order thinking skill training programme have fully digested the training, their self-efficacy could be upgraded and such behavioural change could be seen in the individual self, organisation, community and the surrounding. D

Several studies (Sukserm & Takashi 2012; Frayne & Latham, 1987; Gist, 1989; Gist, Schwoerer, & Rosen, 1989) also show self-efficacy as the mediating factor in the model of training transfer. Sukserm & Takashi (2012) discovered that self-efficacy was the mediator between learning and ethical behaviour but this aspect is widely researched in clinical psychology but rarely explored in the context of human resource development or training programme. Hence it is imperative to carry out a study in the context of training programme to fill the gap in research on self-efficacy as the mediator that links learning and behaviour.

The initiative for the study was triggered by past studies which investigated the three variables (learning, self-efficacy and behaviour) simultaneoysly (Sukserm & Takashi 2012). Several past studies investigated the link between learning and self-efficacy (Zimmerman, 1990, 2000; Aliegro, 2008; Gist 1989; Hodges, 2008; Tannenbaum, Mathieu, Salas, & Cannon-Bowers (1991). While a few studies (Judge and Bono, 2001; Zhao et al., 2005; Kosuwan et al., 2007; Gist, Stevens, & Bavetta 1991; Tannenbaum, Mathieu, Salas, & Cannon-Bowers 1991; Frayne and Latham 1987) investigated self-efficacy and behaviour. In this study, Kirkpatrick's four-level of evaluation is used to evaluate the training (Pershing and Pershing, 2001; Kraiger et al., 2004) and to argue on the human resource development evaluation model (Holton, 1996; Bates, 2004). An empirical study on the link among the three variables (learning, self-efficacy and behaviour) is hoped to fill in the research gap in addition to investigating the effects of the three variables on enhancing effectiveness of training.

The role of self-efficacy as the mediator and moderator has been widely debated and several researchers discovered that self-efficacy was a mediating variable (Ott et al., 2000; Li et al., 2002; Hastings & Brown, 2002). On the other hand, a few past studies revealed that there was no evidence suggesting self- efficacy as a moderating variable (Tedesco et al., 1990; Kongjinda & Witchawut, 2002; Namsrisakulrat, 2003). Nevertheless, self-efficacy is more dominant as a mediating variable than a moderating variable between learning and behaviour. The past studies did not focus on the relationship between learning, self-efficacy and behaviour in the context of higher order thinking skills. The understanding on the variables gives advantages to an organisation involved (especially the Education Ministry) in the training of higher order thinking skills in order to enhance the effectiveness of such training.

This study aims at exploring the direct and indirect links among three variables which are learning, self-efficacy and higher order thinking skill behaviour. This study differs from the previous ones as it investigated the relationship of all three variables with the combined of two models which are Kirkpatrick's Four-level Evaluation Model (1959) and Training Transfer Model by Baldwin dan Ford (1988). With the integration of both models, other indirect factors which influence behaviour could be explained since Kirkpatrick's model alone may not be sufficient to offer explanation. The study focused on self-efficacy as the moderator between learning and behaviour based on Bandura's social cognitive theory. The objective of the study is to enhance the higher order thinking skill behaviour and the indicator for the effectiveness of the training.

Training Evaluation Models Underpinning the Study Transfer of Training Model

Both of the models Kirkpatrick’s Training Evaluation Model and Baldwin’s Transfer of Training Model (Kirkpatrick, 1994; Baldwin and Ford, 1988) underpinned the study of self-efficacy as a mediator between learning and behaviour. It is due to the inability of Kirkpatrick’s model to address factors that could limit or promote transfer of learning. Transfer of training is defined as the extent to which trainees are able to apply knowledge, skills and attitudes learned in a training to the workplace effectively (Newstrom, 1984; Wexley and Latham, 1991, cited in Subedi, 2004).

For training to have occurred effectively, learned behaviour must be applied to the job context and maintained over a period of time (Baldwin and Ford, 1988). Application of the innovation has learnt from the training or transfer of training depends on a number of factors, including the intent or motivation of the learner (trainee characteristics), the workplace environment, including supervisory support (organizational environment and culture), and the instructional design, as well as delivery features (job relevance) of the training programme (Aluko 2014; Subedi, 2004), training design, trainee characteristics, work environment characteristics (Baldwin and Ford 1988) as well as constraints and opportunities to perform learned behaviours on the job. Transfer of training is a problem because the large amount of resources expended on training hardly pays off (Holton, Bates and Ruona, 2000; Holton, Bates, Bookter and Yamkovenko, 2007). According to Baldwin and Ford, self-efficacy (trainee characteristics) is one of the factor that affects learned behaviours leading to better results in the post-training context. In this study, Baldwin's Transfer of Training Model are fused in relation to the workplace environment with the second level of Kirkpatrick's model.

Kirkpatrick Four-Level Evaluation Model

It is imperative to choose the correct training model and scholars share similar ideas on the selection of evaluation model. Kirkpatrick's four level evaluation model is chosen to evalute the training on higher order thinking skills in line with the operational definition of evaluation used in this study. According to Kirkpatrick (1959), training evaluation or effectiveness is to be made at every level involving participants' reactions towards the training programme, learning, behaviour and results. Every level in Kirkpatrick's model is interrelated hence it is vital to evaluate every level following successive order. successively Nevertheless in the context of this study, evaluation focuses on the second and third levels which are learning and behaviour that involves learning transfer concept.

Kirkpatrick's model has been used as the framework for evaluating training effectiveness since five decades ago (Holton, 1996; Kirkpatrick & Kirkpatrick 2010; Giangreco, Carugati, Denmark & Sebastiano, 2010) and this model is also one of the pioneer models used widely in evaluating human resource development as the model is deemed simple and easy to understand (Noe 2010; Griffin 2010; Giangreco et al. 2010). Nevertheless Kirkpatrick's model has its critiques too (Alliger & Janak1989; Cannon-Bowers, Salas, Tannenbauk & Mathieu 1985; Holton 1996). Among the criticisms are that on the correlation between the low levels, that each level is unrelated with the training objective and that the model is too simplistic as it focuses on taxonomy rather than hierarchy.

Kirkpatrick's Four Level Evaluation Model is divided into four levels; the first level is reaction followed respectively by learning, behaviour and results (Kirkpatrick, 1998) with each level being interrelated and influencing the next level. For instance, reaction relates to learning which then influences behaviour change at the workplace that later affects the organisation.

The first level of Kirkpatrick's four-level model is reaction. Reaction measures the extent to which trainee satisfaction or impressions of the program (what the trainees/fellows thought and felt about the training). Evaluation of reaction is important because trainees' positive or negative reactions towards a training course influence learning. If participants' give positive feed backs or reactions to the training, they are motivated to learn and bring about more learning. An increase in learning leads to improved knowledge, skills and positive attitude towards innovation introduced during the training. Learning is the second level of Kirkpatricks' four-model. Learning measures how much participant gain knowledge, improve skills and change their attitudes after attending the course. Through the concept of learning or training transfer, participants can later apply the knowledge and skills at their workplace as reflected in a behavioural change (Clark 2000; Baldwin and Ford, 1988; Cascio, 1991). The third level is behaviour. Behavior measures the extent to which participants could apply knowledge and skills learned to the job context. In other words, evaluation here measures the transfer of what has been learned back to the workplace or training transfer. Results measures the effects on the institutional environment resulting from the fellows' performance. Nevertheless, consideration has to made between learning level and behaviour which is the learning or training transfer concept that refers to the participants' application of knowledge, skills and/or attitude learnt from the training to the workplace (Clark 2000).

Link between Learning, Self-efficacy and Behaviour

Learning and behavior were triggered from the four-level model of Kirkpatrick (1959). Learning measures the extent to which participants' knowledge increases, improved skills and positive attitude changes after attending the training program. Alliger and Janak (1994) define learning as the principles, facts and techniques understood and accepted by participants. Bates (2004) argues that learning evaluation is an indicator that can be measured from learning. Winfrey (1999) stated that learning was beyond the satisfaction of the participants which is efforts to assess the extent to which participants had better knowledge, skills and attitudes than before training. Based on various scholarly views on learning can be summarized that the effectiveness of the training can be measured through learning. In the context of the study, the assessment of learning is measured in terms of improving the knowledge, skills and positive attitude after attending the course. However, between learning and behavior there is another concept known as "training transfer". The concept of transferring training according to Phillips (1991) is the extent to which the behavior learned from the training program is applied in the workplace. Holton et al.

(2001) defines the transfer of work as the extent to which participants apply knowledge, skills and behaviors and attitudes gained from workplace training.
Behaviour refers to the extent to which participants can apply knowledge and skills learned from the training to the job context. Individual behaviour is based on the social cognitive theory which was used by Zimmerman (1990) in his study and it was discovered that learning was a significant factor for enhancing self-efficacy. Based on the social cognitive theory (Bandura 1986), self-efficacy refers to an individual's belief about his or her own capacity to attain success despite having to face challenges. In this study, for participants who have fully digested higher order thinking skills they are able to enhance self-efficacy besides applying the skills for themselves, the organisation, society and the surrounding. Research by (Sukserm & Takahashi 2012; Frayne & Latham, 1987; Gist, 1989; Gist, Schwoerer, & Rosen, 1989) indicated that self-efficacy played a mediating factor in a training transfer model. Sukserm & Takahashi (2012) discovered that self-efficacy was a mediator between learning and ethical behaviour but not much research on this was conducted in the human resource development or training programme aspect. Empirical studies on the link of the three variables (learning, self-efficacy and behaviour) are vital not only for filling in the research gap but also for enhancing the effectiveness of training.

Self-Efficacy as a Mediator

Self-efficacy theory which is an important component of Bandura (1986) is more common than cognitive social theory. Self-efficacy theory suggests individual behaviors, environments and cognitive factors (expectation of results and self-efficacy) are interrelated with each other. Bandura (1978, p. 240) defines self-efficacy as "a person's ability to enforce certain behaviors. Wood and Bandura (1989) developed the definition by suggesting self-efficacy trusts play an important role in regulating processes through motivation and achievement of self-efficacy. Determines how much individual effort will be allocated to an assignment and how long they will survive the task. Individuals with high self-efficacy work diligently to overcome the challenges. On the other hand, individuals with weak self-efficacy have no initiative to overcome the barrier or leave the barrier (Bandura & Schunk 1981;; Schunk 1981). Bandura (1982) concludes that self- efficacy theory considers potential or potential power. His findings suggest that self-efficacy impression helps explain the various behaviors of the individual, including: changes in behavior resulting from the influence of different modes, physiological stress response levels, self-regulation, achievement efforts, internal interest developments and career options.
Self-efficacy is widely applied in various situations and is a predictor of performance and behavior (Bandura 1978, Gist and Mitchell 1992). Observation from various experiments, Bandura (1982, p 61) summarizes that the efficacy of perceptions is often a better predictor of behavior than results or performance. In the study, (Gist 1989, Gist et al. 1989) concluded the empirical evidence supporting the self-efficacy theory is very strong. Self-efficacy theory was found to be appropriate to the study of training transfers in the form of trainees behavior at workplace.

Intrestingly, effective work performance depends on several factors. Among the skills possessed to conduct the behavior correctly (Hinrichs, 1966), how many efforts have been made, the high self-efficacy and the positive that their high beliefs can do (Bandura 1986). Self-efficacy is a mediator of the impact of training programs aimed at improving the effectiveness of employees on performance.
In the context of the study, if the teacher enjoyed HOTs behavior in the classroom, their motivation and belief in their ability (self-efficacy expectation) were higher than those who did not attend training or conventional teaching. Therefore, it is important for organizations in particular Ministry of Education Malaysia or school administrators to study how to improve the self-efficacy of teachers in conducting HOTs behavior to ensure more training transfers occur in the workplace. Hence, the enhancement of HOTs behavior as a goal of the training program can be achieved.

Previous studies revealed that self-efficacy is a mediator between learning and behaviour. However, the role of self-efficacy as a mediator between learning and behaviour mostly in relation to medical psychological issues (Sukserm & Takahashi 2012). Previous study shows that lack of study conducted to investigate self-efficacy mediates the relationship between learning and behaviour in human resource development or training. For example, (Sukserm & Takahashi 2012) found that self-efficacy mediates the relationship between learning and ethical behaviour in corporate social responsibility (CSR) activity in local Thai firms. In medical psychological study, McAuley (1993) concluded self-efficacy as a significant mediator between cognitive learning and behavioral practices in middle-aged adults. Maciejewski et al. (2000) found that self-efficacy mediated the effect of dependent stressful life events and depressive symptoms. While Ott et al. (2000) revealed that self-efficacy is a mediating variable between mastery experience and social persuasion, and adherence to treatment for improving behavior of diabetic people. Li et al. (2002) in his study found that self-efficacy mediates the effects of behavior in elder people between fear of falling and functional ability. Hastings and Brown (2002) found that self-efficacy mediated the effect of mothers' behavior in terms of anxiety and depression. Kaur et al. (2006) found that self-efficacy mediated the relationship between emotional intelligence and problem gambling. Rimal and Moon (2009) examined the casual relationship between dietary knowledge and behavior by including self-efficacy in the models and found that self-efficacy mediated the effects of dietary knowledge and social influence on dietary behavior. The aim of this study is to investigate the extent to which self-efficacy mediates the relationship between learning and behaviour. This study is expected to fill the gap of study due to lack of research has been conducted to explore the role of self-efficacy in the field of HRD or training.

Methods

This section discusses the research plan, the respondents who participated in the study, the instruments used, the procedures and the analysis of data that was carried out.

Research Design

The study applies the cross sectional method with the main data collection procedure involving literature review, questionnaires and pilot study. The methodology is chosen to allow for accurate, relevant data to be collected in line with the research needs as well as getting reliable data for evaluating respondents' perceptions towards the research (Sekaran & Bougie, 2010). Questionnaire items are constructed based on literature review and adaptation of available instruments. Interviews were conducted with 2 programme developers, 2 lecturers in measurement & evaluation and one personnel involved in teacher training for the higher-order thinking skills among Science teachers. The selection of the instrument evaluation expert was done through purposive sampling to ensure the selected ones have the knowledge and experience in using the higher-order thinking skills training module as well as carrying out the training of those skills among Science teachers. Face and content validity was obtained from expert evaluation. Back-to-back translation was used in translating questionnaires (Malay to English) to ensure instrument validity and reliability (Brislin 1970; Cresswell, 2007; Sekaran & Bougie, 2010).

Respondents

A total of 746 respondents (i.e., science teachers) participated in the study. It has to be noted that the respondents were randomly selected based on the zones, including urban and rural school area.

Analytical Procedures for Analytic Mediators

Hypotheses were analysed using multiple intermediate analysis procedures (Preacher & Hayes, 2008) with PROCESS (Hayes, 2012). The advantages of PROCESS versus other software is PROCESS is a modelling tool that can be used for SPSS and SAS which combines many functions to analyse intermediate and moderator variables. PROCESS, can be obtained free of charge for SPSS and SAS and is able to solve problems regarding behavioural analysis involving mediators, moderators or analytical process otherwise. The advantages of PROCESS is that it combines many well-known procedures (such as INDIRECT, SOBEL, MODPROBE, MODMED, RSQUARE and MBESS) to a simple procedure. Researchers do not need to be familiar with various tools in handling single and simple tasks.

Multiple intermediate analysis procedures (Preacher & Hayes, 2008) enable two or more mediators to be analyzed simultaneously in a simple model. Compared to a simple interstitial model, simultaneous testing has some advantages. First, multiple intermediate analysis enables the determination of unique intermediary effects ie the effects of indirect variables and controlling other intermediaries in the form of covariates. Second, the parameter error can be reduced, making the model more accurate and flexible (Preacher & Hayes, 2008). Multiple integer analysis approach is a nonparametric procedure based on corrected error and bootstrapping is considered to be a reasonable method for analysing multiple integer models. In line with the simple intermediate analysis using a single intermediate variable, the bootstrapping approach offers the best test to get the boot-provide the most powerful test to gain confidence limits for indirect effects (MacKinnon, Lockwood, & Wilson, 2004; Taylor , MacKinnon, & Tein, 2008). The Sobel Test (1982) is also used to ensure alignment with the single integer analysis results.

Learning, Self-efficacy and HOTs Behavior Assessment

A questionnaire using 5-answer scale ranging from "Strongly Disagree"(1) to "Strongly Agree"(5) was used to measure learning (knowledge, skill and attitude) of HOTS (30 items), behaviour (17 items) and on efficacy as a mediator (4 items). Knowledge construct; 'I have the knowledge in planning hands-on Science activities for generating HOTS' (loading factor = 0.664, cronbach alpha = 0.703. Skill construct; 'I am skillful in using various strategies to infuse HOTS in Science subject' (loading factor = 0.724, cronbanch alpha = 0.728. Attitude construct; 'I can infuse HOTS in Science subject despite the large number of students' (loading factor = 0.748, cronbach alpha = 0.881). Behaviour construct; 'I use various strategies to infuse HOTS in teaching Science in the class (loading factor = 0.522, cronbach alpha = 0.897). Self-efficacy construct; 'I have adequate skills to develop students' HOTS' (loading factor = 0.603, cronbach alpha = 0.892).

Results and Findings

Descriptive Statistics and Hypotheses Testing

Table 1 presents descriptive statistics and correlations of all study variables. Preliminary results yielded a significant relationship between the three variables, such as learning (KSA changes) (M= 3.420, SD=0.462), self-efficacy (M= 3.86, SD= 0.534), and behavior (M= 3.63, SD= 0.586). Behavior was significantly and positively related with learning (r= 0.562, p < 0.01) and with self-efficacy (r= 0.444, p < 0.01). Learning was significantly and positively related with self-efficacy (r= 0.385, p < 0.01). Results of the multiple mediation analysis for self-efficacy is shown in Table 2. Figures 1 additionally illustrate the findings. Hypothesis 1, proposing a direct relation between learning and self efficacy (ß = .4434, p < .001) was supported. The results of Hypothesis 2 positing specific indirect effects of self-efficacy is displayed in Table 2. Self-efficacy was a statistically significant mediator for learning (ß = .36, p < .01) and behavior (ß = 0.5914, p < .01), supporting Hypotheses 2 and 3.

Table 1. Mean, standard deviation and correlation between learning, self-efficacy and behaviour

Variable	Mean	Std deviation	1	2	3
Learning	3.42	0.462	**NA**	0.385**	0.562**
Self-efficacy	3.86	0.534	0.385**	NA	0.444**
Behavior	3.63	0.586	0.562**	0.444**	NA

1= Learning, 2 = Self-efficacy (SE), 3 = Behavior
**p* < 0.05, ***p* < 0.001

Table 2. Mediation results for learning and behavior

Variables	β	b	t	p
Learning Mediator (SE)	0.4434	0.0399	11.1195	0.000
Direct effects of mediator on behavior	0.2974	0.0345	8.6092	0.000
Total effect	0.7232	0.0392	18.4348	0.000
Remaining direct effect	0.5914	0.0404	14.6249	0.000
Indirect effects-bootstrap results	β	b	Cl	p
	0.1319	0.0224	(0.919, 0.1794)	0.000

Indirect effects-product of coefficients results (Sobel)	β	b	Z	p
	0.1319	0.0194	6.7902	0.000

Note. N = 740 of the samples. Confidence intervals are bias controlled and accelerated. Bootstrap resamples = 5,000. Model fit: $R^2 = .6147$, $F(2, 737) = 223{,}81$, $p < .001$.

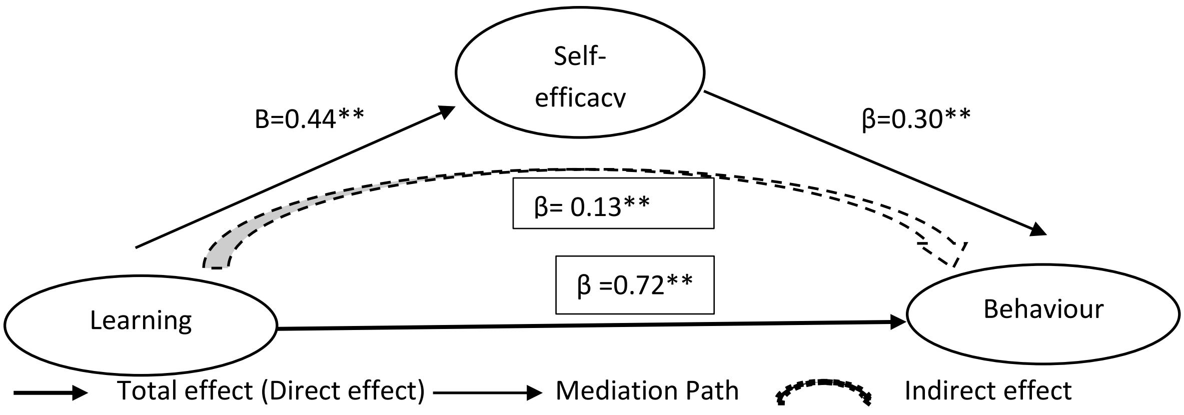

Figure 1 Multiple mediation bootstrap results for behaviour **p < .001.

Regression analysis was used to examine the effects of self-efficacy mediated the effect of the relationship between learning and behavior change. Results showed that learning is a significant predictor to change behavior, $\beta = 0.72$, SE = 0.039, $p < 0.001$, and learning is a significant predictor of efficacy, $\beta = 0.44$, SE = 0.040 $p < 0.001$. With the inclusion of self-efficacy as mediator, the study still showed a significant predictor of behavior but slightly lower than learning to behavior $\beta = 0.59$, SE = 0.034, $p < 0.001$. Due to the inclusion of self-efficacy study still showed a significant predictor and test normal theory shows the effect of intermediate significance ($z = 3.1$, $p < 0.001$), the efficacy is only part mediate or have an indirect effect on the relationship between learning and behavior. Thus self-efficacy is a partial mediator to conduct $\beta = 0.297$, RP = 0.034, $p < 0.001$. Therefore the null hypothesis is rejected.

General Discussion

The purpose of our research was to examine the direct effects of learning as well as the indirect mediating effects in terms of self-efficacy on behavior by using a cross sectional study. By empirically validating hypothesized mediating mechanisms, the research further contributes to a comprehensive learning model. We expected learning to lead to increase behaviour as this relationship is mediated by self-efficacy as a mediating variable. Generally, the findings presented here support our assumptions, which the indirect effect of self-efficacy was significant. Our research was triggered by the fact that even though previous studies revealed direct effects of learning on behavior (e.g., Sukserm & Takahashi 2012; Frayne & Latham, 1987; Gist, 1989; Gist, Schwoerer, & Rosen, 1989), there is sparse research to explain this relationship. In this presentation of our field studies, we provide further evidence that self-efficacy mediates the behavior-outcome relationship, which expands the findings of earlier studies (Gist, 1989; Gist, Schwoerer, & Rosen, 1989; Sukserm & Takahashi 2012) and sheds additional light on the wide-ranging learning picture. These findings can be explained by theoretical considerations, for example, learning (knowledge,skills and attitudes) contribute to the self-efficacy, which in turn leads to increase behavior (Sukserm & Takahashi 2012).

The major finding was that self-efficacy mediates the relationship between learning (KSA change) and HOTS behaviour. This finding was similar to the finding of (Gist and Mitchell 1992; Sukserm and Takahashi 2012). Eventually, self-efficacy encouraged teachers to develop their behaviour. Therefore, self-efficacy played an important role in the relationship between learning (KAS change) and behaviour. The relationship between learning (KSA change) and self-efficacy was positive. From this phenomenon, teachers would have the confidence to believe in terms of implementing teaching and learning strategies that enhance higher order thinking skills. The relationship between learning (KSA changes) and behaviour was positive in the case of teachers who had participated in the in-service teacher training of higher order thinking skills. In this study, we considered that teachers tended to implement teaching and learning strategies and thinking tools that can enhance higher order thinking. In addition, this finding also showed the positive relationship between self-efficacy and HOTS behaviour. This finding was congruent with the studies of (Benkarn 2005; Sukserm & Takahashi 2012 and Zimmerman 2000). Whenever teachers developed more confidence in their beliefs and/or felt greater confidence in applying strategies and thinking tools after attending in-service training, they would behave finally. Additionally, from this study, the researchers believe that the school principals should support, promote and encourage teachers to participate on actual learning, such kind of HOTs activity, in order to develop confidence.

Conclusion

Our findings expanded the results of previous research and shed additional light on evaluation of learning, behaviour and self-efficacy as a mediator simultaneously. Direct and indirect effects of the relationship between learning and behaviour in a cross-sectional study have been empirically examined and confirmed. This research also presents an added value by demonstrating a simultaneous mediation effect in that specific relationship. Findings underline the importance of self-efficacy mediates the effects of learning on behaviour. The perspective of self-efficacy as a partial mediator in this study promising directions for future research that will increase learning, behaviour and transfer of training.

Recommendation

The empirical evidence on direct and indirect effects of learning also has practical implications. Managers fostering learning to improve behavior must be aware of the underlying motivational processes in terms of self-efficacy in order to introduce effective interventions that optimize behaviour. This means that solely focusing on motivational processes will not result in the largest effect. We suggest that learning can also be performed to specifically identify motivational demands, offering a diagnostic perspective in evaluating learning. Based on our results that self-efficacy explain the positive effects of learning on behaviour, evaluation programs may not only examine changes in the outcomes, but also changes in the underlying motivational processes in the terms of self-efficacy.

In terms of the four-level model, the researchers considered that school principal ought to add “self-efficacy” into the procedure of training and/or activity evaluation. This is fruitful for the in-service teacher training as self-efficacy enables the training company finding belief of each teacher capacity. Thus, after completing evaluation on level 2 (learning), the program evaluator should consider and evaluate self-efficacy as a variable that can influence changing of behaviour. Implication of the implementation of the HOTS activities such as questioning techniques, inquiry, socio scientific issues and thinking maps could be applied in the classroom if teacher have high self-efficacy to implement it even though they faced with the big challenges. The findings in the study also open new perspectives for future research by putting self-efficacy in the context of learning (e.g., Gist and Mitchell 1992; Sukserm and Takahashi 2012). Theoretical justifications suggest that beside self-efficacy as the mediators used in this study, additional intervening variables are also worth examining, such as peer coaching as other potential mediator variable (Jones et al. 2015).

References

Aguinis, H. and Kraiger, K. (2009), ‘Benefits of training and development for individuals and teams, organizations, and society’, *Annual Review of Psychology, 60*, 451–74.

Aliegro, J.C. (2008), “The relationship between self-efficacy and self-assessment in foreign language education: a pilot study”, *Journal of Literature, Language and Linguistics, 2,1*, 1-4.

Aluko, F. R. (2009). The impact of an Advanced Certificate in Education programme on the professional practice of graduates. *The International Review of Research in Open and Distance Learning, 10, 4.* Retrieved from http://www.irrodl.org.

Aluko, F.R. & Shonubi, O. K. (2014) Going beyond Kirkpatrick's Training Evaluation Model: The role of workplace factors in distance learning transfer, *Africa Education Review*, *11*(4), 638-657.

Baldwin, T. T. and Ford, J. K. (1988), ‘Transfer of training: a review and directions for future research’, *Personnel Psychology, 41,* 63–105.

Bandura, A. (1986). “Social cognitive theory”, *Annals of Child Development, 6*, 1-60.

Bandura, A. (1978). Reflections on self-efficacy. *Adv. in Behavioral Res. and Therapy, 1(4),* 237–269.

Bandura, A. (1982). Self-efficacy mechanism in human agency. *Amer. Psychologist 37(2),* 122–147.

Bandura, A., & Schunk, D. H. (1981). Cultivating competence, self-efficacy, and intrinsic interest through proximal self-motivation. *J. Personality and Soc. Psych. 41(3)*, 586–598.

Bandura, A., & Wood, R. E. (1989). Effect of perceived controllability and performance standards on self-regulation of complex decision making. *Journal of Personality and Social Psychology, 56*, 805-814.

Barak, M., Ben-Chaim, D., & Zoller, U. (2007). Purposely teaching for the promotion of higher-order thinking skills: A case of critical thinking. *Research in Science Education, 37(4)*, 353–369.

Bates, R. (2004). "A critical analysis of evaluation practice: the Kirkpatrick model and the principle of beneficence", *Evaluation and Program Planning, 27,* 341-7.

Benkarn, P. (2005). "The promotion of self-efficacy in the development process of teacher classroom action research",dissertation,Graduate School,Srinakharinwirot University,Bangkok,

Bhatti, M. A., Ali, S., Mohd Isa, M. F., & Mohamed Battour, M. (2014). Training Transfer and Transfer Motivation: The Infleuence of Individual, Environmental, Situational, Training Design, and Aff ective Reaction Factors. *Performance Improvement Quarterly*, *27*(1), 51-82.

Brislin, R. W. (1970). Back-Translation for Cross-Cultural Research. *Journal of Cross-Cultural Psychology*, *1*(3), 185–216. https://doi.org/10.1177/135910457000100301

Broad, L.M. (2003), Beyond Transfer of Training: Engaging Systems to Improve Performance, Pfeiffer & Co., San Diego, CA.

Burke, L. A., and Hutchins, H. M. (2007). Training Transfer: An Integrative Literature Review. *Human Resource Development Review*, *6*(3), 263-296

Cascio, W.F. (1991). *Applied Psychology in Personnel Management*, Prentice-Hall, Englewood Cliffs, NJ. Chalofsky, N. (1991), "HRD and corporate social responsibility", Organizational Issues and Human Resource Development Research Questions: A Guide for Researchers in Human Resource Development, University Council for Research in Human Resource Development and The Ohio State University, Columbus, OH, 18-27.

Clark, D. (2000). "Transfer of learning", http:///www.nwlink.com/,donclark/hrd/learning/ transfer.html

Creswell, J. W., & Clark, V. L. P. (2007). *Designing and conducting mixed methods research.* Thousand Oaks, CA: Sage Publications

Dori, Y. J., & Herscovitz, O. (2005). Case-based long term professional development of science teachers. *International Journal of Science Education, 27*(14), 131-446.

Frayne, C. A., Latham, G. P. (1987). Application of social learning theory to employee self-management of attendance. *J. Appl. Psych. 72* (3) 387–392.

Giangreco, A., Carugati, A., Denmark, A. & Sebastiano, A. (2010). Are we doing the right thing? Food for thought on training evaluation and its context. *Personnel review*, *39*(2),162-177.

Gist, M. E. (1989). The influence of trail and idea generation among managers. 787-805.

Gist, M. E., Schwoerer, C, & Rosen, B. (1989). Effects of alternative training methods on self-efficacy and performance in computer software training. *Journal of Applied Psvchologv*, *74,* 884-891.

Gist, M.E. and Mitchell, T.R. (1992), "Self-efficacy: a theoretical analysis of its determinants and malleability", *Academy of Management Review*, *17*(2),183-211.

Gist ME, Stevens CK, Bavetta AG. (1991). Effects of self-efficacy and post-training intervention on the acquisition and maintenance of complex interpersonal skills. *Personnel Psychology, 44*, 837-861.

Griffin, R. P. (2010). Means and ends: Effective training evaluation. *Industrial and Commercial Training*, *42*(4), 220-225.

Hastings, R.P. and Brown, T. (2002), "Behavior problems of children with autism, parental self-efficacy, and mental health", *American Journal of Mental Retardation, 107*(3), 222-32.

Hayes, A. F., Glynn, C. J., & Huge, M. E. (2012). Cautions regarding the interpretation of regression coeffi-cients and hypothesis tests in regression models with interactions. *Communication Methods and Measures*, *6*, 1-12.

Hinrichs, J. (1966), *Personnel Training*. McGraw-Hill, New York, NY.

Holton III, E. F., R. A. Bates and W. Ruona. (2000). Development of a generalized learning transfer system inventory. *Human Resource Development Quarterly*, *11* (4), 333–360.

Holton III, E. F., R. A. Bates, A. I. Bookter and V. B. Yamkovenko. (2007). Convergent, divergent validity of the learning transfer system inventory. *Human Resource Development Quarterly, 18*(3), 385–419.

Holton, E. F., III. (1996). The flawed four-level evaluation model. *Human Resources Development Quarterly*, *7*(1), 5-21.

Holton, E.F. III (1996), "The flawed four-level evaluation model", *Human Resource Development Quarterly,7(1),* 5-21.

Holton, E.F. III, Bates, R.A. and Ruona, W.E.A. (2001), "Development of a generalized learning transfer system inventory", *Human Resource Development Quarterly*, *11*(4),333-60.

Hutchins, H. M., Burke, L. A. and Berthelsen, A. M. (2010), 'A missing link in the transfer problem? Examining how trainers learn about training transfer', *Human Resource Management*, *49*, 599–618.

Jones, R. J., Woods, S. A., & Guillaume, Y. R. L. (2015). The effectiveness of workplace coaching: A meta-analysis of learning and performance outcomes from coaching, *Journal of Occupational and Organizational Psychology*, 1-29.

Kirkpatrick, D. L & Kirkpatrick, J. D. (2010). *Evaluating training programs: The four levels* (3Ed.). USA:Berret Koehler Publishers.

Kirkpatrick, D. L. (1994). *Evaluating training programmes: the four levels*. San Francisco, CA: Berrett-Koehler Publishers.

Kirkpatrick, D.L. (1959), *Evaluating Training Programs*, available at: http:///www.businessballs.com/ Kirkpatrick learning evaluation model.htm.

Kirkpatrick, D.L. (1998), *Evaluating Training Programs: The Four Levels*, (2nd Ed), Berrett-Koehler, San Francisco, CA.

Knowles, M. S. (1984). Adult learning and practice. In Nadler, L. (Ed.), *Handbook of human resource development*, 405-445. New York: John Wiley.

Kong, S. L. (2010). Critical thinking for effective teaching and learning. Republic of Singapore: Research Publishing Services.

Kosuwan, S., Suntayakorn, C., Wannapornsiri, C. and Siripornpibul, T. (2007), “The effect of self-efficacy enhancing program on perceived self practice and body weight among overweight female adolescent students, amphor lomsak, phetchaboon province”, *Journal of Nursing Science Naresuan University, 1*(1), 32-46.

Kraiger, K., McLinden, D. and Casper, W.J. (2004), “Collaborative planning for training impact”, *Human Resource Management, 43*(4), 337-51.

Loving, G. L., & Wilson, J. S. (2000). Infusing critical thinking into the nursing curriculum through faculty development. *Nurse Educator, 25*(2), 70- 75.

Maciejewski, P.K., Prigerson, H.G. and Mazure, C.M. (2000), “Self-efficacy as a mediator between stressful life events and depressive symptoms”, *The British Journal of Psychiatry, 176*, 373-8.

MacKinnon, D. P., Lockwood, C. M., & Williams, J. (2004). Confidence limits for the indirect effect: Distribu-tion of the product and resampling methods. *Multivariate Behavioral Research, 39*, 99-128.

McAuley, E. (1993), “Self-efficacy and the maintenance of exercise participation in older adults”, *Journal of Behavioral Medicine, 16*(1),103-13.

Ministry of Education (2012).

Ministry of Education (2013).

Moriarty, B., Douglas, G., Punch, K. and Hattie, J. (1995), “The importance of self-efficacy as a mediating variable between learning environments and achievement”, *British Journal of Education Psychology, 65 (1)*, 73-84.

National Council for Accreditation of Teacher Education (NCATE). (2001). *Standards for professional development schools*. Washington, DC. National Academy Press.

National Research Council (NRC). (1996). *National science education standards.* Washington, DC: National Academy Press.

National Research Council (NRC). (2000). *Inquiry and the National Science Education Standards*. Washington, DC: National Academy Press.

National Science Teachers Association (NSTA). (2003). *Standards for science teacher preparation*. Washington, DC: Author.

Newstrom, J. W. (1984). A role-taker time differentiation integration of transfer strategies. A Paper presented at the meeting of the American Psychological Association, Toronto: Ontario, 24–28 August.

Noe, R. A. (2010). *Employee training and development* (5 Ed.). Boston: McGraw Hill.

Ott, J., Greening, L., Palardy, N., Holderby, A. and DeBell, W.K. (2000), “Self-efficacy as a mediator variable for adolescents’ adherence to treatment for insulin-dependent diabetes mellitus”, *Children’s Health Care, 29*(1), 47-63.

Pershing, J.A. and Pershing, J.L. (2001), “Ineffective reaction evaluation”, *Human Resource Development Quarterly, 12*(1), 73-90.

Phillips, J. (1991), *Handbook of Training Evaluation and Measurement Methods*, (2nd Ed.), Gulf Publishing, Houston, TX.

Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behavior research methods, 40*(3), 879-891.

Rimal, A. and Moon, W. (2009), “Self efficacy as a mediator of the relationship between dietary knowledge and behavior”, paper presented at Annual Meeting of Southern Agricultural Economics Association, Atlanta, GA, USA, 31 January-3 February.

Sekaran, U., & Bougie, R. (2010). *Research Methods for Business*. New York: John Wiley & Sons Ltd.

Seo, E.H. (2008), “Self-efficacy as a moderator in the relationship between self-oriented perfectionism and academic procrastination”, *Social Behavior and Personality, 36*(6),753-64.

Subedi, B. S. 2004. Emerging trends of research on transfer of learning. *International Education Journal, 5* (4): 591–599.

Sukserm, T. and Takahashi, Y. (2012),"Self-efficacy as a mediator of the relationships between learning and ethical behaviour from human resource development in corporate social responsibility activity", *Asia-Pacific Journal of Business Administration*, *4*(1),8 – 22.

Tannenbaum, S. I., Mathieu, J. E, Salas, E., & Canaon-Bowers, J. A. 1991. Meeting trainees' eiqiectations: The influence of training fulfilment on the development of commitment, self-efficacy, and motivation. *Journal of Applied Psvchologv. 76*, 759-769.

Taylor, A. B., MacKinnon, D. P., & Tein, J-Y. (2008). Tests of the three-path mediated effect. *Organizational Research Methods, 11*, 241-269.

Tobin, K., Kahle, J.B. & Fraser, B.J. (Eds.). (1990). *Windows into science classes: problems associated with higher-level cognitive learning*. London: Falmer Press.

Wang, S., Johansson, I .S., Bjorkstrom, M. E., & Nordstrom G. (2010) Critical thinking dispositions among newly graduated nurses. *Journal of Advanced Nursing, 66*(10), 2170-2181.

Winfrey, E.C. (1999), “Kirkpatrick’s four levels of evaluation”, Retrieved from: http://coe.sdsu.edu/eet/Articles/k4levels/start.htm

Zhao, H., Hills, G. and Seibert, S.E. (2005), “The mediating role of self-efficacy in the development of entrepreneurial intentions”, *Journal of Applied Psychology, 90*(6), 1265-72.

Zimmerman, B.J. (1990), “Self-regulating academic learning and achievement: the emergence of cognitive perspective”, *Educational Psychology Review, 2*(2), 173-201.

Zimmerman, B.J. (2000), “Self-efficacy: an essential motive to learn”, *Contemporary Educational Psychology, 25*, 82-91.

EVALUATION OF MATHEMATICAL GAMES IN TERMS OF EDUCATIONAL ASPECTS: ANDROID AND WEB APPLICATIONS

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Abstract: Nowadays interactive education is becoming widespread by using smartboards and pad computers. In addition it is observed that by mathematical games and game assisted teaching, the attitude and success level towards mathematics is increasing day by day. 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. In this study, the android and web applications in Edshelf and PlayStore that can be used in mathematics education were evaluated according to various criteria.

***Keywords*:** Game based learning, mathematic education, android applications, web applications

MATEMATİK OYUNLARININ EĞİTSEL YÖNDEN DEĞERLENDİRİLMESİ: ANDROİD VE WEB UYGULAMALARI

Özet: Günümüzde akıllı tahtaları ve tablet bilgisayarları kullanarak interaktif eğitim yaygınlaşmaktadır. Buna ek olarak, matematik oyunları ve oyun destekli öğretimin, matematiğe yönelik tutum ve başarı düzeyinin her geçen gün arttığı gözlenmektedir. Bundan dolayı, özellikle dijital platformlarda, birçok disiplinde olduğu gibi, matematikte de son yıllarda birçok oyun geliştirilmekte ve çocukların öğrenmesi sağlanmaktadır. Bununla birlikte, bu oyunların yalnızca eğlence amaçlı olmadığı ve eğitsel yönleri olduğu göz önüne alındığında, bu oyun çeşitlerinin belirli özelliklere sahip olması gerekmektedir. Bu çalışmada, Edshelf ve PlayStore'da matematik eğitiminde kullanılabilen android ve web uygulamaları çeşitli kriterlere göre değerlendirilmiştir.

Anahtar Kelimeler: Oyun temelli öğrenme, matematik eğitimi, android uygulamalar, web uygulamaları

Giriş

Bilgisayar destekli eğitim (BDE), bilgisayarın öğrenmenin meydana geldiği bir ortam olarak kullanıldığı, öğretim sürecini ve öğrenci motivasyonunu güçlendiren, öğrencinin kendi öğrenme hızına göre yararlanabileceği, kendi kendine öğrenme ilkelerinin bilgisayar teknolojisi ile birleşmesinden oluşmuş bir öğretim yöntemidir (Şahin ve Yıldırım, 1999). Son derece esnek bir yapıya sahip olan bilgisayarlar, özel hazırlanmış öğretim programları aracılıyla öğretme öğrenme sürecinde zengin bir yaşantı oluşturabilmektedir (Öğüt vd. 2004). Matematiksel kavramların çoğu üst düzeyde bilişsel etkinliği gerektiren soyut kavramlardır. Bilgisayarlar çoğu soyut kavramı görselleştirerek somutlaştırılabilmektedir, böylece çoğu matematiksel kavram öğrenci için somutlaşabilmekte ve kolay kavranması sağlanabilmekte öğretme ve öğrenmeyi olumlu yönde etkilemektedir (Baki, 2000). Dijital oyun ve uygulamaların yaygınlaşması ile günümüzde bilgisayarlar yanında tablet bilgisayarlar ve akıllı telefonlar da teknoloji destekli öğretimde etkin şekilde kullanılmaya başlanmıştır. Nitekim "Net Generation"daki gençlerin neredeyse tamamı bilgisayarları kullanmaktan ve zamanlarının çoğunu mobil tarayarak ya da bilgisayar oyunları oynayarak geçirmektedir (Girard, Ecalle ve Magnan, 2012). Bu durumda, eğitimde bilgisayar oyunları kullanmak, sunduğu fırsatları göz önünde bulundurursak, reddedilemez bir alternatiftir (Korkusuz ve Karamete, 2013). Kebritchi, Hirumi ve Bai (2010); bilgisayar oyunlarının ön bilgi, bilgisayar ve İngilizce dil becerisinin önemli bir etkisi olmaksızın matematik başarısı ve motivasyona katkı sağladığı sonucuna varmıştır. Kula ve Erdem (2005) öğretimsel bilgisayar oyunlarının dördüncü ve beşinci sınıf öğrencilerinin aritmetik işlem becerilerini geliştirmeleri üzerine yaptıkları çalışmada öğrencilerin, bilgisayar oyunlarının motive ediciliğine ve öğreticiliğine ilişkin görüşlerinin olumlu olduğu sonucu elde edilmiştir. Girard vd. (2013) gerçekleştirdikleri meta-analiz çalışması sonucunda, 'Önemli Oyunların'ın (faydalı bir amaca hizmet etmeyi amaçlayan video oyunları) öğrenme için güçlü araçlar olabileceğini düşünmelerini sağladığını ifade etmiştir. Ke'nin (2008) yaptığı çalışma bilgisayar oyunlarının kağıt-kalem çalışmalarıyla karşılaştırıldığında öğrenme motivasyonunu artırmada önemli derecede daha etkili olduğunu, ancak bilişsel matematik testi performansını ve üst bilişsel farkındalığın kolaylaştırılmasında belirgin olarak farklı olmadığını göstermiştir.

Yeni teknolojilerin matematik eğitiminde kullanılmasının yararları, başarıyı arttırmanın yanı sıra, matematiğe karşı olumlu tutum geliştirme, ilgiyi arttırma, matematik derslerine karşı duyulan endişe ve korkuyu azaltma ve daha da önemlisi analitik ve kritik düşünme gibi etkili düşünme alışkanlıklarını geliştirme olarak görülmektedir (Peker, 1985). Öğrenci akademik başarısında derse ilişkin tutum ve ilgi önemli etkenlerdendir. Eğitsel bilgisayar oyunları, bilgisayar oyunlarının motive edici ve eğlendirici özelliklerini barındırmaktadır ve öğretimsel ya da eğitsel amaçlı olarak diğer öğretim yöntemlerinin alternatifi, tamamlayıcısı ve zenginleştiricisi olarak kullanılabilirler (Çankaya ve Karamete, 2008). Yılmaz (2010) altıncı sınıf öğrencileri ile ve Şahin (2016) beşinci sınıf öğrencileri ile "Kesirler" ünitesinde yürüttüğü çalışma sonunda matematik dersinde eğitsel bilgisayar oyunlarının öğrencilerin matematiğe yönelik olumlu tutum geliştirmelerinde yararlı olabileceğini belirtmişlerdir. Dijital oyun tabanlı öğretim ortamının öğrencileri matematik dersine yönelik olumlu tutum kazandırdığı ayrıca başarı güdülerine de yine olumlu yönde katkı sağladığı görüşünü Aksoy (2014)'da desteklemektedir. Öztürk (2007) bilgisayar oyunlarının çocukların bilişsel ve duyuşsal gelişimleri üzerindeki etkisinin incelenmiş olumlu sonuçlar kaydetmiştir. Yılmaz (2014) geometrik cisimleri konu aldığı çalışmasında matematik oyunları kullanımının 5.sınıf öğrencilerinin matematik başarısını arttırdığı ve derse yönelik tutumu olumlu etkilediği görülmüştür.

Etkili ve kalıcı öğrenme sağlamada önemli bir diğer etken öğrencinin öğrenme sürecinde aktif olmasıdır. Günümüz öğretim programı yapılandırmacılık kuramını benimsemektedir ve bu kurama göre öğrenci öğrenme etkinliklerine aktif olarak katılmalıdır. Derslerde öğrencilerin aktif hale gelecekleri ve bilgilerini kendi hızlarında yapılandıracakları yöntem ve tekniklerin kullanılmasının matematik öğretimi açısından yararlı olduğu düşünülmektedir (Fırat, 2011). Aktif öğrenme genellikle öğrencileri öğrenme sürecine yönlendiren herhangi bir öğretim yöntemi olarak tanımlanır (Prince, 2004). Öğrencilerin aktif katılımı sağlamanın çeşitli yolları olmakla birlikte bunlardan en gündemde olanlardan biri teknoloji destekli etkinliklerdir. Teknoloji destekli aktif öğrenme ortamı sosyal etkileşimi desteklemek, öğrencilerin aktif öğrenmesini ve ilgisini teşvik etmek ve kavramsal değişimi geliştiren bir sınıf iklimi yaratmak üzere tasarlanmıştır (Dori ve Belcher, 2005). Oyunların, öğrencilerin günlük yaşamlarında yapmaktan hoşlandıkları bir aktivite olması öğretime aktif olarak katılımlarını sağlamaktadır (Fırat, 2011). Eğitsel oyunlar öğrenenin, öğrenme ortamında sürekli aktif olmasını sağlamaktadır (Şahin ve Yıldırım, 1999). Bilgisayar oyunların eğitsel amaçlar için faydalı olduğu ve ayrıca birçok avantaj sunduğu varsayılmaktadır: (a) öğrenme süreci ve sonuçları için kompleks ve çeşitli yöntemler, (b) etkileşimlilik, (c) duygusal öğrenme konularının yanı sıra bilişsel ve duygusal öğrenme konularını ele alma becerisi; ve belki de en önemlisi, (d) öğrenme için motivasyondur (O'Neil, Wainess & Baker, 2005). Eğitsel açıdan bu denli önemli olan eğitsel oyunların hem eğlendirici hem de eğitici özellikleri bulunması gerekmektedir. Bu nedenle bu çalışmada eğitsel olarak olması beklenen bazı kriterler belirlenerek Matematik oyunlarının değerlendirilmesi amaçlanmaktadır.

Yöntem

Çalışmanın yöntemi doküman analizi/incelemesi olarak belirlenmiştir. Doküman incelemesi, araştırılması hedeflenen, olay veya olgular hakkında, bilgi içeren yazılı materyallerin analizini kapsar (Şimşek, 2009). Araştırmacının çalışması için ihtiyaç duyduğu özgün verileri değişik araçlar kullanarak kendisinin toplaması ile oluşan verilere birincil veriler denmektedir ve doküman inceleme veri toplama yöntemlerinden biridir (Altunışık vd., 2007)

Çalışma Grubu

Matematik Öğretiminde kullanılabilecek kesirler ve ondalık kesirler alt öğrenme alanlarını kapsayan web ve Android uygulamaları ile gerçekleşen oyunlar çalışma grubunu oluşturmaktadır. http://www.edshelf.com ve Play Store'da bulunan toplam 20 web sitesi ve Android uygulaması incelenmiştir.

Veri Toplama Aracı

Mobil öğrenme ile en alakalı görünen teorik yaklaşımlar öğrenen kontrolünü ve karmaşıklık seviyesini belirleyerek güçlük ayarlamayı, kullanıcıların merakını uyandırmayı ve aktif öğrenme tartışmalarına izin vermeyi içerir (Ciampa, 2013). Bu yaklaşımın yanı sıra 2017 yılda Milli Eğitim Bakanlığı'nın yayınladığı taslak ortaokul matematik müfredatı ve esasları incelenerek oyunlarda aranacak kriterler tespit edilmiştir. Çalışma için seçilen uygulamaları eğitsel amaçlı değerlendirmek üzere kriterler geliştirilmiş ve beş alan uzmanı tarafından görüş alınmıştır. Elde edilen kriterler şunlardır:

1. Sınıf Düzeyi ve Soruların Seviyesi
2. Matematiksel Modelleme İçerme
3. Kavramın Farklı Gösterimlerini İçerme
4. Oyunlarda Süre Kısıtlaması
5. İpucu Sunma
6. Dönüt Sunma
7. Motivasyon Kaynağı Barındırma
8. Öğretmen/Veli Kullanımı

Oyunların kısa tanıtımları şu şekildedir:

1. ***Fresh Baked Fractions (https://www.funbrain.com/fract/index.html):*** Oyunun başında dört farklı seviye seçeneği sunulmakta. Oyunda verilen dört kesirden diğerlerine denk olmayanın seçilmesi beklenmektedir. Doğru yanlış bildirimi anında yapılmakta, yanlış cevaplama durumunda doğru seçenek anında gösterilmektedir.

2. ***Braineos (http://www.braineos.com/search/tags/fractions):*** Sorular kesirlerle dört işlem konusunu içermekte olup başlıklar ile zorluk düzeyine göre sıralama yapılmaktadır. Doğru cevap tebrik edilirken, yanlış cevabın doğrusu belirtilmektedir.

3. ***CoolMath4kids (https://www.coolmath4kids.com/math-games/fractions):*** Oyunlar sınıflandırılırken konu başlıkları yanında sınıf düzeyleri de göz önünde bulundurulmuş. Kesirler konu başlığı altında beş oyun görülmektedir. Bu beş oyun prensip olarak aynı şekilde çalışmakta olup oyun senaryosu ve ele aldığı kazanımlar bakımından birbirinden ayrılmaktadır. Oyunlar yarış şeklinde olduğundan hız önem kazanır. Yarışma hali aynı zamanda motivasyon sağlayıcıdır.

4. ***Hooda Math (http://www.hoodamath.com/games/hoodamathdefense.html):*** Sınıf seviyesi, kategori ya da konu bakımından sınıflandırılmış oyunlar yer almakta. Kesirlerle ilgili siteye özgü olan 'Hooda Math Defense' hem akıl yürütme hem de kesirleri karşılaştırma becerisi gerektiriyor. Sorulara cevap verirken süre ölçümü yapılmıyor. Pekiştireç olarak doğru cevap verildiğinde para kazanılıyor ve bu para bir sonraki aşamada savunma güçlendirecek malzeme alımında kullanılıyor. Sorunun yanlış cevaplanması durumunda kesirlerin sayı doğrusunda gösterimi sunularak ipucu veriliyor. Böylece kesirlerin modellenmesi de sağlanıyor. Siteye öğretmen girişi bulunmakla beraber veli girişi bulunmamaktadır.

5. ***Studyladder(https://www.studyladder.com/student/course/mathematics?page=*&g=9):*** Oyunların seçilen konu başlığı altında sınıf seviyesine göre ayrılmış olması kullanım kolaylığı sağlıyor. Matematiksel modellemelere 5. sınıf düzeyi etkinliklerde yer verişmiş. Kesir kavramı her bir kazanım için ele alınmış bu sırada çeşitli gösterim şekillerine yer verilmiştir. Soru cevaplanırken süre tutulmuyor ancak cevaplanmış soruya geri dönüldüğünde doğru cevap, yanlış cevap ve cevaplama süresi sunuluyor. Cevabın doğruluğu alkış ve yeşil renk ile yanlışlığı uyarıcı ses ve kırmızı renk ile ifade ediliyor. Doğru cevaplar ve görevlerin tamamlanması durumunda ödül para kazanılmakta, bu para ile oyun karakteri, evcil hayvanı ve evi düzenlenebilir/biçimlendirilebilir. Öğrenci veli ya da öğretmenin açtığı hesap üzerinden giriş yapabilmekte, bu öğrencinin ilerleme raporunun sağlanması ile takibini sağlamaktadır.

6. ***Braingenie (http://braingenie.ck12.org/):*** Sınıf düzeyinde 1-8 grubu seçildiğinde konu başlıklarına göre sınıflama ile karşılaşılır.Süre ölçümü ekranda görülmekle birlikte sınırlayıcı olarak değil istatistiki bilgi olarak kaydedilmektedir. İpucu soruya özel olarak sunulmamaktadır. Eğer konu ile ilgili yetersizlik hissediliyorsa "video izle" buton ile örnek bir soru üzerinden özet konu anlatımı sunulmaktadır. Yanlış cevap verilmesi durumunda doğru cevap ve açıklaması sunulmaktadır. Üyelerin süre ve doğru cevap istatistikleri listelenir, bu liste motivasyon sağlayıcı olarak kabul edilebilir. Bireysel öğrenime uygun bir sistem olmakla birlikte başka kullanıcılarla düello yapılabilir. Sistemin öğretmen oturumu mevcuttur.

7. ***Ratio Rumble (http://mathsnacks.com/ratio-rumble.html):*** Kesir kavramı "oran" anlamı ile ele alınmıştır, bu kazanım gizil öğrenme ile sağlanmaktadır. Matematiksel modelleme olarak kesri oluşturan çoklukların iksir şişeleri ile somut gösterimi ile sağlanmaktadır. Oyunda ilerledikçe aynı kazanım üzerinden giderek zorlaşan görevler verilmektedir.

8. ***Pearl Diver (http://mathsnacks.com/pearl-diver.html):*** Kesirlerin sayı doğrusunda gösterimi ele alınmıştır. Bunun yanında modelleme olarak level aralarında bir bütünü eş parçalara ayırma etkinliği yer almaktadır. Kesirlerin tam sayılı ve bileşik kesir olarak ifadesi yar almakta. Süre kısıtlaması vardır, hız önem kazanır. İpucu olarak oyun başlarken sayı doğrusu üzerinde referanslara dikkat çekilir. Yanlış nokta belirlendiğinde o noktanın gerçek değeri verilmesi hem dönüt hem ipucu olarak değerlendirilebilir. Doğru

nokta belirlendiğinde inci kazanılır. Belirli sayıda inci verilen sürede toplandığında level atlanır ve para biriktirilir.

9. ***Math Games (https://www.mathgames.com/fractions):*** Çalışmak istenen konu seçildikten sonra sınıf seviyesine göre gruplandırılmış kazanım listesinden seçim yapılır. Özellikle kesirlerin karşılaştırılması kazanımında modelleme kullanılmıştır. Kavramın farklı gösterimleri kullanılmakta ve farklı açılardan ele alınmaktadır. Yıldız ya da uyarı ile dönüt sağlamaktadır. Öğrenci başarısız olunan aşama sonunda da tebrik edilir ve desteklenir. Öğrenci istatistikleri tutulur; üyelerin günlük, haftalık ve aylık ilk 20 başarı listesi yayınlanır.

10. ***Animal Rescue (https://www.mathgames.com/play/mathsmash.html):*** Önce sınıf düzeyi daha sonra çalışmak istenen konu seçilir. Amaç sorunun cevabı olan kutuları tıklayarak yolu açmak ve hayvanları kurtarmaktır.Kesirlerin farklı bir ifade biçimi olan ondalık gösterim bulunmaktadır. Doğru yanıtla hayvanlar kurtarılıp, para biriktirilir. Yanlış cevaba karşılık doğru cevap ve çözüm verilmez, yalnızca uyarı gelir.

11. ***Adding Unit Fractions (android uygulama):*** Seçilen kesir kesrin üç farklı birim kesri birleştirerek oluşturulması amaçlanır. Tercih edilen kesirlerin zorluk seviyesi yıldızlarla ifade edilmiştir. Kesirler modellenerek görsel olarak desteklenmektedir. Modellemeler aynı zamanda ipucudur. Gizil olarak kesirlerin karşılaştırılması becerisini kazandırır. Bunun yanında kesirlerle toplama çıkarma becerisi ve denk kesirler bilgisi kullanılır. Doğru cevaplar çözüm listesinde kaydedilir, bu dönüt olarak kabul edilebilir.

12. ***Fraction Mastery (android uygulama):*** Temel kesir kavramı bilgisinden kesirlerle işlemlere kadar her bir kazanımın ele alındığı levellerden oluşmaktadır. Matematiksel modellemeye yer verilmiştir. Yanlış cevapta doğru çözüm verilmez, doğru cevaplar leveli geçmek için gerekli görevleri tamamlamayı sağlar böylece kilitli olan sıradaki level açılır. Oyuncu isterse 'soru işareti'ne dokunarak ipucu görebilir.

13. ***Slice Fractions (android uygulama/türkçe):*** Konulara göre gruplanmış giderek zorlaşan levellerden oluşmaktadır. Amaç ilerlediği yolda önüne engeller çıkan filin yolunu açmaktır. Oyun temel olarak matematiksel modellemeye dayanmaktadır. Dönütler zayıftır, yanlış yol izlendiğinde fil ilerleyemez, doğru yol izlendiğinde fil yoluna devam edebilir.

14. ***How Much Pizza Ask? (android uygulama):*** Sipariş verilen iki pizza çeşidinin miktarını kesir olarak ifade ederek toplam kaç ne kadar pizza siparişi verildiğinin yazılması beklenir. Toplanacak kesirler oyuncu tarafından manuel ya da otomatik olarak belirlenebilir. Toplanan kesirler pizzalarla modellenmektedir. Modellemeler aynı zamanda ipucudur.

15. ***EG Fractionns/DEMO (android uygulama):*** Seçilen beceri grubunda hangi seviyede kaç soru ile karşılaşılacağı oyun başlarken belirlenir. Kesirlerin sayı doğrusunda gösterimi ve kesirlerle dört işlem ele alınmıştır. Kesirlerin sayı doğrusunda gösterimi ve toplama-çıkarmada bir dairenin parçalara ayrılması ile modellenmiştir. Yanlış cevapta doğruyu bulana kadar tekrar deneme şansı verilir.

16. ***Coop Fractions (android uygulama):*** Sınıf ya da yaşa göre seviye sınıfı bulunmamaktadır. Kesirlerle işlemlerin sonucunu tahmin etmeye yönelik bölümü ücretsizdir. Verilen işlemin sonucunu tahmin edilerek yuva yumurtanın düşeceği noktada sayı doğrusu üzerinde konumlandırılır. Oyuncu seviyesine göre zaman kısıtını ve yuvanın boyutunu belirleyerek zorluğu ayarlar. Sayı doğrusu ile kesirler modellenir. Kesirlerin farklı bir ifade biçimi olan ondalık gösterimi içermektedir. Süre kısıtlaması vardır. Yanlış cevaplama durumunda yumurta kırılır, doğru noktanın değeri gösterilir. Doğru cevaplandığında yumurtalar toplanmış olur.

17. ***Ethan's Fraction Game (android uygulama):*** Pizzaların parçalara bölünmesi ile modellenen kesirlerin belirlenmesi beklenir. Doğru cevap verildikçe çocuk daha hızlı koşar, yanlış cevap verildiğinde ise hızı azalır. Hedefe ulaşma süresi kaydedilir fakat süre kısıtlaması yoktur. En iyi zaman kaydedilir ve bunu aşma çabası motivasyon kaynağıdır.

18. ***Multiplying Fractions (android uygulama):*** Oyuncunun manuel olarak seçtiği iki kesrin çarpımının sonucu hesaplanır. Seçilen kesirler daire modellemesi ile gösterilmektedir. Sonuç yanlış ise doğru cevap verilir ve doğru cevap verildiğinde tebrik edilir.

19. ***Fractions to Decimals Games (android uygulama):*** Alandan yararlanarak kesirler modellenir. Kesirlerin ondalık gösterimlerini içermektedir. Anında dönüt verilir ancak doğru cevap sunulmaz.

20. ***Fractions (android uygulama):*** Her biri farklı kazanım içeren levellerden oluşmakta. Sorulara güneş batana kadar cevaplar verilir, yeterli başarı sağlanırsa diğer levele geçilir. Her levelde yeni uzay gemisi alınarak karakter geliştirilir. Yanlış cevap verildiğinde anında doğrusu görülür.

Tablo 1. İncelenen oyunların kriterlere göre değerlendirilmesi

Adı	Seviye	Mat.sel Modelleme	Kav. Farklı Göst.	Süre Kısıtı	İpucu	Dönüt	Motivasyon	Genel Rapor	Öğretmen/Veli
Fresh Baked Fr	dört farklı seviye seçeneği	yok	yok	yok	yok	anında	yok	yok	yok
Braineos	yok(giderek zorlaşır)	yok	yok	yok	yok	anında	yok	yok	var
CoolMath4kids	sınıf düzeyleri/konu	yok	yok	yarış	yok	anında/doğru cevap verilmiyor	var/yarış hali		var
Hooda Math	sınıf/konu	var	yok	yok	var	anında/doğruyu bulduruyor	var/güçlenme	yok	öğretmen
Studyladder	sınıf	var	var	yok	yok	anında	var/karakter	var	öğretmen/öğrenci
Braingenie	konu/kazanım	yok	yok	yok	var	anında	var/istatistik	var	öğretmen
Ratio Rumble	yok(giderek zorlaşır)	var	yok	yok	yok	anında/doğru cevap verilmiyor	yok	yok	yok
Pearl Diver	yok(giderek zorlaşır)	var	yok	var	var	anında	yok	var	yok
Math Games	sınıf/kazanım	var	var	yok	yok	var (başarısıza destek/tebrik)	var/istatistik	var	yok
Animal Rescue	sınıf	yok	var	yok	yok	anında/doğru cevap verilmiyor	yok	yok	yok
Adding Unit Fr	zorluk	var	yok	yok	var	anında	yok	var	yok
Fraction Master	kazanım(giderek zorlaşır)	var	yok	yok	var	anında/doğru cevap verilmiyor	yok	yok	yok
Slice Fractions	konu/kazanım(giderek zorlaşır)	var	yok	yok	yok	yok	yok	yok	yok
How Much Pizz	yok	var	yok	yok	var	anında	yok	yok	yok
EG Fractionns/	zorluk(manuel)	var	yok	yok	yok	var	yok	yok	yok
Coop Fractions	zorluk(manuel)	var	yok	var	yok	var	yok	yok	yok
Ethan's Fractio	yok	var	yok	yok	yok	var	var/en iyi zaman	yok	yok
Multiplying Fra	yok	var	yok	yok	yok	anında	yok	yok	yok
Fractions to dec	yok	var (alan)	var (ondalık)	yok	yok	anında/doğru cevap verilmiyor	yok	yok	yok
Fractions	var(level/farklı kazanımlar)	yok	yok	var	yok	anında	var(karakter	yok	yok

Verilerin Analizi

Çalışmada elde edilen veriler içerik analizi ile değerlendirilmiştir. Veri analizini başlıca iki gurupta ele almak mümkündür; betimsel analiz, içerik analizi. İçerik analizinde temel amaç, toplanan verileri açıklayabilecek kavramlara ve ilişkilere ulaşmaktır. Verilerin anlamlandırılması, aynı zamanda, öznel bir süreçtir ve bu nedenle yorumların mutlak nesnelliği iddia edilemez (Şimşek, 2009).

Bulgular

Sınıf Düzeyi ve Soruların Seviyesi

Ele alınan 20 oyundan 5 tanesinde sınıf seçimi yer almakta bunlardan üç tanesinde konu seçimi yapılmaktadır. 1 tanesinde kolay, orta, zor, süper beyin seçimiyle oyun başlamaktadır, 1 tanesinde de zorluk yıldız sayısı ile ifade edilmiştir. 3 tanesinde konu bazında seçenek sunulmaktadır ve bunlardan iki tanesi oyun içerisinde giderek zorlaşır. Oyunlardan 1'i her biri farklı kazanımlara yönelik levellerden oluşmaktadır. 2 oyunda zorluk oyun başlarken oyuncu tarafından manuel olarak ayarlanır. Oyunlardan 6 (%30) tanesinde sınıf ya da konu seçimi söz konusu değildir, bunlardan üç tanesi oyun içerisinde giderek zorlaşır.

Matematiksel Modelleme İçerme

İncelenen 20 oyundan 14 (%70) tanesi matematiksel modelleme içerirken 6 tanesi modelleme içermez. Oyunlardan 3'ünde sayı doğrusunda gösterim, 9'inde alandan yararlanarak, 1'inde hacimden yararlanarak ve 1'inde de bir bütünü eş parçalara ayırma yöntemleri ile kesirler modellenmiştir.

Kavramın Farklı Gösterimlerini İçerme

Kesirler kesir çizgisi ile ondalık gösterimle ya da yüzdelik olarak ifade edilebilir. İncelenen oyunlardan 16 (%80) tanesi farklı gösterimleri barındırmamaktadır.

Oyunlarda Süre Kısıtlaması

İncelenen 16 oyunda zaman kısıtlaması yoktur. Oyunların üçünde kısıtlı sürede cevap vermek gerekirken birinde yarış söz konusu olduğundan hız önemlidir.

İpucu Sunma

Oyunların 6 tanesinde oyun sırasında doğru cevabı buldurmak ya da kolaylaştırmak üzere ipucu verilmektedir. İkisinde sayı doğrusu, ikisinde kesirlerin modellenmesi ile ipucu verilmiştir. İki tanesinde ise oyuncu isterse gerek duyduğunda butona tıklayarak konu anlatımı şeklindeki ipucunu görebilir.

Dönüt Sunma

İncelenen oyunların 19unda cevabın doğru ya da yanlış olduğuna dair bir gösterge ile (ses, renk vb) dönüt verilmektedir. Bunlardan dördünde doğru cevap verilmez, birinde doğru cevap eleme yolu ile buldurulur, birinde öğrenci başarısız olsa da olumlu bildirimlerle cesaretlendirilir. Oyunlardan birinde dönüt verilmez.

Motivasyon Kaynağı Barındırma

7 oyunda motivasyon kaynağı tespit edilmiştir. Motivasyon kaynağı dönütler dışında oyuncuyu uygulamaya/oyuna bağlayan, çekici hale getiren faktörler olarak kabul edilmiştir. Oyunlardan birinde yarışma durumu, üçünde karakteri güçlendirme/geliştirme, ikisinde istatistik tutulur ve başarı listesi oluşturulur. Oyunlardan birinde en iyi zaman kaydedilir, bu rekor kırma arzusu getirir.

Öğretmen/Veli Kullanımı

Oyun ve uygulamaların ebeveyn/öğretmen kontrolünde kullanımı ve öğrencinin çalışmalarının takibi açısından veli/öğretmen platformu önemli bir özelliktir. Ancak android uygulamalardan hiç biri böyle bir özellik bulundurmamaktadır. Web sitelerinden ikisi hem veli hem öğretmen, üç tanesi yalnızca öğretmen girişi bulundurmaktadır.

Sonuç

Matematik öğrenimi özellikle küçük yaş gruplarında somutlaştırma güçlüğünden dolayı zorlaşmaktadır. Bu durum öğrencilerin olumsuz tutum oluşturmasına sebep olmaktadır. Ayrıca öğrencinin aktif olması günümüzde kabul gören öğrenim yaklaşımlarının vurgu yaptığı bir noktadır. Oyun temelli yöntemler bu güçlüklerin üstesinden gelmek adına ve daha birçok açıdan tercih edilmektedir. Dijital öğrenim araçlarının popüler olduğu günümüzde çok çeşitli matematik oyunları tasarlanmaktadır. Elbette eğitsel oyunların niteliklerini belirlemek üzere kriterler bakımından incelenmelidirler.

Bu çalışmada edshelf platformunda yer alan web sitelerinde bulunan ve android uygulamalarında ücretsiz ulaşılabilen "kesirler" konulu matematik oyunları şu kriterlere göre incelenmiştir: Sınıf Düzeyi ve Soruların Seviyesi, Matematiksel Modelleme İçerme, Kavramın Farklı Gösterimlerini İçerme, Süre Kısıtlaması, İpucu Sunma, Dönüt Sunma, Motivasyon Kaynağı Barındırma ve Öğretmen/Veli Kullanımı.
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- Az sayıda oyun sınıf düzeyi bakımından kategorize edilmiştir. Ülkelerde uygulanan öğretim programlarının değişken olduğu göz önünde bulundurulduğunda konu bazında seçenekler sunulmasının daha uygun olduğu düşünülebilir. Yine bu şekilde sınıflandırma sunan oyun sayısı çok azdır.
- Oyunların çoğunda matematiksel modelleme bulunmaktadır. Kesirler çokluk ifade eden soyut kavramlar olduğundan öğrenimin kolaylaştırılması bakımında modellenmesi oldukça önemlidir.
- İncelenen oyunların büyük çoğunluğu kavramın farklı gösterimlerini içermemektedir. Kavramın farklı açılardan ele alınması ve her anlamıyla algılanması bakımından önemli olan "kavramların farklı gösterimi" Talim ve Terbiye Kurulu tarafında yayınlanan 2017 taslak öğretim programında da vurgulanmıştır. Oyunların bu noktada destek sunması faydalı olacaktır.
- Oyunların neredeyse tamamında süre kısıtlaması görülmemiştir.
- Bilginin öğrenci tarafından yorumlanarak şekillendirilmesini sağlayan ve öğrenmenin önemli bir öğesi olan ipucunun etkin kullanıldığı oyunlar çok az sayıdadır.
- Oyunların neredeyse tamamında anında dönüt (doğru-yanlış) sunulmaktadır.
- Öğrenci ilgisinin canlı tutmak adına motivasyon sağlayıcı unsurlar az sayıda oyunda yer almaktadır.
- Oyunların veli/öğretmen gözetiminde olması hem güvenlik açısından hem de eğitsel sürecin takibi bakımından önemlidir. Fakat bu noktada imkân sunan az sayıda Web oyunu bulunmakla birlikte hiç Android oyun bulunmamaktadır.

Öneriler

Ortaya çıkan sonuçlar göz önünde bulundurulduğunda genel olarak eğitsel oyunların tasarımında "eğitsel" boyutunun zayıf olduğu söylenebilir. Alan yazında dikkat çekilen ve eğitsel değeri vurgulanan oyun temelli öğrenmenin teknolojinin eğitsel sürece entegrasyonuna ayak uyduramadığı görülmektedir. Oyun kriterlerinin standartlaştırılması üzerine çalışmalar yürütülebilir ve bunlara uygun tasarımlar gerçekleştirilmesi önerilebilir.

Kaynaklar

Aksoy, N. C. (2014). Dijital oyun tabanlı matematik öğretiminin ortaokul 6. sınıf öğrencilerinin başarılarına, başarı güdüsü, öz-yeterlik ve tutum özelliklerine etkisi. *Doktora Tezi, Gazi Üniversitesi, Ankara*.

Altunışık, R., Coşkun, R., Bayraktaroğlu, S., & Yıldırım, E. (2007). Sosyal Bilimlerde Araştırma Yöntemleri. *Sakarya Yayıncılık, Sakarya*, *226*.

Baki, A. (2000). Bilgisayar Donanımlı Ortamda Matematik Öğrenme. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi*, 19, 186-193.

Çankaya, S., & Karamete, A. (2008). Eğitsel bilgisayar oyunlarının öğrencilerin matematik dersine ve eğitsel bilgisayar oyunlarına yönelik tutumlarına etkisi. *Mersin Üniversitesi Eğitim Fakültesi Dergisi*, *4*(2).

Dori, Y. J., & Belcher, J. (2005). How does technology-enabled active learning affect undergraduate students' understanding of electromagnetism concepts?. *The Journal of the Learning Sciences*, *14*(2), 243-279.

Fırat, S. (2011). *Bilgisayar destekli eğitsel oyunlarla gerçekleştirilen matematik öğretiminin kavramsal öğrenmeye etkisi*. *Yüksek Lisans Tezi, Adıyaman Üniversitesi, Adıyaman*.

Girard, C., Ecalle, J., & Magnan, A. (2013). Serious games as new educational tools: how effective are they? A meta-analysis of recent studies. *Journal of Computer Assisted Learning*, *29*(3), 207-219.

Ke, F. (2006, June). Classroom goal structures for educational math game application. In *Proceedings of the 7th international conference on Learning sciences* (pp. 314-320). International Society of the Learning Sciences.

Kebritchi, M., Hirumi, A., & Bai, H. (2010). The effects of modern mathematics computer games on mathematics achievement and class motivation. *Computers & education*, *55*(2), 427-443.

Korkusuz, M. E., & Karamete, A. (2013). Educational Game Development Models. *Necatibey Faculty of Education Electronic Journal of Science & Mathematics Education*, *7*(2).

Kula, A., & Erdem, M. (2005). Öğretimsel bilgisayar oyunlarının temel aritmetik işlem becerilerinin gelişmesine etkisi. Hacettepe Üniversitesi Eğitim Fakültesi Dergisi, 29(29).

O'Neil, H. F., Wainess, R., & Baker, E. L. (2005). Classification of learning outcomes: Evidence from the computer games literature. *The Cirriculum Journal*, *16*(4), 455-474.

Öğüt, H., Altun, A. A., Sulak, S. A., & Koçer, H. E. (2004). Bilgisayar destekli, internet erişimli interaktif eğitim cd'si ile e-eğitim. *The Turkish Online Journal of Educational Technology*, *2*(4).

Öztürk, D. (2007). Bilgisayar oyunlarının çocukların bilişsel ve duyuşsal gelişimleri üzerindeki etkisinin incelenmesi. *Yüksek Lisans Tezi*, *Dokuz Eylül Üniversitesi, İzmir*.

Peker, Ö. (1985). Ortaöğretim Kurumlarında Matematik Öğretiminin Sorunları, Matematik Öğretimi ve Sorunları. Ankara : TED Yayınları, 52.

Şahin, T.Y., Yıldırım, S. (1999). *Ögretim Teknolojileri ve Materyal Gelistirme.* Ankara: Anı

Şahin, H. B. (2016). Eğitsel bilgisayar oyunlarıyla destekli matematik öğretiminin öğrencilerin akademik başarılarına ve duyuşsal özelliklerine etkisi. *Yayınlanmamış Yüksek Lisans Tezi, Eskişehir Osmangazi Üniversitesi Eğitim Bilimleri Enstitüsü*, *Eskişehir.*

Şimşek, H. (2009). Eğitim Tarihi Araştırmalarında Yöntem Sorunu. *Ankara Üniversitesi Eğitim Bilimleri Fakültesi Dergisi,* 42(1), 33-51.

Yılmaz, D. (2014). Ortaokul 5. sınıf matematik dersi geometrik cisimler öğretiminde, matematik oyunları kullanımının öğrenci başarısı ve tutumuna etkisi. *Yüksek Lisans Tezi, Gazi Üniversitesi, Ankara*.

PROPERTIES AND EVALUATION OF MATHEMATICHS ARITHMETIC OPERATION GAMES

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Abstract: The aim of this study was to investigate the four operations in mathematics in terms of addressing the K-12 level games, and to provide advice on the nature of certain criteria will increase the utilization rate of these games. In this direction, using content analysis method, only 17 games which have been accessed from many games of four operations and which have 11 different criteria have been examined. These games have also been evaluated in terms of age range, feedback, platform, number of users, edition / addition / enhancement, online / offline, Turkish language support, level of difficulty, time limitations and so on. According to the findings of the study, it is observed that the age range was taken into account in the games, giving feedback are high, a large part of the 17 selected games are supported by technologies like iPad-iPhone, these games are often designed to be played by a single user, editing / adding / developing feature was not found at all, almost all of the games were seen to be used offline or offline after being uploaded to the online or related platform, Language support is not usually available in games but Turkish language support is not included. In addition, various suggestions have been presented in the direction of these examinations, which can be taken into consideration during the design phase of the games.

Keywords: Mathematics game based learning, arithmetic operation games

MATEMATİKTE 4 İŞLEMLE İLGİLİ OYUNLARIN ÖZELLİKLERİ VE BELİRLİ ÖLÇÜTLERE GÖRE DEĞERLENDİRİLMESİ

Özet: Bu çalışmanın amacı matematik alanında dört işlem konusunu K-12 seviyesinde ele alan oyunları belirli kriterler açısından incelemek ve bu oyunların kullanım oranlarını da artıracak nitelikte öneriler sunmaktır. Bu doğrultuda içerik analizi yöntemi kullanılarak sadece tam sayılar üzerinde 4 işlemin tamamını konu alan pek çok oyun arasından erişim sağlanan ve 11 farklı kriterlere uygun toplam 17 oyun incelenmiştir. Bu oyunlar, eğitsel bir oyunda olması gereken yaş aralığı, geri bildirim, platform, kullanıcı sayısı, düzenleme/ekleme yapılabilir/geliştirilebilir olma, çevrimiçi/çevrimdışı, Türkçe dil desteği, zorluk düzeyi, süre gibi kriterler açısından da değerlendirilmiştir. Çalışmanın bulgularına göre oyunlarda yaş aralığının dikkate alındığı, geribildirim veren oyunların yüksek oranda olduğu, seçilen 17 oyunun büyük bir kısmının ipad-iphone gibi teknolojiler tarafından desteklendiği, bu oyunların genellikle tek kullanıcının oynayabileceği türden tasarlandığı, düzenleme/ekleme yapma/geliştirme özelliğine hiç yer verilmediği, oyunların neredeyse tamamının çevrimiçi ya da ilgili platforma yüklendikten sonra da çevrimdışı olarak kullanıldığı, genellikle oyunlarda dil desteğinin olmadığı olsa da Türkçe dil desteğine yer verilmediği, zorluk düzeyinin ayarlanabildiği, oyunlarda süre özelliğine yer veren oyunlar kadar yer vermeyen oyunlarında olduğu görülmektedir. Ayrıca bu incelemeler doğrultusunda oyunların tasarım aşamasında dikkate alınabilecek türden çeşitli öneriler de sunulmuştur.

Anahtar Kelimeler: Oyun temelli matematik öğretimi, dört işlem matematik oyunları

Giriş

Oyunla öğretiminin başarı, performans ve motivasyonu arttırmada ve öğrencilerin derse olan ilgisini teşvik etmede yarattığı olumlu etkiler yapılan araştırmalarda gözlenmiştir (Randel & Morris, 1992; Papastergiou, 2009; Zhu, 2012; Baek & Touati, 2017; Sung, Hwang, Lin & Hong, 2017). Matematik soyut bir bilim olduğundan öğrencilere zor gelebilmekte ve kavramların somutlaştırılarak sunulmasıyla bu zorluğun giderilebileceği düşüncesiyle eğitsel oyunlara önem verilmektedir. Matematik öğretiminde öğrencilerin matematiğe karşı olumlu tutum geliştirmeleri adına uluslararası ve ulusal birçok çalışma yapılmıştır (Lewis&Aiken, 1970; Markku, 2005; Bekdemir, 2007; Yıldız ve Turanlı, 2010; Asante, 2012; Akt: Polat, 2013). Yapılan bu çalışmalarda matematiğe karşı olumlu tutumları geliştirmek adına birçok yöntem ve strateji önerildiği, bu yöntem ve stratejiler arasında, oyun ve etkinliklerle öğrenme (Köroğlu ve Yeşildere; 2002, Tural, 2005), teknoloji destekli öğrenme (Ersoy, 2003; Çelik ve Ceylan, 2009; Demir ve Bozkurt, 2011) ve somut yaşantılar yoluyla yapılan öğrenme gelmektedir (Arsal, 2002; Burns&Hamm, 2011; Akt: Polat, 2013).

Yukarıda belirtildiği gibi alan yazın incelendiğinde eğitsel oyunların nasıl tasarlanacağından çok eğitsel oyunların eğitime etkisi üzerinde durulmuştur. Matematik oyunlarının öğretime katkısını tartışan alanyazının yanı sıra eğitsel bilgisayar oyunlarının eğitim ortamlarına entegrasyonunda, öğrenci boyutuyla birlikte pedagojik, teknik alt yapı ve öğretmen boyutlarının da önemli olduğu belirtilmektedir (Akıncı, Sırakaya, Yıldırım ve Tüzün, 2010). Bunlara ek olarak geliştirilen oyunların eğitsel olması amacıyla belirli kriterleri de içermesi etkiliği daha da artıracağı düşünülmektedir. Bu nedenle bu çalışmada özellikle bir çok kademede öğretilen dört-işlem konularıyla ilgili oyunların eğitsel açıdan önemli sayılacak belirli kriterler açısından değerlendirilmesi amaçlanmıştır.

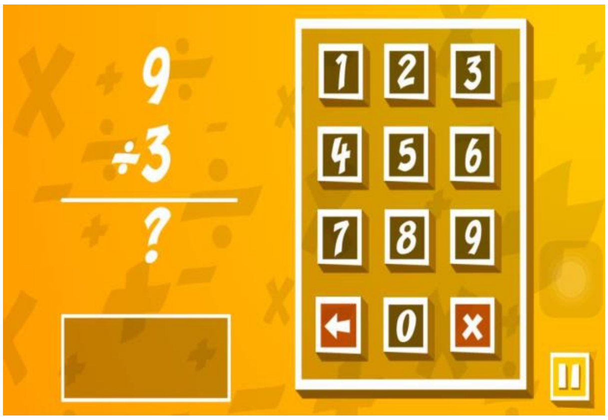
Yöntem

Bu araştırmada, araştırma yöntemi olarak içerik analizi kullanılmıştır. İçerik analizinde temelde yapılan işlem, birbirine benzeyen verileri belirli kavramlar vetemalar çerçevesinde bir araya getirmek ve bunları okuyucunun anlayabileceği bir biçimde düzenleyerek yorumlamaktır (Yıldırım ve Şimşek, 2008: 227). Bu nedenle çalışmada elde edilen verilerin analizi içerik analizi ile gerçekleşmiştir.

Matematik alanında oyun tabanlı öğrenmeyi desteklemek amacıyla hazırlanmış değişik içerik ve özelliklere sahip oyunlar bulunmaktadır. Bu oyunlar incelendiğinde pek çok konunun tek bir oyun tarafından ele alınması kadar sadece tek bir konuyu ele alan oyunlar olduğu da görülmektedir. Bu çalışmada matematik alanında özellikle 4 işlem konusunu K-12 seviyesinde ele alan oyunlar incelenmiştir. Örneğin sadece toplama, çıkarma işlemine yönelik oyunlar değerlendirilmemiştir. Yani sadece tam sayılar üzerinde 4 işlemin tamamını konu alan oyunlar dikkate alınmıştır. Oyunlara herkesin erişebilmesi açısından ücretli oyunlar listeye dahil edilmemiştir. Ayrıca matematik dışında başka konuları da (Sanat, Geometri, Sağlık,Dil Sanatları, Müzik, Okuryazarlık,Fen, Okuma, Yazma, Kelime) ele alan oyunlar incelemeye alınmamıştır. Bazı oyunlar öğrencilerin bir sınıf kapsamında sınıfa özel bir kod ile oyuna katılımı gerekli kılmaktadır. Bu oyunlarda dikkate alınmamıştır. Bu doğrultuda https://edshelf.com/ adresinden matematikte 4 işlem ile ilgili oyun tabanlı öğrenme ortamları araştırılmış, pek çok oyun arasından erişim sağlanan ve kriterlere uygun toplam 17 oyun incelenmiştir. Sırasıyla incelenen oyunlar, bir oyunda olması gereken kriterler açısından da değerlendirilmiştir. Bukriterler şu şekilde sıralanabilir:

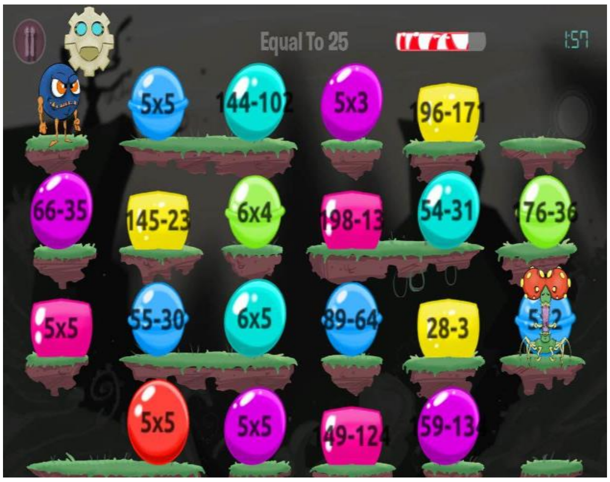
1- Yaş Aralığı
2- Disiplin
3- Geri Bildirim (Var/Yok)
4- Platform (Web, İpad, İphone, Android Telefon, Android Tablet)
5- Kullanıcı Sayısı (Tek, İki, 3 ve üzeri, Bilgisayara karşı)
6- Düzenleme / Ekleme yapılabilir/ Geliştirilebilir (Evet / Hayır)
7- Çevrimiçi / Çevrimdışı
8- Türkçe Dil Desteği (Var / Yok)
9- Ücretli/Ücretsiz
10- Zorluk Düzeyi (Var / Yok)
11- Süre (Var / Yok)

Matematikte 4 İşlemle İlgili Oyunların Özellikleri

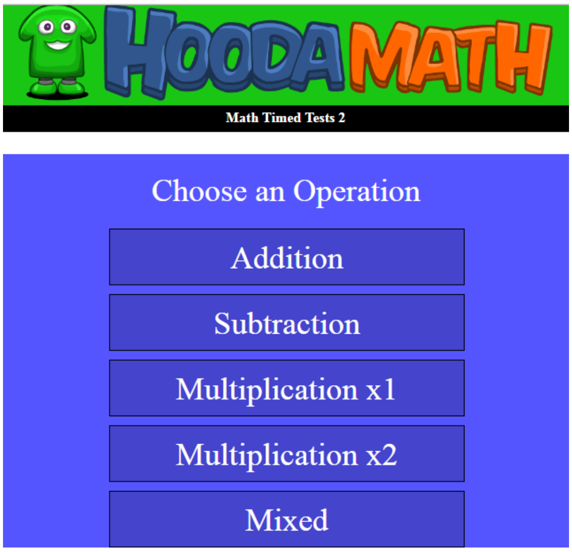


1. Math Planet: Oyun matematikte sayı doğrusu, kesirler, matematikte 4 işlem, koordinat düzlemi gibi konuları basit düzeyde ele alarak giderek zorlaşan bir oyundur. En basit hali ücretsiz olarak oynanmakta, zorluk düzeyinin, sınıf düzeyinin ya da kullanıcı sayısının artması ise ücret karşılığında gerçekleşmektedir. Soruların doğru ya da yanlış cevaplanması konusunda kullanıcı geribildirim almakta, oyun üzerinde herhangi bir ekleme/düzenleme yapılamamakta, oyun indirildikten sonra çevrimdışı da oynanabilmekte, dil desteği bulunmamakta, zamana karşı bir yarış gerçekleşmemekte ve zorluk düzeyi giderek artmaktadır. Ekran tasarımı itibariyle yalın bir görünümü olması nedeniyle kolaylıkla anlaşılmakta, kullanıcı oyun bölümlerini bitirdikten sonra o bölümdeki performansının düzeyini ve hangi soruları doğru ya da yanlış cevaplayabildiğini görebilmektedir.

2. Monster Math: Oyun ana karakterin en yakın arkadaşını canavarlardan kurtarmak için geçmesi gereken her bölümde çeşitli eşitliklerin matematikteki hangi 4 işlem sorusuna eşit olması gerektiğini ölçmektedir. Her bir canavarı geçmek için karakterin güç toplaması gerekmektedir. Bu nedenle de süreye karşı bir yarış söz konusudur. Farklı kullanıcı girişleri yapılarak oyun oynanabilse de aynı anda tek kullanıcı tarafından oynanabilmektedir. Oyunun zorluk düzeyi ayarlanabilmektedir. Ancak daha ileri zorluk düzeyleri için satın alınması gerekmektedir. Sade ve anlaşılır ekran tasarımıyla oldukça anlaşılır bir oyundur. Oyun üzerinde herhangi bir ekleme/düzenleme yapılamamakta, kullanıcı işlemin yanlış olduğuna dair geribildirim almasa da güç alamadığından bunu anlayabilmekte, dil desteği bulunmamakta, her bölümde farklı türden 4 işlem soruları aynı anda yer almaktadır.



3. Hooda Math: http://www.hoodamath.com/ sitesinde sınıf düzeyi, matematikte ilgilenilen konu seçildiğinde uygun oyunlar listelenmektedir. Oyunlarda genel itibariyle süreye karşı bir yarış söz konusudur. Oyunda kaç sorunun yer alacağı, matematikte 4 işlemden hangilerinin/hepsinin yer alıp almayacağı ve zorluk düzeyi seçildikten sonra sorular süre eşliğinde kullanıcıya sunulmaktadır. Yanlış cevaplanan sorular doğru hanesine eklenmeyerek kullanıcıya bir dönüt verilmektedir. En son istatistik olarak ne kadar sürede, kaç sorunun doğru, kaç sorunun ve hangi soruların yanlış cevaplandığı gibi bilgiler kullanıcıya sunulmaktadır. Dil desteği yoktur. Açık ve anlaşılır ekran tasarımı kullanıcıyı oyunu anlamak için yormamaktadır.



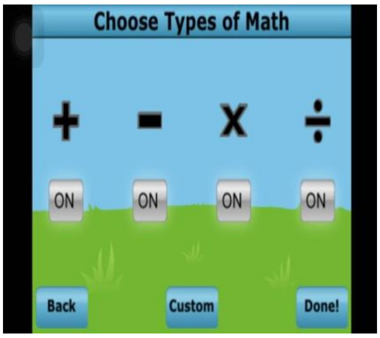
4. Math Monsters – Bingo:

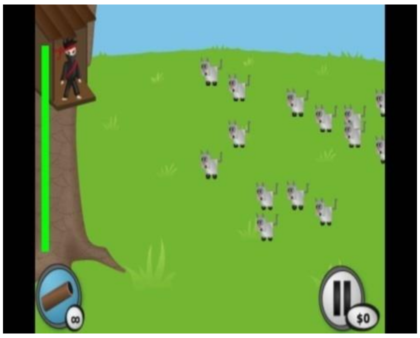
Oyun kullanıcının matematikte 4 işlemden hangisiyle ilgili sorular yanıtlamak istediğini sormakta, seçimiyle ilgili de zorluk düzeyiyle ilgili olarak başlangıç, amatör ya da profesyonel olmak üzere seviyeler sunmaktadır. Seçimin ardından ekrana sorular gelmekte ve kullanıcı matris üzerinde doğru yanıtları işaretlemektedir. Yanlış yanıt işaretlendiğinde her bölümde verilen 5 can azalmaktadır ve kullanıcı buna göre puan almaktadır. Aynı satır ve sütun üzerindeki tüm sayılar işaretlenince ekrana BINGO yazısı çıkmakta ve kullanıcı belirli bir puan kazanmaktadır. Her puan kazanımının ardından kullanıcı zıplama oyunu oynayabilmektedir. Bu oyun ise hızlı olmayı gerektiren bir oyundur. Böylece oyun kullanıcıda daha fazla matematikte 4 işlem sorusu çözme isteği uyandırmaktadır. Oyun matematiksel işlemleri yaparken olmasa da zıplama oyununda hızlı olmayı gerektirmektedir. Ücretsiz bir oyundur ve aralarda ekrana reklamlar çıkmaktadır. Bu kullanıcı açısından olumsuz bir durumdur. Dil desteği bulunmamakta, zorluk düzeyini ayarlamak kullanıcının isteğine göre gerçekleşmekte, düzenleme/geliştirme yapılmamakta ve kullanıcı yanlış yaptığında uyarı işareti ekranda görünmektedir. Oyuna başlarken 5 kullanıcı ismi tanımlanmasına rağmen oyun aynı anda tek kullanıcı tarafından oynanmaktadır.

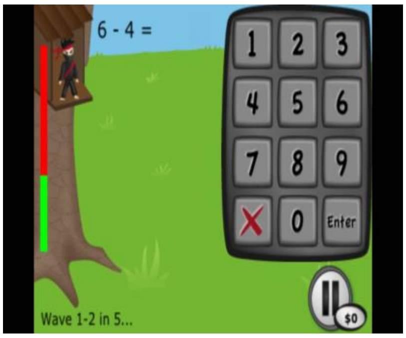
5. Math vs. Dinosaurs:

Oyun Math adlı karakterin dinazorlara ve farklı karakterlere karşı savaşıyla birlikte Matematikte 4 işlemi ele almakta, rastgele ekrana gelen sorular eşliğinde kullanıcının kendisini değerlendirmesini sağlamaktadır. Oyun 60 seviyeden oluşmaktadır. Her seviyede zorluk düzeyi kullanıcı tarafından ayarlanabilmektedir. Aynı seviye içinde matematikte 4 işlemle ilgili basit ve zor sorular gelebilmektedir. Sorularda sadece sonuç sorulmamakta, sonuç verilerek hangi sayıların işlemde yer alması gerektiği de sorulmaktadır. Her 5 seviyede bir daha büyük karakterler ekrana gelmekte, bu karakterler tek bir soruyu doğru bilmekle ölmemekte, daha fazla soruya doğru yanıt vermeyi gerektirmektedir. Çoğu seviyede doğrudan süreye karşı bir yarış bulunmamakla birlikte, bazı seviyeler de ekranda 45 sn süre vererek bu süre içinde ekrana gelen soruları doğru bilerek zarar veren karakterleri öldürmeyi gerektirmektedir. Sorulara geç cevap verildiğinde ana karaktere doğru yaklaşan ve zarar vermek isteyen karakterler seviyenin bitmesine neden olmaktadırlar. Soruların doğru ya da yanlış cevaplanmasına dair geribildirimler sesli olarak verilmekle birlikte, yanlış cevap verildiğinde doğrusu seçenekler üzerinde işaretlenerek de gösterilmektedir. Seviyeler arttıkça kullanıcıya sorulan soru sayısıda artmaktadır. Android telefonlarda her seviye arasında ekrana gelen reklamlar oyuna bağlılığı azaltmaktadır. Aynı zamanda ekrana gelen karakterler Math'i öldürdüğünde kullanıcı ekrana gelen videoları izleme zorunluluğuyla karşılaşmaktadır. Oyun tek kullanıcı tarafından oynanabilmekte, düzenleme/geliştirme yapılamamakta, indirilerek çevrimdışı da kullanılan oyun ücretsiz olarak kullanıcılara sunulmaktadır. Türkçe dil desteği bulunmamaktadır.

6. Math Ninja HD: Oyunun başlangıcında oyunu tanıtan, oyun hakkında bilgi veren bir bölüm bulunmaktadır. Oyun kolay, normal ve zor olarak 3 bölümden oluşmaktadır. Bu düzeylerin seçimi kullanıcıya bırakılmıştır. Ardından oyunda matematikte 4 işlemden hangileriyle ilgili sorular çözmek istenildiğine dair bir ekran gelmektedir. Buradan istenilen işlemler on/off şeklinde seçilmektedir. Seçimlerin ardından ağacın üzerinde bulunan ninja ekrana gelen kedi ve köpekleri hedef alarak vurmaya çalıştığı bir oyun oynamaktadır. Bu karakterlerin hepsini vurması gerekmektedir. Vuramazsa eğer bu karakterler ana karakterin canının azalmasına neden olmaktadır. Vurursa eğer oyunun başında seçtiği matematiksel işlemlere göre sorular kullanıcıya sorulmaktadır. Eğer doğru cevaplarsa kullanıcı 5 $ kazanmakta, yanlış cevaplarsa kazandığı dolarlar düşmemekte ve kullanıcıya doğru cevap gösterilmektedir. Ardından da diğer soruya geçilmektedir. İlgili bölümde sorulan sorular bitene kadar oyun bu şekilde devam etmektedir.



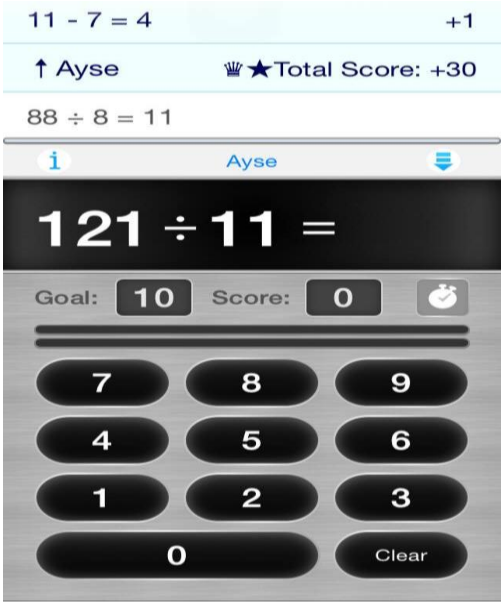




İlerleyen bölümlerde kedi ve köpekler 5'erli şekilde bisiklet ve araba ile ninjaya saldırmakta ve ninjaya yaklaşma hızları artmaktadır. İlk atışta araba ya da bisiklet kaybolmakta ve ninja ise 5'li gruplar halinde kedi ya da köpekleri görmektedir. İlerleyen bölümlerde kazandığı dolarlarla farklı araçlar alıp düşmanlarını daha az atışla yok edebilmektedir. Oyunda toplanan para daha çok karakter yok etmek için kullanılabilmektedir. Sorulan 4 işlem soruları esnasında süre ekranda görülmektedir. Değişen sürelerde ne kadar fazla 4 işlem sorusu cevaplanırsa da o kadar çok para kazanılabilmektedir. Basit 4 işlem sorularının ekrana geldiği bu oyunda geribildirim sorular yanlış cevaplandığında doğrusunu göstermek şeklinde ekrana gelmektedir. Oyun ücretsiz bir şekilde indirilip oynanabilmektedir. Oyunda Türkçe dil desteği bulunmamaktadır. Oyunun zorluk seviyesi seçilmekte, süre ise sadece 4 işlem sorularının cevaplandığı kısımda ekrana gelmektedir. Ayrıca oyunda matematikte 4 işlem soruları oyunlaştırılarak kullanıcıya sunulduğu için kullanıcı hem eğlenmekte hem de kendini değerlendirebilmektedir.

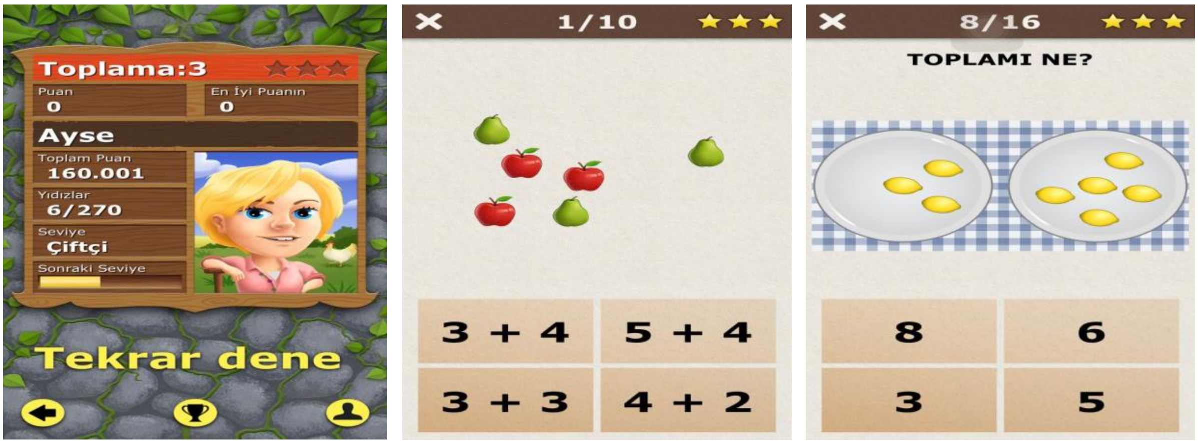
7. Zeus vs. Monsters:

Oyun Zeus'un canavarlara ve farklı karakterlere karşı savaşıyla birlikte Matematikte 4 işlemi ele almakta, rastgele ekrana gelen sorular eşliğinde kullanıcının kendisini değerlendirmesini sağlamaktadır. Oyun 50 seviyeden oluşmaktadır. Her seviyede zorluk düzeyi kullanıcı tarafından ayarlanabilmektedir. Aynı seviye içinde matematikte 4 işlemle ilgili basit ve zor sorular gelebilmektedir. Doğrudan süreye karşı bir yarış bulunmamakla birlikte, sorulara geç cevap verildiğinde ana karaktere doğru yaklaşan ve zarar vermek isteyen karakterler seviyenin bitmesine neden olmaktadırlar. Soruların doğru ya da yanlış cevaplanmasına dair geribildirimler sesli olarak verilmektedir. Seviyeler arttıkça kullanıcıya sorulan soru sayısıda artmaktadır. Android telefonlarda her seviye arasında ekrana gelen reklamlar oyuna bağlılığı azaltmaktadır. Oyun tek kullanıcı tarafından oynanabilmekte, düzenleme/geliştirme yapılamamakta, indirilerek çevrimdışı da kullanılan oyun ücretsiz olarak kullanıcılara sunulmaktadır. Türkçe dil desteği bulunmamaktadır.



8. Mathbeat: Bu oyunda ekrana matematikte 4 işlemle ilgili rastgele sorular gelmektedir. Kullanıcı her doğru yaptığı soru için 1 puan kazanmakta, bir soruya verdiği her yanlış cevap için ise cevap sayısı kadar puan kaybetmektedir. Kullanıcı yaptığı işlemlerin, doğru ya da yanlış cevaplarının dökümünü ve aldığı puanları görebilmektedir. Kullanıcı istediği isimlerle giriş yapabilmekte ve o kullanıcı adıyla puan kazanabilmekte ya da kaybetmektedir. Yalnız bu kullanıcı girişlerine ait toplam puanlar sadece saat butonuna tıklayıp zamana karşı yarışıldığında görülmekte, kullanıcıların karşılıklı yarışması gibi bir durum da söz konusu olmamakta ve kullanıcıların kendi içinde sadece aldıkları en yüksek skor görünmektedir. Yani aynı anda tek kullanıcı soruları cevaplayabilmektedir. Kullanıcı ekrana gelen işlemlerin zorluk düzeyini ayarlayabilmektedir. Ancak soruların zorluk düzeyi yine de çok ileri düzeyde değildir. Kullanıcı doğru yaptığı işlemin geribildirimini kazandığı +1 puanla görmekte, yanlış cevapladığı soru ise doğru cevaplayana kadar ekranda kalmaktadır. Türkçe dil desteği yoktur ancak ekranda dil desteği gerektirecek herhangi bir yönerge de yer almamaktadır. Dolayısıyla bu eksiklik olumsuz bir durum oluşturmamaktadır. Oyun indirilerek çevrimdışı olarak da oynanmaktadır. Düzenleme/ekleme/geliştirme yapmak söz konusu değildir. Aynı anda tek kullanıcı girişiyle sorular yanıtlanmaktadır.

9. King of Math Junior: Oyunun başında ekrana gelen karakterlerden biri seçilerek isim girişi yapılmaktadır. Ardından sayma, toplama, çıkarma, çarpma, bölme, geometri, karşılaştırma, bilmeceler, ölçme ve kesirler gibi kitaplar seçilmektedir. Bunlardan sayma, toplama ve çıkarma ücretsiz olarak oynanabilmekte, diğerleri ise ücretlidir. Seçilen işlem türünde giriş seviyesinden başlanarak bölümdeki tüm aşamaları tamamlama zorunluluğu vardır. İstenilen etaptan başlamaya izin verilmemektedir. Sorular basit düzeyde olmakla birlikte her etapta 10 ya da 16 soru yer almaktadır.

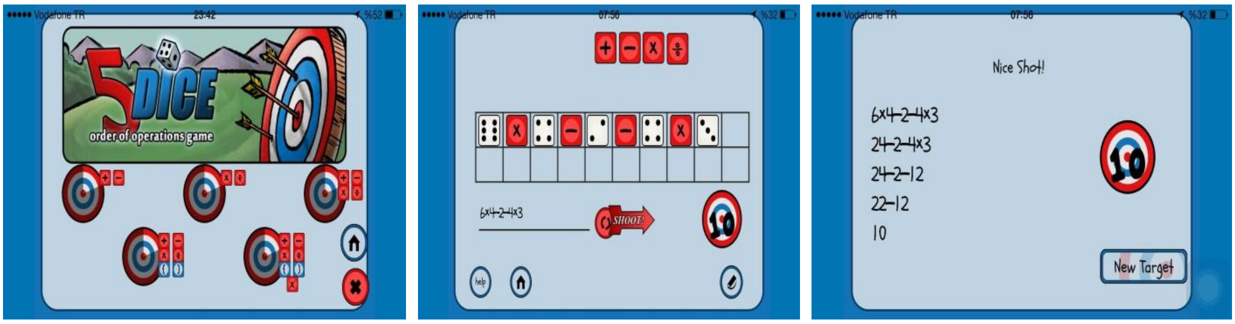


Etap içinde 3 kez yanlış cevap verildiğinde başarısız olunmakta ve baştan farklı sorularla bölümün yeniden geçilmesi gerekmektedir. Doğru ve yanlış cevaplandığında sorular buna dair bir geribildirim verilmekle birlikte yanlış sorunun doğru yanıtı ekrana gelmemektedir. Aynı anda tek kullanıcı oyunu oynayabilmektedir. Düzenleme/ekleme/geliştirme yapmak söz konusu değildir. Oyun indirildikten sonra çevrimdışı da oynanabilmektedir. Oyun da yönergeler Türkçe olarak verilmektedir. Zorluk düzeyi kullanıcı tarafından ayarlanamamaktadır. Ancak sorular basit olsa da kendi içinde zorlaşan bir mantık çerçevesinde ekrana gelmektedir. Süreye karşı bir yarış söz konusu değildir.

10. King of Math: Oyun isim girişi yapılarak başlamaktadır. Ardından cinsiyet girişi yapılmaktadır. Toplama, çıkarma, karışık 1, çarpma, bölme, aritmetik, geometri, kesirler, üslü sayılar, istatistik, denklemler ve karışık 2 gibi kitapların seçim ekranıyla oyun devam etmektedir. Bunlardan toplama, çıkarma ve karışık 1 ücretsiz, diğer kitaplar ise ücretlidir. Seçilen işlem türünde giriş seviyesinden başlanarak bölümdeki tüm aşamaları tamamlama zorunluluğu vardır. İstenilen etaptan başlamaya izin verilmemektedir. Sorular basit düzeyde olmakla birlikte her etapta 10 soru yer almaktadır. Etap içinde 3 kez yanlış cevap verildiğinde başarısız olunmakta ve baştan farklı sorularla bölümün yeniden geçilmesi gerekmektedir. Verilen her yanlış cevapta kazanılan puan üzerinden düşüş söz konusudur. Süreye karşı bir yarış söz konusudur. Belirli bir süre içinde sorunun yanıtı verilmezse oyun bölümden çıkmakta ve tekrar başa dönmektedir.

Oyun indirildikten sonra çevrimdışı da oynanabilmekle birlikte, çevrimiçi oyuna dahil olup oynayan ve en yüksekten düşüğe doğru ne kadar puan alındığına dair kullanıcıların bilgileri görülebilmektedir. Alınan puan sosyal medya (facebook, twitter gibi) üzerinden paylaşılabilmektedir. Sorular doğru ve yanlış cevaplandığında buna dair bir geribildirim verilmekle birlikte yanlış sorunun doğru yanıtı ekrana gelmemektedir. Aynı anda tek kullanıcı oyunu oynayabilmektedir. Düzenleme/ekleme/geliştirme yapmak söz konusu değildir. Oyun da yönergeler Türkçe olarak verilmektedir. Türkçe dil desteği ile birlikte pek çok dil desteği bulunmaktadır. Zorluk düzeyi kullanıcı tarafından ayarlanamamaktadır. Ancak sorular basit olsa da kendi içinde zorlaşan bir mantık çerçevesinde ekrana gelmektedir. Süreye karşı bir yarış söz konusu değildir. Kullanıcı aldığı puana göre seviyesini görebilmekte, diğer kullanıcıların puanları ile kendi aldığı puanı kıyaslayabilmektedir.

11. 5 Dice: Order of Operations Game: Oyun yeni bir oyuncu tanımlayarak başlamaktadır. Oyuncu tanımlaması yapıldıktan sonra oyna, yönergeler, skorlar ve daha fazlası için butonlar bulunmaktadır. Oyunu oyna dedikten sonra tek oyuncu olarak mı yoksa çevrimiçi birden fazla oyuncuyla mı oynanmak istendiği sorulmaktadır. Eğer oyun tek oyuncu olarak oynamak için seçilirse ne tür işlemlerin yapılmak istendiği sorulmaktadır.



Örneğin toplama, çıkarma, çarpma ve bölme gibi işlemler seçildiğinde kullanıcının karşısına çeşitli zarlar ve bu dört işlemin işareti gelip tüm zarlar kullanılarak verilen hedef sayıya ulaşmak için nasıl bir eşitlik oluşturmak gerektiği sorulmaktadır. Verilen zarlarla ve işaretlerle istenen sayıya ulaşılmazsa işlemin yanlış olduğunu söylemekte, yeni bir eşitlik seçilene kadar ya da doğru sonuca ulaşana kadar da işlemi yapmak gerekmektedir. İstenen eşitlik oluşturulduğunda ise hedef bir okla vurulmaya çalışılmaktadır. Eğer eşitlik belirlenemeden yeni bir işleme geçmek istenirse o zaman sorunun doğru yanıtı ekrana gelmektedir. Eğer oyun birden fazla oyuncu tarafından oynanmak istenirse o anda çevrimiçi olan kullanıcılara bağlanmaya çalışmaktadır. Oyunda süre, Türkçe dil desteği, zorluk düzeyi, düzenleme/ekleme yapabilme gibi özellikler ise bulunmamaktadır. Sorunun doğru ya da yanlış cevaplandığına dair geribildirim verilmektedir.

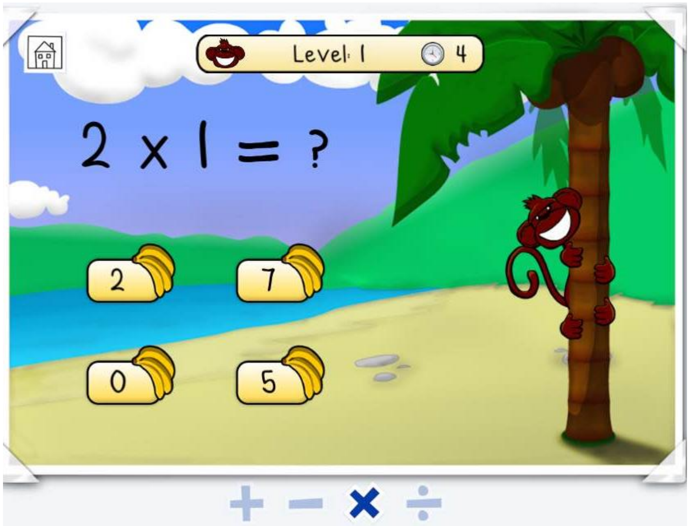
12. Sumdog:

Oyun çevrimiçi olarak oynanmaktadır. Kullanıcı ister ortama kayıt olarak giriş yapmakta ya da oyunu sadece denemek amacıyla ortama girebilmektedir. Oyun çevrimiçi olduğu için oyunun ana sayfasında toplamda verilen doğru cevap sayısı anlık olarak görülebilmektedir. Ayrıca ana sayfa üzerinde öğretmenler ve ebeveynlere yönelik bilgilendirme sayfaları da yer almaktadır. Kullanıcı giriş yapmadan oyunu denemek istediğinde konu, beceri, oyun gibi seçeneklerde seçim yaptığında oyun kullanıcıyı giriş yapmaya zorunlu kılmaktadır, aksi halde oyunu oynama seçeneği ekrana gelmektedir. Oyunu oyna dedikten sonra çevrimiçi kullanıcılar oyuna dahil olmakta ve oynamaktadırlar. Oyun bir dakikalık süre içerisinde ekrana gelen çeşitli sorulara doğru yanıt verebilmeyi gerektirmektedir. Sorular sadece dört işlem soruları değil, sayılar, saatler, geometri gibi konuları da içine almaktadır. Verilen yanlış yanıtlar o bölüm bittiğinde doğru cevabıyla birlikte ekranda görülmektedir. Süre bitince oyun bir sonraki aşamaya geçmekte ve bu aşamadaki sorularda bir derece daha zorlaşmaktadır. Oyun da bu şekilde ilerlemektedir. Eğer kullanıcı bir dakikalık süre içinde hiçbir soruya cevap vermezse o bölüm için hakkı yanmaktadır. Eğer cevap verirse bölüm sonunda topladığı altınları, oynadığı çevrimiçi oyuncular arasındaki sırasını, bir dakikalık süre içinde kimin en fazla ve doğru soru cevapladığını ve başarı oranını görebilmektedir.

13. Numbie Run: Oyunda Numbie adlı karakter çeşitli engelleri aşmaya çalışırken aynı zamanda altın toplamaktadır. Karakterin 3 canı bulunmaktadır. Bu engellere çarptığı vakit canlarını teker teker kaybetmektedir. Tüm canını kaybeden karakter en son oyundan çıkmakta ve kullanıcıya oyuna devam edip etmeyeceğini sormaktadır. Ekranda karakterin gittiği mesafe ve topladığı altın miktarı görülmektedir. Karakter hareketine devam ederken arada kilitli sandıklar çıkmaktadır. Bu sandıklara değdiğinde ise matematikte 4 işlemle ilgili sorular ekrana gelmektedir. Soruyu doğru bildiğinde can kazanmakta, engellere değse de canı gitmemekte ve daha hızlı hareket edebilmektedir. Bu durum birkaç saniye sürmektedir. Bu sandıkların sayısı da çok fazla değildir. O nedenle bir matematik oyunu gibi değilde sanki karakterin can toplamaya ve engelleri aşmaya çalıştığı bir oyun izlenimi yaratmaktadır.

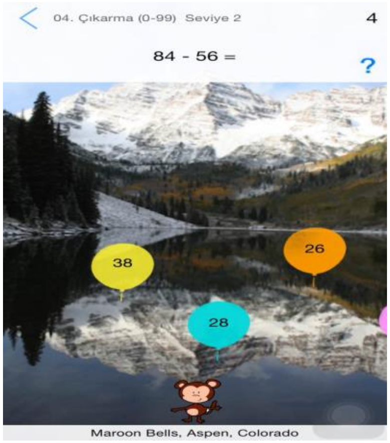
Sandıklardan çıkan matematiksel işlem bilinmeyince karakter can kazanamamakta, sorunun doğru yanıtına ilişkin bir geribildirim de verilmemektedir. Ayrıca karakter ne kadar fazla altın toplarsa oyunun diğer aşamalarını da oynama hakkı kazanmaktadır. Oyun hem çevrimiçi hem de çevrimdışı oynanabilmektedir. Oyunda ekleme/ geliştirme yapılamamaktadır. Tek kullanıcı olarak oynanan oyun ücretsizdir. Kullanıcı Türkçe dil desteği olmasa da var olan diğer dil seçenekleri arasından seçim yapabilmekte, oyunun zorluk düzeyini ayarlayabilmektedir. Oyunda süreye karşı bir yarış bulunmamaktadır.

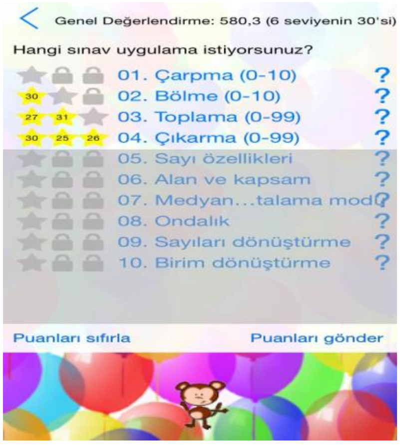
14. DoodleMath: DoodleMath oyununda kullanıcının öncelikle isim ve sınıf düzeyini girip, oyunda görmek istediği karakterini seçerek alanını kişiselleştirmesi gerekmektedir. Oyunun ana sayfasında kullanıcının kendisini farklı sorularla değerlendirebileceği bir değerlendirme bölümü bulunmaktadır. Burada bölüm sonunda kullanıcının başarısı, kaç saniyede kaç doğru yanıt ürettiği gibi bilgiler bulunmaktadır. Kullanıcı her doğru yanıtında bir yıldız kazanmaktadır. Bu kazandığı yıldızlar kullanıcının karakterini fiziksel olarak şekillendirebilmesi için önem kazanmaktadır. Yine anasayfada kullanıcı haftanın yeni konusuyla ilgili olan konuları görebilir. Kişiselleştirme alanından ilerleyişine dair bilgileri, seçtiği doodle'ı şekillendirebileceği alanı görebilir ve kendi doodle'ını da çizebilir. Oyunlar kısmında ise 3 oyun yer almaktadır. Bunlardan ikisi ücretli, matematikte 4 işlemle ilgili olan monkey mania adlı oyun ise ücretsizdir. Bu oyunda her soru 7 sn'lik bir süre için ekrana gelmektedir. Yanıt verilirse ve bu yanıtlar doğruysa her doğru yanıt için maymun ağaca tırmanabilmektedir, her yanlış yanıtta ve süresi içinde cevap verilmeyen her soruda ise bir adım aşağı inmektedir. Oyunda geribildirim maymunun aşağı ve yukarı hareketleriyle birlikte verilmektedir. Oyun esnasında oyunun zorluk düzeyi giderek zorlaşmaktadır. Kullanıcı ekranın altından hangi 4 işleme dair soru çözmek isterse onu seçebilmektedir. Oyunun bu bölümünde bitiş yoktur. Kullanıcı istediği kadar oynayabilmektedir. Tek kullanıcı tarafından çevrimiçi ve çevrimdışı olarak oynanan oyunda belirli bölümler ücretsizdir. Bunlardan biri basit 4 işlem sorularının yer aldığı monkey mania adlı oyundur. Diğer iki oyunu oynayabilmek için ücret ödemek gereklidir. Çeşitli dil destekleri vardır ancak bunlar arasında Türkçe dil desteği yoktur.

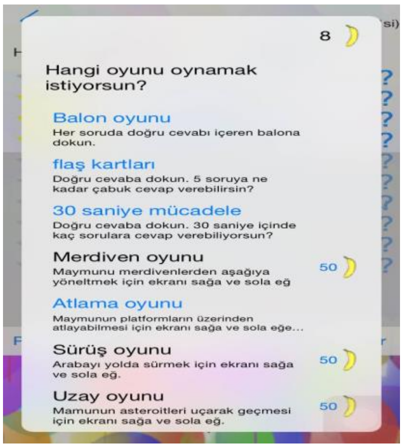


15. Math Champions: Oyunun ana ekranında kullanıcı oyunda aldığı en yüksek skoru görebileceği highscores butonu, oyunun tam versiyonu, daha fazla oyun, oynadığı oyunları derecelendirme, adını değiştirme ve başka kullanıcı isimleri tanımlama gibi butonları görebilmektedir. Kullanıcı oyuncu adına tıkladığında ise tam versiyon kısmında oyunu satın alabilir, tarih bölümünden skorlarını görebilir, yüksek skorlar kısmından tüm oyunlardaki en yüksek aldığı puanları görebilir, deneme bölümünde ücretsiz oyunları deneyebilir, oyna butonuna tıkladığında ise oyuna başlayabilir. Oyunda izin verildiği kadarıyla süre sınırı olmadan verilen matematikte 4 işlem soruları çözülebilmektedir. Sorunun doğru yanıtına ilişkin matematiksel operatör seçilmektedir. İşlemin doğru ya da yanlışlığına ilişkin geribildirim işaretlerle verilmektedir. Birde ekranda oyundan çıkılmak istendiğinde kullanılabilecek durdurma butonu vardır. Oyun tek kullanıcı tarafından düzenleme/ekleme/geliştirme yapmaya izin vermeden kullanılmaktadır. Türkçe dil desteği olmasa da oyunda dil desteği gerektirecek bir unsur bulunmamaktadır. Süreye karşı bir yarış söz konusu değildir. Oyunda zorluk düzeyi kullanıcı tarafından ayarlanamamaktadır. Çevrimiçi ya da çevrimdışı oynanan oyunda ekrana basit matematiksel işlemler rastgele çıkmaktadır. Oyunun tam hali ise ücretlidir.

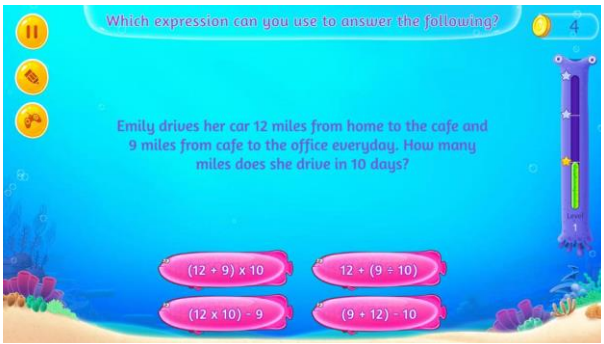
16. Middle School Math 6th Grade: Oyun matematikte 4 işlemle ilgili oyunları 3 seviye olarak ücretsiz şekilde sunmaktadır. Sayı özellikleri, alan ve kapsam, medyan, ondalık, sayıları dönüştürme ve birim dönüştürme gibi bölümleri ise ücret karşılığında oynamaya izin vermektedir. Oyunun ana ekranında yer alan liderler bölümünde çevrimiçi olunduğunda bu oyunu oynamış ve en yüksek puan alan kişiler görülmekte, başarılarda kullanıcının oyun içindeki performansına ait bilgiler yer almakta, geri bildirimde oyunu değerlendirmek için bir ekran karşımıza gelmekte, ödüller alanında toplanan muz sayısına bağlı olarak kullanıcıya bazı haklar verilmektedir. Örneğin 25 muz toplayan maymun karakteri yerine aslan karakterini de seçebilmektedir.







Oyna dendiğinde ise hangi 4 işleme ait oyuna erişmek istendiği kullanıcıya sorulmaktadır. Hangi işlem seçilirse seçilsin balon oyunu, flaş kartları, 30 sn mücadele oyunlarına doğrudan erişim sağlanmakta, merdiven oyunu, atlama oyunu, sürüş oyunu ve uzay oyununa ise bölüm içinde ya 50 muz kazanılarak ulaşılmakta ya da ücret ödenerek erişim sağlanmaktadır. Her oyunda ise kullanıcı soruları doğru yanıtlama süresine göre puan kazanmakta, yıldızı kazanmak için gerekli sorular yanıtlandığında ise o bölüm tamamlanmakta ve oyun bir sonraki seviyeye geçmektedir. Her seviyede ise 3 oyun bulunmaktadır. Hem eğlendiren hem de matematikte 4 işlemle ilgili alıştırma yapmaya izin veren bu oyunda geri bildirim verilmektedir. Oyun tek kullanıcı tarafından oynansa da çevrimiçi diğer oyuncuların performansı görülebilmekte, düzenleme/geliştirme yapılamamaktadır. Çevrimiçi ya da çevrimdışı oynanan oyunda diğer oyuncuların performansı ise sadece çevrimiçi olunduğunda görülebilmektedir. Oyunun bazı bölümleri ücretli, asıl ilgilenilen bölüm olan matematikte 4 işlemle ilgili bölümler ise ücretsizdir. Oyun Türkçe dili esas alınarak tasarlanmış olup zorluk düzeyi kullanıcı tarafından ayarlanamasa da oyun seviyeler halinde ilerlemektedir. Sorular çok zorlayıcı olarak ilerlemese de bölümler arasında küçük seviye farkları bulunmaktadır. Her bölüm içinde kullanıcının soruları cevaplama süreleri görünmekte, tüm soruları toplam kaç saniyede yanıtladıysa o kadar da puan kazanılmaktadır.



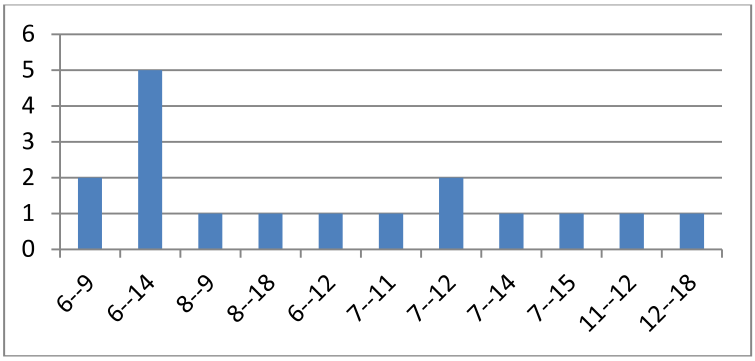
17. 3rd Grade Math: Splash Math Worksheets: Oyunda sayılar, sayı değerleri, matematikte 4 işlemle ilgili sorular, çarpma, bölme, kesirler, ondalıklı sayılarda işlemler, uzunluk ölçüleri ve geometri gibi ayrı bölümler bulunmaktadır. Bunlardan istenilen herhangi biri seçilerek denenmektedir. Ancak sonrasında tekrar oynanmak istendiğinde ücret ödenmesi gerektiğine dair uyarı çıkmaktadır. Matematikte 4 işlemle ilgili bölümde ekrana 4 işlemle ilgili karışık alıştırmalar ve problemler gelmektedir. Oyunda doğru yanıt verildiğinde altın toplanmakta, yanlış yanıt verildiğinde ise yanıtın yanlış olduğuna dair geribildirim ekrana gelmektedir. Tek kullanıcı tarafından oynanan oyunda düzenleme/geliştirme yapılmamakta, Türkçe dil desteği, zorluk düzeyi ve süre yer almamaktadır. Ayrıca oyun çevrimiçi ya da çevrimdışı oynanmakla birlikte oyuna başlamadan önce ise 1'den 5'e kadar sınıf düzeyi ayarlanabilmektedir.

Bulgular

Bu bölümde matematikte 4 işlem konusuyla ilgili oyun tabanlı öğrenme ortamlarında en çok dikkat çeken kriterler ele alınmış ve incelenen oyunlar doğrultusunda bu kriterler yorumlanmaya çalışılmıştır.

1. Yaş Aralığı

Oyunlar tasarlanırken dikkat edilmesi gereken önemli unsurlardan birisi de oyunun ele alınacağı yaş aralığıdır. Oyunda dikkate alınan konu/konuların hangi yaş düzeyleri için gerekli olduğunu dikkate alarak tasarlamak oyunun tercih edilme oranını ve dolayısıyla başarısını da artıran bir durumdur. Matematikte 4 işlemle ilgili oyun tabanlı öğrenme ortamlarınınK-12 düzeyinde yaş aralıklarına göre dağılımları Şekil 1' de sunulmaktadır.

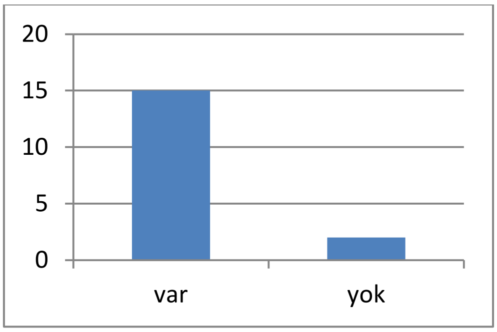


Şekil 1. Oyun tabanlı öğrenme ortamlarının K-12 düzeyinde yaş aralıkları

Şekil 1'e göre matematikte 4 işlemle ilgili oyunlar en çok 6-14 (n=5) yaş aralığında yer almaktadır. Ardından 6-9 (n=2) ve 7-12 (n=2) yaş aralıkları gelmektedir. Grafikten de görüleceği üzere matematikte 4 işlemle ilgili oyun tabanlı öğrenme ortamlarında konunun ağırlıklı olarak işlendiği sınıf düzeyleri de düşünüldüğünde daha çok ilk ve ortaokulu kapsayan yaş aralıklarında yer aldığı görülmektedir. Lise düzeyinde sadece 1 oyunun yer alması dikkat çekmektedir. Bu oyunlar dikkatle incelendiğinde ise yaş grubuna bağlı olarak oyunda yer alan soruların zorluk düzeyinin değiştiği ifade edilebilir.

2. Geri Bildirim (Var/Yok)

Matematikte 4 işlemle ilgili oyun tabanlı öğrenme ortamlarının oyunlarda verilen geri bildirime göre dağılımları Şekil 2' de sunulmaktadır.

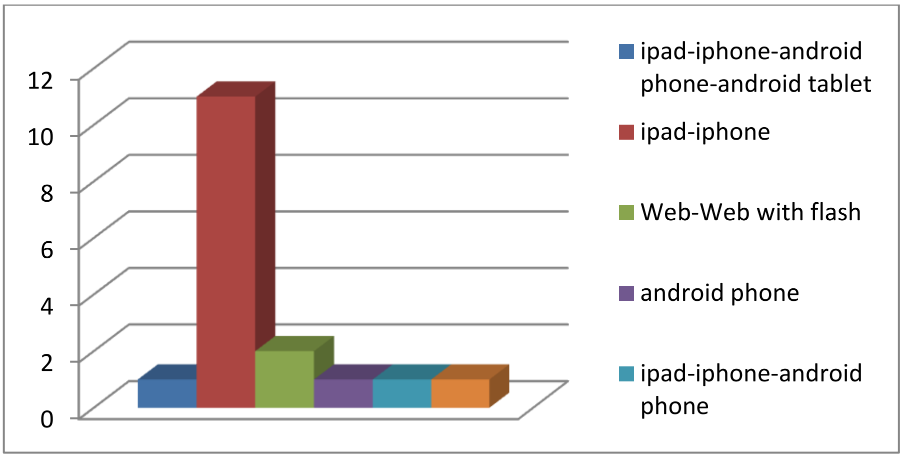


Şekil 2. Oyun tabanlı öğrenme ortamlarının geri bildirim verme oranları

Öğrenme sürecini destekleme, yanlış öğrenmelerinin önüne geçme, yapılan dikkatsizliklerin farkına varma, hiçbir fikir yürütülemeyen soruları çözebilme mantığı kazanma, adım adım kendini değerlendirme ve soruları çözebilme yeterliği/yetersizliğine dair bilgi edinme açısından oldukça destekleyici bir unsurdur. Bu nedenle de öğrenme ortamlarında geribildirimin önemi yadsınamaz. Bu nedenle geribildirimin nasıl verildiği de önemlidir. Her sorudan sonra mı veriliyor, bölüm sonunda ayrıntılı olarak mı veriliyor, işaretlerle, onay ya da uyarı sesleriyle ya da sözel olarak mı gösterildiğinin etkisi kullanıcıdan kullanıcıya değişebilir. Matematikte 4 işlemle ilgili oyun tabanlı öğrenme ortamlarında geribildirim verilme oranı Şekil 2'ye (n=15, %88,23) göre oldukça yüksek görünmektedir. Bu oyunlar ayrıntılı olarak incelendiğinde büyük bir kısmında her sorudan sonra onay ve uyarı sesleriyle birlikte ekranda görünen tik/çarpı gibi işaretlerle birlikte geribildirimin verilmesi dikkat çekmektedir. Bazı oyunlarda yanlış cevap verilen her sorudan sonra sorunun çözüm şekli ekranda hemen görünmektedir. Bazı oyunlarda ise bölüm sonunda toplu bir şekilde doğru ve yanlış verilen cevaplar, doğru cevapla birlikte görüntülenmektedir.

3. Platform (Web, İpad, İphone, Android Telefon, Android Tablet)

Günümüz öğrenme ortamlarında tercih ettiğimiz teknolojiler giderek daha hızlı değişmekte ve çeşitlenmektedir. Dolayısıyla bu ortamlara uygun üretilen oyunlarda kullanıcı potansiyelini artırabilmek açısından farklı teknolojileri destekleyecek şekilde tasarlanmaktadır. Matematikte 4 işlemle ilgili tasarlanan oyun tabanlı öğrenme ortamlarına ilişkin oyunların kullanılabileceği teknolojiler Şekil 3'te görülmektedir.

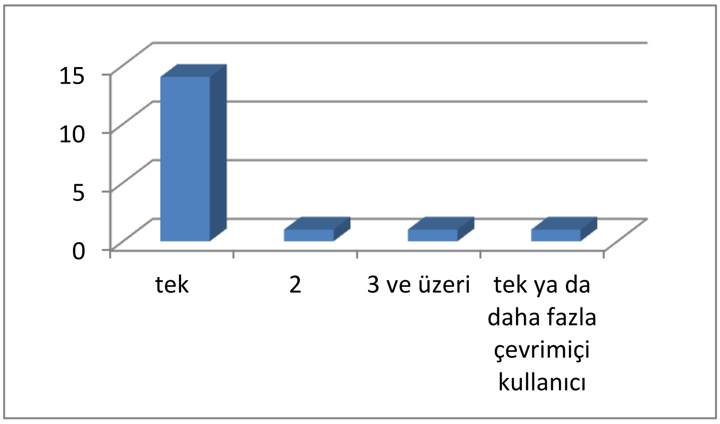


Şekil 3. Oyun tabanlı öğrenme ortamlarında tercih edilen teknolojiler

Şekil 3 dikkatle incelendiğinde matematikte 4 işlemle ilgili oyun tabanlı öğrenme ortamlarının en çok ipad-iphone (n=11) gibi teknolojiler tarafından desteklendiği görülmektedir. Diğer teknolojilerin ise tercih edilme oranlarının genel olarak eşit olduğu dikkat çekmektedir. İpad-iphone teknolojilerinin birlikte kullanılma oranları yüksek iken sadece ipad ve androidphone tarafından desteklenen 1 oyunun yer alması oyunların tek bir teknoloji yerine birden fazla teknolojiye yönelik tasarlanması şekilde yorumlanırken ayrıca Apple firmasının da bu konuda daha aktif çalıştığı söylenebilir.

4. Kullanıcı Sayısı (Tek, İki, 3 ve üzeri, Bilgisayara karşı)

Bir oyundaki kullanıcı sayısı bireysel öğrenme ya da işbirlikli öğrenme şeklinde yorumlanabilir. Tek kullanıcının oynayabildiği oyunlar daha çok bireysel öğrenmeye hizmet ederken, birden fazla kullanıcının yer aldığı oyunlar işbirlikli öğrenmeyi ve kullanıcının sosyal buradalık hissini yaşamasını teşvik edebilir, öğrenmeyi olumlu şekilde destekleyebilir. Ancak Şekil 4'te görüldüğü gibi matematikte 4 işlemle ilgili oyun tabanlı öğrenme ortamları incelendiğinde oyunlarda kullanıcı sayısının genellikle tek kullanıcıyı içerdiği görülmektedir.

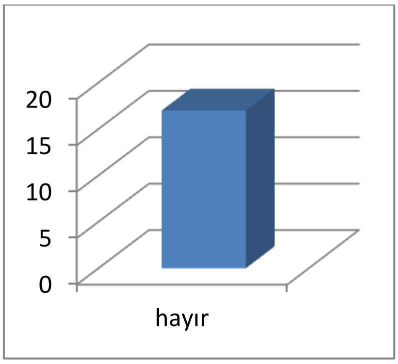


Şekil 4. Oyun tabanlı öğrenme ortamlarındaki kullanıcı sayısı

Oyunlar incelendiğinde genellikle tek kullanıcının oynayabildiği oyunlar çevrimdışı da oynanabilirken, iki, üç ve üzeri kullanıcı içeren oyunlarda çevrimiçi olmak da önem kazanmaktadır. Bu aslında sürekli internete bağlılığı gerektiren bir durum olması nedeniyle de tercih edilme durumunu azaltabilecek bir unsur olarak düşünüldüğü içinde bu tür oyunların genellikle tek kullanıcıyı esas alarak tasarlandığı düşünülebilir.

5. Düzenleme / Ekleme Yapılabilme/ Geliştirme

Oyun tabanlı öğrenme ortamlarında düzenleme/ekleme yapabilme/geliştirme gibi özellikler oldukça önem kazanmaktadır. Kullanıcı oyunda hoşuna gitmeyen unsurları kaldırabilir, kendi düzeyine uygun şekilde oyunu tasarlayabilir, oyunda önem verdiği özellikleri ortama ekleyebilir ve dolayısıyla kendisi için daha çekici bir öğrenme ortamı hazırlayabilir. Bu durumda öğrenenin motivasyonu ve öğrenmeyi olumlu şekilde etkileyecek anahtar bir özellik olarak düşünülebilir.

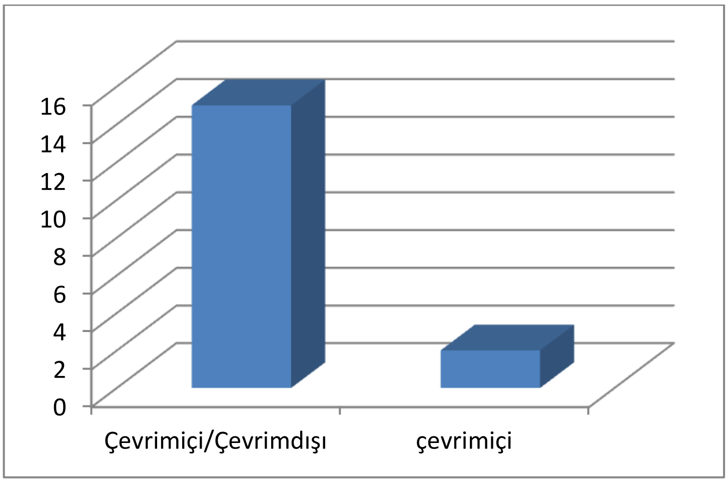


Şekil 5. Oyun tabanlı öğrenme ortamlarında düzenleme/ekleme yapabilme/geliştirme

Ancak Şekil 5'te görüldüğü gibi matematikte 4 işlemle ilgili oyun tabanlı öğrenme ortamları incelendiğinde bu özelliğe hiç yer verilmediği yani düzenleme/ekleme yapma/geliştirme özelliğine hiç yer verilmediği dikkat çekmektedir. Bu nedenle oyunlar tasarlanırken bu unsurda dikkate alınarak geliştirilebilir. Böylece kullanıcılara da bireysel öğrenme ortamlarını oluşturma fırsatı sağlanmış olabilir. Ayrıca bu özellik günümüzde de önem verilmeye başlanmış olan programlama mantığını kullanıcılara kazandırabilir.

6. Çevrimiçi / Çevrimdışı

Bir oyun tabanlı öğrenme ortamının kullanılması için internetin gerekli olması durumu interneti olmayan öğrencilerin bu fırsattan yararlanmasını engelleyebilir ya da bu ortamı kullanırken sürekli internete bağlı kalma durumunu şart kılabilir. Böyle bir imkana sahip olamayan kullanıcılar için bir olumsuzluk oluşturmamak ve bu tür öğrenme ortamlarını kullanmak isteyenlere fırsat eşitliği sağlayabilmek adına bu tür ortamlar tasarlanırken bu durumunda dikkate alınması oldukça önemlidir. Şekil 6'ya bakıldığında matematikte 4 işlemle ilgili oyun tabanlı öğrenme ortamları açısından bu durumun dikkate alındığını söylemek mümkündür. Oyunların neredeyse tamamı (n=15) çevrimiçi ya da ilgili platforma yüklendikten sonra da çevrimdışı olarak kullanılmasını desteklemektedir.

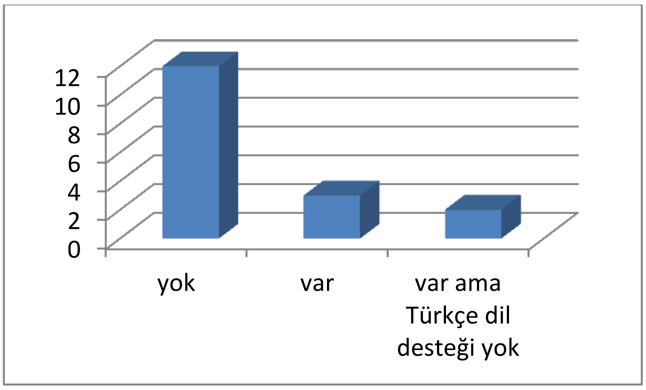


Şekil 6. Oyun tabanlı öğrenme ortamlarını çevrimiçi ya da çevrimdışı kullanabilme

Oyunların çevrimdışı olarak kullanılma durumu da oyunların kullanılma olasılığını artıracak bir ölçüt olarak düşünülebilir. Dolayısıyla oyunlar tasarlanırken bu özellik de dikkate alınmalıdır.

7. Türkçe Dil Desteği (Var / Yok)

Bir oyunda dil desteğinin sunulması oyunun hitap edeceği kitlenin oranını da belirleyecek bir unsurdur. Ne kadar çok dil açısından destek sunuluyorsa bu o oyunun o kadar fazla kullanıcı tarafından doğru algılanıp kullanılması, oyunun başarıya ulaşması ve oyunda ele alınan konu açısından da doğru sonuçlara ulaşılması olarak düşünülebilir. Hazırlanan oyunlarda Türkçe dil desteğine yer vermek başka dil bilmeyen ülkemiz vatandaşları açısından oldukça önemli bir unsurdur. Bazı oyunlar ekran tasarımıyla dil desteği gerektirmeyecek kadar açık olsa da bazı oyunlar oyundaki her şeyi anlamayı gerekli kılmaktadır. Bu da dil desteğinin ne kadar önemli olduğunun bir işareti olarak düşünülebilir. Matematikte 4 işlemle ilgili Türkçe dil desteği Şekil 7 dikkate alınarak incelendiğinde ise oyunların büyük kısmında (n=14) Türkçe dil desteğinin yer almadığı, nicelik olarak çok az bir kısmında (n=2) ise dil desteği olsa da Türkçe dil desteğinin bulunmadığı görülmektedir.

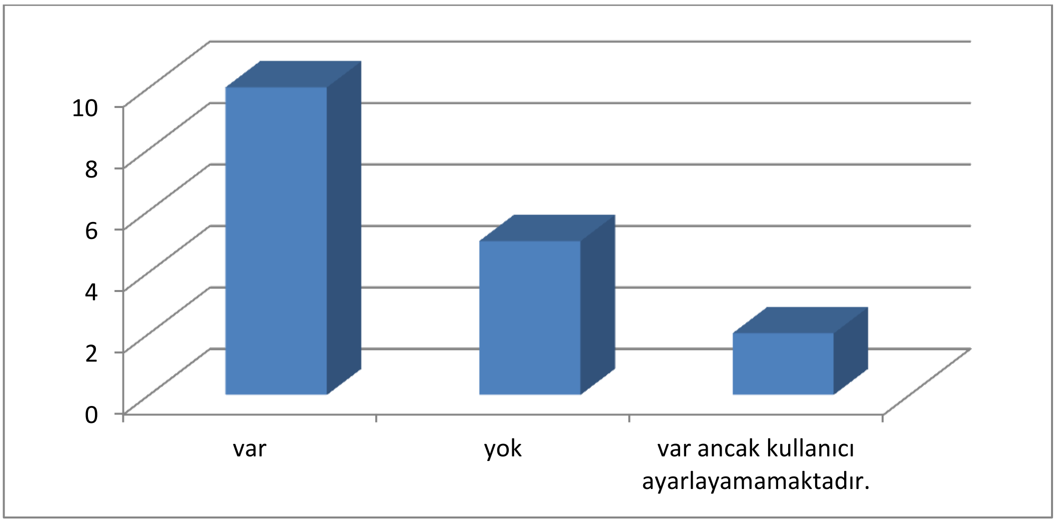


Şekil 7. Oyun tabanlı öğrenme ortamlarında Türkçe dil desteği

Ayrıca dil desteği öğrenenin öğrenme ortamını bireyselleştirmeye de önemli bir katkı sağlamaktadır. Bu durumda öğrenmeye motivasyon, anlamlandırma, verimlilik, etki, hız ve başarı gibi unsurlar açısından olumlu bir destek sağlayabilmektedir.

8. Zorluk Düzeyi (Var / Yok)

Zorluk düzeyi kullanıcının oyunun başlangıç seviyesinden başlayarak adım adım yeterlik ve başarma durumuna göre bir sonraki aşamaya geçmesineolanak sağlar. Kullanıcı bilgi seviyesine göre istediği aşamadan başlayabilir. Kullanıcıyı sınırlamamak açısından önemli bir özellik olduğu gibi aşamalar arasındaki ilerleyişin başarılı olma oranı kullanıcının oyunda işlenen konuya ilişkin bilgi düzeyiyle ilgili farkındalığını da artırabilir. Dolayısıyla kullanıcı eksiklerinin ve başarılı yönlerinin bilincinde bireysel gelişimini de izleyebilir. Ayrıca kullanıcı zorluk düzeyini artırdığında ve başarılı olduğunda başarmaya motivasyonu artacak ya da başarısız olduğunu hissettiğinde eksiklerini tamamlamaya dönebilecektir.

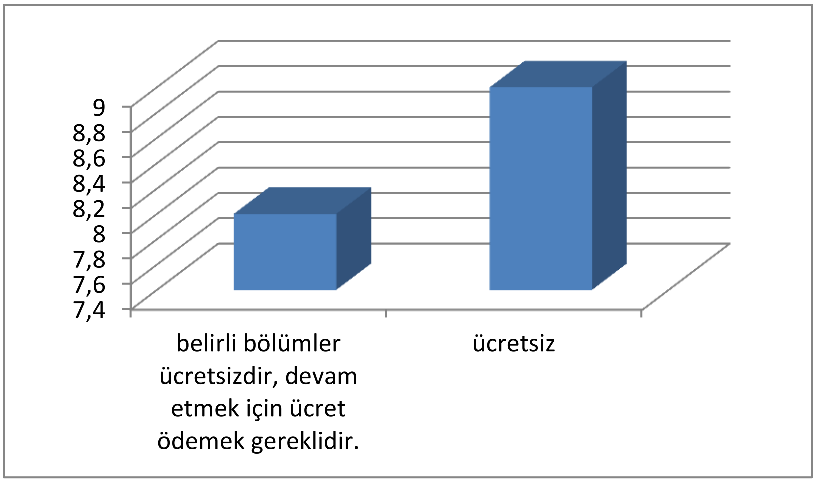


Şekil 8. Oyun tabanlı öğrenme ortamlarında zorluk düzeyi

Şekil 8'de görüldüğü gibi matematikte 4 işlemle ilgili oyun tabanlı öğrenme ortamlarında zorluk düzeyinin bulunması oranının (n=10) daha yüksek olduğu görülmektedir. Kademeli öğrenmeye oldukça yakın bir ders olan matematik açısından da oyunlarda zorluk düzeyinin yer alması oldukça önemli bir durumdur. Çünkü zorluk düzeyi, kullanıcının bilgi düzeyini sınaması, yeterliği ve eksiklerinin farkına varması, bilgi düzeyini ilerletme isteğini olumlu yönde teşvik etmesi ve bireysel gelişimini gözlemlemesi açısından önemli bir özelliktir. Oyunların büyük kısmında var olduğu görülse de bu tür öğrenme ortamlarında yer verilmesi gereken önemli bir özelliktir. Bazı oyunlarda (n=2) da zorluk düzeyinin kullanıcı tarafından ayarlanmadığı belirli seviyeyi geçtikten sonra zorluk düzeyinin oyun tarafından artırıldığı da görülmektedir. Ancak bu durum kullanıcının isteği dışında gerçekleştiği için öğrenmeye karşı motivasyonu olumsuz etkileyebilir. Dolayısıyla bu durum kullanıcının seçimine bırakılmalıdır.

9. Ücretli/Ücretsiz

Oyunların ücretsiz olması kullanılma oranlarını artıran bir durum olarak düşünülebilir. Kullanıcı oynamak istediği oyuna başlamadan önce ya da başladıktan sonra karşısına çıkan herhangi bir ücret ödeme engelinden sonra oyunu oynamaktan vazgeçebilir. Dolayısıyla ücretli olup olmama durumu oyunları tercih etmek açısından önemli bir durumdur. Bu rapor kapsamında da matematikte 4 işlemle ilgili oyun tabanlı öğrenme ortamlarıyla ilgilenenlerin kolaylıkla erişebilmesi açısından ücretsiz oyunlar (n=9) tercih edilmiştir. Ancak her ne kadar ücretsiz olanlar tercih edilse de oyunun belirli bir aşamasına geçmek için ücret ödeme engeliyle karşılaşılan oyunların sayısı (n=8) da yüksektir.

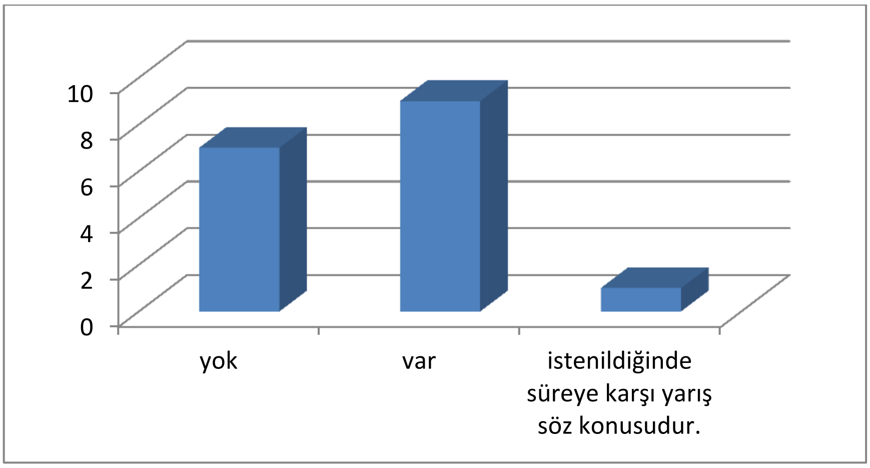


Şekil 9. Oyun tabanlı öğrenme ortamlarının ücretli/ücretsiz olma durumu

Şekil 9'da da görüleceği üzere tamamı ücretsiz oyunlar kadar kullanıcıya deneme imkanı veren, oyunu beğendiyse devam etmek için ücret ödemeyi gerekli kılan oyunlarda mevcuttur.Oyunun ücretli olması yerine kullanıcıya deneme şansı veren bu tür oyunlarda oyunun tercih edilme oranına katkı sağlayabilir.

10. Süre (Var / Yok)

Oyunlardaki süre kriteri genel oyun mantığı çerçevesinde değerlendirilebilir. Genel olarak oyunlarda yer alan bu ölçütün kullanıcılar üzerindeki etkisi de değişim gösterebilir. Bazı kullanıcılar için belirli bir sürede ne kadar soruyu doğru yanıtladığı ve ne kadar çok puan aldığı bir başarı ölçütü olarak kullanıcıyı motive ederken, bazı kullanıcılar bu durumdan sıkılabilir ve oyunu oynamayı bırakabilir. Matematikte 4 işlemle ilgili oyun tabanlı öğrenme ortamlarında sürenin yer aldığı (n=9) oyunlar kadar yer almadığı (n=7) oyunlarda bulunmaktadır. Aslında incelenen oyunlar genel olarak matematikte 4 işlem bilgisini değerlendirmeye yönelik oyunlar olması nedeniyle kullanıcının süreye karşı yarışı oldukça yerinde olabilir. Ancak düşük yaş gruplarına da hitap eden bu tür oyunlarda sürenin genellikle olmaması dikkat çekici bir unsurdur. Burada önemli olan kullanıcının motivasyonunu düşürmeden sadece kendisini değerlendirmek olabilir.



Şekil 10. Oyun tabanlı öğrenme ortamlarında süre

Aslında süre ölçütü kullanıcının istediği an devreye sokabileceği bir ölçüt de olabilir. Şekil 10'a göre sadece bir oyunda yer alan bu özellik kullanıcının isteğine bırakılmıştır. Dolayısıyla kullanıcı bir bilgi eksikliği varsa bunu tamamladıktan sonra kendisini değerlendirmek açısından süreye karşı yarışabilir. Bu da kullanıcının başarmaya karşı motivasyonunu olumlu yönde etkileyebilir.

Sonuç ve Öneriler

Matematikte 4 işlemle ilgili oyun tabanlı öğrenme ortamları incelendiğinde bu tür ortamlar için dikkat çeken bazı önemli durumların oyunlar tasarlanırken dikkate alınması oldukça önemli görünmektedir. Bu durumlar aşağıda maddeler halinde listelenecektir:

- Matematikte 4 işlemle ilgili oyunlar ele aldığı yaş aralıklarına göre incelendiğinde 6-7 yaşından başlayıp 14-15 yaşına kadar bir aralığı temsil etmektedir. Dolayısıyla hem ilkokul hem de ortaokul düzeyini ele alan bu oyunlarda oldukça basit düzeyde soruların ekrana geldiği görülmektedir. Dolayısıyla ortaokul düzeyinde yer alan bir öğrenci bu oyundan çabucak sıkılabilir ve oyunu bırakabilir. Bir oyunda özellikle matematik gibi bir disiplin açısından bu kadar fazla yaş aralığının dikkate alınmaması oyunun tercih edilme oranını azaltabilir. Bu nedenle de dikkate alınması gereken önemli bir sorun olduğu düşünülmektedir.
- Matematikte 4 işlemle ilgili lise düzeyinde sadece bir oyunun yer alması, tasarım ve oyun mantığı açısından basit işlemleri bile yaş düzeyine uygun şekilde oyuna dahil edebilmesi lise düzeyinde de bu konuyla ilgili oyunların daha fazla olması gerektiğini düşündürmektedir.
- Bazı oyunların hesap makinesi şeklinde tasarlanması, oyuna dair hiçbir kurgu ve unsurun bulunmaması da kullanıcının oyunu terk etme ihtimalini artıracak bir durum olabilir.
- Oyunların sadece tasarlandığı şekilde kullanılabiliyor olması kullanıcının oyun üzerinde istediği ya da istemediği özellikleri ekleyip/çıkartabilmesi gibi unsurların bulunmaması, yani oyun üzerinde herhangi bir ekleme/değiştirme yapamaması da kullanıcının oyunu terk etme ihtimalini artırabilecek bir durum olabilir. Dolayısıyla kullanıcıya esneklik tanıyacak, öğrenme-eğlenme ortamını kendisine uygun olarak bireyselleştirecek şekilde tasarlanması oyunlarında tercih edilme oranını artıracak bir özellik olarak düşünülebilir.
- İncelenen oyunların genellikle iphone-ipad oyunları olması dikkat çekmektedir. Oyunların birden fazla platformu destekleyecek şekilde tasarlanması daha fazla kullanıcıya ulaşması açısından da önemli bir ölçüttür.
- Oyunlarda geribildirim verilmesi, kullanıcının eksik ve iyi yönlerini görmesi, öğrenme sürecini desteklemesi açısından önemli bir ölçüt olarak düşünülebilir. Yalnız geribildirimin verilme zamanının ve şeklinin de bir o kadar önemli olduğu düşünülmektedir. Geribildirimin yalnız sesli ve simgesel verilmesi yerine sorunun hangi kısmında yanlış yaptığını görmesi açısından yanlışının hemen ardından işlemsel olarak da karşısına gelmesi önemli olabilir. Oyunun bölüm sonunda tüm geribildirimlerin toplu şekilde verilmesinin etkili olmadığı düşünülmektedir.
- Bir oyunda kullanıcı sayısı işbirlikli öğrenme açısından önemli bir ölçüt olarak düşünülebilir. Ancak kullanıcı sayısının artması durumunda kullanıcının da çevrimiçi olması gerekmektedir. Dolayısıyla bu kullanıcıyı sınırlandıran bir durum olacağından oyuna başlamadan oyunu tek ya da birden fazla kullanıcıyla oynamayı isteyip istemediği kullanıcıya yöneltilmeli ve kullanıcı isteği doğrultusunda oyuna devam edebilmelidir.
- Oyunları geliştirenler genellikle ticari amaç doğrultusunda bu işi yaptıklarından tasarladıkları oyunları belirli bir ücret karşılığında kullanıcılara sunmaktadırlar. Ancak oyuna dair hiçbir fikri olamayan kullanıcı

ücretli olması nedeniyle oyunu denemeden fikir yürütebilir ve kullanmaktan vazgeçebilir. Dolayısıyla bu oyunların tercih edilme ihtimalini azaltan bir etken olabileceğinden kullanıcıya oyunun belirli bölümlerini deneme imkanı verilmeli, ilerleyen aşamalara geçmek için ücret ödenmesi gerekliliği doğabilir.

- Oyunlar tasarlanırken dikkat edilmesi gereken önemli ölçütlerden birisi de çevrimiçi/çevrimdışı oyunu oynayabilme durumudur. Kullanıcının oyunu çevrimdışı oynayabilmesi, internete bağlanma zorunluluğunu ortadan kaldıracağı için oldukça önemlidir. Oyunlar tasarlanırken bu ölçütün dikkate alınması da oldukça önemlidir.
- Oyunlarda dil desteği var olsa bile Türkçe dil desteğinin bulunmaması oldukça dikkat çekicidir. Sadece belirli bir kesime hitap eden oyunların tercih edilme oranı da azalacaktır. Matematikte 4 işlemle ilgili bazı oyunlarda dil desteği gerekmese de bazı oyunları anlamak ve ilerleyebilmek adına dil desteği önem kazanmaktadır. Dolayısıyla oyunlar tasarlanırken dikkat edilmesi gereken bir ölçüt olarak karşımıza çıkmaktadır.
- Oyunların çoğunda zorluk düzeyi ya da süreye karşı yarışın yer alması önemli özelliklerdir. Kullanıcının öğrenme-eğlenme ortamını bireyselleştirebilmesi, gerek oyunun zorluk düzeyini ayarlamak gerekse süreye karşı yarışmak istediğinde bu özellikleri oyuna dahil edebilmesi kullanıcının motivasyonu ve oyundaki etkililiğini ortaya çıkartabilmesi açısından önemli ölçütlerdir.

Kaynakça

Akıncı, A.,Sırakaya, M., Yıldırım, D. ve Tüzün, H. (2010, Eylül). Eğitsel bilgisayar oyunlarının eğitim ortamlarına entegrasyonu. 4. Uluslararası Bilgisayar ve Öğretim Teknolojileri Sempozyumu Bildiriler Kitabı (ss. 108-112). Konya, Türkiye.

Baek, Y.,&Touati, A. (2017). Exploring how individualtraitsinfluenceenjoyment in a mobile learninggame. Computers in Human Behavior, 69, 347-357

Papastergiou, M. (2009). Digitalgame-basedlearning in high-schoolcomputerscienceeducation: Impact on educationaleffectivenessandstudentmotivation. ComputersandEducation, 52(1), 1–12.

Polat, S. (2013). Origami ile Matematik Öğretimi, Mustafa Kemal Üniversitesi Sosyal Bilimler Enstitüsü Dergisi, 10(21), 21, 15-27.

Randel, J. M. & Morris, B. A. (1992). TheEffectiveness of Games forEducationalPurposes: A Review of RecentResearch.,Simulation& Gaming, 23 (3), 261-275.

Sung, H.Y, Hwang,G.J., Lin, C.J., Hong, T.W.(2017).ExperiencingtheAnalects of Confucius: An experientialgame-basedlearningapproachtopromotingstudents' motivationandconception of learning. ComputersandEducation, 110, 143-153.

Zhu, D., (2012), Using Games toImproveStudents' CommunicativeAbility, Journal of Language TeachingandResearch, July, Vol.3, No.4, http://ojs.academypublisher.com/index.php/jltr/article/view/jltr0304801805/5011, 801-805.

THE EFFECT OF TEACHING THE ATOMIC STRUCTURE OF MATTERS BY CREATIVE DRAMAS TO THE ACHIEVEMENT OF STUDENT AT THE 6 th CLASS SCIENCE AND TECNOLOGHY LESSON IN PRIMARY SCHOOL

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Abstract: The purpose of this research is to examine the effect of teaching creative drama method on student achievement in primary science course. For this purpose, teaching with creative drama method was compared with traditional method.The Research was conducted with 6th grade student in the fall semester of the academic year 2008-2009. In the study, pre-test and post-test control semi-experimental design was used. As a result of the research, a statistically significant difference was found in favor of "Particle Structure of Matter" unit by Experimental group learning through creative drama method. The results of the research show that the use of creative drama method in the teaching of granular structure unit of madden increases student achievement.

Keywords**:** Creative drama, science education, atomic structure of matter

İLKÖĞRETİM 6. SINIF FEN VE TEKNOLOJİ DERSİNDE MADDENİN TANECİKLİ YAPISI ÜNİTESİNİN YARATICI DRAMA İLE ÖĞRETİMİNİN ÖĞRENCİLERİN BAŞARISINA ETKİSİ

Özet: Bu araştırmanın amacı, ilköğretim fen ve teknoloji dersinde yaratıcı drama yöntemi ile yapılan öğretimin öğrenci başarısı üzerine etkisini incelemektir.Bu amaçla, yaratıcı drama yöntemi ile yapılan öğretimin, geleneksel yöntemle karşılaştırılması yapılmıştır.Araştırma 2008-2009 öğretim yılı güz döneminde 6.sınıf öğrencileri ile yapılmıştır. Araştırmada öntest-sontest kontrol gruplu yarı deneysel desen kullanılmıştır. Araştırma sonucunda "Maddenin Tanecikli Yapısı" ünitesini yaratıcı drama yöntemi ile öğrenen deney grubu lehine istatistiksel olarak anlamlı bir fark bulunmuştur. Araştırma sonuçları maddenin tanecikli yapısı ünitesinin öğretiminde yaratıcı drama yöntemi kullanımının öğrenci başarısını artırdığını göstermektedir.

Anahtar Sözcükler: Yaratıcı drama, fen bilimleri eğitimi, maddenin tanecikli yapısı

Giriş

Fen eğitiminin amaçları ile fennin doğası ve fen ve teknoloji okuryazarlığı birbirlerini tamamlayan bir döngü içerisindedir. Fen bilimleri eğitiminin temel amaçlarından biri öğrencileri bilimsel olarak okuryazar düzeye getirmektir. Bilimsel okuryazarlık; fen bilimlerinin doğasını bilmek, bilginin nasıl elde edildiğini anlamak, fen bilimlerindeki bilgilerin bilinen gerçeklere bağlı olduğunu ve yeni kanıtlar topladıkça değişebileceğini kabul edebilmek, fen bilimlerindeki temel kavramları, teori ve hipotezleri kavramak, bilimsel kanıt ile kişisel görüş arasındaki farkı algılamak olarak tanımlanmaktadır. Bilimsel okuryazar bireylerden oluşan toplumlar hem yeniliklere kolayca uyum sağlar, hem de kendileri yeniliklere önderlik edebilirler (Soylu 2004). Fen ve teknoloji okuryazarı bireyler, bilgiye ulaşmada ve kullanmada, problem çözmede, fen ve teknoloji ile ilgili sorunlar hakkında olası riskleri, yararları ve eldeki seçenekleri dikkate alarak karar vermede ve yeni bilgi üretmede daha etkin bireylerdir.

Fenciler, fen ve teknoloji ile ilgili konular hakkında karar vermede toplumu bilinçlendirir ve destekler. Bu, demokratik bir toplumda fen okuryazarlığına ulaşmak için çok önemli bir gerekçedir. Fen, teknoloji, toplum ve çevre arasındaki etkileşimleri anlamak için bilimsel bilgi gereklidir fakat bu tek başına yeterli değildir. Bu etkileşimlerin anlaşılması için fenne özgü değerler yanında, söz konusu topluma ve çevreye özgü değerlerin de hesaba katılması gereklidir (Tunç 2008).

Günümüz insanının, hayatın her safhasını etkileyen teknolojik gelişmeleri algılayıp yorumlayabilmesi için temel bir fen ve teknoloji genel kültürü eğitiminden geçirilmesinin gerekliliği açıkça görülmektedir. Böylece, bireyler bilimin değerini anlar, ona karşı pozitif bir tutum geliştirir, teknolojinin toplum hayatı üzerindeki etkisini görür ve en önemlisi fen, teknoloji, toplum ve çevre arasındaki ilişkiyi ve birbirlerini nasıl etkilediklerini merakla izler (Tunç 2008).

Fen öğretiminde, çocuğun merak duygusunu uyandırarak işe başlanmalıdır. Burada önemli olan öğrencinin soru sormasıdır. Çocuk sorularına cevap bulabilmek için gözlemlerde bulunur, araştırma yapar ve de vardığı sonuçları tartışır. Bu bahsedilen süreçleri izleyen çocuklar, deneyerek, görerek, dokunarak, yaşantısı ile ilişki kurarak hayatının ileriki dönemlerine katkıda bulunur. Eğitimde kullanılan dramada çocukların aktif olarak tecrübeyle yoğrulmuş olmasına olanak sağlayacaktır (Karadağ ve Çalışkan 2005).

Ülkemizdeki ilköğretim öğrencilerinin derslerdeki başarı düzeyleri incelendiğinde Fen ve Teknoloji dersinden çok zorlandıkları görülmektedir. Fen okuryazarlığının özellikleri göz önünde bulundurulduğunda mantıksal, matematiksel ve doğa zekaya sahip bireylerin Fen ve Teknoloji derslerindeki başarılarının yüksek olduğu görülmektedir. Peki, Fen ve Teknoloji dersi sadece mantıksal, matematiksel ve doğa zeka düzeyleri yüksek olan öğrencilerin başarılı olduğu diğer zeka türlerine sahip öğrencilerin ise başarısız olduğu bir ders mi olmak zorunda? İşte bu yüzden Fen ve Teknoloji dersi işlenirken çeşitli öğrenme yöntem ve tekniklerin işe koşulması gerekmektedir.

Yüzyıllardır düşünürler tarafından savunulduğu görülen yaşantı yoluyla eğitim, oyunla eğitim, eğitimde duyuların ve eğlencenin önemi gibi yaklaşımlara 21. yüzyılın eğitim sistemleri artık duyarsız kalmamaktadır. Yapılan tüm araştırmalar bu savunuların haklılığını ortaya koyar niteliktedir. Çağdaş dünyanın ihtiyacına uygun olarak kendine güvenen, sorun çözme ve karar verme becerileri gelişmiş, yaratıcı düşünme becerisine sahip bireylerin yetiştirilmesi yeni yöntem ve yaklaşımları gerektirir, bu amaçlara uygun olan yaklaşımlardan bir tanesi de yaratıcı dramadır (Bozdoğan 2003).

Dramanın eğitimde kullanılmasıyla oyun okulun içine çekilir. Sınıfta oynanan oyunlar çocukları kaynaştırır. Her çocuk kendini sınıfın yani grubun bir parçası hisseder. Başkalarından öğrenmeye istekli hale gelir. Oyun içinde kendini keşfeder ve kendini ifade fırsatı bulur (Morgül 2003).

Fen öğretiminde, çocuğun merak duygusunu uyandırarak işe başlanmalıdır. Burada önemli olan öğrencinin soru sormasıdır. Çocuk sorularına cevap bulabilmek için gözlemlerde bulunur, araştırma yapar ve de vardığı sonuçları tartışır. Bu bahsedilen süreçleri izleyen çocuklar, deneyerek, görerek, dokunarak, yaşantısı ile ilişki kurarak hayatının ileriki dönemlerine katkıda bulunur. Eğitimde kullanılan dramada çocukların aktif olarak tecrübeyle yoğrulmuş olmasına olanak sağlayacaktır (Karadağ ve Çalışkan 2005). Bu bahsedilen süreçleri izleyen çocuklar, deneyerek, görerek, dokunarak, yaşantısı ile ilişki kurarak hayatının ileriki dönemlerine katkıda bulunur. Eğitimde kullanılan dramada çocukların aktif olarak tecrübeyle yoğrulmuş olmasına olanak sağlayacaktır (Karadağ ve Çalışkan 2005).

Temelde drama uygulanarak yapılan fen etkinlikleri ile çocuğun aşağıda belirtilen bilişsel becerilerinin geliştirilmesine çalışır:

1. Bir sorunu algılama ve tanımlama.
2. Bir soruna ya da çözümüne ilişkin bilgileri edinme.
3. Edindiği bilgileri, belleğinde sistemli bir biçimde depolama, gerektiğinde kullanma; edindiği bilgiyi koruma ve yenileme, gereksiz bilgileri yitirme. Aşırı bilgi yüklememe.
4. Edindiği bilgilerin günlük yaşamda kullanıldığında çevreye uyumu kolaylaştırdığını anlama, depoladığı bilgileri akıcı bir yaklaşımla yeniden kullanma, bilgilerin ışığında bazı sonuçlara ulaşma. Sorunlara uyumsuz ya da yetersiz çözümler bulunduğunda geriye dönüp yeniden başlama ve düzeltme. Bu düzeltmelerle ilgili gerekli kavram ve davranış biçimlerini edinme.
5. Karşılaştığı sorunlara yeni seçenekler ve çözümlerle yaklaşma. Sonuçta yeni sorular üretme.
6. Sorunların çözümünün belirsiz ya da zor olduğu durumlarda sorundan kaçma ya da üzüntü gibi tepkiler göstermeyip, gerçekçi çözümler arama. Özellikle belirsiz durumunda, karşılaştığı olayları, üstesinden rahatça gelinebilecek bir duruma getirmek için yapılandırma ve sınıflandırma.
7. Düşüncelerini belirtme ve dile getirme. Bilgi ve düşüncelerini paylaşma. Bu paylaşma süresince yenilgiye uğradığında bu yenilgiyi nasıl gidereceğinin yollarını bulma.
8. Kendini eleştirme, olumlu ve olumsuz değerlendirme yapabilme. Doğru olduğundan kuşku duymadığı bilgileri sonuna kadar savunabilme; kendi yanlışlarını kabul etme, başkalarının bilgisine saygı duyma.
9. Belirli hedef ve amaçlara yönelme. Bu amaçlar doğrultusunda davranışlarını düzeltme.
10. Kendi kendini denetleme (Gönen ve Dalkılıç 2000).

Dramatik etkinlik ortamında çocukların bilmeye ihtiyaç duydukları şeylerin cevabını bulabilmeleri sağlanmalıdır. Dramatik oyun ancak "nasıl?", "niçin?", "nerede?", "ne zaman?", "kim?", "ne?", "neden?" kavramlarının üstünde durularak oynandığında çocukların yaratıcı düşüncelerine yeni boyutlar kazandırabilir (Gönen ve Dalkılıç 2000). Öğretmenin tek yönlü monologundan çok; öğrencinin çok boyutlu eğitimi, derslerde aktiflik, bireyler arası iletişim, yaratıcılık ve kişilik gelişimi gibi pek çok boyut doğal bir öğrenme ortamında gerçekleşir (Adıgüzel 2002).

Pantidos ve ark. (2001), Bertiz (2005), Başkan (2006), Yılmaz (2006) ve Yalım (2003) yaptıkları araştırmalar sonucunda yaratıcı drama yönteminin uygulandığı deney grubu ile geleneksel yöntemin uygulandığı kontrol grubunda Fen Bilgisi dersindeki başarı düzeylerini karşılaştırdıklarında deney grubu lehine anlamlı bir fark bulmuşlardır.

Yöntem

Model

Bu çalışma, ilköğretim 6. sınıf Fen ve Teknoloji dersi programında yer alan "Maddenin Tanecikli Yapısı" ünitesindeki konuların öğretiminde, yaratıcı drama ile öğretim ve geleneksel öğretimin öğrencilerin başarılarına etkisinin karşılaştırılmasını amaçlayan, deneysel araştırma yöntemi ile yapılmıştır. Çalışmada "Denk kontrol gruplu ön test – son test deseni" kullanılmıştır.

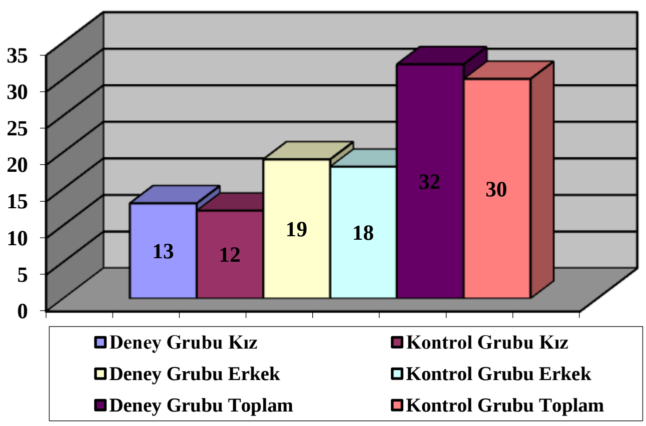
Çalışmanın Örneklemi

Bu çalışma 2008–2009 öğretim yılı birinci yarıyıl döneminde, ilköğretim 6. sınıf Fen ve Teknoloji dersi programında yer alan "Maddenin Tanecikli Yapısı" ünitesindeki konuların öğretiminde, yaratıcı drama ile öğretimin öğrenci başarısına etkisinin araştırıldığı Karaman / Merkez Vali Ali Akan İlköğretim Okulunda gerçekleştirilmiştir. Karaman / Merkez Vali Ali Akan İlköğretim Okulunda bulunan 6. sınıflar arasından birbirlerine denk rastgele belirlenmiş iki sınıf deney ve kontrol grubu olarak ayrılmış olup 62 öğrenciden oluşmaktadır. Örnekleme ilişkin veriler Tablo 1 ve Şekil 1'de gösterilmiştir.

Tablo1. Merkez Vali Ali Akan ilköğretim okuluna ait örnekleme ilişkin veriler

Gruplar		Kız	Erkek	Toplam
Deney Grubu	Öğrenci Sayısı	13	19	32
	Grup içinde %	40.6	59.4	100
	Örneklem içinde %	21	30.6	51.6
Kontrol Grubu	Öğrenci Sayısı	12	18	30
	Grup içinde %	40	60	100.0
	Örneklem içinde %	19.4	29.0	48.4
Toplam	Öğrenci Sayısı	25	37	62
	Örneklem içine %	40.3	59.7	100.0

Bu öğrencilerin gruplara göre dağılımı görsel olarak da Şekil.1'de verilmiştir.



Şekil 1. Merkez Vali Ali Akan ilköğretim okuluna ait örnekleme ilişkin veriler

Veri Toplama Araçları

Fen başarı testi, 53 sorudan oluşmaktadır. Testteki soruların tamamı “Maddenin Tanecikli Yapısı” ünitesiyle ilgilidir. Başarı testi için ilköğretim 6.sınıf fen ve teknoloji ders kitabında yer alan “Maddenin Tanecikli Yapısı” ünitesinde hedeflenen kazanımlara uygun olarak öğrencilerin başarılarını ölçmek üzere 60 soru hazırlanmıştır. Hazırlanan başarı testinin geçerliliği ve güvenilirliğini tespit etmek için 2007 - 2008 eğitim-öğretim yılında “Maddenin Tanecikli Yapısı” ünitesini görmüş olan 99 tane ilköğretim 7. sınıf öğrencisine pilot çalışma olarak uygulanmıştır. Pilot çalışma verileri ITEMAN (Item and Test Analysis Program) programı ile analiz edilmiştir. Analiz sonucunda, 60 soruluk başarı testi analiz sonuçları ve uzman görüşleri de göz önünde bulundurularak 53 soruya indirilmiştir. Testin son halinin ITEMAN (Item and Test Analysis Program) programı ile analizi sonucunda elde edilen Cronbach Alfa güvenilirlik katsayısının 0.926, yani testin yaklaşık % 92 oranında güvenilir olduğu bulunmuştur. Uzmanlar geçerliliği ve güvenirliliği test edilen 53 sorudan oluşan başarı testinin “Maddenin Tanecikli Yapısı” ünitesi ile ilgili kazanımları ölçebilecek içeriğe sahip olduğunu belirtmişlerdir.

Verilerin Analizi

Uygulamaya başlamadan önce ve uygulama bittikten sonra uygulanan fen başarı testinin değerlendirilmesiyle elde edilen tüm verilerin istatistik analizleri SPSS 15.00 (Statistical Package For Social Sciences) paket programı kullanılarak yapılmıştır. İstatistiksel analiz yapılmadan önce, verilerin dağılım biçimine bakılmıştır. Normal dağılım gösteren gruplara parametrik testler uygulanmıştır. Parametrik testler için Bağımsız t-testi ve Anova testi seçilmiş ve verilerin analizlerinde bu testler kullanılmıştır. Normal dağılım göstermeyen gruplara ise non-parametrik testler uygulanmıştır. Non-parametrik testler için ise Kruskal Wallis ve Mann-Whitney U testleri seçilmiş ve verilerin analizlerinde bu testler kullanılmıştır.

Bulgular

“Maddenin Tanecikli Yapısı” ünitesinin öğretiminde, yaratıcı drama ile öğretimin öğrenci başarısına etkisini ölçmek için hazırlanan başarı testine ait veriler Bağımsız t testi olarak karşılaştırılmıştır. Ayrıca grupların almış oldukları puanların yüzdeleri Bar analizi yapılarak Grafiklere dönüştürülmüştür. Yapılan Bağımsız t-testi sonuçları, Levene istatistiği göz önünde bulundurularak yorumlanmıştır. Levene istatistiği ve Bağımsız t-testi sonucu bulunan P değerlerinin karıştırılmaması için, P değerleri sırasıyla Levene istatistiği için P_1; Bağımsız t-testi için ise P_2 olarak verilmiştir.

Başarı Testi

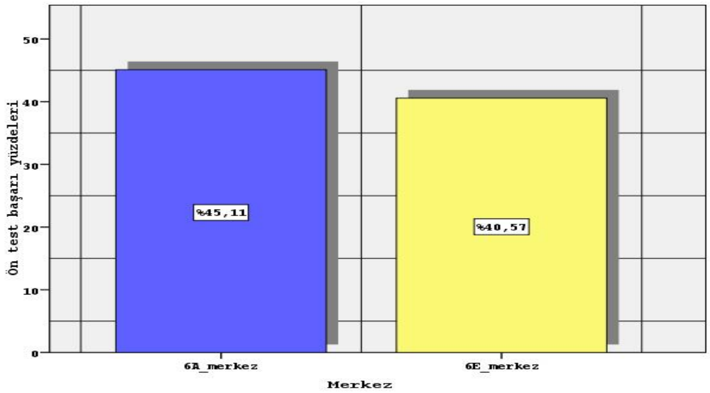
Öntest

Deney ve kontrol grubu öğrencilerinin uygulama öncesinde ön-test başarı düzeylerine ait veriler Tablo 2, Şekil 2 ve Tablo 3’de verilmiştir.

Tablo 2. Deney ve kontrol gruplarına ait ön-test başarı puanları

	Gruplar	N	$\overline{X}$	Std. Sapma	Std. Hata
Ön-test	**Merkez Vali Ali Akan İ.Ö.O. (Deney Grubu)**	32	23,906	6,32639	1,11836
	Merkez Vali Ali Akan İ.Ö.O. (Kontrol Grubu)	30	21,500	8,63733	1,57695

Tablo 2'ye göre; Merkez Vali Ali Akan İlköğretim Okulu deney grubunun ve kontrol grubunun başarı puanları sırasıyla; 23.906 ve 21.500'dir. Grupların ön-test başarı puanları yüzdesine ilişkin yapılan bar analizi Şekil 2'deki gibidir. Grupların ön-test başarı puanları arasında oluşan farkların anlamlı olup olmadığını belirlemek için yapılan Bağımsız t-testi sonuçları Tablo 3'de verilmiştir.



Şekil 2. Deney ve kontrol gruplarının ön-test başarı puanları yüzdeleri

Tablo 3. Deney ve kontrol gruplarına ait ön-test başarı puanlarının karşılaştırıldığı bağımsız t-testi sonucu

	Varyansların Eşitliği için Levene testi		**Anlam farklılığı için t-testi**				
	F	**P_1**	**t**	**Sd**	**P_2**	**Ortalama puan farkı**	**Std. Hata Farkı**
Varyanslar eşit ise	2,808	,099	1,257	60	,214	2,40625	1,91423
Varyanslar eşit değilse			1,245	52,972	,219	2,40625	1,93326

(P_2 < 0.05 düzeyinde anlamlı bir farklılık vardır)

Tablo 3.'e göre; Merkez Vali Ali Akan İlköğretim Okulunun ön-test başarı puanlarındaki varyanslar eşittir (F = 2,808; P_1 > 0.05). Varyansların eşitliği durumunda, yapılan Bağımsız t-testi sonucuna göre; P_2 > 0.05 olduğundan uygulama öncesinde kontrol ve deney gruplarındaki öğrencilerin ön test başarı puanları arasında anlamlı bir fark bulunmamıştır (t_{60} = 1,257; P_2 > 0.05). Gruplara ait ön-test ortalamaları her ne kadar biraz farklı olsa da bu gruplar arasında bir farklılık oluşturmamaktadır. Bu sonuca göre ön test başarı puanları açısından Merkez Vali Ali Akan İlköğretim Okulundaki kontrol ve deney gruplarının denk gruplar olduğunu söyleyebiliriz.

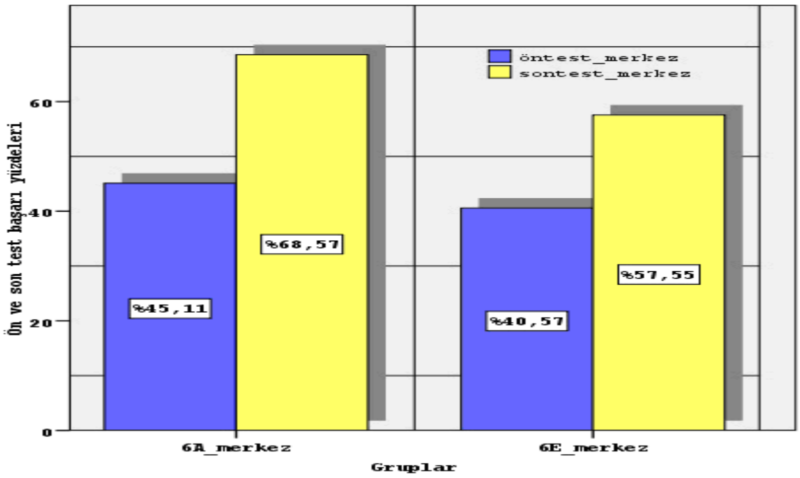
Son Test

Deney ve kontrol grubu öğrencilerinin uygulama sonrası son-test olarak uygulanan başarı testine ait veriler Tablo 4., Şekil 3. ve Tablo 5.'de verilmiştir.

Tablo 4. Deney ve kontrol gruplarına ait son-test başarı puanları

	Gruplar	**N**	$\overline{X}$	**Std. Sapma**	**Std. Hata**
Son test	**Merkez Vali Ali Akan İ.Ö.O. (Deney Grubu)**	32	36,343	11,33254	2,00333
	Merkez Vali Ali Akan İ.Ö.O. (Kontrol Grubu)	30	30,500	11,41007	2,08318

Tablo 4.'e göre; Merkez Vali Ali Akan İlköğretim Okulu deney ve kontrol grubuna ait başarı puanları sırasıyla; 36.343 ve 30.500'dür. Grupların son test başarı puanları yüzdesine ilişkin yapılan bar analizi Şekil 3'deki gibidir. Grupların son-test başarı puanları arasında oluşan farkların anlamlı olup olmadığını incelemek için Bağımsız t-testi uygulanmıştır. Elde edilen veriler Tablo 5.'de verilmiştir.



Şekil 3. Deney ve kontrol gruplarının ön ve son test başarı puanları yüzdeleri

Tablo 5. Deney ve Kontrol gruplarına ait son-test başarı puanlarının karşılaştırıldığı bağımsız t-testi sonucu

	Varyansları Eşitliği için Levene testi		**Anlam farklılığı için t-testi**				
	F	**P_1**	**T**	**Sd**	**P_2**	**Ortalama puan farkı**	**Std. Hata Farkı**
Varyanslar eşit Ise	,007	,932	2,022	60	,048	5,84375	2,88951
Varyanslar eşit Değilse			2,022	59,687	,048	5,84375	2,89015

(P_2 < 0.05 düzeyinde anlamlı bir farklılık vardır)

Tablo 5.'e göre; Merkez Vali Ali Akan İlköğretim Okulunun son-test başarı puanlarındaki varyanslar eşit değildir. ($F = 0.007$; $P_1 > 0.05$). Varyansların eşitliği durumundaki Bağımsız t-testi sonucuna göre, Merkez Vali Ali Akan İlköğretim Okulu deney grubunun ön ve son test başarı puanları arasındaki fark 0.05 manidarlık düzeyinde anlamlıdır ($t_{60} = 2.022$; $P_2 < 0.05$). Bu sonuca göre; Merkez Vali Ali Akan İlköğretim Okulu deney grubundaki öğrenciler son testte daha başarılı oldukları için deney grubunun son testi lehine anlamlı bir faklılık vardır. Son testlerde Merkez Vali Ali Akan İlköğretim Okulu deney grubu öğrencilerinin kontrol grubu öğrencilerine göre daha başarılı oldukları görülmektedir.

Araştırmanın bulguları doğrultusunda yapılan değerlendirme neticesinde aşağıdaki sonuçlara ulaşılmıştır:

1. Merkez Vali Ali Akan İlköğretim Okulunda bulunan deney ve kontrol gruplarına yapılan ön-test sonuçları analiz edildiğinde uygulama öncesinde deney ve kontrol gruplarının bir birine denk gruplar olduğu görülmektedir.

2. Araştırma sonucunda, Merkez Vali Ali Akan İlköğretim Okulunda bulunan deney ve kontrol gruplarının son-test başarı puanlarına ilişkin yapılan analiz sonuçları, deney grubundaki öğrencilerin lehine anlamlı bir farklılık olduğunu göstermektedir.

3. Araştırma bulguları ve sonuçlarına göre "Maddenin Tanecikli Yapısı" ünitesindeki konuların yaratıcı drama ile öğretim kapsamında görmüş olan deney grubu öğrencileri, geleneksel öğretimin uygulandığı kontrol grubu öğrencilerine göre daha başarılı oldukları görülmüştür.

4. Bu sonuç yaratıcı drama ile ilgili daha önce yapılan araştırma sonuçlarıyla da tutarlılık göstermektedir. Araştırma sonucunda elde edilen veriler incelendiğinde yaratıcı drama ile öğretimin öğrencilerin başarılarını olumlu yönde etkilediği görülmektedir.

Öneriler

Yapılmış olan bu araştırmanın bulguları ve sonuçları doğrultusunda şu önerilerde bulunulmuştur.

1- Yaptığımız araştırma sonuçları bize, yapılandırmacı kuramın temel taşlarından biri olan yaratıcı drama ile öğretimin okul öncesinden başlayarak ilköğretimin bütün kademelerinde faydalanılması gerektiğinin bir göstergesidir.

2- Yaratıcı drama ile öğretim yapılmadan önce öğrencilerin yöntem hakkında bilgilendirilmesi gerekmektedir. Böylece yöntemin uygulanması sırasında öğrenciler zorluk çekmeyecek ve olası bir kargaşaya mahal verilmemiş olacaktır.

3- Yaratıcı drama ile öğretimin uygulanmasındaki en önemli sorunlardan bir tanesi uygulamanın yapılacağı mekandır. Yaratıcı drama ile öğretim yapan öğretmenlerin uygulamaya başlamadan önce uygulamanın yapılacağı mekanı ayarlaması gerekmektedir. Hatta okullarda bir yaratıcı drama sınıfı olması gerekmektedir. Böylelikle yaratıcı drama ile öğretim daha kolay ve öğretici olacaktır.

4- Yaratıcı drama ile öğretimde diğer bir sorun sınıf mevcududur. Sınıf mevcutlarının yüksek olduğu sınıflarda uygulama sırasında ister istemez zorluklar ve kargaşa çıkmaktadır. Bunu önlemek için öğretmenlerin mevcutları az olan sınıfları seçerek uygulamayı yapmaları yöntemin başarısını yükseltecektir.

5- Yaratıcı dramanın öğretmenlere tanıtılması ve rehber olması için Milli Eğitim Bakanlığınca hizmet içi kursları açılmalıdır.

6- Yüksek öğretimde yaratıcı drama, seçmeli veya zorunlu ders olarak öğretmen adaylarına verilmelidir. Bu sayede öğretmen adayları ileride derslerinde yaratıcı drama ile öğretimi uygularken zorluk çekmeyeceklerdir.

Not: Bu çalışma Selman TUNCEL'in "İlköğretim 6. Sınıf Fen ve Teknoloji Dersinde Maddenin Tanecikli Yapısı Ünitesinin Yaratıcı Drama ile Öğretiminin Öğrencilerin Başarısına Etkisi" isimli tez çalışmasından üretilmiştir.

Kaynaklar

Adıgüzel, H.Ö. (2002). (Editör). Yaratıcı Drama 1985-1995 Yazıları. Ankara: Natürel Kitap Yayıncılık.

Bozdoğan, Z. (2003). Okulda Rehberlik Etkinlikleri ve Yaratıcı Drama. İstanbul: Nobel Yayın Dağıtım.

Gönen, M., Dalkılıç, N. U. 2000. Çocuk Eğitiminde Drama Yöntem ve Uygulamalar. İstanbul: Epsilon Yayıncılık.

Karadağ, E., Çalışkan, N. (2005). İlköğretimde Drama "Oyun ve İşleniş Örnekleriyle". Ankara: Anı Yayıncılık.

Morgül, M. (2003). Eğitimde Yaratıcı Dramaya Merhaba. Ankara: Kök Yayıncılık.

Soylu, H. (2004). Fen Öğretiminde Yeni Yaklaşımlar (Keşif Yoluyla Öğrenme). Ankara: Nobel Yayın Dağıtım.

Tuncel, S. (2009). İlköğretim 6. Sınıf Fen ve Teknoloji Dersinde Maddenin Tanecikli Yapısı Ünitesinin Yaratıcı Drama ile Öğretiminin Öğrencilerin Başarısına Etkisi. Yüksek Lisans Tezi, Selçuk Üniversitesi Fen Bilimleri Enstitüsü, Konya.

Tunç, T. ve ark. (2008). Milli Eğitim Bakanlığı İlköğretim Fen ve Teknoloji Öğretmen Kılavuz Kitabı. Ada Matbaacılık. Ankara.

A STUDY ON COURSE EXPECTATION AND SATISFACTION OF AN ENGINEERING DEPARTMENT STUDENTS

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Abstract: In this study, the expectations on course instructor and application area of the students who are studying in the Department of Industrial Engineering, Gazi University and who took Engineering Economics course were tried to be determined by the method of multiple linear regression. The data were obtained through questionnaires. The purpose of the study is to make improvements on the subjects in the priority correction field using the statistical strategy maps.

***Keywords*:** Expectation, satisfaction, multiple linear regression, statistical strategy maps

BİR MÜHENDİSLİK BÖLÜMÜ ÖĞRENCİLERİNİN DERS BEKLENTİLERİ VE MEMNUNİYETLERİ ÜZERİNE BİR ÇALIŞMA

Özet: Bu çalışmada, Gazi Üniversitesi Endüstri Mühendisliği Bölümü'nde öğrenim gören ve Mühendislik Ekonomisi dersi alan öğrencilerin ders sorumlusu ve uygulama alanı hakkındaki beklentileri, çoklu doğrusal regresyon yöntemi ile belirlenmeye çalışılmıştır. Veriler anket yolu ile elde edilmiştir. Çalışmanın amacı; istatistiksel strateji haritaları yardımıyla öncelikli düzeltme alanında bulunan konular üzerinde iyileştirmeler yapmaktır.

Anahtar Kelimeler: Beklenti, memnuniyet, çoklu doğrusal regresyon, istatistiksel strateji haritaları

Giriş

Gazi Üniversitesi Mühendislik Fakültesi Endüstri Mühendisliği Bölümü öğrencilerinin ders sorumlusu ve uygulama alanı hakkındaki beklenti ve memnuniyetlerini belirlemek amacıyla 32 soruluk bir anket çalışması uygulanmıştır. Bu çalışmanın amacı, ders sorumlusu ya da uygulama alanında yaşanan aksaklıklar var ise ortaya çıkarmak ve belirlenen aksaklıkları iyileştirmeye çalışmaktır. Çalışma sonucunda, öğrencilerin verdikleri cevaplar doğrultusunda hem toplam öğrenci üzerinden hem de cinsiyetlere göre hazırlanan strateji haritaları hazırlanmıştır.

Strateji Haritalarının Oluşturulması

Keçecioğlu (2008) işletme yöneticilerinin stratejik düşünmeye farklı pencereler açılması gerektiğini düşünmektedir. Çünkü tüm kurumların(üniversite, fabrika, hastane vb.) belirli hedeflere ulaşmak kendilerine farklı zaman dilimlerinde uygun stratejiler belirlemek zorunda kalırlar. Sahip olunan tüm stratejilerin birlikte grafiksel olarak gösterilmesine strateji haritası adı verilmektedir (Kaplan ve Norton, 2004). Strateji haritaları oluşturulurken memnuniyet puanları, önem katsayıları ve haritayı bölgelere ayıran eksen çizgileri aşağıdaki gibi hesaplanmaktadır.

Memnuniyet Puanlarının Oluşturulması

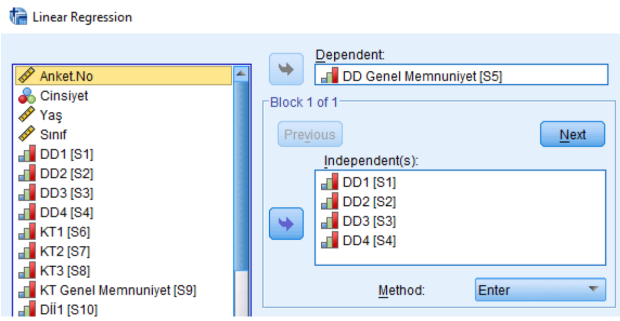
Elde edilen ifade ortalamalarının yüzlük sisteme çevrilerek strateji haritalarında kullanılacak memnuniyet puanlarına ulaşılır. İfade ortalamalarından 1 çıkarmamızın sebebi 1-5 aralığında aldığımız likert cevapları 0-100 puan aralığında olmasını sağlamaktır ve bu değerler Tablo 1 de verilmiştir.

Tablo 1. Memnuniyet puanları hesaplaması

Soru Kodu	İfade Ortalaması	Hesaplama	Memnuniyet Puanı
DD1	4,44	(4,44-1)*100/4	86,0
DD2	4,34	(4,34-1)*100/4	83,4
DD3	3,88	(3,88-1)*100/4	71,9
DD4	4,52	(4,52-1)*100/4	88,0

Önem (Beklenti) Puanlarının Oluşturulması

Bölüm sonunda sorulan, bölüm ile ilgili genel memnuniyet düzeyini bağımlı değişken, bölümdeki diğer soruları bağımsız değişken olarak modele dahil ettiğimiz çoklu doğrusal regresyon modeli sonucunda oluşan standart katsayılar, strateji haritaları için önem (beklenti) puanını oluşturmaktadır. Şekil 1 de çoklu doğrusal regresyon modeli için değişkenler verilmiştir.



Şekil 1. Çoklu doğrusal regresyon modeli için değişkenlerin belirlenmesi

Kurulan çoklu doğrusal regresyon modeli için, hesaplanan standart katsayılar Tablo 2'deki gibidir.

Tablo 2. Standart katsayılar

Soru Kodu	Standart Katsayılar
DD1	0,137
DD2	0,281
DD3	0,340
DD4	0,137

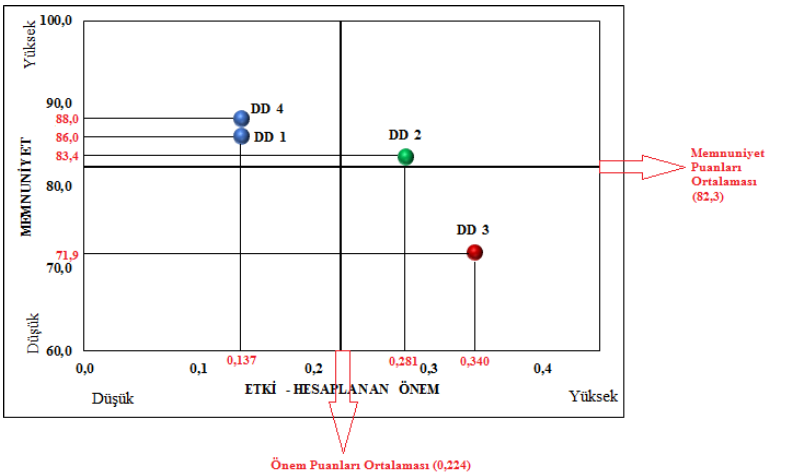
Belirlenen Noktaların Strateji Haritalarına Yerleştirilmesi

Önem (Beklenti) ve Memnuniyet puanları elde edildikten sonra önem (beklenti) puanı x-ekseninde, memnuniyet puanları y-ekseninde olacak şekilde grafikteki yerleri belirlenir ve bu değerler Tablo 3 de gösterilmiştir.

Tablo 3. İfadelerin eksen noktaları

Soru Kodu	Önem (Beklenti) (x-ekseni)	Memnuniyet Puanı (y-ekseni)
DD1	0,137	86,0
DD2	0,281	83,4
DD3	0,340	71,9
DD4	0,137	88,0
Ortalama (Eksen Ortalamaları)	**0,224**	**82,3**

Şekil 2 de örnek bir strateji harita örneği verilmektedir.



Şekil 2. Strateji haritası örneği

Araştırma Yöntemi ve Bulguları

Araştırma Yöntemi

Çalışma 99 öğrenci üzerinden tamamlanmıştır. Veriler anket yolu ile toplanmıştır. Veriler IBM SPSS Statistics 22 programına aktarılarak analiz çalışmaları yapılmıştır. Çalışma verileri değerlendirilirken sayısal değişkenler için tanımlayıcı istatistikler (ortalama, standart sapma), kategorik değişkenler için frekans dağılımları verilmiştir. Strateji haritaları oluşturulurken kullanılan önem değerleri, çoklu doğrusal regresyon analizi sonucu ile hesaplanmıştır. Elde edilen memnuniyet ve önem değerleri ile strateji haritaları oluşturulmuştur.

Araştırma Bulguları

Araştırmaya ait demografik bulgular aşağıdaTablo 4 de verilmiştir.

Tablo 4. Tanımlayıcı istatistikler

	Sayı	**%**
Cinsiyet		
Erkek	39	39,8
Kadın	58	59,2
Cevapsız	1	1,0
Sınıf		
2	1	1,0
3	49	50,0
4	40	40,8
Cevapsız	8	8,2
Yaş (ortalama±standart sapma)	94	22,04±1,509

Tablo 5'e göre araştırmaya katılan öğrencilerin %39,8'i erkek iken %59,2'si kadındır. Öğrencilerin %1,0'i cevap vermemiştir. Ayrıca %1,0'i ikinci sınıf öğrencisi iken %50,0'si üçüncü sınıf ve %40,8'i ise dördüncü sınıf öğrencisidir. Öğrencilerin %8,2'si cevap vermemiştir ve yaş ortalaması 22,04'tür.

Tablo 6'ya göre araştırmaya katılan öğrencilerin %3,1'i "Sınavların adil değerlendirildiğine inanıyorum." ifadesine ara sıra cevabını vermiş iken %9,2'si sık sık, %28,6'sı çoğunlukla ve %59,2'si ise her zaman cevabını vermiştir. Ayrıca %4,1'i "Aldığım notların doğru verildiğine inanıyorum." ifadesine ara sıra cevabını vermiş iken %13,3'ü sık sık, %27,6'sı çoğunlukla ve %55,1'i ise her zaman cevabını vermiştir. %2,1'i "Öğrencilerin hepsine eşit uzaklıktadır." ifadesine hiçbir zaman cevabını vermiş iken %11,3'ü ara sıra, %21,6'sı sık sık, %26,8'i çoğunlukla ve %38,1'i ise her zaman cevabını vermiştir. Öğrencilerin %1,0'i "Yoklama ve devamsızlık işlemlerinin etkin olduğuna inanıyorum." ifadesine hiçbir zaman cevabını vermiş iken %6,1'i ara sıra, %5,1'i sık sık, %15,3'ü çoğunlukla ve %72,4'ü ise her zaman cevabını vermiştir. %5,3'ü"Genel olarak Ders Değerlendirmeden memnuniyet dereceniz." ifadesine ara sıra cevabını vermiş iken %16,8'i sık sık, %38,9'u çoğunlukla ve %38,9'u ise her zaman cevabını vermiştir.

Tablo 5. Ders değerlendirme ifadelerine verilen cevapların dağılımı

		Hiçbir Zaman	Ara Sıra	Sık Sık	Çoğunlukla	Her Zaman
Sınavların adil değerlendirildiğine inanıyorum.	Sayı	0	3	9	28	58
	%	0,0	3,1	9,2	28,6	59,2
Aldığım notların doğru verildiğine inanıyorum.	Sayı	0	4	13	27	54
	%	0,0	4,1	13,3	27,6	55,1
Öğrencilerin hepsine eşit uzaklıktadır.	Sayı	2	11	21	26	37
	%	2,1	11,3	21,6	26,8	38,1
Yoklama ve devamsızlık işlemlerinin etkin olduğuna inanıyorum.	Sayı	1	6	5	15	71
	%	1,0	6,1	5,1	15,3	72,4
Genel olarak Ders Değerlendirmeden memnuniyet dereceniz.	Sayı	0	5	16	37	37
	%	0,0	5,3	16,8	38,9	38,9

Tablo 6. Kişisel tutum ifadelerine verilen cevapların dağılımı

		Hiçbir Zaman	Ara Sıra	Sık Sık	Çoğunlukla	Her Zaman
Kılık-kıyafetine dikkat eder.	Sayı	0	3	8	24	62
	%	0,0	3,1	8,2	24,7	63,9
Tertipli ve düzenli olmaya dikkat eder.	Sayı	0	0	5	17	76
	%	0,0	0,0	5,1	17,3	77,6
Sabırlı ve soğukkanlıdır.	Sayı	0	3	8	28	59
	%	0,0	3,1	8,2	28,6	60,2
Genel olarak Kişisel Tutumundan memnuniyet dereceniz.	Sayı	0	4	9	23	60
	%	0,0	4,2	9,4	24,0	62,5

Tablo 7. Ders işlemleri ve iletişim ifadelerine verilen cevapların dağılımı

		Hiçbir Zaman	Ara Sıra	Sık Sık	Çoğunlukla	Her Zaman
Derse hazır gelir.	Sayı	0	0	1	4	93
	%	0,0	0,0	1,0	4,1	94,9
Derse zamanında ve düzenli olarak gelir.	Sayı	0	0	1	2	95
	%	0,0	0,0	1,0	2,0	96,9
Araştırma ve öğrenmeyi teşvik edici konuları seçer.	Sayı	0	1	10	21	65
	%	0,0	1,0	10,3	21,6	67,0
Alanındaki güncel değişimleri takip eder.	Sayı	0	0	3	17	78
	%	0,0	0,0	3,1	17,3	79,6
Bizlerin derse katılımını sağlar.	Sayı	0	4	11	21	61
	%	0,0	4,1	11,3	21,6	62,9
Sorulan sorulara açık, net ve tatminkâr cevaplar verir.	Sayı	0	2	11	40	44
	%	0,0	2,1	11,3	41,2	45,4
Sınıfta rahat ve dostça bir ortam oluşturur.	Sayı	1	7	12	34	44
	%	1,0	7,1	12,2	34,7	44,9
Ders saatleri dışında da ulaşmak ve görüşmek mümkündür.	Sayı	0	5	15	33	44
	%	0,0	5,2	15,5	34,0	45,4
Genel olarak Ders İşlemleri Ve İletişimden memnuniyet dereceniz.	Sayı	0	2	10	35	49
	%	0,0	2,1	10,4	36,5	51,0

Tablo 7'e göre araştırmaya katılan öğrencilerin %3,1'i "Kılık-kıyafetine dikkat eder." ifadesine ara sıra cevabını vermiş iken %8,2'si sık sık, %24,7'si çoğunlukla ve %63,9'u ise her zaman cevabını vermiştir. %5,1'i "Tertipli ve düzenli olmaya dikkat eder." ifadesine sık sık cevabını vermiş iken %17,3'ü çoğunlukla ve %77,6'sı ise her zaman cevabını vermiştir. Öğrencilerin %3,1'i "Sabırlı ve soğukkanlıdır." ifadesine ara sıra cevabını vermiş iken %8,2'si sık sık, %28,6'sı çoğunlukla ve %60,2'si ise her zaman cevabını vermiştir. Araştırmaya katılan öğrencilerin %4,2’si “Genel olarak Kişisel Tutumundan memnuniyet dereceniz.” ifadesine ara sıra cevabını vermiş iken %9,4’ü sık sık, %24,0’ü çoğunlukla ve %62,5’i ise her zaman cevabını vermiştir.

Tablo 8. Öğrenme/öğretme yöntem ve teknikleri ifadelerine verilen cevapların dağılımı

		Hiçbir Zaman	Ara Sıra	Sık Sık	Çoğunlukla	Her Zaman
Derste ilgiyi sürekli canlı tutar, derste sıkılmam.	Sayı	1	9	23	52	13
	%	1,0	9,2	23,5	53,1	13,3
Ders saatlerini etkili olarak kullanmaktadır.	Sayı	1	0	3	28	66
	%	1,0	0,0	3,1	28,6	67,3
Bilgi düzeyi bu dersi anlatmak için bence yeterlidir.	Sayı	0	0	0	14	84
	%	0,0	0,0	0,0	14,3	85,7
Ders ile ilgili sınavlarda derste öğrendiğimiz şeyler sorulur.	Sayı	0	2	9	25	62
	%	0,0	2,0	9,2	25,5	63,3
Derse ilişkin ödevlerin bana faydası olduğuna inanıyorum.	Sayı	0	8	11	27	52
	%	0,0	8,2	11,2	27,6	53,1
Ders araçlarını etkin bir şekilde kullanır.	Sayı	1	0	6	23	68
	%	1,0	0,0	6,1	23,5	69,4
Derse ilişkin verdiği/tavsiye ettiği kaynaklar günceldir.	Sayı	1	1	12	27	57
	%	1,0	1,0	12,2	27,6	58,2
Derse ilişkin verdiği/tavsiye ettiği kaynaklar yeterlidir.	Sayı	1	3	9	35	49
	%	1,0	3,1	9,3	36,1	50,5
Genel olarak Öğrenme/Öğretme Yöntem ve Tekniklerinden memnuniyet dereceniz.	Sayı	0	1	8	43	45
	%	0,0	1,0	8,2	44,3	46,4

Tablo 8 de araştırmaya katılan öğrencilerin %1,0’i “Derse hazır gelir.” ifadesine sık sık cevabını vermiş iken % 4,1’i çoğunlukla ve %94,9’u ise her zaman cevabını verdiği görülmektedir. %1,0’i “Derse zamanında ve düzenli olarak gelir.” ifadesine sık sık cevabını vermiş iken %2,0’si çoğunlukla ve %96,9’u ise her zaman cevabını vermiştir. Öğrencilerin %1,0’i “Araştırma ve öğrenmeyi teşvik edici konuları seçer.” ifadesine ara sıra cevabını vermiş iken %10,3’ü sık sık, %21,6’sı çoğunlukla ve %67,0’si ise her zaman cevabını vermiştir ve %3,1’i “Alanındaki güncel değişimleri takip eder.” ifadesine sık sık cevabını vermiş iken %17,3’ü çoğunlukla ve % 79,6’sı ise her zaman cevabını vermiştir. Araştırmaya katılan öğrencilerin %4,1’i “Bizlerin derse katılımını sağlar.” ifadesine sık sık cevabını vermiş iken %11,3’ü sık sık, %21,6’sı çoğunlukla ve %62,9’u ise her zaman cevabını vermiştir. Ayrıca %2,1’i “Sorulan sorulara açık, net ve tatminkâr cevaplar verir.” ifadesine ara sıra cevabını vermiş iken %11,3’ü sık sık, %41,2’si çoğunlukla ve %45,4’ü ise her zaman cevabını vermiştir. Bu öğrencilerin %1,0’i “Sınıfta rahat ve dostça bir ortam oluşturur.” ifadesine hiçbir zaman cevabını vermiş iken %7,1’i ara sıra, %12,2’si sık sık, %34,7’si çoğunlukla ve %44,9’u ise her zaman cevabını vermiştir ve %5,2’si “Ders saatleri dışında da ulaşmak ve görüşmek mümkündür.” ifadesine ara sıra cevabını vermiş iken %15,5’i sık sık, %34,0’ü çoğunlukla ve %45,4’ü ise her zaman cevabını vermiştir. %2,1’i “Genel olarak Ders İşlemleri Ve İletişimden memnuniyet dereceniz.” ifadesine ara sıra cevabını vermiş iken %10,4’ü sık sık, %36,5’i çoğunlukla ve %51,0’i ise her zaman cevabını vermiştir.

Tablo 9. Uygulama/uygulama alanı (bilgisayar laboratuvarı) ifadelerine verilen cevapların dağılımı

		Hiçbir Zaman	Ara Sıra	Sık Sık	Çoğunlukla	Her Zaman
Uygulama alanı yeterli büyüklüktedir.	Sayı	60	5	8	11	14
	%	61,2	5,1	8,2	11,2	14,3
Uygulama alanındaki bilgisayarlar yeterlidir.	Sayı	70	4	7	7	10
	%	71,4	4,1	7,1	7,1	10,2
Uygulama alanındaki bilgisayarlarda ders ile ilgili programlar mevcuttur.	Sayı	64	3	7	9	15
	%	65,3	3,1	7,1	9,2	15,3
Uygulamada, derste işlenen konular pekiştirilir.	Sayı	47	7	8	13	23
	%	48,0	7,1	8,2	13,3	23,5

Genel olarak Uygulama/Uygulama Alanından (Bilgisayar Laboratuvarı) memnuniyet dereceniz.	Sayı	65	8	9	6	9
	%	67,0	8,2	9,3	6,2	9,3

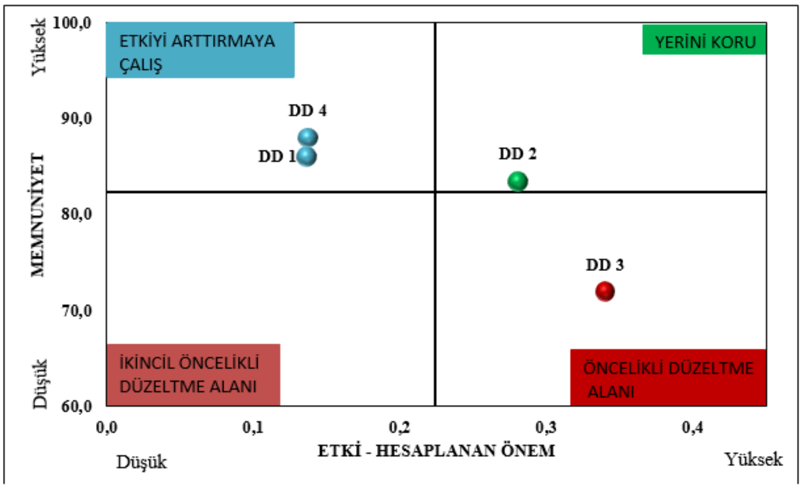
Tablo 9'da araştırmaya katılan öğrencilerin %1,0'i "Derste ilgiyi sürekli canlı tutar, derste sıkılmam." ifadesine hiçbir zaman cevabını vermiş iken %9,2'si ara sıra, %23,5'i sık sık, %53,1'i çoğunlukla ve %13,3'ü ise her zaman cevabını vermiştir. %1,0'i "Ders saatlerini etkili olarak kullanmaktadır." hiçbir zaman cevabını vermiş iken %3,1'i sık sık, %28,6'sı çoğunlukla ve %67,3'ü ise her zaman cevabını verdiği Çizelge 9'da görülmektedir. Ayrıca %14,3'ü "Bilgi düzeyi bu dersi anlatmak için bence yeterlidir." ifadesine çoğunlukla cevabını vermiş iken %85,7'si ise her zaman cevabını vermiştir. Dahası %2,0'si "Ders ile ilgili sınavlarda derste öğrendiğimiz şeyler sorulur." ifadesine ara sıra cevabını vermiş iken %9,2'si sık sık, %25,5'i çoğunlukla ve %63,3'ü ise her zaman cevabını vermiştir. Araştırmaya katılan öğrencilerin %8,2'si "Derse ilişkin ödevlerin bana faydası olduğuna inanıyorum." ifadesine ara sıra cevabını vermiş iken %11,2'si sık sık, %27,6'sı çoğunlukla ve %53,1'i ise her zaman cevabını vermiştir ve %1,0'i "Ders araçlarını etkin bir şekilde kullanır." ifadesine hiçbir zaman cevabını vermiş iken %6,1'i sık sık, %23,5'i çoğunlukla ve %69,4'ü ise her zaman cevabını vermiştir. Araştırmaya katılan öğrencilerin %1,0'i "Genel olarak Öğrenme/Öğretme Yöntem ve Tekniklerinden memnuniyet dereceniz." ifadesine ara sıra cevabını vermiş iken %8,2'si sık sık, %44,3'ü çoğunlukla ve %46,4'ü ise her zaman cevabını vermiştir.

Tablo 10'da araştırmaya katılan öğrencilerin %61,2'si "Uygulama alanı yeterli büyüklüktedir." ifadesine hiçbir zaman cevabını vermiş iken %5,1'i ara sıra, %8,2'si sık sık, %11,2'si çoğunlukla ve %14,3'ü ise her zaman cevabını vermiştir. Araştırmaya katılan öğrencilerin %71,4'ü "Uygulama alanındaki bilgisayarlar yeterlidir." ifadesine hiçbir zaman cevabını vermiş iken %4,1'i ara sıra, %7,1'i sık sık, %7,1'i çoğunlukla ve %10,2'si ise her zaman cevabını vermiştir. Araştırmaya katılan öğrencilerin %65,3'ü "Uygulama alanındaki bilgisayarlarda ders ile ilgili programlar mevcuttur." ifadesine hiçbir zaman cevabını vermiş iken %3,1'i ara sıra, %7,1'i sık sık, %9,2'si çoğunlukla ve %15,3'ü ise her zaman cevabını vermiştir. Araştırmaya katılan öğrencilerin %48,0'i "Uygulamada, derste işlenen konular pekiştirilir." ifadesine hiçbir zaman cevabını vermiş iken %7,1'i ara sıra, %8,2'si sık sık, %13,3'ü çoğunlukla ve %23,5'i ise her zaman cevabını vermiştir. Araştırmaya katılan öğrencilerin %67,0'si "Genel olarak Uygulama/Uygulama Alanından (Bilgisayar Laboratuvarı) memnuniyet dereceniz." ifadesine hiçbir zaman cevabını vermiş iken %8,2'si ara sıra, %9,3'ü sık sık, %6,2'si çoğunlukla ve %9,3'ü ise her zaman cevabını vermiştir.

Tablo 10. Ders değerlendirme ifadelerine memnuniyet değerleri

İfade Kodu	**İfadeler**	**Memnuniyet Değeri**
DD1	Sınavların adil değerlendirildiğine inanıyorum.	86,0
DD2	Aldığım notların doğru verildiğine inanıyorum.	83,4
DD3	Öğrencilerin hepsine eşit uzaklıktadır.	71,9
DD4	Yoklama ve devamsızlık işlemlerinin etkin olduğuna inanıyorum.	88,0
DD Genel Memnuniyet	Genel olarak Ölçme ve Değerlendirmeden memnuniyet dereceniz.	77,9

Araştırmaya katılan öğrencilerin ders değerlendirme ifadelerinden en memnun oldukları ifade %88,0 ile "Yoklama ve devamsızlık işlemlerinin etkin olduğuna inanıyorum." ifadesi iken en az memnun oldukları ifade ise %91,9 ile "Öğrencilerin hepsine eşit uzaklıktadır." ifadesidir. Öğrencilerin genel ders değerlendirme memnuniyeti ise %77,9'dur. Ders değerlendirme strateji haritası Şekil 3'de gösterilmektir.

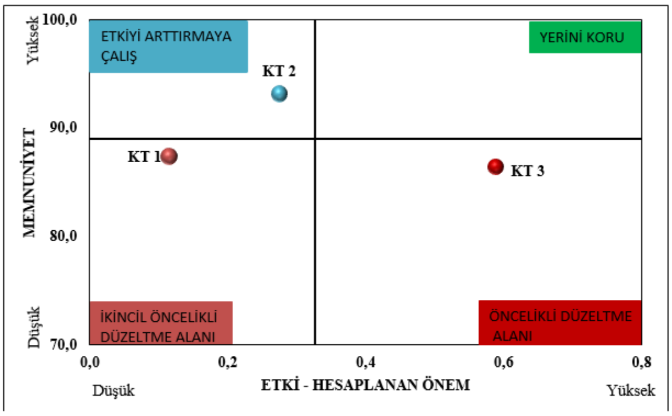


Şekil 3. Ders değerlendirme strateji haritası

Tablo 11'de araştırmaya katılan öğrencilerin kişisel tutum ifadelerinden en memnun oldukları ifade %93,1 ile "Tertipli ve düzenli olmaya dikkat eder." ifadesi iken en az memnun oldukları ifade ise %86,5 ile "Sabırlı ve soğukkanlıdır." ifadesidir. Öğrencilerin genel kişisel tutum memnuniyeti ise %86,2'dir. Kişisel tutum strateji haritası Şekil 4'de gösterilmektedir.

Tablo 11. Kişisel tutum ifadelerine memnuniyet değerleri

İfade Kodu	**İfadeler**	**Memnuniyet Değeri**
KT1	Kılık-kıyafetine dikkat eder.	87,4
KT2	Tertipli ve düzenli olmaya dikkat eder.	93,1
KT3	Sabırlı ve soğukkanlıdır.	86,5
KT Genel Memnuniyet	Genel olarak Kişisel Tutumundan memnuniyet dereceniz.	86,2



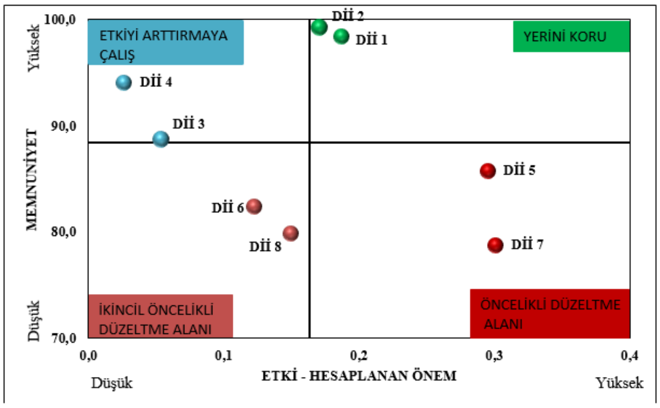
Şekil 4. Kişisel tutum strateji haritası

Tablo 12'e göre öğrencilerin ders işlemleri ve iletişim ifadelerinden en memnun oldukları ifade %98,5 ile "Derse hazır gelir." ifadesi iken en az memnun oldukları ifade ise %78,8 ile "Sınıfta rahat ve dostça bir ortam oluşturur." ifadesidir. Öğrencilerin genel ders işlemleri ve iletişim memnuniyeti ise %84,1'dir. Ders işlemleri ve iletişim stratejileri haritası ise Şekil 5'de sunulmuştur.

Tablo 12. Ders işlemleri ve iletişimden ifadelerine memnuniyet değerleri

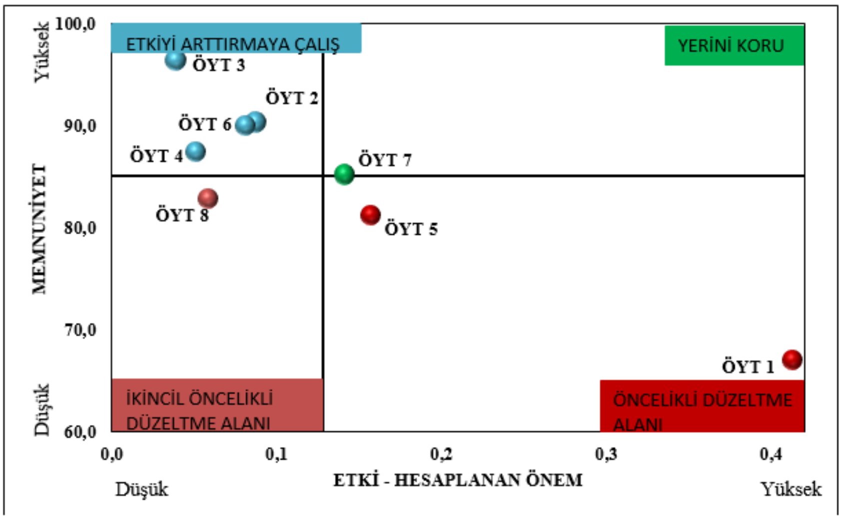
İfade Kodu	**İfadeler**	**Memnuniyet Değeri**
Dİİ1	Derse hazır gelir.	98,5
Dİİ2	Derse zamanında ve düzenli olarak gelir.	99,2
Dİİ3	Araştırma ve öğrenmeyi teşvik edici konuları seçer.	88,7
Dİİ4	Alanındaki güncel değişimleri takip eder.	94,1
Dİİ5	Bizlerin derse katılımını sağlar.	85,8
Dİİ6	Sorulan sorulara açık, net ve tatminkâr cevaplar verir	82,5

Dİİ7	Sınıfta rahat ve dostça bir ortam oluşturur.	78,8
Dİİ8	Ders saatleri dışında da ulaşmak ve görüşmek mümkündür.	79,9
Dİİ Genel Memnuniyet	Genel olarak Ders İşlemleri Ve İletişimden memnuniyet dereceniz.	84,1



Şekil 5. Ders işlemleri ve iletişim strateji haritası

Tablo 13'e göre araştırmaya katılan öğrencilerin öğrenme/öğretme yöntem ve teknikleri ifadelerinden en memnun oldukları ifade %96,4 ile "Bilgi düzeyi bu dersi anlatmak için bence yeterlidir." ifadesi iken en az memnun oldukları ifade ise %67,1 ile "Derste ilgiyi sürekli canlı tutar, derste sıkılmam." ifadesidir. Öğrencilerin genel öğrenme/öğretme yöntem ve teknikleri memnuniyeti ise %84,0'tür.Öğrenme/öğretme yöntem ve teknikleri strateji haritası Şekil 6 da verilmiştir.



Şekil 6.Öğrenme/öğretme yöntem ve teknikleri strateji haritası

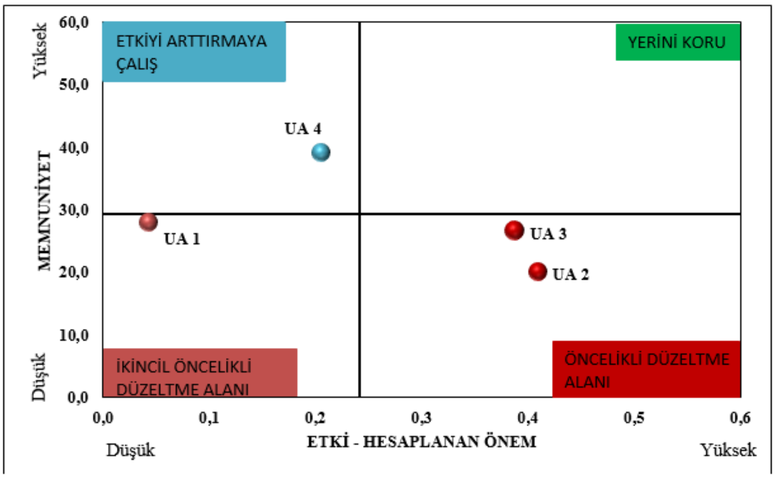
Tablo 13. Öğrenme/öğretme yöntem ve teknikleriifadelerine memnuniyet değerleri

İfade Kodu	İfadeler	Memnuniyet Değeri
ÖYT1	Derste ilgiyi sürekli canlı tutar, derste sıkılmam.	67,1
ÖYT2	Ders saatlerini etkili olarak kullanmaktadır	90,3
ÖYT3	Bilgi düzeyi bu dersi anlatmak için bence yeterlidir.	96,4
ÖYT4	Ders ile ilgili sınavlarda derste öğrendiğimiz şeyler sorulur.	87,5
ÖYT5	Derse ilişkin ödevlerin bana faydası olduğuna inanıyorum.	81,4
ÖYT6	Ders araçlarını etkin bir şekilde kullanır.	90,1
ÖYT7	Derse ilişkin verdiği/tavsiye ettiği kaynaklar günceldir.	85,2
ÖYT8	Derse ilişkin verdiği/tavsiye ettiği kaynaklar yeterlidir.	83,0
ÖYT Genel Memnuniyet	Genel olarak Öğrenme/Öğretme Yöntem ve Tekniklerinden memnuniyet dereceniz.	84,0

Tablo 14. Uygulama/uygulama alanından (bilgisayar laboratuvarı)ifadelerine memnuniyet değerleri

İfade Kodu	İfadeler	Memnuniyet Değeri
UA1	Uygulama alanı yeterli büyüklüktedir.	29,6
UA2	Uygulama alanındaki bilgisayarlar yeterlidir.	21,2
UA3	Uygulama alanındaki bilgisayarlarda ders ile ilgili programlar mevcuttur.	31,7
UA4	Uygulamada, derste işlenen konular pekiştirilir.	41,4
UA Genel Memnuniyet	Genel olarak Uygulama/Uygulama Alanından (Bilgisayar Laboratuvarı) memnuniyet dereceniz.	21,7

Araştırmaya katılan öğrencilerin uygulama/uygulama alanından (bilgisayar laboratuvarı) ifadelerinden en memnun oldukları ifade %41,4 ile "Uygulamada, derste işlenen konular pekiştirilir." ifadesi iken en az memnun oldukları ifade ise %21,2 ile "Uygulama alanındaki bilgisayarlar yeterlidir." ifadesidir. Öğrencilerin genel uygulama/uygulama alanından (bilgisayar laboratuvarı) memnuniyeti ise %21,7'dir.Şekil 7 de uygulama/uygulama alanından (bilgisayar laboratuvarı) strateji haritası sunulmuştur.



Şekil 7. Uygulama/uygulama alanından (bilgisayar laboratuvarı) strateji haritası

Genel Strateji Haritaları Gösterimi

Oluşturulan strateji haritalarının toplu gösterimi Tablo 15'deki gibidir.

Tablo 15. Strateji haritaları toplu gösterimi

Soru Kodu	İfadeler	GENEL	KADIN	ERKEK
DD 1	Sınavların adil değerlendirildiğine inanıyorum.	Bölge III	Bölge III	Bölge III
DD 2	Aldığım notların doğru verildiğine inanıyorum.	Bölge IV	Bölge IV	Bölge I
DD 3	Öğrencilerin hepsine eşit uzaklıktadır.	Bölge I	Bölge I	Bölge II
DD 4	Yoklama ve devamsızlık işlemlerinin etkin olduğuna inanıyorum.	Bölge III	Bölge IV	Bölge III
KT 1	Kılık-kıyafetine dikkat eder.	Bölge II	Bölge II	Bölge II
KT 2	Tertipli ve düzenli olmaya dikkat eder.	Bölge III	Bölge III	Bölge IV
KT 3	Sabırlı ve soğukkanlıdır.	Bölge I	Bölge I	Bölge I
DİI 1	Derse hazır gelir.	Bölge IV	Bölge III	Bölge IV
DİI 2	Derse zamanında ve düzenli olarak gelir.	Bölge IV	Bölge III	Bölge IV
DİI 3	Araştırma ve öğrenmeyi teşvik edici konuları seçer.	Bölge II	Bölge III	Bölge II
DİI 4	Alanındaki güncel değişimleri takip eder.	Bölge II	Bölge III	Bölge III
DİI 5	Bizlerin derse katılımını sağlar.	Bölge I	Bölge I	Bölge I
DİI 6	Sorulan sorulara açık, net ve tatminkâr cevaplar verir	Bölge III	Bölge I	Bölge II
DİI 7	Sınıfta rahat ve dostça bir ortam oluşturur.	Bölge I	Bölge I	Bölge I

Dİİ 8	Ders saatleri dışında da ulaşmak ve görüşmek mümkündür.	Bölge III	Bölge II	Bölge II
ÖYT 1	Derste ilgiyi sürekli canlı tutar, derste sıkılmam.	Bölge I	Bölge I	Bölge I
ÖYT 2	Ders saatlerini etkili olarak kullanmaktadır	Bölge III	Bölge III	Bölge III
ÖYT 3	Bilgi düzeyi bu dersi anlatmak için bence yeterlidir.	Bölge III	Bölge IV	Bölge IV
ÖYT 4	Ders ile ilgili sınavlarda derste öğrendiğimiz şeyler sorulur.	Bölge III	Bölge III	Bölge III
ÖYT 5	Derse ilişkin ödevlerin bana faydası olduğuna inanıyorum.	Bölge I	Bölge I	Bölge II
ÖYT 6	Ders araçlarını etkin bir şekilde kullanır.	Bölge III	Bölge III	Bölge III
ÖYT 7	Derse ilişkin verdiği/tavsiye ettiği kaynaklar günceldir.	Bölge IV	Bölge IV	Bölge II
ÖYT 8	Derse ilişkin verdiği/tavsiye ettiği kaynaklar yeterlidir.	Bölge II	Bölge II	Bölge I
UA 1	Uygulama alanı yeterli büyüklüktedir.	Bölge II	Bölge II	Bölge III
UA 2	Uygulama alanındaki bilgisayarlar yeterlidir.	Bölge I	Bölge I	Bölge I
UA 3	Uygulama alanındaki bilgisayarlarda ders ile ilgili programlar mevcuttur.	Bölge I	Bölge I	Bölge I
UA 4	Uygulamada, derste işlenen konular pekiştirilir.	Bölge III	Bölge III	Bölge III

Sonuç ve Öneriler

Araştırmadan elde edilen bulgulara göre öncelikli düzeltme alanında bulunan ifadelerden başlamak üzere bu yönleri geliştirmeli ve iyileştirilmelidir. Öncelikli düzeltme alanında bulunan ifadeler;

- “Öğrencilerin hepsine eşit uzaklıktadır.”, “Sabırlı ve soğukkanlıdır.”,
- “Bizlerin derse katılımını sağlar.”,
- “Sınıfta rahat ve dostça bir ortam oluşturur.”,
- “Derste ilgiyi sürekli canlı tutar, derste sıkılmam.”,
- “Derse ilişkin ödevlerin bana faydası olduğuna inanıyorum.”
- “Uygulama alanındaki bilgisayarlar yeterlidir.”
- “Uygulama alanındaki bilgisayarlarda ders ile ilgili programlar mevcuttur.”

Yukarıda elde edilen sonuçlara göre Endüstri Mühendisliği bölümünde eğitim gören öğrencilerin ders memnuniyet dereceleri ve beklentiler belirmiştir.

Referanslar

Keçecioğlu, T., 2008. Stratejik Düşünmedeki Keskin Viraj Ya Da Soyut Varlıkların Zaferi: Strateji Haritaları, Ege Akademik Bakış, 8 (2), 469-485.

Kaplan, R.S. ve Norton, D. P. 2005. Strategymaps: Convertingintangibleassetsintotangibleoutcomes, Boston: HarvardBusiness School Press.

USE OF 3D PRINTERS IN EDUCATION

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Abstract: 3D printing technology which is the latest trend technology, is possible to use in many areas. Examples include industrial manufacturing, medicine and health, aviation and space, architecture and construction, military applications, textiles, food, education and many other areas. The education title has a strategic importance for 3D printers. It is seen as an important tool in increasing creativity in interactive, mechanical and technical courses. With the effective use of this technology in the educational environment, different experiences can be experienced in different areas. Designing, printing and calculating 3D objects in mathematics. Through the use of 3D printer technologies that include many examples of applications such as designing and printing reliefs in geography, designing and printing artistic objects in art education, printing molecular models in biology, explaining challenging concepts to learners, attracting students to participate more effectively in class, classroom interaction may be easier. In this way, students will be able to prepare for their careers and gain valuable skills for the future. In this study, the use of 3D printer in education has been examined.

***Keywords*:** 3D Printing, addditive manufacturing education

3D YAZICILARIN EĞITIMDE KULLANIMI

Özet: Son dönemin trend teknolojisi olan 3 boyutlu yazıcı teknolojisini birçok alanda kullanmak mümkün. Endüstriyel imalat, tıp ve sağlık, havacılık ve uzay, mimarlık ve inşaat, askeri uygulamalar, tekstil, gıda, eğitim ve diğer birçok alan buna örnek olarak verilebilir. Eğitim başlığı 3 boyutlu yazıcılar için stratejik bir öneme sahiptir. İnteraktif olarak geçen, mekanik ve teknik derslerdeki yaratıcılığın arttırılmasında önemli bir araç olarak görülmektedir. Bu teknolojinin eğitim ortamında etkin bir şekilde kullanımı ile çok farklı alanlarda farklı deneyimler yaşanabilmekte. Matematik'de 3 boyutlu objelerin dizayn edilmesi, yazdırılması ve hesaplanması. Coğrafya'da rölyefler tasarımı ve baskısı, sanat eğitimde sanatsal nesnelerin tasarlanıp yazdırılması, Biyoloji'de molekül modellerinin basımı gibi birçok uygulama örneği bulunan 3 boyutlu yazıcı teknolojileri sayesinde, zorlu kavramların öğrencilere açıklanması, öğrencilerin ilgisini çekip daha etkin derse katılımlarının sağlanması ve sınıf içi etkileşim daha kolay olabilmektedir. Bu sayede geleceğe dönük olarak, öğrencilerin kariyerlerine hazırlanma ve kendilerine değerli beceriler kazandırılabilme imkanı sağlanabilmektedir. Bu çalışmada 3 boyutlu yazıcıların eğitimde kullanımı incelenmiştir.

***Anahtar Sözcükler*:** Üç boyutlu yazma, eklemeli imalat, eğitim

Giriş

Son yılların trend başlığı eklemeli imalat teknolojileri ve uygulamaları birçok kulvarda önemli bir çalışma alanı haline gelmiştir. Eklemeli imalatı, malzemelerin katmanlar halinde yazılmasıyla belirli bir modelin üç boyutlu olarak imal edilmesi olarak tanımlayabiliriz. Yeni endüstriyel devrim olarak tanımlanan Endüstri 4.0'ın da önemli bir bileşeni olan 3D yazıcıların üretim iş modellerinde önemli değişiklikler getireceği düşünülmekte. Bu teknoloji düşük malzeme kullanımı, ürünlerin hafifliği ve çok fonksiyonlu bileşenlerin tasarımına imkan vermektedir. Eklemeli imalat teknolojileri ilerledikçe yeni malzemelerin imalatı sağlanabilecektir. Geleneksel olarak, imalat için tasarım yapmak, imalat karmaşıklıklarını, güçlükleri ortadan kaldırarak ve imalat maliyetini en aza indirgeyerek daha iyi ürünler tasarlamak anlamına gelmektedir. Eklemeli imalatın (AM) benzersiz özellikleri, kompleks geometrik, çok malzemeli, çok işlevli parçaları tek bir işlemde herhangi bir ilave masrafa gerek kalmaksızın kullanabildiğinden, eklemeli imalat (AM) tasarımı temelde farklı bir anlama sahip. Bu nokta, geleneksel imalat proseslerine göre büyük bir avantaj sağlamakta. Bununla birlikte, bu avantajdan faydalanabilmek için, malzeme bilgilerini tasarım ve imalat simulasyonları ile bütünleştiren sofistike tasarımcı becerileri ve araçları gereklidir. Karmaşık geometrik şekiller üç boyutlu yapılardır ve bunlar genellikle alt kısımları veya içi boşluklu yapılardır. Organik yapılar böyle karmaşık yapıların bir örneğidir. Tornalama, frezeleme, kalıplama ve dökme gibi konvansiyonel teknolojiler karmaşık yapıların yaratılmasında ancak sınırlı bir başarısı vardır ve aşırı maliyet ve zaman gerektirebilir. Eklemeli imalatın gelecekteki kullanımı belirsiz olsa da, karmaşık geometrik şekillere sahip çok özel ve çok fonksiyonlu parçalar için endüstrideki uygulamaların yakın zamanda genişlemesi beklenmekte.

3D yazdırma teknolojilerinden etkin olarak faydalanmaya yardımcı olacağını düşünülen maddeler şunlardır;
* Geleneksel imalatta nesnenin şekli ne kadar karmaşıksa, o kadar çok maliyetlidir. 3D bir yazıcıda, karmaşıklık maliyeti sadelikle benzerdir. Bu teknoloji fiyatlandırma modellerine yeni bir bakış açısı kazandıracaktır.
* Tek bir 3D yazıcı birçok şekle dönüşebilir. Geleneksel imalat makineleri çok daha az çok yönlüdür ve yalnızca işleri sınırlı bir spektrumda yapabilirsiniz. 3D baskı, insan makine mühendislerini yeniden eğitmek veya fabrika makinelerini yeniden teçhiz etmekle ilişkili genel masrafları ortadan kaldırır. Tek bir 3D yazıcının yalnızca farklı bir dijital plana ve hammaddeye ihtiyacı vardır.
* Toplu üretim, montaj hattının omurgası üzerine inşa edilmiştir. Modern fabrikalardaki makineler, daha sonra robotlar ya da insan çalışanları, bazen de kıtalar tarafından birleştirilen aynı nesneleri üretir. Bir üründe ne kadar fazla parça varsa, o kadar uzun süre toplanacak ve daha pahalı hale gelecektir. Nesneleri tabakalaştırarak bir 3D yazıcı, aynı anda bir kapı ve bağlı menteşeleri basabilir, montaj gerektirmez. Daha az montaj, tedarik zincirlerini kısaltır, emek ve ulaşımda tasarruf sağlar;
* Bir 3D yazıcı, bir nesneye ihtiyaç duyulduğunda isteğe bağlı olarak yazdırabilir. Yerinde üretim kapasitesi, şirketlerin fiziksel envanter stoklamasına olan ihtiyacı azaltır. Üç boyutlu yazıcılar, bir işletmenin müşteri siparişlerine yanıt olarak talep üzerine özel veya özel objeler yapmasına olanak tanıdığından, yeni türde ticari hizmetler mümkün hale gelir.
* Geleneksel imalat teknolojilerinde farklı tasarımda şekiller oluşturma kapasitemiz, elimizdeki araçlar sayesinde sınırlıdır. Örneğin, geleneksel bir ahşap torna tezgahı sadece yuvarlak nesneler üretebilir. Değirmen, bir freze aleti ile erişilebilen parçaları yalnızca üretebilir. Bir kalıplama makinesi sadece kalıplara dökülebilen ve daha sonra bir kalıptan çıkarılan şekilleri üretebilir. Bir 3D yazıcı bu engeller kaldırır ve geniş yeni tasarım alanlarını açar. Bir yazıcı şimdiye kadar sadece doğada mümkün olan şekilleri imal edebilir.
* Bir 3D yazıcı rehberliğinin çoğunu bir tasarım dosyasından alır. Eşit bir karmaşıklığa sahip bir nesne yapmak için bir 3D yazıcı, bir püskürtmeli kalıplama makinesinden daha az operatör kabiliyeti gerektirir.
* Bir üretim biriminin hacmine göre, bir 3D yazıcı geleneksel bir imalat makinesinden daha fazla üretim kapasitesine sahiptir. Örneğin, bir püskürtmeli kalıplama makinesi yalnızca nesneleri kendi başına daha küçük hale getirebilir. Buna karşılık, bir 3D yazıcı nesneleri baskı yatağı kadar geniş yapabilir. Bir 3D yazıcı ayarlanmışsa, yazdırma aygıtı serbestçe hareket edebilir, bir 3D yazıcı kendi kendinden daha büyük nesneler üretebilir.
* Daha az atık yan ürün. Metal içinde çalışan 3D yazıcılar, geleneksel metal üretim tekniklerine göre daha az atık üretirler.
* Farklı hammaddeleri tek bir üründe birleştirmek günümüz imalat makinelerini kullanarak zordur. Geleneksel imalat makineleri, parçaları parçalayarak, keserek veya kalıba döktüğünden, bu işlemler farklı hammaddeleri kolayca karıştıramaz. Çok malzemeli 3D baskı geliştikçe, farklı hammaddeleri harmanlayıp karıştırma kapasitesini kazanılacaktır.
* Hassas fiziksel replikasyon. Bir dijital müzik dosyası, ses kalitesini kaybetmeden sonsuza kadar kopyalanabilir. Gelecekte 3D baskı bu dijital hassaslığı fiziksel nesnelerin dünyasına genişletecek. Tarama teknolojisi ve 3D baskı, birlikte fiziksel ve dijital dünyalar arasında yüksek çözünürlüklü şekil değiştirmeyi getirecektir.

Eğitimde 3D Yazıcı Teknolojisi

3 boyutlu (3D) yazıcı teknolojisini birçok alanda kullanmak mümkün. Endüstriyel imalat, tıp ve sağlık, havacılık ve uzay, mimarlık ve inşaat, askeri uygulamalar, tekstil, gıda, eğitim ve diğer birçok alan buna örnek olarak verilebilir. Eğitim başlığı 3 boyutlu (3D) yazıcılar için stratejik bir öneme sahiptir. İnteraktif olarak geçen, mekanik ve teknik derslerdeki yaratıcılığın arttırılmasında önemli bir araç olarak görülmektedir. Bu teknolojinin eğitim ortamında etkin bir şekilde kullanımı ile çok farklı alanlarda farklı deneyimler yaşanabilmektedir. İlköğretimden üniversiteye kadar, okullar kullanılan 3D yazıcılar güven arttıran ve öğrencilerin hayal gücünü artıran yeni ve yeni öğrenme fırsatları sunan bir teknolojidir. Bu teknoloji eleştirel düşünme açısından paradigmayı değiştirirken, öğrencileri mantık ve mantık kullanarak sorunları çözen fiziksel nesneler yaratma yetkisi vermektedir. Etkileşimli, mekanik ve teknik dersler oluşturmak için bazı okulda 3D baskı teknolojileri kullanılmaktadır. Bu, genç akıllara ilham vererek ve öğrenmeyi daha eğlenceli hale getirmektedir. Mimarlık eğitimi, sanat eğitimi, biyoloji eğitimi, kimya eğitimi, jeoloji eğitimi, tarih eğitimi, matematik eğitimi, bilim ve mühendislik eğitimi gibi alanlarda 3D yazıcı teknolojilerinin kullanımı görülmektedir.

Literatür Araştırması

Daha önce "Hızlı Prototipleme" olarak bilinen 3D baskı, 1990'lardan beri tasarımla ilgili dersleri geliştirmek için mühendislik eğitiminde kullanılmıştır (Zecher 1998). Yıllar geçtikçe, yavaş yavaş birinci sınıf tasarım ve taslak hazırlama dersleri ile üst düzey capstone projeleri için tasarım ve imalat müfredatının önemli bir bileşeni haline gelmiştir. (Stamper ve ark., 2000, Lantada ve ark., 2010). 3D baskının mühendislik eğitiminde bu kadar popüler hale gelmesinin başlıca nedeni, geleneksel işleme süreçlerine kıyasla operasyonunun basit olması ve öğrenme deneyimini önemli derecede etkileyen spontan sonuçlar vermesidir (Stamper ve ark., 2000, Maletsky ve ark., 2003). Literatürden 3D baskının görselleştirme, gerçek dünya uygulamalarını sunma ve kuramlar ile uygulamalar arasındaki boşluğu kapatmada yararlı olduğu gözlemlenmiştir (Johnson ve ark., 2009, Kim ve ark., 2004). Bu tasarımlar, CNC değirmeni veya torna tezgahı gibi geleneksel işleme yöntemleri kullanılarak üretilmesi zor olan karmaşık geometrik yapıları içerir. 3D baskı ile, prototipler kolayca imal edilebilir ve öğrenci projeleri makul zaman aralığı ve bütçe aralığı içerisinde tamamlanabilir.

Serbest dolum kabiliyeti ve yakın zamanda temin edilebilen çok malzemeli işlemler, kullanım kolaylığına ek olarak, mühendislik uygulamaları ve diğer bazı alanlar için yeni bir pencere açmakta. Üretilebilirliğin geleneksel görüşü bu yeni teknoloji tarafından sorgulanmaktadır. 3D taramanın yanı sıra, 3D baskının imalat eğitiminde "yeni bir sınır" tanımladığı düşünülmektedir (Sinha, 2009).

Mühendislik eğitmenlerinin erişimde böylesine canlı bir teknolojiye sahip olmaları büyük bir avantaj. Fakat bazı durumlarda, öğrenciler makinelerin yeteneğinin ötesinde şeyler tasarlayabildiğinden, öğrenci projeleri başarısız olabilmekte. Wan ve Syed (2012), boyutsal, fonksiyonel, operasyonel ve ekonomik konularda 3D baskı kullanma konusundaki bu problemleri özetlemişlerdir. Bu nedenle, mühendislikte eğitimcilerin, öğrencileri yeni teknolojiyi kullanmaya hazırlaması gerekmektedir. (Wan, 2015).

ABD Michigan'da bir grup eğitici, açık kaynaklı 3D baskının nasıl uygulanabileceğini öğrenmek ve özellikle bilim, mühendislik, teknoloji ve matematik alanlarında müfredatı iyileştirmek için bir atölye çalışması yapılmıştır (Schelly ve ark, 2015). Kuzey Carolina'daki bir lisede bir STEM programı, biyoloji ve mühendislik deneylerle "cep telefonu kameraları için mikroskop adaptörleri tasarlama ve yazma", "roketler için robotik ve elemanlar tasarım ve baskı" gibi konularda çalışmalar yapılmıştır (Hathcock, 2014).

Virginia'daki bir orta okuldaki sekizinci sınıf öğrencileri, elektrik konusundaki bir dersin parçası olarak konuşmacılar için üç boyutlu bas ve konileri tasarlamıştır (Virginia Middle Schoolers, 2014). Bu dersler öğrencileri ileri imalat sanayinde işlere hazırlamak amacıyla düzenlenmiştir.

Çin'de bir grup araştırmacı, 10 yaşındaki öğrencilerin mekansal yeteneklerini incelemek için bir 3D baskı kursu düzenlemiş, öğrencilerin zihinsel rotasyon becerilerini belirlemek için bir ön test çalışması yapmıştır. Daha sonra, deney grubuna Google'ın SketchUp ve 3D yazıcıdaki baskı modelleri gibi 3D araçların kullanımı konusundaki yedi aylık bir ders verilmiştir. Sonuçlar "kızların gelişimi mekansal yeteneklerinin erkeklerinkinden daha hızlı olduğunu" ve 3D baskı kursunun erkeklerin zihinsel dönüş yeteneğini önemli ölçüde geliştirdiğini göstermiştir (Chen ve ark., 2014).

Yunanistan'da iki lisede 33 öğrenciden oluşan bir grubun kör çocukların görme engeli yazıları olan eserler oluşturmasını ve kör ve kör olmayan öğrenciler arasındaki iletişimi güçlendirmesi ve eğitimi amacıyla 3D baskıyı denemişlerdir (Kostakis ve ark., 2015).

Sonuç ve Öneriler

3D baskı teknolojileri günümüz dünyasında kilit öneme sahip bir konuma gelmektedir. Bu çalışmada endüstriyel imalat, tıp ve sağlık, havacılık ve uzay, mimarlık ve inşaat, askeri uygulamalar, tekstil, gıda, eğitim ve diğer birçok alanda kullanılan bu teknolojinin eğitim alanındaki çalışmaları incelenmiştir. Eğitim başlığı altındaki çalışma ile 3D baskı teknolojisinin hem eğitim sürecinde hem de eğitim sonrası iş hayatında önemli avantajlar getirebileceği öngörülmüştür. Henüz çok yaygın olmaması nedeniyle bu teknolojinin eğitim alanında daha etkin kullanılmasının yolları aranmalıdır. Sonuç olarak eğitim politikalarının bu yeni teknolojiye uygun hale getirilmesi ve eğitim içeriklerinin bu teknolojilerle daha entegre bir yapıya dönüştürülmesi ile eğitim verimliliğin arttırılabileceği önerilmektedir.

Kaynaklar

Wan H., 2015, Proceedings of the 2015 ASEE Gulf-Southwest Annual Conference, 3D Printing for Engineering Students – Understanding and Misunderstanding, American Society for Engineering Education

Zecher, J., 1998, “Integration of a Rapid Prototyping System in a MET Curriculum,” Proceedings of 1998 ASEE Annual Conference & Exposition, Session 3549.

Stamper, R. E. and Dekker, D. L., 2000, “Utilizing Rapid Prototyping to Enhance Undergraduate Engineering Education,” Proceedings of the 30th ASEE/IEEE Frontiers in Education Conference, Session F3C, pp.1-4.

Lantada, A. D., Morgado, P. L., Sanz, J. L. M., Munoz-Guijosa, J. M., and Otero, J. E., 2010, “Toy Design Experience: Improving Students’ Motivation and Results in a Final Year Subject,” Proceedings of 2010 IEEE Education Engineering (EDUCON), pp.1481-1487.

Maletsky, L. P. and Hale, R. D., 2003, “The Practical Integration of Rapid Prototyping Technology into Engineering Curricula,” Proceedings of 2003 ASEE Midwest Section Meeting.

Johnson, W. M., Coates, C. W., Hager, P., and Stevens, N., 2009, “Employing Rapid Prototyping in a First-Year Engineering Graphics Course,” Proceedings of 2009 ASEE Southeast Section Conference.

Kim, I. Y., De Weck, O., Nadir, W., Young, P., and Wallace, D., 2004, “Innovative Modern Engineering Design and Rapid Prototyping Course: A Rewarding CAD/CAE/CAM Experience for Undergraduates,” Proceedings of 2004 ASEE Annual Conference & Exposition, Session 332.

Sinha, A., 2009, “New Frontiers in Manufacturing Education: Rapid Prototyping, 3D Scanning and Reverse Engineering,” Proceedings of 2009 ASEE Southeast Section Conference.

Wan, H. and Syed, F.A., 2012, “Preparing to Use Rapid Prototyping: Lessons Learned from Design and Manufacturing Projects,” 2012 ASEE Annual Conference & Exposition, June 10-13, San Antonio, TX.

Rachael E. Elrod, (2016) "Classroom innovation through 3D printing", Library Hi Tech News, Vol. 33 Issue: 3, pp.5-7.

Chen, M., Zhang, Y. and Zhang, Y. (2014), “Effects of a 3D printing course on mental rotation ability among 10-year-old primary students”, International Journal Of Psychophysiology, Vol. 94 No. 2, p. 240.

Hathcock, L. (2014), “A look inside a high school MakerSpace lab”, http://go.galegroup.com/ps/i.do?id=GALE%7CA392304104&v=2.1&u=gain40375&it=r&p=&sw=w&asid=690302ac6ee8dab1187a4946d1f876bb.

Kostakis, V., Niaros, V. and Giotitsas, C. (2015), “Open source 3D printing as a means of learning: an educational experiment in two high schools in Greece”, Telematics & Informatics, Vol. 32 No. 1, pp. 118-128, (accessed 20 October 2015).

Schelly, C., Anzalone, G., Wijnen, B. And Pearce, J. (2015), “Open-source 3-D printing technologies for education: bringing additive manufacturing to the classroom”, Journal Of Visual Languages & Computing, Vol. 28, pp. 226-237.

Virginia Middle Schoolers (2014),“Virginia middle schoolers make electricity real”, Teaching & Learning, Vol. 35 No. 2, p. 24.

EXAMINATION OF HIGH SCHOOL STUDENTS' ENVIRONMENTAL ATTITUDES ACCORDING TO THEIR LOGICAL/ INTUITIVE THINKING AND EMOTIONAL INTELLIGENCE

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Abstract: The aim of this study was to examine the relationship between high school students' emotional intelligence, logical and intuitive thinking skills and attitudes towards environment. The study sample consists of 994 students enrolled in high schools in downtown Ankara. To determine the students' logical and intuitive thinking styles, the "Logical/ Intuitive Thinking Scale" developed by Pacini and Epstein (1999) and adapted by Turk (2077). In order to determine student's EQ levels, Emotional Intelligence Scale developed originally by Schutte et. al. (1998), which was later modified by Austin et.al. (2004) and translated into Turkish by Gocet (2006), was administered. The final assesment tool that was used in the study was the "Environmental Attitude Scale" developed by Unal (2010). The analysis concluded that there were positively significant relationships between student's scores at the three assessment tools.

***Keywords*:** Environmental education, environmental attitude, emotional intelligence, logical/ intuitive thinking

LİSE ÖĞRENCİLERİN ÇEVREYE YÖNELİK TUTUMLARININ SEZGİSEL/MANTIKSAL DÜŞÜNME VE DUYGUSAL ZEKÂLARINA GÖRE İNCELENMESİ

Özet: Bu çalışmanın amacı lise öğrencilerinin duygusal zekâ, mantıksal/sezgisel düşünme becerileri ile çevreye yönelik tutumları arasındaki bağlantıları incelemektir. Bu araştırmanın örneklemini Ankara'da öğrenim görmekte olan 994 lise öğrencisi oluşturmuştur. Öğrencilerin mantıksal ve sezgisel düşünme stillerini belirlemek için, Pacini ve Epstein (1999) tarafından geliştirilen ve Türk (2011) tarafından uyarlanan "Mantıksal /Sezgisel Düşünme Ölçeği" kullanılmıştır. Öğrencilerin duygusal zekâ düzeylerini belirlemek için Schutte ve arkadaşları (1998) tarafından geliştirilen, daha sonra Austin ve ark. (2004) tarafından modifiye edilen (2004) ve Göçet (2006) tarafından Türkçe'ye çevrilen Duygusal Zekâ Ölçeği kullanılmıştır. Ayrıca çalışmada son olarak Ünal (2010) tarafından geliştirilen "Çevre Tutum Ölçeği" değerlendirme aracı olarak kullanılmıştır. Analiz sonucunda öğrencilerin üç değerlendirme aracından elde ettikleri puanları arasında pozitif yönde anlamlı ilişkilerin olduğu sonucuna varılmıştır.

***Anahtar Sözcükler*:** Çevre eğitimi, çevreye yönelik tutum, duygusal zekâ, mantıksal/sezgisel düşünme

Giriş

Gün geçtikçe büyük bir ivme ile artan çevre sorunlarının belirlenmesine ve söz konusu sorunların bir an önce çözülmesine yarar sağlayacak çalışmaların artırılması, bu alanda gerçekleştirilen eğitiminin kalitesine önemli ölçüde bağlıdır (Aldrich & Benjamin, 1997; Brisk, 2000). Toplumun çevre konusunda yeterince bilgi ve bilince sahip olmasının, duyarlı ve olumlu davranış değişikliklerinin sağlanmasının, doğal çevrenin korunmasının ve zarar görmüş çevrenin yeniden kazanılmasının temelinde eğitim yatmaktadır (Ünal, 2010). Çevre eğitimi, insan, kültür ve biyofiziksel çevre arasındaki ilişkiyi anlamak ve kabullenmek amacıyla önemli tutumlar ve beceriler geliştirmek için düşünceleri anlaşılır kılma ve değerleri onaylama sürecidir. Çevre eğitimi, aynı zamanda, çevre kalitesiyle ilgili sorunlar hakkındaki davranış şifresinin bireysel olarak çözülmesinde ve karar almada uygulama yapmayı gerekli kılmaktadır (Palmer, 1998). Çevreye yönelik tutum, bireylerin çevreyle ilgili değer yargılarının, hislerin çevrenin korunmasını, düzeltilmesini sağlamak için gerekli güdülenmenin kazanılmasına yardımcı olan ve çevreye yönelik olumlu ve olumsuz tavırlar sergileme biçiminde kendini gösteren öğrenilmiş eğilimlerdir (Brause, 1993).

Çevreye yönelik tutum eğilim olarak düşünüldüğünde bireyleri bu eğilime yönlendiren faktörler nelerdir sorusu akıllara gelebilir. Örneğin, bireyin zekası ve düşünme stili onu çevreye yönelik nasıl bir tutum sergileme eğilimine yönlendirir? Zekâ ile çevreye yönelik tutum arasında bir bağıntı olabilir mi? Zeka bireyin amaca yönelik davranma, mantıklı düşünme ve çevresiyle verimli bir etkileşim kurma (Wechsler, 1940) iken duygusal zekâ, insanların duyguları algılama ve anlama kapasiteleri arasındaki farkları oluşturan beceriler setidir. Duygusal zekâ bireyin duyguları algılama ve ifade etme, duyguyu düşünceye asimile etme, duygu ile anlama, kendisinin, başka insanların duygularını düzenleme ve mantık yürütme yetisidir (Mayer & Salovey, 1997). Mantık yürütme mantıksal düşünme süreciyle bağlantılıdır. Mantıksal düşünme kişinin geleneksel olarak yerleşmiş mantık kurallarına ve bulgularına dayalı olarak akıl yürütmesi olarak tanımlanmaktadır. Sezgisel düşünme ise otomatik, bütüncül ve ilişkilendirmeci bir biçimde çalışan ve duygusal önem içeren geçmiş deneyimlerin etkisine açık düşünme biçemi olarak tanımlanır (Denes-Raj & Epstein, 1994). Okul öğrenmeleri daha çok mantıksal düşünmeyi gerektiren görevlerden oluşmaktadır. Ancak mantıksal/sezgisel sistemin paralel çalışmaları nedeniyle sezgisel sistemin mantıksal sistemi olumsuz etkilemesi, mesela bir yanlılık yaratması, mümkündür. Öğrenci aksi gerektiği halde genellemelere dayalı, hızlı ve otomatik karar verme süreçlerini işletebilmektedir Türk (2011). Bu nedenle bu çalışmada çevreye yönelik tutum, duygusal zekâ ve mantıksal/sezgisel düşünme biçemi etkileşimli değişenler olarak ele alınmıştır. Söz konusu etkileşim çalışmanın amacı olarak belirlenmiştir.

Yöntem

Araştırmada lise öğrencilerinin çevreye yönelik tutum, duygusal zekâ, mantıksal/sezgisel düşünme düzeylerinin ve aralarındaki ilişkilerin belirlenmesi amaçlanmıştır. Araştırma, ilişkisel tarama modeliyle gerçekleştirilmiştir. Araştırmada veri toplama araçlarının uygulandığı okullar basit yansız örnekleme yöntemiyle belirlenmiştir. Bu araştırmanın evrenini lise öğrencileri oluştururken, çalışılabilir evrenini ise söz konusu grup içerisinden random yoluyla seçilen Ankara'da öğrenim gören öğrenim görmekte olan 994 lise öğrencisi oluşturmuştur. Araştırmadan elde edilen veriler arasındaki ilişki, Pearson Korelasyon Katsayısı ile hesaplanırken, bağımsız t-testi ile de ortalamalar hesaplanarak incelenmiştir.

Çalışmanın Veri Toplama Araçları

Araştırmada öğrencilerin mantıksal ve sezgisel düşünme biçimlerini belirleyebilmek için Pacini ve Epstein (1999) tarafından geliştirilen ve Türk (2011) tarafından Türkçe'ye uyarlanan "Mantıksal ve Sezgisel Düşünme Ölçeği" kullanılmıştır. Ölçek, mantıksal düşünme ve sezgisel düşünme olmak üzere iki boyuttan oluşmaktadır. Buna göre Cronbach alfa değerinin ölçeğin geneli için. 75, sezgisellik alt boyutu için.79 ve mantıksal düşünme alt boyutu için .71 olduğu ortaya çıkmıştır (Türk, 2011). 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. Araştırmada Schutte ve diğerleri (1998) tarafından geliştirilen ve Türkçe'ye uyarlama çalışması Göcet (2006) tarafından yapılan Duygusal Zekâ Ölçeği kullanılmıştır. Duygusal Zekâ Ölçeği, "iyimserlik, duyguların ifadesi ve duygulardan faydalanma" olmak üzere üç boyutlu bir ölçektir. DZÖ'nün Göcet (2006) tarafından Cronbach Alpha (α), iç tutarlılık katsayıları ölçeğin bütünü için. 81, iyimserlik faktörü için .77, duyguların ifadesi için .73 ve duygulardan faydalanma faktörü için .54 olarak bulunmuştur.

Bulgular

Araştırmada öncelikli olarak öğrenciler, mantıksal ve sezgisel düşünme biçimlerinden hangisini daha baskın kullandıklarına göre iki gruba ayrılmıştır. Söz konusu gruplama Mantıksal ve Sezgisel Düşünme Ölçeği puanlarına göre gerçekleştirilmiştir. Öğrencilerin ağırlıklı olarak kullandıkları düşünme biçimlerine ilişkin frekans ve yüzde dağılımları Tablo 1'de verilmiştir.

Tablo 1. Düşünme biçimlerine ilişkin frekans ve yüzde dağılımları

Düşünme Biçimleri	**f**	**%**
Mantıksal Düşünme	499	50.2
Sezgisel Düşünme	495	49.8
TOPLAM	994	100

Tablo 1'e göre araştırmaya katılan öğrencilerin % 50.2'si ağırlıklı olarak mantıksal ve % 49.8'i de sezgisel düşünme biçimine sahiptirler. Başka bir ifadeyle örneklem seçiminde öğrenci oranları düşünme biçimlerine göre birbirine yakın olmuştur.

Öğrencilerin Mantıksal/Sezgisel Düşünme Biçimleri Açısından Duygusal Zekâ Farklılıklarına İlişkin Bulgular

Öğrencilerin duygusal zekâ puan ortalamalarının mantıksal/ sezgisel düşünme biçimlerine göre farklılaşıp farklılaşmadığını belirlemek için bağımsız t-testi uygulanmıştır. Elde edilen bulgular aşağıda özetlenmiştir (Tablo 2).

Tablo 2. Mantıksal/sezgisel düşünme biçimine göre duygusal zekânın karşılaştırılmasına ilişkin t testi sonuçları

Duygusal Zeka	Düşünme Biçimleri	Ortalama	Standart Sapma	t	sd	p
İyimserlik	Mantıksal	3.75	.564	2.09	992	.037
	Sezgisel	3.82	.545			
Duygulardan Faydalanma	Mantıksal	3.18	.865	2.51	992	.012
	Sezgisel	3.31	.834			
Duyguların İfadesi	Mantıksal	3.28	.707	3.62	992	.000
	Sezgisel	3.44	.697			
Duygusal Zeka	Mantıksal	3.47	.551	3.30	992	001
	Sezgisel	3.58	.554			

Tablo 2'de görüldüğü gibi, sezgisel düşünen öğrencilerle mantıksal düşünen öğrencilerin duygusal zekânın iyimserlik, duyguların ifadesi ve duygulardan faydalanma alt boyutlarında ve ölçeğin genelinde anlamlı fark bulunmaktadır. Elde edilen bulgulara göre sezgisel düşünen öğrencilerin duygusal zekaları mantıksal düşünen öğrencilere göre daha yüksek çıkmıştır.

Öğrencilerin Mantıksal/Sezgisel Düşünme Biçimleri Açısından Çevreye Yönelik Tutum Farklılıklarına İlişkin Bulgular

Öğrencilerin çevreye yönelik tutumlarının düşünme biçimlerine göre farklılaşıp farklılaşmadığını anlamak amacıyla "t- testi" yapılmıştır. Analiz sonucunda elde edilen bulgular Tablo 3'te sunulmuştur.

Tablo 3. Mantıksal/sezgisel düşünme biçimine göre çevreye yönelik tutumlarının karşılaştırılmasına ilişkin t testi sonuçları

Çevreye Yönelik Tutum	Düşünme Biçimleri	Ortalama	Standart Sapma	t	sd	p
Tutum	Mantıksal	4.23	.502	-.135	992	.892
	Sezgisel	4.24	.511			
Davranış	Mantıksal	3.63	.697	-1.231	992	.218
	Sezgisel	3.69	.660			
Farkındalık	Mantıksal	3.93	.516	-1.196	992	.232
	Sezgisel	3.97	.517			
Çevreye Yönelik Tutum	Mantıksal	3.92	.487	-1.103	992	.270
	Sezgisel	3.96	.482			

Tablo 3 incelendiğinde sezgisel düşünen öğrencilerle mantıksal düşünen öğrencilerin çevreye yönelik tutumlarında anlamlı farklılıklar bulunmadığı görülmektedir. Başka bir ifadeyle, öğrencilerin çevreye yönelik tutumları düşünme biçimlerine göre istatistiksel açıdan anlamlı bir fark göstermemektedir Ancak sezgisel düşünen öğrencilerin davranışa yönelik puanlarına ait aritmetik ortalamaları incelendiğinde (X=3.69), mantıksal düşünen öğrencilerin ortalamasından (X=3.63) yüksek olduğu görülmektedir. Dolayısıyla sezgisel düşünen öğrencilerin çevre ile ilgili davranışlarında mantıksal düşünen öğrencilere göre daha bilgili oldukları söylenebilir. Farkındalığa yönelik aritmetik ortalamalar incelendiğinde sezgisel düşünen öğrencilerin puan ortalamasının (X=3.97), mantıksal düşünen öğrencilerin ortalamasından (X=3.93) yüksek olduğu dikkat çekmektedir. Her ne kadar bu fark istatistiksel olarak anlamlı olmasa da sezgisel düşünen öğrencilerin çevre ile ilgili farkındalık düzeylerinin mantıksal düşünen öğrencilerden daha ilerde olduğu söylenebilir. Ölçekten elde edilen puanların aritmetik ortalamasına bakıldığında sezgisel düşünen öğrencilerin çevreye yönelik tutumlarının (X=3.96), mantıksal düşünen öğrencilere göre (X=3.92)daha yüksek olduğu ortaya çıkmıştır. Gruplara ait aritmetik ortalamalar incelendiğinde, mantıksal düşünen öğrencilerin tutum ortalamasının (X =4.23), sezgisel düşünen öğrencilerin tutum ortalamasıyla (X=4.24) hemen hemen aynı değerlerde olduğu görülmektedir. Bu bulguya göre mantıksal düşünen öğrenciler ile sezgisel düşünen öğrenciler arasında tutumları bakımından önemli bir fark bulunmamaktadır.

Öğrencilerin Mantıksal/Sezgisel Düşünme Biçimi, Duygusal Zeka Faklılıkları ile Çevreye Yönelik Tutumları Arasındaki İlişkiye Yönelik Bulgular

Öğrencilerin, Çevre Tutum ve Duygusal Zeka Ölçeklerinden aldıkları puanlar arasındaki ilişkiyi incelemek üzere Pearson Korelasyon Katsayıları hesaplanmıştır. Elde edilen sonuçlar Tablo 4'te gösterilmiştir.

Tablo 4. Duygusal zeka ve çevreye yönelik tutum puanlarına ilişkin pearson korelasyon katsayıları

Duygusal Zeka	**r**	İyimserlik	Duygulardan Faydalanma	Duyguların İfadesi
Tutum	r	.353	.024	.085
	p	.000*	.450	.008*
Davranış	r	.369	.180	.208
	p	.000*	.000*	.000*
Farkındalık	r	.427	.033	.133
	p	.000*	.293	.000*

* Correlation is significant at the 0.01 level (2-tailed)

Tablo 4'te görüldüğü gibi öğrencilerin duygulardan faydalanma ile tutumları ve farkındalık düzeyleri arasında anlamlı ilişkilerin bulunmadığı belirlenmiştir. Diğer alt boyutlarda pozitif yönlü anlamlı ilişkiler olduğu ortaya çıkmıştır.

Tablo 5. MSDÖ, ÇTÖ ve DZÖ puanlarına ilişkin pearson korelasyon katsayıları

Duygusal Zeka		Mantıksal/Sezgisel Düşünme	Çevreye Yönelik Tutum	Duygusal Zeka
Mantıksal/Sezgisel	r	1	.408	.536
Düşünme	p		.000*	.000*
Çevreye Yönelik	r	.408	1	307
Tutum	p	.000*		.000*
Duygusal Zeka	r	.536	.307	1
	p	.000*	.293	.000*

* Correlation is significant at the 0.01 level (2-tailed)

Tablo 5'te verildiği gibi, öğrencilerin çevreye yönelik tutum, mantıksal/sezgisel düşünme ve duygusal zeka düzeyleri arasında pozitif yönlü anlamlı ilişkiler olduğu ortaya çıkmıştır. Dolayısıyla öğrencilerin çevreye yönelik olumlu/olumsuz tutum geliştirmelerinde duygusal zeka ve mantıksal/sezgisel düşünme türlerinin etkili olduğu söylenebilir.

Sonuç

Mantıksal ve sezgisel düşünme biçimleri ile ilgili yürütülen çalışmalar daha çok bilişsel kısayol kullanımları, yargı yanlılığı, kişilik özellikleri ve gelişimsel yön ile ilgilidir (Türk, 2011). Alan yazında çevreye yönelik tutum, mantıksal/sezgisel düşünme ve duygusal zeka ile ilgili yürütülmüş bir çalışmaya rastlanamamış olması önemli bir boşluktur. Bu nedenle araştırma sonucundan elde edilen bulgulara paralel çalışma sonuçlarına rastlanmamıştır. Yine de araştırma sonucu elde edilen bulgulara yakın sonuçlar, yapılan taramalar çerçevesinde bu bölümde tartışılmıştır. Literatür taramasında problem çözme, duygusal zeka ve çevreye yönelik tutum arasında nasıl bir ilişki olabileceği yönünde yapılan çalışmalar incelenmiştir. İşmen (2001) tarafından yapılan çalışmada, duygusal zeka düzeyi arttıkça problem çözme becerisi algısının da arttığı belirlenmiştir. Benzer şekilde Mustafaoğlu ve Önen (2017) tarafından yapılan çalışmada da öğrencilerin duygusal zeka düzeyleri ve problem çözme becerileri arasında pozitif yönde anlamlı bir ilişki bulunduğu belirlenmiştir. Aksoy (2003), tarafından yapılan çalışmada öğrencilerin problem çözme yönteminin basamaklarını kullanarak karşılaştıkları çevre sorunlarına mantıklı çözüm yolları geliştirdikleri ve sistemli bir şekilde düşünme becerisi geliştirerek çevre bilincini daha sağlıklı bir şekilde geliştirebildikleri belirlenmiştir. Yapılan bu araştırmada sezgisel düşünen öğrencilerin duygusal zekalarının mantıksal düşünen öğrencilere göre daha yüksek olduğu ortaya çıkmıştır. Ayrıca öğrencilerin çevreye yönelik tutum, mantıksal/sezgisel düşünme ve duygusal zeka düzeyleri arasında pozitif yönlü anlamlı ilişkiler olduğu ortaya çıkmıştır. Dolayısıyla öğrencilerin çevreye yönelik olumlu/olumsuz tutum geliştirmelerinde duygusal zeka ve düşünme türlerinin etkili olduğu söylenebilir.

Araştırmada öğrencilerin duygulardan faydalanma ile tutumları ve farkındalık düzeyleri arasında anlamlı ilişkilerin olmadığı sonucu elde edilirken diğer alt boyutlarda pozitif yönlü anlamlı ilişkiler olduğu ortaya çıkmıştır. Diamond ve Loewy, (1991) tarafından yapılan çalışmada da okullarda verilen eğitimin farkındalığı artırma, tutum ve spesifik bir davranışı değiştirmede yetersiz olduğu gözlenmiştir. Bu sonucun temel nedenlerinden biri genel bir tutum ile spesifik bir davranış arasında yeterli kararlılık ve tutarlılığın bulunmamasıdır (Bell ve diğer., 1996). Araştırmaya katılan öğrencilerin % 50.2'si ağırlıklı olarak mantıksal ve % 49.8'i de sezgisel düşünme biçimine sahip oldukları belirlenmiştir. Türk (2011) bu durumun okul öğrenmelerinin daha çok mantıksal düşünmeyi gerektiren görevlerden oluşmasından kaynaklandığını düşünmektedir. Araştırmadan elde edilen bulgular incelendiğinde sezgisel düşünen öğrencilerin çevreye yönelik tutumlarının, mantıksal düşünen öğrencilere göre daha olumlu olduğu ortaya çıkmıştır. Ancak mantıksal düşünen öğrenciler ile sezgisel düşünen öğrenciler arasında tutumları bakımından istatistiksel olarak önemli bir fark bulunmadığı dikkat çekmektedir. Oysa sezgisel düşünen öğrencilerin tutumlarının mantıksal düşünen öğrencilere göre anlamlı bir şekilde daha olumlu olması beklenmektedir. Bunun nedeni mantıksal/sezgisel sistemin yapısının paralel çalışmaları nedeniyle sezgisel sistemin mantıksal sistemi olumsuz etkilemesinden kaynaklanmaktadır (Türk, 2011). Braus (1993) farkındalık terimini, sosyal gruplara ve bireylere çevreye karşı bilinç ve duyarlılık kazandırma şeklinde tanımlanmaktadır. Nitekim araştırmada sezgisel düşünen öğrencilerin çevre ile ilgili farkındalık düzeylerinin mantıksal düşünen öğrencilerden daha ilerde olduğu belirlenmiştir. Özetle, öğrencilerin çevreyle ilgili değer yargıları kazanmaları, çevrenin korunmasını ve düzeltilmesini görev bilmeleri için liselerde çevre eğitimine gereken önem verilmelidir. Araştırma sonucunda yapılacak sonraki çalışmalarda örneklem genişletilerek, öğrencilerin çevreye yönelik tutumları, çevreye yönelik olumlu ve olumsuz tavırlar sergileme biçemleri irdelenmeli, düşünme stilleri ve duygusal zeka özellikleri bağlamında farklı değişkenler ile sorgulanması önerilmektedir.

Kaynaklar

Aksoy, B. (2003). Problem çözme yönteminin çevre eğitiminde uygulanması. *Pamukkale Üniversitesi Eğitim Fakültesi Dergisi*, 14(2), 83-98.

Aldrich, M. & Benjamin (c1997). *Environmental education*. London: The IEA Education and Training Unit and the IEA Environment Unit.

Brause, J. A. & Wood, D. (1993). *Environmental education in the schools creating a program that works*. USA: Desktop Publishing

Brisk, M.A. (2000). *Çevre dostu 1001 proje, ögrenciler için uygulamalı çevrecilik egitimi*. İstanbul: Beyaz Yayınları. Denes-Raj V., Epsteın S. (1994). Conflict Between Intuitive and Rational Processing: When People Behave Against Their Better Judgment. Journal of Personality and Social Psychology, 66 (5), 819-829.

Diamond, William, D. & Ben, Z. Loewy (1991). Effects of probabilistic rewards on recycling attitudes and behavior. *Journal of Applied Social Psychology*, 21 (19) 1590-1607.

Göçet, E. (2006). *Üniversite öğrencilerinin duygusal zeka düzeyleri ile stresle başaçikma tutumlari arasindaki ilişki*. Yüksek lisans tezi, Sakarya Üniversitesi, Sosyal Bilimler Enstitüsü.

Işmen, A. E. (2001). Duygusal zeka ve problem çözme. *M.Ü. Atatürk Eğitim Fakültesi Eğitim Bilimleri Dergisi*,13, 111-124.

Mayer, J. D. & Salovey, P. (1997). *What is Emotional Intelligence*? Edit: Salovey P. & D.J. Sluyter, *Emotional Development and Emotional Intelligence*. New York: Basic Books.

Mustafaoğlu, F. M. & Önen, A. S. (2017). *Lise öğrencilerinin duygusal zeka düzeyleri ile problem çözme becerileri arasındaki ilişkinin incelenmesi*. 26. Uluslararası Eğitim Bilimleri Kongresi (s.2004-2006). Ankara: Pegem Akademi.

Pacini, R. & Epstein, S. (1999). The relation of rational and experiential information processing styles to personality, basic beliefs, and the ratio-bias phenomenon. *Jounal of Personality and Social Psychology*, 76, 972-987.

Palmer, A. R. (1998). Evaluating ecological footprints. *Electronic Gren Journal*, Special issue 9.

Schutte, N. S., Malouff, J. M., Hall, L. E., Haggerty, D. J., Copper, J. T. & Golden, C. J. (1998). Development and validation of a measure of emotional intelligence. *Personality and Individual Differences*, 25, 167-177.

Türk, E.G. (2011). *Ergenlerin düşünme biçemlerini yordayan faktörler: anne baba, üstbiliş ve epistemolojik inançlar*. DoktoraTezi, Ankara Üniversitesi Eğitim Bilimleri Enstitüsü, Ankara.

Ünal, Ş. (2010). *Ortaöğretim seviyesindeki 10. sınıf öğrencilerinin çevre bilinci düzeylerinin belirlenmesi*. Yüksek Lisans Tezi, Gazi Üniversitesi Eğitim Bilimleri Enstitüsü, Ankara.

Wechsler, D. (1940). The measurement of adult intelligence. *The Journal of Nervous and Mental Disease*, 91(4), 548.

THE THINKING STYLES OF SECONDARY SCHOOL STUDENTS AND THEIR INTERNET USAGE

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Abstract: The aim of this study is to analyze the relationship between thinking styles and using safe internet of secondary school students. Within the scope of the research, data was collected from 69 secondary school students studying in the city center of Ankara. Based on a relational scanning model, the study used "Thinking styles Inventory" developed by Sternberg-Wagner (1992) and adapted to Turkish by Kaya (2009) and Fer (2005), and "Safe Internet Usage Scale" developed by Beder (2015) for the purpose of data collection. According to the results of research; the usage of safe internet, the awareness and beliefs of students are generally higher. The study indicated that students had legislative, executive, judicial, global and local dimensions of thinking styles.

Keywords**:** Secondary school students, safe use of the internet, internet skills, thinking styles.

ORTAOKUL ÖĞRENCİLERİNİN DÜŞÜNME STİLLERİNE GÖRE GÜVENLİ İNTERNET KULLANIMLARI

Özet: Bu çalışmanın amacı ortaokul öğrencilerinin düşünme stilleri ve güvenli internet kullanımı arasındaki ilişkiyi incelemektir. Araştırma kapsamında veriler Ankara il merkezinde öğrenim gören 69 ortaokul öğrencisinden toplanmıştır. İlişkisel tarama modelinden yararlanılan bu araştırmada veriler Sternberg ve Wagner (1992) tarafından geliştirilen; Kaya (2009) ve Fer (2005) tarafından Türkçeye uyarlanan "Düşünme Stilleri Envanteri" ve Beder (2015) tarafından Güvenli İnternet Kullanımı Ölçeği ile elde edilmiştirAraştırma sonuçlarına göre, öğrencilerin güvenli internet kullanımı ile ilgili bilinç düzeyleri genel olarak yüksek çıkmıştır. Öğrencilerin Yasa Yapıcı, Yürütmeci, Yargılayıcı, Bütünsel ve Ayrıntısal Düşünme Stillerine sahip oldukları belirlenmiştir.

Anahtar Sözcükler**:** Ortaokul öğrencileri, güvenli internet kullanımı, internet becerileri, düşünme stilleri.

Giriş

İnternet, çok sayıda bilgisayar sisteminin TCP/IP protokolü ile birbirine bağlandığı, bütün dünyada yaygın olarak kullanılan ve giderek büyüyen bir iletişim ağıdır (Gençer, 2011). Sosyal paylaşım sitelerinin yaygın bir şekilde kullanılmasıyla internet ve mobil cihazlar kişisel etkileşim ve iletişim aracı olarak kullanıldığı için iletişim biçimleri önemli ölçüde değişmiştir (McLoughlin & Burgess, 2009). Özellikle sosyal ağların ve video paylaşım sitelerinin popülerliğinin artması internetin bilinçsiz bir şekilde eğlence amaçlı kullanımını yaygınlaştırmıştır (Davidson & Martellozzo, 2013). Günümüzde sosyal ağlar çocuklar ve gençler arasında yaygın bir şekilde kullanmaktadır (Marwick, 2014). Sosyal ağlar içerisinde ise ilk sırayı hiç şüphesiz Facebook almaktadır (Furnell & Phippen, 2012). İnternetin yaygın kullanımı güvenli internet kullanımı sorunlarını da beraberinde getirmektedir. Bu sorunlar arasında en çok karşılaşılan, internet veya diğer elektronik cihazları kullanarak, başkasına hakaret etme ya da tehdit amacıyla kullanılması olan siber zorbalıktır (Juvoven & Gross, 2008). Uzmanlar ergen ya da genç bireylerde interneti kötüye kullanmaya neden olan faktörler arasında bireyin internet kullanımına ailesinin herhangi bir müdahalede bulunmayışının önemli olduğunu ifade etmektedirler (Young, 2004). Ergen sürekli bir kimlik arayışındadır, bu süreçte internet sadece bir zaman geçirme aracı olmaktan ziyade ergenin kendisine ait sanal bir dünya yaratabileceği bir uzaydır (Yücel, 2009). Young (2004), ergen ya da gençlerde interneti kötüye kullanmaya nedenleri arasında onların sosyal yaşantılar yerine sadece interneti düşünmelerinin bir etken olabileceğini belirtmektedir. Bu görüşe göre internet kullanımı kişinin sahip olduğu düşünme stillerinden etkilenebilmektedir. Düşünme stilleri, bireyin sahip olduğu yetenekleri kullanmada tercih edilen yoldur (Zhang, 2001). Düşünme stili, bireyin dünya ile ilişkisinde, onu algılamada, hedeflediği amaçlara ulaşmada ve problem çözmede, farkında olsun ya da olmasın geliştirdiği bilgi işleme metodu ve yaklaşımıdır (Parlette & Rae, 1993). Literatür düşünme stillerinin iki türlü sınıflandırılabileceğini göstermektedir (Zhang & Sternberg, 2000). Birinci grup yasama, yargı, global, hiyerarşik ve liberal düşünme stillerinden oluşmaktadır. Bu düşünme stilleri genel olarak karmaşık bilgi işlemeyi gerektirir ve yaratıcılık ağırlıklıdır. İkinci tip düşünme stilleri yürütme, lokal, monarşik ve muhafazakar stiller gibi daha az bilişsel çaba gerektiren, yerleşik, bilinen ölçütlere ve kurallara göre olan) bilgi işleme süreçlerini içerir. Diğer dört düşünme stili (anarşik, oligarşik, içsel ve dışsal) ise gerçekleştirilecek olan konu ya da işin gerekliliğine bağlı olarak her iki gruptaki düşünme stillerinin özelliklerini gösterebilirler. Örneğin, yasama düşünme stilini daha çok kullanan iki bireyden biri daha içsel diğeri ise daha dışsal eğilimli olabilir. Bu durum, yürütme düşünme stiline sahip iki bireyde de görülebilir (Buluş, 2005). Bireyin düşünme stili, eğitim ve çalışma ortamında o konunun-işin gerektirdiği düşünme stili ise bu durumda bireyin başarılı olma olasılığı daha yüksektir (Çatalbaş, 2006). Bu bağlamda öğrencilerin düşünme stillerinin incelenmesi eğitim ortamında hedeflenen başarıyı artırmada önemli bir değişken olacaktır. Artık günümüzde internet sitelerindeki eğitsel amaçlı, bilgilendirici ve eğlendirici içerikler bilgi, resim, oyun vb. çocuklar için zengin ve etkileyici öğrenme ortamları haline gelmiştir. Bununla birlikte çocuklara ve gençlere zarar verebilecek içeriklere sahip internet siteleri de oldukça fazladır. İnternetin olası tehlikeleri yüzünden çocuklara internet kullanımını yasaklamak ise etkisiz ve yanlış bir davranış olacaktır (Odabaşı, Çoklar, & Kavakçı, 2007). Bu nedenle internet kullanımı konusunda öğrencileri bilinçlendirmek gerekmektedir. Bunun için öncelikle onların güvenli internet kullanımı konusundaki bilinç düzeylerini ve düşünme stilleri ile olan bağlantılarını irdelemek önemli bir başlangıç olacaktır. Bu görüşten hareketle çalışmanın amacı ortaokul öğrencilerinin düşünme stillerini ve güvenli internet kullanımlarını incelemek olarak belirlenmiştir.

Yöntem

Bu araştırmanın evrenini lise öğrencileri oluştururken, çalışılabilir evrenini ise söz konusu grup içerisinden random yoluyla seçilen Ankara'da öğrenim gören öğrenim görmekte olan 69 lise öğrencisi oluşturmuştur. İlişkisel tarama modelinde gerçekleştirilen bu araştırmada veri toplama araçları olarak Sternberg ve Wagner (1992) tarafından geliştirilen; Kaya (2009) ve Fer (2005) tarafından Türkçeye uyarlanan "Düşünme Stilleri Envanteri" ve Beder (2015) tarafından geliştirilen Güvenli İnternet Kullanımı Ölçeği kullanılmıştır. "Güvenli İnternet Kullanımı Ölçeği" 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 veri toplanması aşamasında video destekli anket çalışması uygulanmıştır. 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

Öğrencilerin cinsiyetlerine göre düşünme stilleri incelenmiş elde edilen bulgular Tablo 1'de gösterilmiştir.

Tablo 1. Cinsiyete göre düşünme stilleri puanlarının karşılaştırılması

	Cinsiyet	N	X	Ss	sd	t	p
Yürütmeci	Kız	42	4.25	.641	67	.56	.57
	Erkek	27	4.16	.617			
Yargılayıcı	Kız	42	3.55	.756	67	.90	.84
	Erkek	27	3.51	.650			
Yasa yapıcı	Kız	42	4.23	.567	67	.118	.10
	Erkek	27	4.00	.561			
Ayrıntısal	Kız	42	3.25	.635	67	.674	.86
	Erkek	27	3.22	.839			
Bütünsel	Kız	42	3.59	.785	67	1.05	.37
	Erkek	27	3.74	.598			

Tablo 1 incelendiğinde kız ve erkek öğrencilerin düşünme stillerinin birbirlerinden anlamlı bir şekilde farklılık göstermediği görülmektedir. Ancak kız öğrencilerin yürütmeci, yargılayıcı, yasa yapıcı ve ayrıntısal düşünme boyutlarında; erkek öğrencilerin ise bütünsel düşünme boyutunda daha yüksek ortalamaya sahip oldukları belirlenmiştir.

Araştırmaya katılan kız ve erkek öğrencilerin güvenli internet kullanımları ve farklı alanlardaki güvenli internet kullanımlarını belirleyen boyutlarda fark olup olmadığını belirlemek için t-testi yapılmış ve elde edilen bulgular Tablo 2'de özetlenmiştir.

Tablo 2. Cinsiyete göre güvenli internet kullanımı puanlarının karşılaştırılması

	Cinsiyet	N	X	Ss	sd	t	p
Güvenli İnternet Kullanımı	Kız	42	3.04	.28	67	-3.3	.00
	Erkek	27	3.26	.25			
Siber Zorbalık	Kız	42	3.60	.75	67	-3.5	.00
	Erkek	27	4.22	.63			
Sorun Olabilecek Paylaşımlar	Kız	42	3.48	.387	67	-79	.43
	Erkek	27	3.56	.411			
Şifre ve Kullanıcı Adı Kolaylığı	Kız	42	3.05	.673	67	-.95	.34
	Erkek	27	3.20	.504			
Telif Hakkı İhlali	Kız	42	2.12	.504	67	-4.4	.00
	Erkek	27	2.74	.642			
Tuzak E-posta	Kız	42	3.48	1.19	67	3.1	.01
	Erkek	27	2.64	.917			
Yazılımsal Tehdit	Kız	42	1.69	1.09	67	-6.8	.00
	Erkek	27	3.55	1.12			
Sahtecilik ve Dolandırıcılık	Kız	42	1.30	.975	67	.80	.42
	Erkek	27	1.14	.456			
İstenmeyen İçerik	Kız	42	3.09	.496	67	-.79	.43
	Erkek	27	3.18	.395			

Tablo 2'de görüldüğü gibi öğrencilerin güvenli internet kullanımları cinsiyetlerine göre anlamlı bir şekilde değişim göstermektedir. Erkek öğrencilerin interneti kız öğrencilere göre daha güvenli kullandıkları ortaya çıkmıştır. Ölçeğin alt boyutları incelendiğinde Siber Zorbalık, Telif Hakkı İhlali ve yazılımsal tehdit alt boyutlarında görülen anlamlı farklılaşmaların erkek öğrenciler lehine olduğu dikkat çekmektedir. Ölçeğin yazılımsal tehdit alt boyutunda ise kız öğrenciler lehine anlamlı farklılaşma olduğu belirlenmiştir.

Tablo 3. Öğrencilerin güvenli internet kullanımlarının düşünme stillerine göre incelenmesi

		Düşünme Stilleri
Güvenli İnternet Kullanımı	Pearson Correlation	.240**
	Sig. (2-tailed)	.000
	N	69

**. Correlation is significant at the 0.01 level (2-tailed).

Tablo 3'te görüldüğü gibi düşünme stilleri 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

Bu çalışmanın amacı ortaokul öğrencilerinin düşünme stillerini ve güvenli internet kullanımlarını incelemektir. Literatür incelendiğinde düşünme stilleri ve güvenli internet kullanımı konularının beraber araştırıldığı bir çalışmaya rastlanmamıştır. Ancak internetin bilinçli ve güvenli kullanımı ile ilgili yapılan çalışmaların çokluğu dikkat çekmektedir. Yapılan en kapsamlı çalışma Avrupalı Çevrimiçi Çocuklar (EU Kids Online) Projesidir. Proje kapsamında 24 ülkenin katılımıyla sayısı 9-16 yaşları arasında 25142 çocuğa ve ebeveynlerine yüz yüze anket uygulanmıştır. Araştırma sonucunda zorbalık, cinsel mesaj alma, yabancılarla yüz yüze görüşme, kullanıcı tarafından oluşturulan zararlı içerik ve kişisel verilerin kötüye kullanımı ortaya çıkan çevrimiçi risklerdir. İnterneti en fazla okul çalışmaları, video klip izleme, oyun oynama ve anlık mesajlaşma amacıyla kullanmaktadırlar. Diğer kullanım amaçları arasında başkalarıyla fotoğraf ya da mesajlar paylaşmak, web kamerası kullanma, dosya paylaşım siteleri ve blog kullanma yer almaktadır. Araştırmanın Türkiye'deki çocuklar ile ilgili sonuçlarına bakıldığında çocukların %46'sı sosyal paylaşım sitesindeki hesaplarını kendi kişisel bilgilerinin dışardan herkesin erişebileceği "herkese açık" seçeneği ile kullanmakta, diğer taraftan çocukların üçte biri bu bilgileri sadece arkadaşları ile paylaşmaktadır. Çocukların %19'u adres bilgilerini, %8'i ise telefon numaralarını sosyal paylaşım sitesinde paylaşmaktadır. Araştırmaya katılan çocuklar interneti en fazla okul işleri için kullanmakla birlikte, interneti video klip izlemek, oyun oynamak, sosyal ağ sitesindeki profiline giriş yapmak, e-posta gönderip almak, anlık ileti göndermek, müzik ya da film indirmek ve haberleri okumak ya da izlemek için kullandıklarını da belirtmişlerdir (Ogur, 2016). Proje sonuçlarının Türkiye boyutu öğrencilerin güvenli internet kullanımlarını hangi değişkenlerin etkileyebileceği sorusunu akıllara getirmektedir. Bu nedenle çalışmada düşünme stili irdelenen değişken olmuştur. Araştırma sonucunda erkek öğrencilerin kız öğrencilere göre güvenli internet kullanımında daha bilinçli oldukları belirlenmiştir. Literatür incelendiğinde araştırma sonucunun aksine kız öğrencilerin erkek öğrencilere göre güvenli internet kullanımında daha bilinçli ve problemsiz hareket ettikleri belirlenen çalışmalar bulunmaktadır (Altundağ & Altundağ, 2016; Beder, 2015; DiNicola, 2004; Kubey, Lavin & Barrows, 2001; Johansson & Götestam, 2004). Ölçeğin alt boyutları incelendiğinde Siber Zorbalık, Telif Hakkı İhlali ve yazılımsal tehdit alt boyutlarında görülen anlamlı farklılaşmaların erkek öğrenciler lehine olduğu dikkat çekmektedir. Ölçeğin yazılımsal tehdit alt boyutunda ise kız öğrenciler lehine anlamlı farklılaşma olduğu belirlenmiştir. Kız öğrencilerin alt boyutlarda daha bilinçli olduklarına dair benzer bir bulgu Altundağ ve Altundağ (2016) tarafından elde edilmiş olup, 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. Slonje ve Smith, (2008) tarafından ergenlik döneminde siber zorbalığın yaygınlığını tespit etmek için yapılan araştırmada, cinsiyet değişkeni açısından farklılığın az olduğu saptanmıştır. Ayrıca siber mağdurların genellikle siber zorbalık davranışlarını kendi arkadaşlarına anlattıklarını veya hiç kimseye bahsetmemeyi tercih ettiklerini, yetişkinlerin ise siber zorbalıktan haberdar olmadıklarını ve çocukların ne hissettiklerini bilmediklerini tespit etmiştir. Kız ve erkek öğrencilerin güvenli internet kullanımı konusunda farklı boyutlarda anlamlı farklılaşmalar oluşturacak şekilde senaryolara cevap vermeleri belki güvenli internet kullanımdan haberdar olmamalarından kaynaklanabilir. Araştırma sonuçlarına göre kız ve erkek öğrencilerin düşünme stillerinin birbirlerinden anlamlı bir şekilde farklılık göstermediğini söylemek mümkündür. Ancak kız öğrencilerin yürütmeci, yargılayıcı, yasa yapıcı ve ayrıntısal düşünme boyutlarında; erkek öğrencilerin ise bütünsel düşünme boyutunda daha yüksek ortalamaya sahip oldukları belirlenmiştir. Yürütme düşünme stili, uygulama odaklıdır. Bu düşünme stiline sahip bireyler başkalarının önceden ortaya attığı fikirleri geliştirmeyi, kuralları takip etmeyi ve daha önceden yapılandırılmış problemleri tercih ederler. Yürütmeci düşünme stiline sahip olan bireyler, öğretmenlerin rehberliğine ihtiyaç duyarlar. Hazır sunulan matematik problemlerini çözmek, başkalarının fikirlerini aktarabilecekleri seminer ve konferansları vermek vb. işleri tercih eden bireylerdir (Altuntaş, 2008; Dai & Feldhusen, 1999). Yasa yapıcı düşünme stiline sahip bireyler, yaratıcılık, planlama, tasarlama ve biçimlendirme odaklıdır ve problem çözümlerini oluşturmaktan ve planlamaktan hoşlanan, kendi kurallarını koyabilen bireylerdir (Buluş, 2005; Çubukçu, 2004; Yıldızlar, 2010). Bu düşünme stiline sahip bireyler; kendi aktivitelerini açıkça ifade etmeyi, ödevlerini kendi tarzlarında yapmak isteyen, kitap karıştırmayı, keşfetmeyi, fen projelerini, şiir ve hikâye yazmayı, beste yapmayı ve orijinal sanat eserleri yaratmayı severler (Çelik, 2008; Siyer, 2015). Yargısal düşünme stili değerlendirme, yargılama, karşılaştırma odaklıdır (Buluş, 2005) ve bu düşünme stiline sahip bireyler başkalarının eserlerini tenkit etmekten, eleştirel makaleler yazmaktan, tepki ve tekliflerde bulunmaktan hoşlanırlar (Altuntaş, 2008). Adak, (2006)'a göre, ayrıntısal düşünme stili, eylemleri yürütürken genelden çok ayrıntıya odaklanma eğilimini ifade etmektedir. Bu düşünme stiline sahip bireyler somut düşüncelerle uğraşırlar ve detaylara konsantre olarak çalışmayı gerektiren işlere katılmaktan zevk alırlar (Duman & Çelik, 2011). Yürütmeci, yargılayıcı, yasa yapıcı ve ayrıntısal düşünme stiline sahip bireylerde görülen bu özellikler özellikle bayanlarda baskın olarak görülen niteliklerdir. Dolayısıyla araştırmaya katılan kız öğrencilerin yürütmeci, yargılayıcı, yasa yapıcı ve ayrıntısal düşünme stilleri ortalamalarının erkek öğrencilere göre daha yüksek olması şaşırtıcı bir sonuç değildir. Erkek öğrencilerin bütünsel düşünme stili boyutuna kız öğrencilere göre daha yüksek ortalamaya sahip olması bu stilin daha çok soyut meselelerle düşünmeyi gerektirmesinden kaynaklanabilir. Çünkü bütünsel düşünenler nesnenin parçalarına bakmak yerine nesneye ilk başta bir bütün olarak yaklaşırlar (Umay & Arıol, 2011). Bu düşünme stiline sahip bireyler, resmin tamamını görme, ilişkileri arama, grup çalışması içinde işbirliği, satırlar arasını okuma (genel anlamı yakalama), birçok seçenekleri görme, dürüstlük duygusu, aynı anda birkaç iş yapma, beden dilini okuma, başkalarının işe karışmasını isteme gibi özelliklere sahiptirler (Şimşek, 2008; Siyer,2015). Her bir düşünme stilinin kişiye kazandırdığı bu özellikler araştırmada elde edilen düşünme stilleri ve güvenli internet kullanımı puanları arasında çok güçlü olmasa da pozitif bir ilişkinin varlığını sağlamıştır. Çünkü birey farklı düşünme stillerinin ona kattığı özellikler sayesinde internet kullanımı konusunda bir bilinç düzeyine erişebilmiştir. Literatür taramasında güvenli internet kullanımı ile düşünme stilleri arasındaki ilişkiyi beraber inceleyen çalışmalara rastlanmamıştır. Dolayısıyla elde edilen bulgularda karşılaştırma yoluna gidilememiştir. Bu nedenle düşünme stilleri ve güvenli internet kullanımı konusunda yapılabilecek çalışmalara ağırlık verilmesi gerektiği düşünülmektedir. Daha geniş bir örneklemin katılımıyla ve farklı değişkenlerin varlığı da göz önüne alınarak bu ilişkinin tekrar irdelenmesinin literatüre çok önemli katkılar sağlayacağı düşüncesindeyiz.

Kaynaklar

Adak, A. (2006). *Okul öncesi eğitimi öğretmenlerinin fen öğretimine yönelik tutumları ile düşünme stilleri arasındaki ilişkinin incelenmesi*. Yayınlanmamış yüksek lisans tezi, Pamukkale Üniversitesi, Denizli

Altundağ, M. & Altundağ, C. (2016). *Ortaokul öğrencilerinin güvenli internet kullanım durumlarının ve bilişötesi becerilerinin belirlenmesi. ICEMST*, Bodrum, Turkey, May 19-22.

Altuntaş, E. A. (2008). *Okul yöneticilerinin düşünme stilleri ile problem çözme becerileri arasındaki ilişki*.Yayınlanmamış yüksek lisans tezi, Gaziosmanpaşa Üniversitesi, Tokat.

Beder, A. (2015). *Ortaokul öğrencilerinin güvenli internet kullanım durumlarının belirlenmesi*. Yüksek lisans tezi, Afyon Kocatepe Üniversitesi Fen Bilimleri Enstitüsü, Afyonkarahisar.

Buluş, M. (2005). İlköğretim bölümü öğrencilerinin düşünme stilleri profile açısından incelenmesi. *Ege Eğitim Dergisi*, 1(6), 1–24.

Çatalbaş, Erkan (2006). *Lise öğrencilerinin düşünme stillerinin akademik başarı ve ders tutumları arasındaki ilişki (inceleme-metin)*.Yayımlanmamış Yüksek Lisans Tezi, Konya: Selçuk Üniversitesi Sosyal Bilimleri Enstitüsü.

Çelik, B. (2010). *Kadın yöneticilere yönelik tutumlar ve düşünme stilleri arasındaki ilişki*. Yayınlanmamış yüksek lisans tezi, Gaziosmanpaşa, Tokat.

Çubukçu, Z.(2004).*Öğretmen adaylarının düşünme stillerinin öğrenme biçimlerini tercih etmelerindeki etkisi*. XIII. Ulusal Eğitim Bilimleri Kurultayı, İnönü Üniversitesi, Malatya, 6-9 Temmuz 2004.

Dai, D. Y.,& Feldhusen, F. J. (1999). A Validation study of the thinking styles inventory: Implications for gifted education. *Roeper Review*, 21(4), 302-307.

Davidson, J. & Martellozzo, E. (2013). Exploring young people's use of social networking sites and digital media in the Internet safety context: a comparison of the UK and Bahrain. *Information, Communication & Society*,16 (9).

DiNicola, M. D. (2004). *Pathological internet use among college students: The prevalence of pathological ınternet use and its correlates*. A thesis of Doctor of Philosophy Ohio: Ohio University.

Duman, B., & Çelik, Ö. (2011). İlköğretim öğretmenlerinin düşünme stilleri ile kullandıkları öğretim yöntemleri arasındaki ilişki. *Elementary Education Online*, 10(2),785-797.

Fer, Seval. 2005. Düşünme stili envanterinin geçerlik ve güvenirlik çalışması. *Kuram ve Uygulamada Eğitim Bilimleri*. 5 (2), 463-461.

Furnell, S., & Phippen, A. (2012). Online privacy: a matter of policy? *Computer Fraud & Security*, (8), 12-18.

Gençer, S. L. (2011). *Ortaöğretim öğrencilerinin internet bağımlılık durumlarının internet kullanım profilleri ve demografik özelliklere göre farklılıklarının incelenmesi*. Doktora tezi. SDÜ Fen Bilimleri Enstitüsü.

Johansson, A., & Götestam, G. K. (2004). Internet addiction: characteristics of a questionnaire and prevalence in norwegian youth (12–18 years). *Scandinavian Journal of Psycholog*. 45, 223–229.

Juvonen, J. & Gross, E. F. (2008). Extending the school grounds? – Bullying experiences in cyberspace. *Journal of School Health*, 78: 496-505.

Kaya, B. 2009. *İlköğretim 6-7-8. sınıf öğrencilerinin düşünme stilleri ile matematik akademik başarılarının okul türüne, cinsiyete ve sınıf düzeyine göre incelenmesi*. Yüksek Lisans Tezi, Yıldız Teknik Üniversitesi, Sosyal Bilimler Enstitüsü, İstanbul.

Kubey, R.W., Lavin M.J. & Barrows, J.R. (2001). Internet use and collegiate acedemic performance decrements: Early findings. *Journal of Communication*, 51, 366-382.

Marwick, A. (2014). Networked privacy: How teenagers negotiate context in social media. *New Media & Society*, 16(7), 1051–1067.

McLoughlin, C., & Burgess, J. (2009). *Texting, sexting and social networking among Australian youth and the need for cyber safety education*. AARE International Education Research Conference, Canberra.

Odabaşı, F., Çoklar, A. N.& Kavakçı, I. (2007). *Yeni dünya: İnternet - Ailelerin yeni dünyadaki sorumlulukları nelerdir?* 8. Aybastı-Kabataş Kurultayı.

Ogur, B. (2016). *Ortaokul öğrencilerinin internet kullanım alışkanlıklarının araştırılması*. Atatürk Üniversitesi Eğitim Bilimleri Enstitüsü Bilgisayar ve Öğretim Teknolojileri Eğitimi Ana Bilim Dalı, Erzurum.

Parlette N, Rae R. Thinking about thinking (thinking styles of people). *Association Management*, 45, 70-74, 1993.

Siyer, A. (2015). *Ortaokul 7.sınıf öğrencilerinın düşünme stilleri ile sahip oldukları matematiksel güç düzeyleri arasındaki ilişkinin incelenmesi*. Çukurova Üniversitesi Sosyal Bilimler Enstitüsü, Adana.

Slonje, R.& Smith, P.K. (2008). Cyberbullying: Another main type of bullying? *Scandinavian Journal of Psychology*, 49, 147-154.

Sternberg, R. J., & Wagner, R. K. (1992). *Thinking styles inventory*: Unpublished Test. New Haven, CT: Yale University.

Şimşek, A. (2008). Tarih derslerinde bütünsel öğrenme: gestaltçı yaklaşımdan holistik yaklaşıma bir bakış denemesi. *Uluslararası İnsan Bilimleri Dergisi*, 5(2), 1-16.

Umay, A., & Arıol, Ş. (2011). Baskın olarak bütüncül stilde düşünenlerle baskın olarak analitik stilde düşünenlerin problem çözme davranışlarının karşılaştırılması. *Pamukkale Üniversitesi Eğitim Fakültesi Dergisi*, 3(1), 27-37.

Yıldızlar, M. (2010). Farklı kültürlerden gelen öğretmen adaylarının düşünme stilleri. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi*, 39, 383-393.

Young, K.S. (2004).Internet addiction a new clinic alphenomen onandits consequences. *American behavioral scientist*, 48(4), 402-415.

Yücel, N. (2009). *Ergenlerin akran ilişkileri ve yalnızlık düzeylerinde evde internet kullanımının etkisinin incelenmesi*. Yüksek lisans tezi, Ankara Üniversitesi Fen Bilimleri Enstitüsü.

Zhang, L. F. (2001). Do thinking styles contribute to academic achievement beyond self-rated abilities? *The Journal Of Psychology*,135 (6), 621-637.

Zhang, L.,& Sternberg, R. J. (2000). Are learning approaches and thinking styles related? A study in two chinese populations. *The Journal of Psychology*, 134(5), 469-489.

SOLUTION OF SIMPLE GEOMETRY QUESTIONS USING IMAGE PROCESSING TECHNIQUES ON THE ANDROID PLATFORM: SMART PHONE APPLICATION

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Abstract: In this study especially for elementary school students, a smart phone application developed to solve simple geometry questions by using image processing techniques on Android Platform. With this mobile application; perimeter, area and volume calculations can be done quickly so that students can be test whether their answers are correct. When previous studies have examined, it was seen that perimeter, area and volume calculations can be done by taking like the length, height and radius information from user but image processing techniques not used at this calculation process. In developed application C++ programming language is used also benefiting from OpenCV (Open Computer Vision) library and TesserAct OCR API (TesserAct Optical Character Recognition Application Programming Interface).

Keywords**:** Geometry, perimeter, area, volume, education.

ANDROİD PLATFORMUNDA GÖRÜNTÜ İŞLEME TEKNİKLERİ KULLANARAK BASİT GEOMETRİ SORULARININ ÇÖZÜMÜ: AKILLI TELEFON UYGULAMASI

Özet: Bu çalışmada özellikle ilköğretim öğrencileri için, Android platformunda görüntü işleme teknikleri kullanarak basit geometri sorularını çözen akıllı telefon uygulaması geliştirilmiştir. Bu uygulama ile çevre, alan ve hacim hesaplamaları hızlıca yapılabilir bu sayede öğrenciler sorulara doğru cevap verip vermediklerini test edebilirler. Daha önceki çalışmalar incelendiğinde kullanıcıdan uzunluk, yükseklik, yarıçap gibi bilgiler alınarak çevre, alan ve hacim hesaplamalarının yapıldığı ancak hesaplama işlemleri için görüntü işleme tekniklerinin kullanılmadığı görülmüştür. Geliştirilen uygulamada C++ programlama dili kullanılmış ayrıca OpenCV (Open Computer Vision) kütüphanesinden ve TesserAct OCR API (TesserAct Optical Character Recognition Application Programming Interface)'den yararlanılmıştır.

Anahtar Sözcükler**:** Geometri, çevre, alan, hacim, eğitim.

Giriş

Dış dünyada özellikle sanat ve mimaride karşımıza çıkan geometri; aritmetik, cebir, istatistik alanlarında kavramları görselleştirme amaçlı kullanılır (Napitupulu, 2001). Geometrinin temelinde, öncelikle kavram ve şekiller görselleştirilir, sonra görselleştirmeye dayalı çizimler oluşturulur, son olarak görselleştirme ve çizimlere dayalı genellemeler yapılır (Köse, 2008).

Öğrenciler üzerinde yapılan araştırmalar sonucunda, öğrencilerin geometrik kavramları öğrenme, anlama ve bu kavramları ilişkilendirerek problem çözmede kullanmakta zorluk çektikleri görülmüştür. Öğrencilerin özellikle en çok çevre ve alan kavramlarında hata yaptıkları, bu kavramları birbirine karıştırdıkları görülmüştür (Tan Şişman & Aksu, 2009). Emekli (2001) 7. ve 8. sınıf öğrencilerinin çevre, alan formüllerinde hata yaptıklarını saptarken, Moreira ve Contente yedinci sınıf öğrencileri üzerinde yaptıkları çalışmalarında (Moreira ve Contente, 1997) bu öğrencilerin alan ve çevre kavramlarını karıştırdıklarını ve bu kavramların ilişkili olduklarında inandıklarını ortaya koymuşlardır. Kamii ve Kysh'ın 4. ve 8. sınıf arasındaki öğrenciler üzerinde yaptıkları çalışmada (Kamii ve Kysh, 2006) öğrencilerin çoğunun kareyi alan ölçü birimi olarak düşünmediği görülmüştür. Kidman ve Cooper (1997) 4, 6 ve 8. sınıf öğrencilerinin dikdörtgenin alan ve çevre hesaplamalarını karıştırdıklarını, öğrencilerin yaklaşık %50'sinin dikdörtgensel bölgenin alanını hesaplarken çevre hesaplaması yaptıklarını, bunlara ek olarak 8. sınıf öğrencilerinin %33 ünün alan korunumu kavramında yanılgıya düştüğünü gözlemlemişlerdir.

Keith'e göre (Keith, 2000) başarılı bir geometri öğretimi, geometriyi anlayan ve iyi bir geometri alt yapısına sahip öğretmenlerin olmasına ve bu öğretmenlerin alt yapılarını kullanarak geometriyi doğru ve etkili bir şekilde nasıl öğreteceğini bilmelerine bağlıdır. Ayrıca Jones ve Mooney 2002 yılında yaptıkları çalışmalarına göre (Jones ve Mooney, 2002) geometri, matematik öğretmen adaylarının bu dersi öğretme konusunda en az güvene sahip oldukları dolayısıyla öğretme performansının da düşük olduğu alandır.

Teknolojinin gelişmesiyle birlikte teknolojik ürünler hayatımızın vazgeçilmez bir parçası olmuştur. Eğitim alanında bu ürünlerin kullanımıyla eğitim, öğretme ve öğrenmenin daha etkin hale geldiği kaçınılmaz bir gerçektir. Bilgisayarlar özellikle matematik öğretiminde bazı konuların öğrenilmesi, algoritmaların kurulması, işlem, araştırma, analiz ve çözüm adımlarında kullanılır (Baki, 2001). Bilgisayar kullanımıyla matematiksel kavramlar arasında ilişki kurup kurallar çıkarılıp genelleme yapma öğretilebileceği gibi (Karataş, 2017), hipotez kurma, grafiksel çizimler ile geometrik gösterimler sağlanarak öğrenme kalıcı hale getirilebilir (Aydoğmuş, 2010). Cabri, Cindirella, Maple, Derive gibi bilgisayar yazılımları matematik eğitiminde kullanılmaktadır. Bu yazılımların farklı açılardan değerlendirilmesinin yapıldığı çalışmalar (Açıkgül, 2012)' de verilmiştir. Bilgisayarların yanı sıra, tablet, akıllı telefon gibi birçok teknolojik ürün eğitimde öğretme ve öğrenme amaçlı kullanılabilir (Oran ve Karadeniz, 2007; Küçükarslan vd., 2009; Menzi vd., 2012; Sarıtaş ve Üner, 2013; Odabaşı vd., 2012; Kıcı, 2010; Atmaca vd., 2014).

Çalışma kapsamında çevre ve alan kavramlarını öğrenme, öğrendikleri bilgileri uygulamada problem yaşayan, özellikle ilköğretim seviyesindeki öğrencilere yardımcı olmak amacıyla Android (Android İşletim Sistemi, 2017) işletim sistemine sahip cihazlar üzerinde kullanılabilecek basit geometri sorularının çevre veya alan hesaplamasını görüntü işleme teknikleri kullanarak yapan mobil tabanlı akıllı telefon uygulaması geliştirilmiştir. Android platformunda geometri sorularının çözümüne yönelik mobil tabanlı geliştirilen uygulamalar incelendiğinde birkaç uygulamaya rastlanmıştır. Geometry Solver (2017) taban, kenar, yükseklik, çap, yarıçap gibi uzunluk bilgilerini kullanıcıdan alan, seçilen geometrik şekle (dik üçgen, silindir, üçgen piramit, küre, dikdörtgenler prizması, koni) göre alan veya hacim hesaplamalarını yapan ayrıca bu hesaplamaların formüllerinin de açıklama olarak ekranda verildiği İngilizce dilinde geliştirilmiş bir uygulamadır. Geometri Çöz (2017) kullanıcı tarafından seçilen geometrik şekillerin (üçgen, kare, daire, silindir, küp, koni) alan, çevre ve hacim hesaplamalarını bulmak için kullanıcıdan gerekli uzunluk, yükseklik, yarıçap gibi bilgilerin istendiği Türkçe dilinde geliştirilmiş bir uygulamadır. Geometry Problem Solver (2017) Geometry Solver uygulaması gibi bilgileri kullanıcıdan alarak alan, hacim hesaplaması yapan İngilizce dilinde geliştirilmiş bir uygulamadır. Calc Area Solver Pro (2017) uygulaması uzunluk bilgilerinin kullanıcıdan alındığı, Geometry Problem Solver ve Geometry Solver uygulamalarına göre daha fazla geometrik şeklin alan ve hacimlerinin hesaplanabildiği İngilizce geliştirilmiş bir uygulamadır. Tutr - Maths & Algebra Tutoring (2017) ise sınıf bilgisi seçildikten sonra (6-10) matematik, ingilizce ve fen dersleriyle ilgili soruların fotoğraflarının çekilip, çekilen fotoğrafın uygulamaya yüklendiği daha sonra uygulama geliştiricilerin oluşturduğu deneyimli eğitmen ekip tarafından uygulamanın çözümünün kullanıcıya gönderildiği İngilizce geliştirilmiş bir uygulamadır. Easy A Elite (2017) uygulaması 2 ve 3 boyutlu geometrik şekiller için kenar uzunluğu, açı vb. bilgileri kullanıcıdan alarak alan ve hacim hesaplaması yapan İngilizce geliştirilmiş uygulamadır. Geometri YGS LYS Konu Anlatım (2017) uygulaması Türkçe olarak geliştirilmiş YGS ve LYS sınavlarına hazırlanan öğrenciler için geliştirilmiş geometri konu anlatımı, matematik formülleri, pratik çözüm teknikleri içeren bir uygulamadır. Interactive Math PRO (2017) uygulaması da bilgileri kullanıcıdan alarak çeşitli geometrik şekillerin alan, hacim hesaplamalarının yanı sıra 2. ve 3. dereceden denklem çözmeye imkân sağlayan İngilizce geliştirilmiş uygulamadır.

Android platformunda geliştirilen mobil uygulamalar incelendiğinde kullanıcıdan uzunluk, yükseklik, çap vb. bilgiler alınarak çevre, alan ve hacim hesaplamalarının yapıldığı, hesaplama işlemleri için görüntü işleme tekniklerinin kullanılmadığı görülmüştür. Bu çalışmada diğer uygulamalardan farklı olarak kullanıcıdan herhangi bir bilgi almadan görüntü işleme teknikleri kullanılarak basit geometrik şekillerin alan ve çevre hesaplamaları yapılmaktadır.

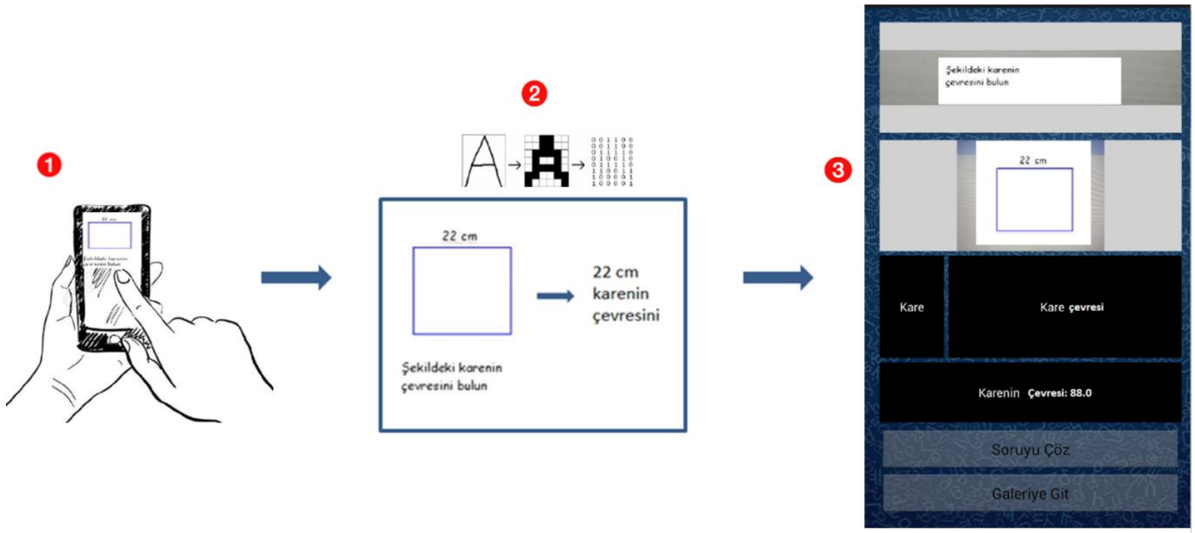
Opencv Kullanılarak Mobil Platform Üzerinde Görüntü İşleme Uygulamaları

Geliştirilen mobil uygulamada, kullanıcı alan veya çevresi hesaplanacak geometri sorusuna ait fotoğrafı mobil telefondan veya fotoğrafını çekerek uygulamaya yükler. Kullanıcının mobil telefondan, kâğıt üzerinden (test kitabı, soru kâğıdı vb.) veya bilgisayar ekranından fotoğrafını çekerek uygulamaya yüklediği geometrik şeklin; üçgen, kare, dikdörtgen, daire veya beşgenden hangisi olduğunun belirlenmesi, geometrik şeklin üzerinde veya soru içinde verilen uzunluk bilgilerinin algılanması, çevre ve alan hesaplamalarından hangisinin istendiğinin belirlenmesi için OpenCV açık kaynaklı görüntü işleme kütüphanesinden yararlanılmıştır.

Literatürde mobil cihazlar üzerinde OpenCV kütüphanesinden yararlanılarak geliştirilmiş uygulamalar mevcuttur. Çağlayan ve arkadaşları (Çağlayan vd., 2014) melanom cilt kanseri riskini tahmin etmeye yönelik OpenCV kütüphanesi kullanarak görüntü işleme ve sınıflandırma algoritmalarını kullanan veri madenciliği tekniklerine dayalı akıllı mobil telefon uygulaması geliştirmiştir. Ma ve arkadaşları (Ma vd., 2013), mobil cihazlar üzerinde yan yüzleri algılayan bir uygulama geliştirmişler geliştirdikleri yüz yakalama uygulaması ile OpenCV kütüphanesinin yüz yakalama algoritmasını karşılaştırıp algoritmalarının başarısını kanıtlamışlardır. Tataroğlu ve Özden (2014) Android üzerinde OpenCV kütüphaneleri mobil turizm uygulaması geliştirmişlerdir. Duvar ve Urhan (2014) Android OpenCV kütüphanesi ve Java Native Interface (JNI) kullanan görüntü stabilizasyonu sistemi önermişlerdir. Abughalieh ve arkadaşları (Abughalieh vd., 2014) SURF, CAMShift, Lucas-Kanade algoritmalarını birleştirerek Android ortamında OpenCV kullanarak gerçek zamanlı takip sistemi geliştirmişlerdir. Aigerim ve arkadaşları (Aigerim vd., 2014) Android platformunda mobil cihazlar üzerinde gerçek zamanlı çalışabilen, Cascade Sınıflandırıcı ve OpenCV kütüphanesi kullanarak trafik levhalarını tanıyan bir uygulama geliştirmişlerdir. Chaudhari ve Patil (2015) Android telefonlar üzerinde OpenCV kütüphanesi kullanarak gerçek zamanlı video işleyip nesne tespit eden bir uygulama geliştirmişlerdir. Elrefaei ve arkadaşları (Elrefaei vd., 2015) Android platformda OpenCV kütüphanesi kullanarak imge işlemeye dayalı elektrik sayacı okuyan ve %85.71 doğrulukta çalışan mobil uygulama geliştirmişlerdir. Setiawardhana ve arkadaşları (Setiawardhana vd., 2015) sağır ve dilsiz bireyler için Android platformunda işaret dili öğrenmeye dayalı bir uygulama geliştirmişlerdir. Uygulama el yakalama için OpenCV kütüphanesi kullanılırken, K-NN algoritması el işaretlerinin dönüşümü için kullanılmıştır.

Önerilen Mobil Uygulama

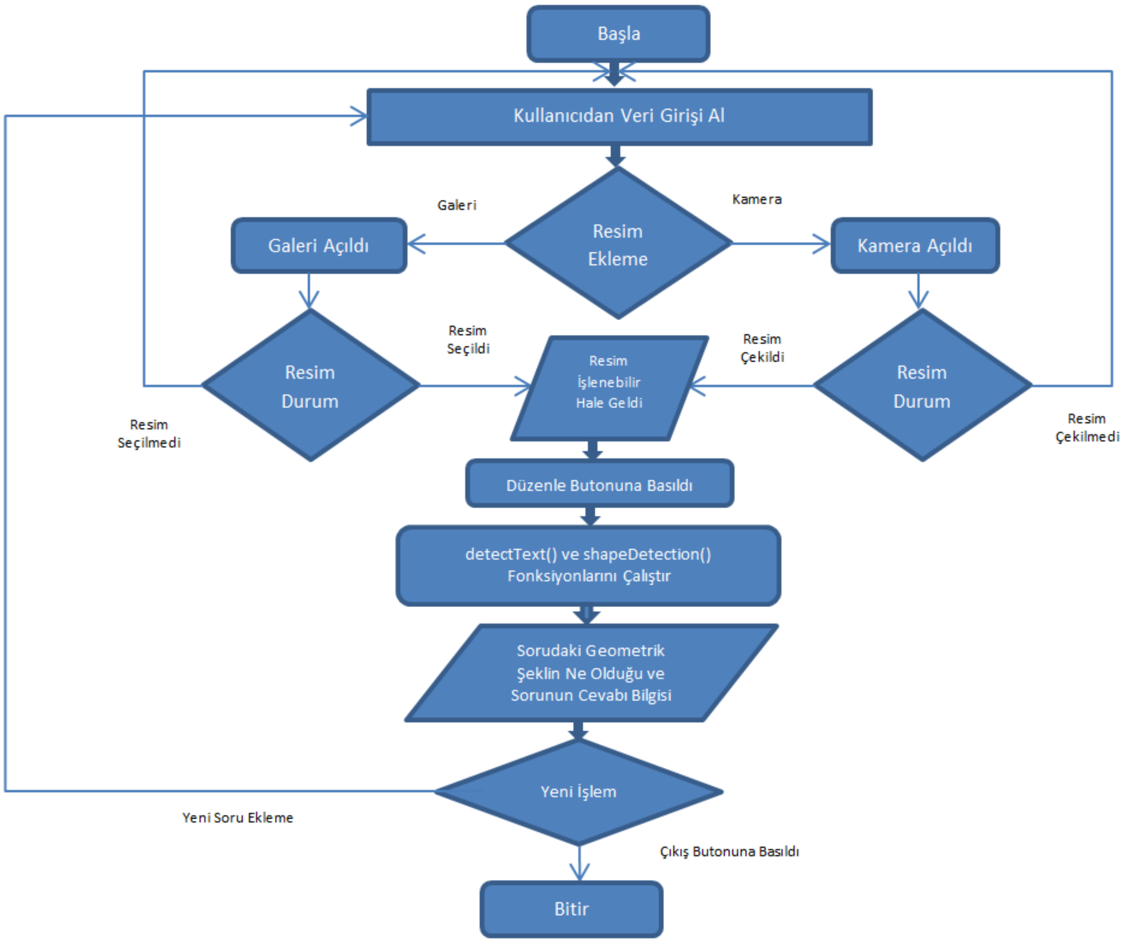
Şekil 1'de geliştirilen mobil uygulamanın mimari yapısı verilmiştir. Sistem üç ana aşamadan oluşmaktadır bu aşamalardan ilkinde mobil cihaz ile çekilen veya cihazın galerisinden yüklenen sorunun resmi alınır, ikinci aşamada ise bu resim görüntü işleme yöntemleriyle analiz edilir, son aşamada görüntü işleme tekniği kullanılarak elde edilen bilgilere göre soruda istenen hesaplama yapılıp sorunun cevabı uygulama ekranına yazdırılır.



Şekil 1. Mobil uygulama sistem mimarisi

Alan ve çevre hesaplama işlemlerinin yanı sıra, geliştirilen mobil uygulama ile ilköğretim çağında özellikle 2. ve 3. sınıf öğrencilerine geometrik şekillerin de öğretilmesi amaçlandığından, galeriden yüklenen ya da kamera ile resmi çekilen şeklin hangi geometrik şekil olduğu kolaylıkla tespit edebilmektedir.

Şekil 2'de geliştirilen mobil uygulamaya ait akış diyagramı verilmiştir. Mobil uygulamada gerekli nesneler oluşturulup, en son kayıtlı veriler okunduktan sonra uygulama kullanıcıdan veri girişi (sorudaki geometrik şeklin ve varsa şekle ait sorunun resmi) almaya hazır hale gelir. Kullanıcıya iki farklı resim ekleme seçeneği sunulmuştur. Bunlardan ilkinde kullanıcı mobil cihazın galerisinden soru ve şeklin resmini yükleyebilirken, diğer seçenekte ise cihazın kamerası kullanılarak sorudaki geometrik şekil ve soru metninin resmi çekilir. Mobil uygulamada sorudaki geometrik şekil ve soru metninin resimleri için iki ayrı alan bulunmaktadır. Şekil 1'den de görülebileceği gibi ilk alan soru metninin resmi için oluşturulmuşken, ikinci alan ise sorudaki geometrik şeklin resmi için oluşturulmuştur. Uygun resim ekleme seçeneği seçilip şekle ve soruya ait resimler yüklendikten sonra, resimler üzerinde OpenCV kütüphanesinde yer alan fonksiyonlara ek olarak yazılan fonksiyonlar kullanılarak, sorudaki geometrik şekil ve soruda istenen işleme göre sonuç bilgisi ekrana yazdırılır. Son adımda ise kullanıcı ya uygulamaya yeni soru eklemeye devam eder ya da uygulamadan çıkar.



Şekil 2. Mobil uygulama akış şeması

Geometrik Şeklin Belirlenmesi

Uygulama temelde resmi çekilen geometrik şeklin hangi şekil (üçgen, kare, dikdörtgen, daire ve beşgen) olduğunu algılayabilirken, soru cümlesinde yer alan şeklin çevre, alan ve hacim hesaplamalarından hangisini istiyorsa istenilen sonucu ekrana döndürmektedir. Uygulamaya OpenCV kütüphanesi içindeki shapedetection() fonksiyonuna ek özellikler eklenerek galeriden yüklenen veya resmi çekilen geometrik şeklin üçgen, kare, dikdörtgen, daire, beşgen olmak üzere bu beş geometrik şekilden hangisi olduğunun algılanması sağlanmıştır.

Uygulamada kullanılan shapedetection() fonksiyonunda; öncelikle şeklin görüntüsü gri seviye görüntüye dönüştürülür. Resimdeki çizgi hatlarını düzeltip yumuşatarak, resimdeki bulanık gürültüyü azaltmak için Gaussian filtreleme kullanılmıştır (Gaussian Filtreleme, 2017). Resimdeki geometrik şeklin hatları algılatılarak, şeklin kenarlarının koordinat noktaları ve bu noktaların sayısı tespit edilmiştir. Daha sonra bu şekle ait köşe noktalarının sayısı bulunarak şeklin hangi geometrik şekil olduğu belirlenmiştir.

Soru Metninin Algılanması

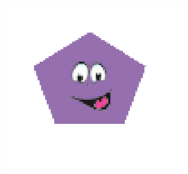
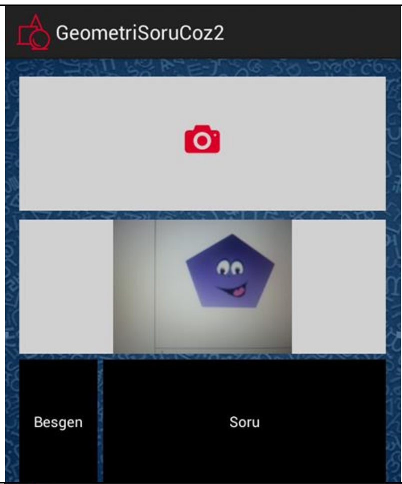
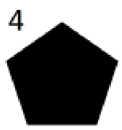
Geliştirilen mobil uygulamada iki farklı soru tipi üzerinde durulmuştur. Bunlardan ilki şekli verilen geometrik şeklin hangi şekil olduğu, ikincisi ise soru metni ayrıca verilmiş olan soru tipleridir. Soru metninin algılanması için Optik karakter tanıma (OCR) yöntemlerinden yararlanılmıştır. OCR görüntüyü yazıya dönüştürme işlemidir. Optik karakterlerin tanınmasında topolojik tabanlı, yapay sinir ağları, matris eşleme, öznitelik analizi gibi yöntemler mevcuttur. OCR sistemi temelde üç adımdan oluşur. Bunlar ön işleme, özellik çıkarımı ve sınıflandırma adımlarıdır. Ön işleme adımı sayısallaştırma, ikili görüntüye dönüştürme, bölütleme, düzgeleme ve inceltme adımlarından oluşur. Öznitelik bulma adımında ise sınıf içindeki değişintiyi azaltan, sınıflar arası değişintiyi arttıran nitelik bilgilerine erişmeyi amaçlar, bu adım sonucunda öznitelik vektörleri elde edilir. Sınıflandırma adımında ise farklı sınıflandırma algoritmaları kullanılarak öznitelik vektörleri sınıflandırılır.

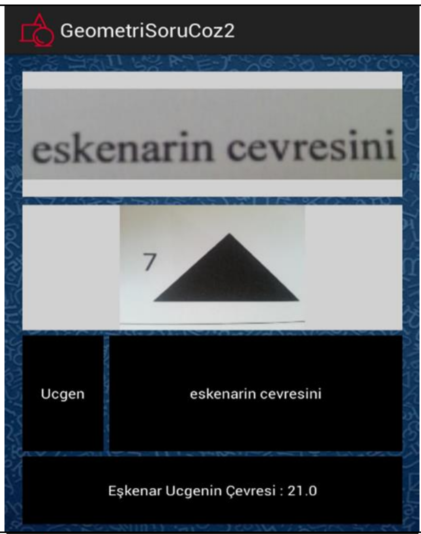
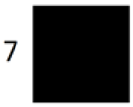
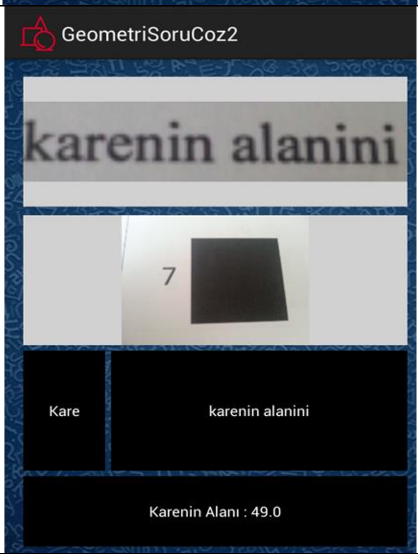
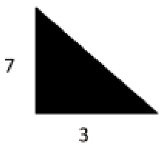
Soru metni resminde istenilenin ne olduğu (çevre, alan, hacim), uzunluk vb. bilgilerin algılanması için OCR API' lerinden biri olan TesserAct OCR API kullanılmıştır. Bu API nin kullanılmasının en önemli sebebi bellekte az yer kaplaması ve hızlı olmasıdır. Bu API de giriş resmi öncelikle ikili görüntüye dönüştürülür, daha sonra karakterlerin dış çizgileri belirlenir, kelimeler elde edilir ve son olarak görüntüden metin çıkartılır.

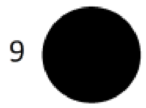
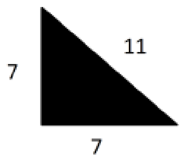
Bulgular

Geliştirilen mobil uygulama farklı 19 soru için test edilmiş, bu sorulardan 17' sinin sonucunu doğru bulmuştur. Tablo 1'de bu sorulardan 8'ine ait soru şekli, mobil uygulama cevabının ekran görüntüleri, sorunun gerçek cevabı ve bulgunun doğru ya da yanlış olduğu bilgileri verilmiştir.

Tablo 1. Örnek test soruları

Soru	Uygulama Görüntü	Uygulama Cevap/ Orijinal Cevap	Doğru (D)/ Yanlış (Y)
1) Aşağıdaki şekil nedir? 	 	Besgen/ Beşgen	D
2)Aşağıdaki beşgenin cevresini hesaplayınız?  	 	0.0/ 20	Y

3) Aşağıdaki eskenarin çevresini hesaplayınız?  	 	21.0/ 21	D
4) Aşağıdaki karenin alanini hesaplayınız?  	 	49.0/ 49	D
5) Aşağıdaki dik ucgenin alanini hesaplayınız?  	 	0.5/ 10.5	Y

6) Aşağıdaki yarıçapı verilen kurenin hacmini (*Π*=3.14**)** hesaplayınız? 		3052.08/ 3052.08	D
7) Aşağıdaki ikizkenarin çevresini hesaplayınız? 		25.0/ 25	D
8) Aşağıdaki dikdörtgenin cevresini hesaplayınız? 		28.0/ 28	D

Sonuçlar ve Gelecek Çalışmalar

Yapılan kapsamlı literatür araştırmaları sonucunda; geometrik kavramları öğrenme, anlama, ilişkilendirme ve bu bilgileri problem çözme doğrultusunda kullanmanın, öğrencilerin oldukça zorlandığı problemlerden biri olduğu görülmüştür. Bu çalışma kapsamında özellikle ilköğretim öğrencilerinin, basit geometri sorularının çözümü için yararlanabileceği yardımcı eğitici araç geliştirilmesi amaçlanmıştır. Yapılan çalışmada Android platformunda mobil cihazlar üzerinde kullanılabilecek üçgen, kare, dikdörtgen, daire ve beşgen geometrik şekilleri için, ilgili geometrik şekli tanıma, bu geometrik şekle ait soruda istenen çevre, alan ve hacim hesaplamalarını yapan mobil uygulama geliştirilmiştir.

İleriki çalışmalarda uygulamanın tanıyabileceği geometrik şekiller genişletilebilir. Uygulamada kullanılan TesserAct OCR API den kaynaklı daha uzun paragraflık soruları okuması için, bu API'ye ek bazı fonksiyonlar eklenerek resmin metne dönüştürülmesi işlemi hızlandırılabilir. Ayrıca üçgen, kare, dikdörtgen, daire ve beşgen sorularında açıları okuma, iç içe şekillerin algılanması gibi farklı soru tiplerinin çözülmesi için uygulamaya yeni fonksiyonlar eklenebilir, eklenen bu fonksiyonlar farklı geometrik şekillerle ilgili soruların çözümünde kullanılabilir.

Kaynaklar

Abughalieh, K., Qadi, W., Melkon, K., Fakes, B., Sababha, B., & Al-mousa, A. (2014). A compact portable object tracking system. *2014 5th International Conference on Information and Communication Systems (ICICS*), Jordan.

Açıkgül, K. (2012). Öğretmen adaylarinin dinamik geometri yazilimi kullanarak geometrik yer problemlerini çözüm süreçlerinin ve bu süreçlere ilişkin görüşlerinin incelenmesi. Yüksek Lisans Tezi, İnönü Üniversitesi, Malatya, Türkiye.

Aigerim, S., Meirambek, Z., Askar, Z., & Yedilkhan, A. (2014). Recognition of traffic signs. *Application of Information and Communication Technologies (AICT), 2014 IEEE 8th International Conference on*, Astana.

Android İşletim Sistemi. (2017). Retrieved from https://tr.wikipedia.org/wiki/Android_(işletim_sistemi).

Atmaca, U. İ., Uygun, N. G., & Çağlar, M. F. (2014). Haberleşme mühendisliği için mobil öğrenme uygulaması. *URSI-TÜRKİYE'2014 VII. Bilimsel Kongresi*, Elazığ, Türkiye.

Aydoğmuş, B. S. (2010). Matematik öğretmenlerinin öğretim yazılımlarından yararlanma konusundaki görüşleri. Yüksek Lisans Tezi, Marmara Üniversitesi, İstanbul, Türkiye.

Baki, A. (2001). Bilişim teknolojisi ışığı altında matematik eğitiminin değerlendirilmesi. *Milli Eğitim Dergisi*, 149, 26-31.

Calc Area Solver Pro. (2017). Retrieved from https://play.google.com/store/apps/details?id=com.appalapapp.calcareasolverpro

Chaudhari, S. B. & Patil, S. A. (2015). Real time video processing and object detection on android smartphone. *International Conference on Electrical, Electronics, Signals, Communication and Optimization (EESCO) - 2015*, India.

Çağlayan, M., Çekirge, B., Birant, D., & Yıldırım, P. (2014). Mobil uygulama ile görüntü işleme ve veri madenciliği tekniklerine dayalı melanom tahmin desteği sağlanması. *Akıllı Sistemlerde Yenilikler ve Uygulamaları Sempozyumu 2014 (ASYU 2014)*, İzmir, Türkiye.

Duvar, R., & Urhan O. (2014). 1-boyutlu projeksiyon temelli görüntü stabilizasyonunun mobil bir cihaz üzerinde gerçek zamanlı gerçeklenmesi. *2014 IEEE 22nd Signal Processing and Communications Applications Conference (SIU 2014)*, Trabzon, Türkiye.

Easy A Elite. (2017). Retrieved from https://play.google.com/store/apps/details?id=com.androidapp.easyaelite

Elrefaei, L. A., Bajaber, A., Natheir, S., AbuSanab, N., & Bazi, M. (2015). automatic electricity meter reading based on ımage processing. *2015 IEEE Jordan Conference on Applied Electrical Engineering and Computing Technologies (AEECT)*, Jordan.

Emekli, A. (2001). Ölçüler konusunun öğretiminde yanılgıların teşhisi ve alınması gereken tedbirler. Yayınlanmamış Master Tezi. Selçuk Üniversitesi, Konya, Türkiye.

Gaussian Filtreleme. (2017). Retrieved from http://ceng.gazi.edu.tr/~mahmut/image_processing/Image_processing/14_tr/aciklama.aspx

Geometri Çöz. (2017). Retrieved from https://play.google.com/store/apps/details?id=com.ercinbark.ornek.geouygulama

Geometri YGS LYS Konu Anlatım. (2017). Retrieved from https://play.google.com/store/apps/details?id=com.mas.ygs.lys.geometri

Geometry Problem Solver. (2017). Retrieved from https://play.google.com/store/apps/details?id=ryanhopkins.geometryproblemsolver

Geometry Solver. (2017). Retrieved from https://play.google.com/store/apps/details?id=com.Geometry_Solver

Interactive Math Pro. (2017). Retrieved from https://play.google.com/store/apps/details?id=com.lm28.mathsinteractiveformulas

Jones, K., & Mooney, C. a. H. T. (2002). Trainee primary teachers' knowledge of geometry for teaching. *Proceedings of the British Society for Research into Learning Mathematics*, *22*(2), 95-100.

Kamii, C., & Kysh, J. (2006). The difficulty of "length x width": Is a square the unit of measurement?. *Journal of Mathematical Behavior, 25*, 105-115.

Karataş, İ. (2017). Experiences of student mathematics-teachers in computer based mathematics learning environment. International Journal for Mathematics Teaching and Learning. Retrieved from http://www.cimt.plymouth.ac.uk/journal/karatas.pdf

Keith, J. (2000). Teacher Knowledge and Professional Development in Geometry". *Proceedings of the British Society for Research into Learning Mathematics, 20*(3), 109-114.

Kıcı, D. (2010). Üniversite öğrencilerinin mobil öğrenmenin üniversite eğitimindeki etkisi konusundaki beklentileri üzerine bir araştırma. *International Conference on New Trends in Education and Their Implications,* Antalya, Türkiye.

Kidman, G., & Cooper, T. (1997). Area integration rules for grades 4, 6, 8 students". *Proceedings of the 21st Annual Conference of the International Group for the Psychology of Mathematics Education*, Lahti, Finland.

Köse, N. Y. (2008). İlköğretim 5. sınıf öğrencilerinin dinamik geometri yazılımı cabri geometriyle simetriyi anlamlandırmalarının belirlenmesi: Bir eylem araştırması. Yüksek Lisans Tezi, Anadolu Üniversitesi, Eskişehir, Türkiye.

Küçükarslan, S., Koçak, Ş., & Kara, M. (2009). Cepte taşınabilir aygıtların eğitimde kullanılması üzerine bir öneri: mp4 oynatıcı örneği. *Akademik Bilişim Konferansı 09*, Şanlıurfa, Türkiye.

Ma, G., Meng, W., Xu, S., & Zhang, X. (2013). Rotational ınvariant face detection on a mobile device. *2013 International Conference on Virtual Reality and Visualization*, China.

Menzi, N., Önal, N., & Çalışkan, E. (2012). Mobil teknolojilerin eğitim amaçlı kullanımına yönelik akademisyen görüşlerinin teknoloji kabul modeli çerçevesinde incelenmesi. *Ege Eğitim Dergisi, 13*(1), 40-55.

Moreira, C Q., & Contente, M d R. (1997). The role of writing to foster pupil's learning about area. In E. Pehkonen (Ed.). *Proceedings of the 21st PME International Conference*.

Napitupulu, B. (2001). An exploration of students' understanding and van hiele levels of thinking on geometric constructions. Master Theses, Simon Fraser University, Canada.

Odabaşı, H. F., Mısırlı, Ö., Günüç, S., Şahin Tımar, Z., Ersoy, M., Som, S., Dönmez, F İ., Akçay, T., & Erol, O. (2012). Eğitim için yeni bir ortam: twitter. *Anadolu Journal of Educational Sciences International, 2*(1), 89-103.

Oran, M. K., & Karadeniz, Ş. (2007). İnternet tabanlı uzaktan eğitimde mobil öğrenmenin rolü. *Akademik Bilişim'07-IX. Akademik Bilişim Konferansı ,* Kütahya, Türkiye.

Sarıtaş, T., & Üner, N. (2013). Eğitimdeki yenilikçi teknolojiler: bulut teknolojisi. *Eğitim ve Öğretim Araştırmaları Dergisi (Journal of Research in Education and Teaching),2*(3), 192-201.

Setiawardhana Hakkun ,R. Y., & Baharuddin, A. (2015). sign language learning based on android for deaf and speech ımpaired people. *2015 International Electronics Symposium (IES),* Indonesia.

Tan Şişman, G., & Aksu, M. (2009). Yedinci sınıf öğrencilerinin alan ve çevre konularındaki başarıları. *İlköğretim Online, 8*(1), 244-253.

Tataroğlu, G. A., & Özden, K. E., (2014). Matching historical images for augmented reality. *2014 IEEE 22nd Signal Processing and Communications Applications Conference (SIU 2014),* Trabzon.

Tutr-Instant Doubt Clearance. (2017). Retrieved from https://play.google.com/store/apps/details?id=com.sakosoft.android.tutrapp

PRESERVICE TEACHERS' VIEWS ABOUT ENGINEERING DESIGN BASED SCIENCE EDUCATION

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Abstract: In this study, it is aimed to carry out the design planning and practices together with the inquiry based instruction to pre-service science teachers. It was also aimed to take pre-service teachers' views about this teaching strategy. In this study process, the interdisciplinary application of science, mathematics and technology fields as well as teaching the engineering design process to the participants have been taken into consideration. A total of 38 pre-service science teachers in two universities participated in this study. Firstly, the Scientific Process Skills (SPS) test was administered as a pre-test to the participants. Secondly, in order to help pre-service teachers to understand engineering design process and to learn its stages, four practices were conducted in group working under the supervision of the researchers. Participants were required to prepare lesson plans appropriate to 5E learning cycle model and to develop a problem and a design that can be applied to the problem as a final stage. They have implemented the plans they have prepared, presented the problem they have created to other groups and offered them the opportunity to design. After the practices of all groups was over, the SPS Test was reapplied as a post-test. The SPS test, which was applied as the pre- and post-test, and the 5-question interview form of the opinions of the participants after the application were used as the data collection tools in this study. The results of SPS test showed that the SPS test scores of both university participants' were increased and a significant difference was found between pre-test and post-test scores after the application. According to the data obtained from the interview form, preservice teachers suggest that the practice has contributed positively to skills and learning, and have a positive view of the applicability of this practice in schools

***Keywords*:** Inquiry based instruction, engineering design process, pre-service science teachers,

FEN BİLGİSİ ÖĞRETMEN ADAYLARININ TASARIM TEMELLİ FEN EĞİTİMİNE YÖNELİK GÖRÜŞLERİ

Özet: Bu çalışmada fen bilgisi öğretmen adaylarına bir fen konusu öğretirken 5E modeli içerisinde yer verilmiş bir tasarım planlama ve uygulama süreci yaşatılması ve bu öğretim biçimi hakkındaki görüşlerinin alınması hedeflenmiştir. Bu çalışma sırasında öğretmen adaylarına Fen, Teknoloji, Mühendislik, Matematik alanlarının disiplinler arası şekilde ve uygulamalı olarak öğretilmeye çalışılmış ve daha sonra yapılan uygulama ile ilgili öğretmen adaylarının görüşleri alınmıştır. İki ayrı üniversitenin Eğitim Fakültesi Fen Bilgisi Öğretmenliği A.B.D.'nın 3. sınıfında öğrenim görmekte olan toplam 38 öğretmen adayı çalışmaya katılmışlardır. Çalışmaya başlamadan önce öğretmen adaylarına BSB testi ön test olarak uygulanmıştır. Daha sonra dört ayrı tasarım örneği araştırmacıların gözetiminde öğretmen adaylarına grup çalışması yaptırılarak tasarım yapmanın aşamaları öğretilmiştir. Öğretmen adaylarından 5E öğrenme modeline göre belirlenen konuları anlatmaları ve konu ile ilgili istedikleri 5E aşamasında kullanabilecekleri bir tasarım gerçekleştirmeleri istenmiştir. Hazırladıkları tasarımı sunumları sırasında çalışmadaki diğer öğretmen adaylarına da yapma fırsatı vermişlerdir. Tüm grupların sunumları bittikten sonra BSB algı ölçeği son test olarak tekrar uygulanmıştır. Çalışmada veri toplama araçları olarak, ön ve son test olarak uygulanan BSB algı ölçeği, uygulama sonrası öğretmen adaylarının görüşlerinin alındığı görüşme formu kullanılmıştır. Ayrıca tasarım sürecinde yaşanan sorunların tespiti için de bazı öğretmen adayları ile görüşme yapılmıştır. BSB algı ölçeği sonuçlarına göre uygulama sonrası her iki üniversite öğrencilerinin BSB testi puanı artmış olup anlamlı farklılık oluşmuştur. Görüşme formundan elde edilen verilerin analizi nitel analiz yöntemlerinden betimsel analizi yoluyla yapılmıştır. Görüşme formundan elde edilen verilere göre öğretmen adayları uygulamanın beceri ve öğrenme açısından olumlu katkı sağladığı görüşündedirler ve bu uygulamanın okullarda uygulanabilirliği ile ilgili olumlu görüşe sahiptir

***Anahtar Sözcükler*:** Sorgulamaya dayalı öğretim, mühendislik tasarım süreçleri, öğretmen adayları,

Giriş

Yaşadığımız çağda küreselleşen dünyaya uyum sağlayabilmek için, bireylerin bilgi temelli yaşamasının yanı sıra yeni beceriler de kazanmasının gerekliliği ortaya çıkmaktadır. Uluslararası bağlamda iletişim ve etkileşimin arttığı, bilgi akışının hızlandığı bu dönemde, aynı zamanda, ülkeler ekonomik açıdan güçlü bir yapılanmaya sahip olmaya çalışmaktadır. Uluslararası düzeydeki bu rekabette, sahip olduğu bilgi ve becerileri en iyi kullanabilen bireyler yetiştirebilenler üstün gelmektedir. Ekonomik kalkınmanın, bilim ve teknolojideki gelişmenin eğitimden geçtiğini fark edenler eğitim alanında da yenilikler gerçekleştirmektedirler. Son dönemlerde fen eğitimi alanında yaygınlaşan öğretim yaklaşımlarından birisi STEM eğitimidir. Fen, teknoloji, mühendislik ve matematik alanlarının entegrasyonunu içeren bu yaklaşımın bilgi ve beceri açısından öğrencileri gelecek yıllara hazırlayacağı, STEM alanlarına ilgilerini teşvik edeceği düşünülmektedir (Cunningham & Hester, 2007; English & Mousoulides, 2011; Teo & Ke, 2014). Gelecek Dünyamızda bilim insanı ve mühendislere olan ihtiyacın fazla olması (Benuzzi, 2015), buna karşılık mühendislik mezun sayısının giderek azalması, STEM alanlarına yönelik mesleki tercihlerin azalması ve bu mesleki alanlarda yeterli özelliklere sahip bireylerin yetiştirilememesi bu yaklaşımın çıkış noktasını oluşturmaktadır (English, 2012; Taylor, 2008). Bununla beraber, fen eğitiminin önemli hedeflerinden birisi olan bilimsel okuryazar ve teknoloji okuryazarı bireyler yetiştirmek ve 21. yüzyılın sorunları üzerinde çalışarak araştırmalara destek olacak bilim insanlarının yetişmesi (Schnittka, Bell & Richards, 2010) de STEM eğitiminin ortaya çıkmasında belirleyici olmuştur. Ayrıca gelecek nesillerin ihtiyaçları dikkate alınarak 21. yüzyılda kazandırılması gereken bilgi ve becerilerin de bu yaklaşım ile bireylere kazandırılması göz önünde bulundurulmuş, bu bağlamda, teknik olarak uzman, bilgili, güçlü analitik becerilere sahip, yaratıcı, lider ve etik düşünebilen bireylerin yetiştirilmesi hedeflenmiştir (Bairaktarova, Cox, & Evangelou, 2011).

STEM çalışmalarının yaygınlaşmasının bir nedeninin de öğrencilerin bilim insanlarına ve mühendislere yönelik bakış açıları olduğu düşünülmektedir. Yapılan çalışmalara göre öğrenciler; bilimi araştırma, mühendisliği onarma, teknolojiyi ise tasarım yapma ve yaratıcılık olarak tanımlamaktadır. Öğrenciler, fen ve teknoloji tasarı derslerinde eğlendikleri, bilim ve mühendisliğin topluma faydalı olduğunu düşündükleri halde mühendis olmayı düşünmemektedirler (Silver, Rushton, 2008).

STEM eğitiminin etkili olabilmesi için sınıf ortamında uygulanabilecek çalışmalara mühendislik tekniklerinin dahil edilmesi gerekmektedir (Corbett, 2012) Bu amaçla okullarda mühendislik tasarım süreci uygulanmaktadır. Bu süreç, mühendislik problemlerinin belirlenmesi ve çözümlenesini hedefler (English, Hudson, & Dawes, 2012). Mühendislik tasarım süreci, istenilen ihtiyaçları karşılamak için bir sistem tasarlamaktır. Bu süreç, ihtiyaçları karşılamak için kaynakları dönüştürmede fen bilimleri, matematik ve mühendislik bilimlerinin uygulandığı bir karar verme sürecidir (ABET, 2011).

Mühendislik tasarım süreci, model oluşturma sürecine benzemektedir. Bu sürece göre; bir problem durumu belirlenir, problemin çözümüne yönelik fikirler öne sürülür, çözüm önerilerinden birisi seçilir ve açıklanır, test edilir, sonuçlar analiz edilir ve çözüm önerisini gözden geçirmek ye da reddetmek üzere kullanılır, revize edilen çözüm önerisi açıklanır ve süreç belirlenen probleme uygun çözüm önerisi bulununcaya kadar tekrar edilir (Corbett, 2012; Zawojewski, Hjalmarson, Bowman & Lesh, 2008).

Mühendislik tasarım sürecinin okullarda uygulanabilmesi için Engineering is Elementary (Hester & Cunningham, 2004) ve Proje Tabanlı Öğrenme (Corbett, 2012) olmak üzere iki farklı yaklaşımdan yararlanılmaktadır. Engineering is Elementary yaklaşımında etkinlikler soru sorma, hayal etme, planlama, yaratma ve geliştirme olmak üzere temel mühendislik tasarım sürecine dayanmaktadır (English, Hudson, & Dawes, 2012). Proje tabanlı öğrenme ise, öğrencilerin katılımını teşvik eden, proje ile ilgili açık yönlendirmeler sağlayan bir yaklaşımdır (Corbett, 2012).

Araştırmalar mühendislik tasarım süreci uygulamalarının öğrencilerin problem çözme becerileri (Borgford-Parnell, Deibel, & Atman, 2010) üzerine olumlu etkisi olduğunu göstermiştir. Bu uygulamaların öğrencide istenilen bilimsel bilginin oluşturulması üzerine yapılan çalışmalarda da bilginin oluşturulmasını, anlaşılmasının kolaylaştırılmasını, kavramsal değişimi olumlu etkilediği belirlenmiştir (Schnittka, Bell & Richards, 2010; Fortus, Dershlimer, Krajcik, Marx, Mamlak-Noaman, 2004). Buna karşılık, mühendislik tasarım süreci etkinliklerine dahil olan öğrencilerin fen kavramlarını tam olarak öğrenemedikleri farklı çalışma sonuçlarında görülmektedir (Silk, Schunn & Cary, 2007).

Yapılan araştırmalar incelendiğinde, STEM eğitimi ve bu eğitim yaklaşımı içinde uygulanan mühendislik tasarım süreci ile ilgili çalışmaların ilkokul ve ortaokul düzeyinde yaygınlaşmasına rağmen, uygulamaları gerçekleştirecek olan öğretmenleri eğitimi ile ilgili çalışmaların sınırlı kaldığı görülmektedir (Ames, 2014). Öğretmenler ile gerçekleştirilen araştırmalarda öğretmenlerin uygulamalar ile ilgili kendilerini hazır hissetmedikleri, STEM okullarında öğretmenlik yapmanın zor olduğu düşüncesinde oldukları, pedagojik içerik bilgisi ve özgüvenlerinin yetersiz olduğu tespit edilmiştir (Ames, 2014; Benuzzi, 2015; Teo & Ke, 2014). Bu durumda öğretmenlerin STEM konularını öğretmede yetersiz olabilecekleri, zorlanabilecekleri düşüncesi ortaya çıkmaktadır. Öğretmen yetiştirme programları da bu uygulamalara yönelik çalışmalarda sınırlı kalmaktadır (Benuzzi, 2015, Teo & Ke, 2014).

Bu sınırlılıkların, öğretim programında mühendislik uygulamalarını hedef alan, öğrencilere mühendislik becerileri kazandırmayı amaçlayan, ülkemizde gelecek yıllarda uygulanacak fen bilimleri programını uygulayacak öğretmenler için de sorun oluşturacağı düşünülmektedir. Bu bağlamda öğretmenlerin mühendislik uygulamalarını gerçekleştirebilecek bilgi ve becerileri kazanmaları önemlidir. Bu düşünce doğrultusunda bu çalışmada, sorgulamaya dayalı öğretim süreci ile birlikte mühendislik tasarım sürecinin uygulandığı çalışmalara katılan öğretme adaylarının bilimsel süreç becerilerine yönelik algılarının ve uygulama ile ilgili görüşlerinin tespit edilmesi amaçlanmıştır.

Çalışmanın Amacı

Çalışmada fen bilgisi öğretmen adaylarına sorgulamaya dayalı öğretim sürecinin yaşatılması ve bununla birlikte tasarım planlama ve bu planı uygulama çalışmaları yaptırma hedeflenmiştir. Bu amaç doğrultusunda yapılan çalışmalar sırasında öğretmen adaylarının bilimsel süreç becerileri ile ilgili algılarında bir değişme olup olmadığı görülmeye çalışılmıştır. Ayrıca tasarım planlama ve yapma ile ilgili görüşlerinin ne olduğu tespit edilmiştir. Bu amaçlar doğrultusunda aşağıdaki problem oluşturulmuştur. " Fen Bilgisi Öğretmen adaylarının mühendislik tasarım süreci gerçekleştirerek yaptıkları öğretimleri sırasında bilimsel süreç becerileri ile algıları ve yapılan uygulama hakkındaki görüşleri nasıldır?" Bu probleme bağlı olarak "fen bilgisi öğretmen adaylarının mühendislik tasarım süreci ile ilgili yaşantıları sonrası sahip oldukları bilimsel süreç becerilerine yönelik algılarında anlamlı bir farklılık var mıdır?" ve "fen bilgisi öğretmen adaylarının mühendislik tasarım süreci ile ilgili yaşantıları sonrası görüşleri nasıldır?" soruları alt problemler olarak belirlenmiştir.

Yöntem

Çalışma bir zayıf deneysel desen niteliğindedir. Çalışma sürecinde öğretmen adaylarına mühendislik tasarım sürecinin öğretilmesinin yanı sıra Fen, Matematik, Teknoloji alanlarının disiplinler arası uygulanması da dikkate alınmıştır. Böyle bir öğretim sunarken öğretmen adaylarının bilimsel süreç becerileri ile ilgili algıları ve görüşleri tespit edilmeye çalışılmıştır.

Çalışma Grubu

Araştırma grubunu iki devlet üniversitesinin son sınıfında okuyan 38 fen bilgisi öğretmen adayı oluşturmaktadır. Üniversitelerden birine A diğerine B üniversitesi olarak isimlendirme yapılmıştır. Üniversiteler Türkiye'nin farklı iki bölgesinde yer almaktadır. A üniversitesinde 15 öğrenci, B üniversitesinde 23 öğrenci çalışma grubunu oluşturmaktadır. Bu öğrenciler her iki üniversitede de fen bilgisi öğretmenliği anabilim dalında öğrenim gören son sınıf öğrencileridir.

Veri Toplama Araçları

Çalışmada veri toplama araçları olarak, ön ve son test olarak uygulanan 22 maddelik Bilimsel Süreç Becerileri Algı Ölçeği, uygulama sonrası öğrencilerin görüşlerinin alındığı 5 soruluk online görüşme formu kullanılmıştır.
Bilimsel Süreç Becerileri Algı Ölçeğinin orijinal versiyonu Rambuda ve Fraser (2004) tarafından geliştirilen coğrafya öğretmenlerine yönelik bilimsel süreç beceri algı ölçeğidir. Bu ölçeğin üç farklı üniversitenin eğitim fakültesi öğrencilerinden oluşan örneklem üzerinde Türkçeye ve fen öğretmenlerine yönelik uyarlaması Yıldırım, Sürmeli, Güven ve Ergun (2016) tarafından yapılmıştır. 22 maddeden oluşan dörtlü likert tipindeki ölçek, üç farklı üniversitenin eğitim fakültesi son sınıf öğrencilerinden toplam 686 öğrenciye uygulanmıştır. Ölçeğin dil eşdeğerliğini test etmek için ölçeğin Türkçe ve İngilizce formları İngilizce öğretmenliği anabilim dalındaki toplam 58 öğrenciye uygulanmış ve elde edilen puanlar arasında pozitif ve anlamlı korelasyonlar tespit edilmiştir. Ölçeğin faktör yapısını saptamak amacıyla uygulanan açımlayıcı ve doğrulayıcı faktör analizleri sonuçlarına göre ölçek Temel bilimsel süreç becerileri (gözlem, sınıflandırma, iletişim, ölçme, tahmin, çıkarım yapma) ve bütünleştirilmiş bilimsel süreç becerileri (değişkenleri kontrol etme, hipotez oluşturma, deney yapma, veri yorumlama, operasyonel tanımlama, model oluşturma) olmak üzere 2 boyutlu bir yapıdan oluşmaktadır. Ölçekteki her bir madde için madde faktör yükleri .46 ile .78 arasında, iç tutarlılık katsayısı ise .91 olarak bulunmuştur. Bu çalışmada Bilimsel Süreç Becerileri Algı Ölçeğinin uygulanmasından elde edilen Cronbach alpha değerleri Tablo 1'de verilmiştir.

Tablo1. Bilimsel süreç becerileri algı ölçeğinin cronbach alpha değerleri

Gruplar	N	Cronbach Alpha
Öntest-Temel Beceriler	13	,85
Öntest –Bütünleştirilmiş Beceriler	9	,87
Öntest-Toplam	22	,92
Sontest-Temel Beceriler	13	,81
Sontest- Bütünleştirilmiş Beceriler	9	,84
Sontest-Toplam	22	,89

Yapılan tasarımlarla ilgili olarak öğretmen adaylarına uygulama sonrası açık uçlu sorulardan oluşan uygulama ile ilgili görüşlerini değerlendirmeye yönelik hazırlanmış görüşme formu online olarak doldurtulmuş olup yaptıkları tasarımlarla ilgili görüşlerinin ne olduğu tespit edilmeye çalışılmıştır. Daha sonra gönüllü olan öğretmen adayları arasından belirlenen 15 kişilik bir öğrenci grubu ile de tasarım sürecinde karşılaştıkları sorunları belirlemek amacı ile de yüz yüze görüşme yapılmıştır.

Veri Analizi

Ölçek uygulamasından elde edilen verilerin analizi için nicel veri analizinden yararlanılmıştır. Bu amaçla SPSS 17 istatistik programı kullanılmıştır. Bilimsel Süreç Becerileri Algı ölçeğinin ön test-son test puanları arasındaki farkın tespit edilmesi için non-parametrik Wilcoxon, gruplar içindeki farkların tespit edilmesi için Kruskal Wallis analizleri yapılmıştır. Görüşme formundan elde edilen verilerin analizi ise nitel analiz yöntemlerinden betimsel analizi yoluyla yapılmıştır.

Araştırma Süreci

Çalışmaya başlamadan önce öğrencilere 22 maddelik Bilimsel Süreç Becerileri Algı Ölçeği testi ön test olarak uygulanmıştır. İkinci aşamada, öğretmen adaylarının mühendislik tasarım sürecini anlamaları ve aşamaları öğrenmeleri amacı ile dört ayrı tasarım uygulaması grup çalışması ile araştırmacıların gözetiminde yaptırılmıştır. Üçüncü aşamada, tasarım yapmaya uygun olan ortaokul fen konuları belirlenmiş ve her biri bir öğrenci gurubuna verilmiştir. Öğretmen adaylarından 5 E öğrenme modeline göre ders planlarını hazırlanmaları ve son aşama olarak konu ile bir problem ve problem ile ilgili uygulanabilecek bir tasarım geliştirmeleri istenmiştir. Hazırladıkları planları derste uygulamış, oluşturdukları problemi diğer gruplara sunarak onlara da tasarım yapma fırsatı sunmuşlardır. Tüm grupların sunumları bittikten sonra BSB Testi son test olarak tekrar uygulanmıştır. Her grup kendi çalışmaları da dahil olmak üzere altı ayrı tasarım çalışmasına katılmışlardır.

Tasarım yapmak için kullanılan fen konuları ve kazanımları aşağıdaki tablo 2 de verilmiştir.

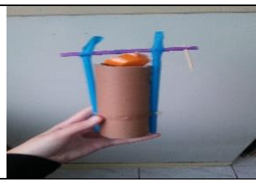
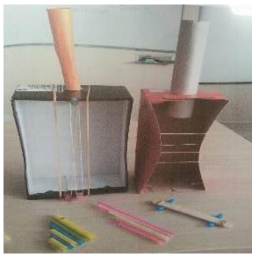
Tablo 2. Uygulamada kullanılan fen konu ve kazanımları

Ünite	**Konular**
6.7.1. İletken ve Yalıtkan Maddeler	**Konu/Kavramlar**: İletken maddeler, yalıtkan maddeler, iletken ve yalıtkan maddelerin kullanım alanları 6.7.1.1. Tasarladığı elektrik devresini kullanarak maddeleri, elektriği iletme durumlarına göre sınıflandırır. 6.7.1.2. Maddelerin elektriksel iletkenlik ve yalıtkanlık özelliklerinin hangi amaçlar için kullanıldığını günlük yaşamdan örneklerle açıklar.
7.2.2. Kuvvet-Katı Basıncı İlişkisi	**Konu/Kavramlar**: Basınç, katı basıncını etkileyen değişkenler (kuvvet, yüzey alanı), sıvı basıncını etkileyen değişkenler (derinlik, sıvının cinsi), basıncın günlük yaşam ve teknolojideki uygulamaları 7.2.2.1. Katı basıncını etkileyen değişkenleri deneyerek keşfeder ve bu değişkenler arasındaki ilişkiyi analiz eder. 7.2.2.2. Sıvı basıncını etkileyen değişkenleri deneyerek keşfeder ve bu değişkenler arasındaki ilişkiyi analiz eder. 7.2.2.3. Katı, sıvı ve gazların basınç özelliklerinin günlük yaşam ve teknolojideki uygulamalarına örnekler verir.
7.2.4. Enerji Dönüşümleri	**Konu/Kavramlar:** Enerjinin korunumu, sürtünmeyle kinetik enerji kaybı 7.2.3.2. Enerjiyi iş kavramı ile ilişkilendirir, kinetik ve potansiyel enerji olarak sınıflandırır 7.2.4.1. Kinetik ve potansiyel enerji türlerinin birbirine dönüştüğünü örneklerle

	açıklar ve enerjinin korunduğu sonucunu çıkarır. 7.2.4.2. Sürtünme kuvvetinin kinetik enerji üzerindeki etkisini örneklerle açıklar *a. Sürtünme kuvvetinin kinetik enerji üzerindeki etkisinin örneklendirilmesinde sürtünmeli yüzeyler, hava direnci ve su direnci dikkate alınır.* *b. Sürtünen yüzeylerin ısındığı, basit bir deneyle gösterilerek kinetik enerji kaybının ısı enerjisine dönüştüğü çıkarımı yapılır.*
7.4.2. Işığın Soğrulması	**Konu/Kavramlar:** Işığın soğrulması, cisimlerin siyah, beyaz ve renkli görünmesi, güneş enerjisi 7.4.2.1. Işığın madde ile etkileşimi sonucunda madde tarafından soğrulabileceğini keşfeder 7.4.2.4. Güneş enerjisinin günlük yaşam ve teknolojideki yenilikçi uygulamalarına örnekler verir ve kaynakların etkili kullanımı bakımından Güneş enerjisinin önemini tartışır.
8.2.1. Basit Makineler	**Konu/Kavramlar:** Sabit makara, hareketli makara, palanga, kaldıraç, eğik düzlem, çıkrık, basit makinelerin kullanım alanları 8.2.1.1.Basit makinelere örnekler verir ve sağladığı avantajları örneklerle açıklar 8.2.1.2. Basit makinelerin günlük yaşamdaki kullanım alanlarına örnekler verir. 8.2.1.3. Basit makinelerden yararlanarak günlük yaşamda iş kolaylığı sağlayacak bir düzenek tasarlar ve yapar.
6.4.2. Sesin Maddeyle Etkileşmesi	**Konu/Kavramlar:** Sesin yansıması, sesin soğrulması, ses yalıtımı 6.4.2.1. Sesin madde ile etkileşimi sonucunda oluşabilecek durumları kavrar. 6.4.2.2. Sesin yayılmasını önlemeye yönelik tahminlerde bulunur ve tahminlerini test eder. 6.4.2.3. Ses yalıtımının önemini açıklar ve ses yalıtımı için geliştirilen teknolojik ve mimari uygulamalara örnekler verir.

Aşağıdaki tablo 3'de öğretmen adaylarının gerçekleştirdikleri tasarımlar ve problemleri verilmiştir.

Tablo 3. Öğretmen adaylarının tasarımları ve problemleri

Konular	Tasarım sorusu	Tasarım
8.2.1. Basit Makineler	Daha az kuvvet uygulanarak kuyudan su alınması sağlayan bir düzenek nasıl olur?	
6.4.2. Sesin Maddeyle Etkileşmesi	Farklı materyaller ile müzik aleti yapılabilir mi?	
5.6.1. Basit Bir Elektrik Devresinde Lamba Parlaklığını Etkileyen Değişkenler	Parlaklığı değişen lamba tasarımı	
6.7.1. İletken ve Yalıtkan Maddeler	Elektriği iletmeyen eldiven tasarımı	

7.2.2. Kuvvet-Katı Basıncı İlişkisi	300 gramlık bir yükü kumlu bir zeminde en kolay ve kumda en az şekilde bir iz bırakarak taşıyabilecek bir araç tasarlanabilir mi?	
İletken ve Yalıtkan Maddeler	Her madde elektriği iletir mi? İletirse aynı oranda mı iletir?	
7.4.2. Işığın Soğrulması	Beyaz ışığı kullanarak renkli ışık yayan bir obje elde edebilir miyiz?	
7.2.4. Enerji Dönüşümleri	Çek bırak araba nasıl tasarlanır?	

Bulgular

"Fen bilgisi öğretmen adaylarının mühendislik tasarım süreci ile ilgili yaşantıları sonrası sahip oldukları bilimsel süreç becerilerine yönelik algılarında anlamlı bir farklılık var mıdır?" sorusu birinci alt problemdir. Bu soruya yanıt bulmak için ön ve son test olarak uygulama öncesi ve sonrası çalışma gruplarına bilimsel süreçler becerileri ile ilgili algı testi uygulanmıştır. Bu testle ilgili sonuçlar aşağıda verildiği gibidir.

Tablo 4. Ölçek puanları dağılımın normalliğini denetlemek amacı ile yapılan bir örneklem Kolmogorov-Smirnov testi sonuçları

Değerler		Öntest-Temel Beceriler	Öntest Bütünleş-tirilmiş	Öntest-Toplam	Sontest Temel	Sontest Bütünleş-tirilmiş	Sontest Toplam
N		38	38	38	35	35	35
Normal Parametreler	$\bar{X}$	41,05	26,31	67,36	44,85	74,17	74,17
	SS	5,44	4,58	9,46	4,40	7,78	7,78
Kolmogorov-Smirnov Z		,79	,64	,64	,68	,56	,56
p		,54	,80	,79	,74	,90	,90

Bilimsel Süreç Becerileri Algı Ölçeği ön test-son test uygulamalarından elde edilen puanların normal dağılım gösterip göstermediğini belirlemek amacı ile yapılan tek örneklem Kolmogorov-Smirnov testi sonucunda dağılımın normal dağılmadığı görülmüştür (p>,05).Bu nedenle analizler non-parametrik testlerle yapılmıştır.

Tablo 5. Bilimsel süreç becerileri algı ölçeği deney grubu öntest-sontest puanları arasında farklılık olup olmadığını belirlemek üzere yapılan Wilcoxon analizi sonuçları

Puan	**Gruplar**	N	$\bar{x}_{sira}$	$\sum_{sira}$	z	p
Sontest-Öntest Temel Beceriler	Azalanlar	8	13	104	-3,46	,00*
	Artanlar	27	19,48	526		
	Eşit	0				
	Toplam	35				
Sontest-Öntest Bütünleştirilmiş Beceriler	Azalanlar	0	,00	,00	-5,16	,00*
	Artanlar	35	18	630		
	Eşit	0				

	Toplam	35				
Sontest-Öntest Toplam	Azalanlar Artanlar Eşit Toplam	7 28 0 35	14,14 18,86	99 531	-3,54	,00*

Tablo 5'de Bilimsel Süreç Becerileri Algı Ölçeği deney grubu öntest-sontest puanları arasında farklılık olup olmadığını belirlemek üzere yapılan Wilcoxon (İşaretlenmiş Sıralar Testi) analizi sonuçları verilmektedir. Tabloya göre, Wilcoxon testi sonucunda sıralamalar ortalamaları arasındaki fark istatistiksel olarak anlamlı bulunmuştur (p<,05). Söz konusu farklılık son test lehine gerçekleşmiş, uygulama sonunda öğretmen adaylarının temel bilimsel süreç becerileri, bütünleştirilmiş bilimsel süreç becerileri algıları anlamlı biçimde artış göstermiştir.

Tablo 6. Bilimsel süreç becerileri algı ölçeği puanlarının grup değişkenine göre farklılaşıp farklılaşmadığını belirlemek üzere yapılan Kruskal Wallis-H testi sonuçları

Puan	**Gruplar**	N	$\bar{x}_{sira}$	x^2	sd	p
Öntest temel beceriler	Üniversite B Üniversite A	23 14 37	17,81 22,39	1,519	1	,21
Öntest bütünleştirilmiş beceriler	Üniversite B Üniversite A	23 14 37	18,54 21,14	,48	1	,48
Öntest toplam beceriler	Üniversite B Üniversite A	24 14 38	18,04 22	1,125	1	,28
Sontest temel beceriler	Üniversite B Üniversite A	21 14 35	14,45 23,32	6,34	1	,01*
Sontest bütünleştirilmiş beceriler	Üniversite B Üniversite A	21 14 35	14,12 23,82	7,55	1	,00*
Sontest toplam beceriler	Üniversite B Üniversite A	21 14 35	14,12 23,82	7,55	1	,00*

Tablo 6'da Bilimsel Süreç Becerileri Algı Ölçeği puanlarının grup değişkenine göre farklılaşıp farklılaşmadığını belirlemek üzere yapılan Kruskal Wallis-H Testi sonuçları görülmektedir. Tabloya göre ön-testler açısından grupların sıralamalar ortalamaları arasında fark bulunamazken, son-testler açısından grupların sıralamalar ortalamaları arasındaki fark istatistiksel olarak anlamlı bulunmuştur (p<,05).

Tablo 7. Wilcoxon analizi sonuçları Üniversite A – Üniversite B örneklemi

Puan	**Gruplar**	N	$\bar{x}_{sira}$	$\sum_{sira}$	z	p
Sontest-Öntest Temel Beceri (Grup 1)	Azalanlar Artanlar Eşit Toplam	5 15 0 20	5,90 12,03	29,50 180,5	-2,82	,00*
Sontest-Öntest Bütün.. Beceri (Grup 1)	Azalanlar Artanlar Eşit Toplam	0 20 0 20	,00 10,50	,00 210	-3,92	,00*
Sontest-Öntest Toplam (Grup 1)	Azalanlar Artanlar Eşit Toplam	4 16 0 20	8,38 11,03	33,50 176,5	-2,67	,00*
Sontest-Öntest Temel Beceri (Grup 2)	Azalanlar Artanlar Eşit Toplam	3 11 0 14	7,00 7,64	21 84	-1,98	,04*
Sontest-Öntest	Azalanlar	0	,00	,00	-3,29	,00*

Bütün.. Beceri (Grup 2)	Artanlar Eşit Toplam	14 0 14	7,50	105		
Sontest-Öntest Toplam (Grup 2)	Azalanlar Artanlar Eşit Toplam	3 11 0 14	6,33 7,82	19 86	-2,10	,03*

Tabloda 7'de Bilimsel Süreç Becerileri Algı Ölçeği puanlarının gruplar içinde öntest-sontest puanları arasında farklılık olup olmadığını belirlemek üzere yapılan Wilcoxon (İşaretlenmiş Sıralar Testi) analizi sonuçları verilmektedir. Tabloya göre, her iki grubun sıralamalar ortalamaları arasındaki farklar istatistiksel olarak anlamlı bulunmuştur ($p<,05$). Bu farklar son testler lehine gerçekleşmiş, her iki grupta da öğretmen adaylarının bilimsel süreç becerileri algıları anlamlı biçimde artış göstermiştir.

İkinci alt problem olarak belirlenen "fen bilgisi öğretmen adaylarının mühendislik tasarım süreci ile ilgili uygulamalar sonrası görüşleri nasıldır? sorusuna yanıt bulmak için açık uçlu sorulardan oluşan görüşme formu ile öğretmen adaylarının görüşleri online olarak alınmıştır. Betimsel analiz ile değerlendirilen görüşme sonuçları aşağıda verilmiştir.

Tablo 8. Öğretmen adaylarının yapılan uygulama ile ilgili görüşleri

Olumlu Görüşler	f
Beceri	
* Mühendislik, tasarım becerileri kazandırma	**6**
Tasarım, ürün oluşturma	**5**
Materyal kullanma	**2**
Bilimsel süreç becerileri	**2**
Beceri	**4**
*Yaratıcı düşünme	**10**
Hayal gücünün kullanılması	**3**
Üst düzey beceriler	**2**
Problem çözme	**1**
Eleştirel düşünme	**1**
*Grup çalışması	
Fikir-düşünce paylaşımı	**5**
Başkalarının fikirlerine önem verme	**2**
Öğrenme	
*Aktif öğrenme	**9**
*Konunun daha iyi öğrenilmesi	**9**
*Kalıcı öğrenme	**8**
Günlük yaşam bağlantısı sağlama	**5**
Yaparak yaşayarak öğrenme	**3**
Anlamlı öğrenme-önceki bilgilerle ilişkilendirme	**2**
Öğrenci merkezli	**2**
Yaşam boyu öğrenme	**1**
Pekiştireç etkisi	**1**
Çoklu zekâya uygun	**1**
*Derse karşı olumlu tutum, ilgi, merak	**8**
*Eğlenceli olması	**8**
*Disiplinlerarası ilişki (Fen-Mat-Müh-Tek ilişkisi)	**7**
Farklı	**4**
Uygulanabilir	**2**
Başarıya etkisi	**1**
Özgüven artışı sağlaması	**1**

Tabloda 8'de her iki üniversitedeki öğretmen adaylarının 5E öğrenme modeli ile birlikte uygulanan tasarım süreci ile ilgili açık uçlu sorulara verdikleri yanıtlar görülmektedir. Tabloda da görüldüğü gibi, öğretmen adaylarının hepsi dâhil oldukları uygulama süreci ile ilgili olumlu görüş bildirmiştir. Öğretmen adaylarının en fazla değindikleri olumlu görüş nedenleri ise, uygulamanın tasarım becerileri kazandırma, yaratıcı düşünme, aktif öğrenme, konunu daha iyi ve kalıcı öğrenilmesi, derse karşı olumlu tutum oluşturması, eğlenceli olması ve disiplinler arası ilişki sağlaması ile ilgilidir.
Uygulama sürecine yönelik olumlu görüşünde tasarım becerisini vurgulayan bir öğrencinin ifadesi şu şekildedir:

…öğrencilerin aktif olarak yeni ürünler tasarlaması hem öğrenci hem de ülke için olumlu sonuçlar doğuracaktır...hayatımızı kolaylaştıracak pek çok tasarımı hayata geçirebilirler..
Bir diğer öğrenci ise tasarım yapma ile ilgili görüşlerini konunun öğrenilmesi ile ilişkilendirerek şu şekilde ifade etmiştir:
5E modeline ek olarak mühendislik basamağı konuyu somutlaştırıyor. Bir tasarı yaparak nasıl olduğunu, işlevini daha iyi anlayabiliyoruz. Örneğin basit makineler konusunda bir basit makine tasarlamak.. Mekanizmasının nasıl olduğunu somut bir şekilde anlıyor ve öğreniyoruz.
Uygulama sürecine yönelik olumlu görüşlerinde grup çalışması ve işbirlikli öğrenmeye vurgu yapan öğrencilerin ifadeleri şöyledir:
Öğrenciler grup halinde çalışabilme, birbirlerinin fikirlerine önem verme özelliği kazanırlar.
Bir diğer öğrenci ise işbirlikli uygulamanın uluslararası sınavlardaki başarıyı etkileyebileceği görüşündedir:
5E modeline mühendislik basamağının eklenmesi, öğrencilerin düşündüklerini deneme olasılığı sunar ve tam bir işbirlikli öğrenme ortamıdır… Sunumlarımızda gördük ki, fazlasıyla zamanımız var. Belki bu basamak eklenirse üst düzey becerileri ölçen uluslararası sınavlarda başarı oranımız artar.

Tablo 9. Öğretmen adaylarının tasarım temelli 5E öğretim modelinin okullarda uygulanması ile ilgili görüşleri

Olumlu		**Olumsuz**	
Öğrenme		Zaman sınırlılığı	4
*Daha öğretici	7	Her konuda uygulanamama	4
Verimli	3	Öğretmen uygulama bilgisinin sınırlılığı	3
Öğrenilen konunun somutlaştırılması	3	Okul fiziki şartları	1
Günlük yaşam bağlantısı	3	Malzeme sınırlılığı	1
Kalıcı öğrenme	2	Malzeme maliyeti	1
Yaparak yaşayarak öğrenme	2	Başarı düzeyi yüksek öğrenciye uygun olması	1
Öğrenilenlerin uygulamaya dönüştürülmesi	1		
Tasarlamanın konu pekiştirmesi için önemi	1		
Başarıda artış	1		
Yaşam Becerileri			
Grup çalışması			
İşbirlikli öğrenme ortamı	1		
Farklı görüşler, düşünme biçimi kazandırma	4		
*Yaratıcı düşünme	5		
Hayal gücü	2		
Eleştirel bakış açısı	1		
Özgür düşünme	1		
Problem çözme becerisi	1		
İletişim becerisi	1		
Bilimsel süreç becerileri	1		
Düşündüklerini uygulama, deneme	1		
Tasarım becerisi			
Tasarı, ürün geliştirme	3		
Motor beceri geliştirir	2		
*****İlgi çekici, dikkat çekici, eğlenceli	6		
Aktif öğrenci	4		
Öğrenci gelişimi	4		
Disiplinler arası	2		
21. yüzyıl becerilerini geliştirir	1		
Kolay uygulama	1		

Tabloda 9'da öğretmen adaylarının tasarım temelli 5E öğretim modelinin okullarda fen derslerinde uygulanması ile ilgili görüşleri yer almaktadır. Tabloya göre, öğretmelerin büyük çoğunluğu, uygulama ile ilgili olumlu görüş belirtmiştir. Olumlu görüşlerine neden olarak da uygulamanın daha öğretici olması, grup çalışmasına olanak sağlaması, tasarım becerisi kazandırması ve ilgi çekici olmasını göstermişlerdir. Az sayıda öğrenci okullarda uygulama konusunda olumsuz görüş ifade etmiştir. Öğretmen adayları olumsuz görüşlerinin nedenleri olarak da en fazla, uygulamaların zaman alması, sınıf mevcutlarının kalabalık olması, öğretmenlerin uygulama konusunda bilgilerinin sınırlı olmasını belirtmişlerdir. Bunların dışında, okulun fiziki şartları, malzeme temini ve maliyeti ile uygulamanın sadece başarı düzeyi yüksek öğrencilere uygun olması gibi nedenler de ifade edilmiştir.

Öğretmen adaylarının tasarım temelli 5E öğretim modelinin okullarda uygulanmasına yönelik olumlu görüşleri ile ilgili neden belirten bir öğretmen adayı görüşlerini şöyle belirtmiştir:

5E+mühendislik tasarım süreci okullarda uygulanmalıdır.. Öğrenciler bu şekilde birbirleri ile fikir alış verişine girebilir ve farklı düşünceler ortaya çıkar.. Ders daha eğlenceli ve akılda kalıcı bir şekilde işlenir.

Öğretmen adaylarının tasarım temelli 5E öğretim modelinin okullarda uygulanmasına yönelik olumsuz görüşlerini dayandırdıkları nedenler arasında zaman sınırlılığı ve her konunun bu uygulamaya uygun olmaması yer almaktadır. Bu konu ile ilgili öğretmen adaylarından birinin ifadesi şu şekildedir: *Her konunun anlatımında 5E kullanılabilir. Ama her konu için mühendislik çalışması uygun değildir. Genelde müfredat yoğun olduğu için konularda mühendislik çalışmaları da uygulanırsa konular yetişmeyebilir… Çünkü 5E ye göre mühendislik daha fazla zaman gerektirir.* Uygulama sonrası çalışmaya katılan öğretmen adayları arasından seçilen 15 öğrenci ile yapılan yüz yüze görüşme sonrası elde edilen verilerin sonuçları Tablo 10, ve 11 de verilmiştir.

Tablo 10. Öğretmen adaylarının tasarım süreci ile ilgili görüşleri

		(N)	Nedenleri (N)
Arkadaşlarınızın sunumları sırasında sınıfta yapmanızı istedikleri tasarımları yaparken nerelerde zorlandınız?	Tasarım planlama	8	Materyallerin eksikliği, çeşit azlığı (3)
	Fikir bulma	2	Materyallere karar verememe (2)
	Problem belirleme	2	Zaman kısıtlı (2)
	Materyal belirleme	2	Kısıtlama ve koşulların iyi belirlenmemesi (1)
	Tasarım deneme	1	El becerisi gerektirmesi (1)
			Kısıtlamaların çok olması (1)
			Sorunun ne olduğunu ve ne istenildiğini anlaşılmaması (1)
			İstenilen koşullara uyma zorunluluğu (1)
			Grup çalışması yapmak (1)

Tablo 10'a göre görüşmeye katılan öğretmen adaylarının çoğu sınıf içerisinde tasarım yaparken en çok tasarımı planlamada sorun yaşadıklarını ifade etmişlerdir. Buna sebep olarak materyallerin çeşitlerinin az olması kendi karasızlıkları ve kısa zamanda sonuca ulaşmalarının gerekmesinden dolayı olduğunu söylemişlerdir. Ayrıca fikir bulma, problem belirleme aşamalarında da zorlandıklarını beyan etmişlerdir. Buna neden olarak da fikir üretildikten sonra diğer aşamaların çok kolay şekilde gerçekleştirilebildiğini söylemişlerdir. Bir kısım öğretmen adayı çok fazla kısıtlama olmasından dolayı zorlandığını ifade ederken bir kısmı koşulların yeterince sıkı belirlenmemesinin zorlayıcı olduğunu belirtmiştir.

Tablo 11. Öğretmen adaylarının tasarım planlama ve gerçekleştirme süreci ile ilgili görüşleri

Tasarım planlama ve gerçekleştirme süreci	f	Nedeni
Kendimiz yaptık	9	Grup çalışması ile kendimiz yapabildik
Başka çalışmalardan esinlendik	4	Yapılan çalışmalardan ilham alsak da kendimiz geliştirerek Yapılan çalışmaları inceleyip onlardan fikir aldık
Bir kaynaktan faydalanarak yaptık	2	Kendi başımıza bir fikir bulamayınca ve internetten konumuza uygun bir tasarım bulduk

Tablo 11'de görüşmeye katılan öğretmen adaylarının çoğu tasarımlarının fikrinin kendi fikirleri olduğunu beyan etmişlerdir. Az sayıda öğretmen adayı tasarım fikrini başka tasarımlardan esinlenerek o tasarımların eksiklerini tamamlayacak fikirlerle yeni tasarımlar oluşturduklarını görmüşlerdir. İki öğretmen adayı ise internet ya da başka kaynaklardan konularına uygun tasarım bulduklarından onu yapmayı tercih etmişlerdir.

Sonuç ve Öneriler

Bu çalışmada 5 E öğrenme modeli ile birlikte mühendislik tasarım sürecinin uygulandığı çalışmalara katılan öğretme adaylarının bilimsel süreç becerilerine yönelik algılarının ve uygulama ile ilgili görüşleri araştırılmıştır. Uygulama öncesi öğretmen adaylarına ön test ve son test olarak uygulanan Bilimsel Süreç Becerileri Algı Ölçeği sonuçları değerlendirildiğinde, öğretmen adaylarının temel bilimsel süreç becerileri, bütünleştirilmiş bilimsel süreç becerileri algılarının anlamlı biçimde artış gösterdiği tespit edilmiştir. Uygulama grupları karşılaştırıldığında, bilimsel süreç becerileri algılarında ön-testler açısından grupların farklılaşmamış, son-testler açısından gruplar arasındaki fark ikinci grup lehine istatistiksel olarak anlamlı bulunmuştur. Bununla beraber, grupların kendi içinde bilimsel süreç becerileri algıları anlamlı biçimde artış göstermiştir. Yapılan çalışmalarda da mühendislik tasarım uygulamalarının bilimsel süreç becerilerini geliştirdiği, özellikle öğrencilerin gözlem yapma, ölçme, tasarımı geliştirmeye yönelik öneride bulunma becerilerine olumlu etkisi olduğu tespit edilmiştir (Strong, 2013).

5E öğrenme modeli ile birlikte uygulanan tasarım süreci ile ilgili olarak öğretmen adaylarının görüşleri değerlendirildiğinde, öğretmen adayları uygulamanın beceri ve öğrenme açısından olumlu katkı sağladığı görüşünde oldukları belirlenmiştir. Öğretmen adayları, beceri açısından, mühendislik ve tasarım yapma becerisi, yaratıcı düşünme becerisi ve grup çalışması yapma becerisine kazandırma; öğrenme açısından ise aktif öğrenme ortamı oluşturma, konuların daha iyi ve kalıcı öğrenilmesi, konu ile günlük yaşam bağlantısının kurulması konularında olumlu görüşe sahiptirler. Bunlara ek olarak, gerçekleştirilen uygulamanın derse karşı olumlu tutum oluşturma, dersi eğlenceli hale getirme ve disiplinler arası ilişki sağlayacağı görüşündedirler. Öğretmen yetiştirme programlarının okullarda değişsen öğretim programlarına uyumlu olması gerektiği (Teo & Ke, 2014) göz önünde bulundurulduğunda, öğretmen adaylarının bu görüşleri doğrultusunda, 5E modeli ile birlikte uygulanan mühendislik tasarım sürecinin kazandırdığı beceriler ve boyutlar açısından gelecek yıllarda uygulanacak ve mühendislik uygulamalarını içeren Fen Bilimleri öğretim programının amaçlarını karşılayabileceği düşünülmektedir.

Çalışma sonuçlarına göre öğretmen adaylarının çoğu 5E öğrenme modeli ile birlikte uygulanan tasarım sürecinin okullarda uygulanabilirliği ile ilgili olumlu görüşe sahiptir. Belirlenen olumlu görüşler öğrenme ve yaşamsal beceriler ile ilişkilidir. Öğrenme açısından öğretici, verimli olması, soyut konuları somutlaştırabilmesi, günlük yaşam bağlantısı kurması; yaşamsal beceriler açısından ise, grup çalışmasına olanak vermesi, tasarım becerisi geliştirmesi ve yaratıcı düşünmeyi geliştirmesi olumlu katkı olarak değerlendirilmiştir. Bu uygulamaların derste öğrencilerin aktif olmasını sağlaması, öğrencilerin ilgisini ve dikkatini çekmesi de belirtilen olumlu görüşler arasındadır.

Yapılan araştırmalara göre öğretmenlerin sınıflarında STEM eğitimini gerçekleştirebilmeleri için eğitim desteğine, zamana, ekonomik desteğe ihtiyaçları vardır (Sublette, 2013). Bununla birlikte öğretmenlerin mühendislik tasarım sürecinin fen sınıflarında uygulayabilmeleri için pedagojik içerik bilgisini geliştirmeler gerekmektedir (Capobianco, & Rupp, 2014). Ayrıca öğretmenler STEM temelli etkinliklerinin fen alanlarından özellikle fizik alanı ile uygun olduğu görüşündedir (Eroğlu, Bektaş, 2016). Mevcut çalışmada da 5E öğrenme modeli ile birlikte uygulanan tasarım sürecinin okullarda uygulanabilirliği ile ilgili az sayıda öğretmen adayı olumsuz görüş belirtmiştir. Zaman sınırlılığı, öğretmen uygulama bilgisinin yetersizliği, her konuda uygulanamaması belirtilen olumsuz görüşlerdir.

5E öğretim modeli ile birlikte uygulanan mühendislik tasarım uygulamalarının öğretmen adaylarının tamamının hoşuna gittiği ve bu uygulamaları öğretmen olduklarında kullanacaklarını ifade etmişlerdir. Öğretmen adaylarının çoğu tasarımı belirlerken fikir üretmede sorun yaşadıklarını, konu ile ilgili bir tasarım fikri bulabilmek için araştırma yaptıklarını ve birçok kaynaktan fikir alarak kendi tasarımlarını yapabildiklerini ama genel olarak her aşamada sorun yaşadıklarını ifade etmişlerdir. Ayrıca bir kısmı düşündükleri kadar zor olmadığını gördüklerini ve sıklıkla kullanılması gerektiğini söylemişlerdir.

Öğrencilerin fen, teknoloji, mühendislik ve matematik alanlarındaki ilgilerini teşvik etmek üzere ülkemiz de dahil olmak üzere pek çok ülkede ilkokul ve ortaokul öğrencilerine yönelik çalışmalar yapılmaktadır. Bu çalışmaların etkili olabilmesi öğretmenlerin uygulamalar konusunda ne kadar iyi yetiştirildikleri ile ilişkilidir (Teo & Ke, 2014). STEM ve mühendislik tasarım süreci konusunda bilgili yetişkinler, öğrencilerin bu konularda gelişim göstermelerine olumlu etki sağlamaktadır (Gamse, Martinez, Bozzi, 2016). Sistemdeki mevcut öğretmenlerin gelişimi için bazı ülkelerde STEM öğretmen liderlerinin yetiştirilmesine yönelik merkezler (CMAST: Matematik ve Fen Öğretim Sistemi Merkezi, EETPD: İlkokul Öğretmenleri Mühendislik Mesleki Gelişim Programı) mevcut olup, buradaki lider öğretmenlerin STEM pedagojisi, profesyonel gelişim, öğretmen liderlik sürecini desteklemek ve rehberlik yapmak, liderlik stratejisi gibi konularda eğitim alarak okullardaki öğretmenlere sınıf içi uygulamalarda destek olmaları amaçlanmaktadır (Boots, 2013; Sublette, 2013). Bununla birlikte, bazı ülkelerde STEM okulları ya da STEM programları uygulayan kurumlar olduğu halde, öğretmen yetiştirme programlarında bu yaklaşıma yönelik programlar yetersizdir (McMahon, 2011; Teo & Ke, 2014). Ülkemizde de ilkokul ve ortaokul öğrencilerini STEM alanlarına hazırlamak ve dahil etmek amacı ile üniversitelerde ve bazı özel kurumlarda kısa dönemli eğitimler verilmektedir. Ancak öğretmen yetiştirme programlarında amaca hizmet edecek eğitimler henüz programlarda yer almamaktadır. Ülkemizde gelecek yıllarda uygulanacak fen bilimleri öğretim programındaki mühendislik uygulamaları göz önünde bulundurulduğunda, öğretmenlerin bu uygulamaları öğrencilerin tasarımla ilgili disiplinler arası bilgiyi anlayarak uygulayacakları ve becerileri kazanacakları şekilde planlamaları önemlidir. Bu açıdan, mevcut çalışmada 5E öğrenme modeli ile tasarım sürecinin birlikte uygulanması ve uygulama sonucunda öğretmen adaylarının uygulama ile ilgili olumlu görüş bildirmeleri ve bilimsel süreç becerileri algılarının gelişme göstermesi önemli sonuçlardır. Mevcut öğretmen yetiştirme programı için de örnek olabilecek bu çalışmanın geliştirilmesi amacı ile öğretmen yetiştirme programlarında Fen Bilimleri öğretim programında tasarım sürecine uygun olabilecek konuların tespit edilmesi ve uygulama örneklerine yer verilmesi, derslerin öğretmen adaylarının uygulama yapabilecekleri şekilde planlanması önerilmektedir. Gerçekleştirilecek çalışmaların Eğitim Fakülteleri-MEB işbirliği sağlanarak sistemdeki mevcut öğretmenlere ile paylaşılması önerilmektedir.

Kaynaklar

ABET (2011). Criteria for Accrediting Engineering Programs, 2012 – 2013. The Berndt. Group. http://www.abet.org/engineering-criteria-2012-2013/

Ames, R.T. (2014). A survey of Utah's public secondary education science teachers to determine their feelings of preparedness to teach engineering design. Master Thesis, Technology and Engineering Education, Utah State University, Logan, Utah.

Bairaktarova, D., Cox, M.F. & Evangelou, D. (2011) Leadership training in science, technology, engineering and mathematics education in Bulgaria, European Journal of Engineering Education, 36:6, 585-594,

Benuzzi, S. (2015). Preparing future elementary teachers with a stem-rich, clinical, co-teaching modeling of student teaching. Doctoral Dissertation, Department of Educational Leadership, California State University, Long Beach.

Borgford-Parnell, J., Deibel, K. & Atman, C.J. (2010). From engineering design research to engineering pedagogy: bringing research results directly to the students. *International Journal of Engineering Education, 26* (4), 748–759

Boots, N.K. (2013). *Examining Teachers' Perspectives on an Implementation of Elementary Engineering Teacher Professional Development*. Doctoral Dissertation, Purdue University, Indiana.

Capobianco, B. M., & Rupp, M. (2014). STEM teachers' planned and enacted attempts at implementing engineering design-based instruction. *School Science & Mathematics, 114*(6), 258-270.

Corbett, K.S. (2012). *The Engineering Design Process as A Model for Stem Curriculum Design*. Doctoral Dissertation, College Of Engineering and Science Louisiana Tech University.

Cunningham, C.M. & Hester, K. (2007). *Engineering is elementary: an engineering and technology curriculum for children.* In: Proceedings of the 2007 American Society for Engineering Education Annual Conference & Exposition, Honolulu, Hawaii. Washington DC: American Society for Engineering Education

English, L.D. & Mousoulides, N. (2011). Engineering-based modelling experiences in the elementary and middle classroom. In: M.S. Khine and I.M. Saleh, eds. *Models and modeling: Cognitive tools for scientific enquiry. Models and Modeling in Science Education Series*. Dordrecht: Springer, 173–194.

English, L.D., Hudson, P.B. & Dawes, L. (2012) Engineering design processes in seventh-grade classrooms: bridging the engineering education gap. *European Journal of Engineering Education, 37*(5), 436-447.

Eroğlu, S. & Bektaş, O. (2016). STEM eğitimi almış fen bilimleri öğretmenlerinin stem temelli ders etkinlikleri hakkındaki görüşleri. *Eğitimde Nitel Araştırmalar Dergisi - Journal of Qualitative Research in Education, 4*(3), 43-67.

Fortus, D., Dershimer, R. C., Krajcik, J., Marx, R. W., & Mamlok-Naaman, R. (2004). Design-based science and student learning. *Journal of Research in Science Teaching, 41*, 1081–1110.

Gamse, B.C., Martinez, A. & Bozzi, L. (2016). Calling STEM experts: how can experts contribute to students' increased STEM engagement? *International Journal of Science Education*, Part B, 1-29.

McMahon, A.P. (2011*). Elementary Teachers' Mental Models of Engineering Processes: A Comparison of Two Countries Practices*. Doctoral Dissertation, Graduate School of Education, University of Missouri, St Louis.

Rambuda, A. M., & Fraser, W. J. (2004). Perceptions of teachers of the application of science process skills in the teaching of geography in secondary schools in the Free State province. *South African Journal of Education, 24*(1), 10–17.

Schnittka, C. G., Bell, R. L., & Richards, L. G. (2010). Save the penguins: Teaching the science of heat transfer through engineering design. *Science Scope, 34* (3), 82-91.

Silver, A. & Rushton, B.S. (2008) Primary-school children's attitudes towards science, engineering and technology and their images of scientists and engineers. *Education 3-13*, 36 (1), 51-67

Silk, E. M., Schunn, C. D., & Cary, M. S. (2007). The impact of an engineering design curriculum on science reasoning in an urban setting. *Journal of Science Education and Technology*, *18*, 209–223.

Strong, M.G. (2013*). Developing Elementary Math and Science Process Skills Through Engineering Design Instruction*. Master thesis, School of Education, Hofstra University.

Sublette, H. (2013). *An effective model of developing teacher leaders in STEM education*. Doctoral Dissertation, Graduate School of Education and Psychology, Pepperdine University.

Teo, T. W. & Ke, K. J. (2014). Challenges in STEM Teaching:Implication for Preservice and Inservice Teacher Education Program. *Theory Into Practice, 53*,18–24.

Taylor, P.(2008). Engineers Australia Media Release 29/01/2008. Fixing Australia's engineering skills shortage [online]. http://www.engineersaustralia.org.au/.../fixing-australia-s-engineering-skills- shortage-urgent-and-sharedresponsibility.

Yıldırım, M., Sürmeli, H., Güven, İ. & Ergun, M. (2016). Adaptation A Scale For Teachers' Perceptions Of The Applications Of Scientific Process Skills: A Study Of Validity And Reliability. *TOJET: The Turkish Online*

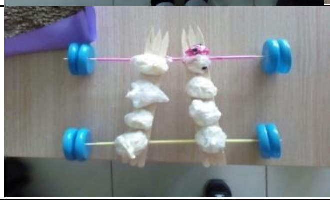
Journal of Educational Technology, November, 174-188. (Paper presented in 7th International Conference on New Horizons in Education (INTE), (Vienna, Austria)

Zawojewski, J., Hjalmarson, J. S., Bowman, K., & Lesh, R. (2008). A modeling perspective on learning and teaching in engineering education. In J. Zawojewski, H. Diefes-Dux, & K. Bowman (Eds.), *Models and modeling in engineering education: Designing experiences for all students*. Rotterdam: Sense Publications.

EK. Örnek Tasarım Planı

<table>
<tr><td>Konu/Kavramlar:</td><td colspan="3">Basınç, katı basıncını etkileyen değişkenler (kuvvet, yüzey alanı), sıvı basıncını etkileyen değişkenler (derinlik, sıvının cinsi), basıncın günlük yaşam ve teknolojideki uygulamaları</td></tr>
<tr><td>5E'nin Keşfetme aşamasında</td><td colspan="3">Basıncın tanımının yapılmasının ardından öğrencilere bir karikatür gösterilir.


Bu karikatürde hareketle öğrencilerden basıncın tanımından hareketle sabit bir yükle kumlu bir zeminde en az (basınçla) kumda iz bırakacak şekilde bir araç tasarlamaları istenir. Öğrencilerden 3-4 kişilik gruplar oluşturulur. Öğrencilere içinden seçim yapabilecekleri fazla sayıda kullanabilecekleri malzemeler verilir. 15-20 dakika süre verilir. Bu süre zarfında öğrencilerin çalışmaları izlenir. Gerekli yerlerde ipuçları verilir. Materyallerini tasarladıktan sonra onlara neden bu materyali tasarladıkları, materyallerini nasıl yaptıkları ve hangi malzemeleri kullandıkları vb. bilgileri yazmaları gereken kağıtlar dağıtılarak doldurmaları istenir. Her gruptan bir sözcü seçilerek materyallerini tanıtmaları istenir. Araç kumlu zeminde denenir ve bıraktığı iz ölçülür. Her grup için bu aşama yapıldıktan sonra izler karşılaştırılır. Öğretmenin tasarlamış olduğu araç gösterilir ve onunda denemesi yapılır. En az iz bırakan araç seçilir.</td></tr>
<tr><td>Tasarım Planı</td><td colspan="3">Problem: 300 gramlık bir yükü kumlu bir zeminde en kolay ve kumda en az şekilde bir iz bırakarak taşıyabilecek bir araç tasarlanabilir mi?
Hipotez: Evet. Kumlu bir zeminde doğru yüzey alanı ve ağırlık ilişkisiyle yani basıncın ayarlanmasıyla bir araç tasarlanabilir.</td></tr>
<tr><td>Fen Kazanımı</td><td colspan="3">Basınç" kavramının ne olduğunu ve nelere bağlı olduğunu keşfeder</td></tr>
<tr><td>Matematik Kazanımı</td><td colspan="3">İstenilen kritere uygun materyal tasarımında basıncı hesaplamak ve bunun için gerekli hesaplamaları yapar.</td></tr>
<tr><td>Mühendislik Kazanımı</td><td colspan="3">Günümüzdeki yük kamyonlarına benzer, özellikle tekerlek yapısı dikkate alınarak materyali tasarlar.</td></tr>
<tr><td>Teknoloji Kazanımı</td><td colspan="3">Materyali tüm verilen özellikleri göz önünde bulundurarak, gerekli hesaplamalar ve tasarımlar sonucu hayata geçirme çalışmaları yapar.</td></tr>
<tr><td>Kriterler</td><td colspan="3">Sabit olarak belirlenen ağırlığı aracınız ile tek seferde taşıyınız.
Tasarladığınız proje için aracın ağırlıkla birlikte kumlu zemin üzerinde ilerleme seyrini gözlemleyiniz.
Verilen malzemelerden istediğinizi kullanınız.
Kullanacağınız malzemeler size verilenlerle sınırlıdır.</td></tr>
<tr><td>Materyaller</td><td>Büyük kapak
Küçük kapak
Ağırlıklar</td><td>Çöp şiş
Tutkal
Pipet</td><td>Paket Lastiği
Cetvel
Kum</td></tr>
<tr><td>Sunumu yapan grup</td><td colspan="3">Belirli malzemeler kullanılarak en küçük basınçta bir şey tasarlanmalı. Bunun için iki farklı boyutta pet şişe kapağı kullanıldı. Yüzey alanı büyüdükçe basınç azalır. Bundan dolayı ya büyük yüzey alanlı büyük kapak kullanılmalı ya da küçük yüzey alanlı kapaklardan çok sayıda kullanılmalıdır. Büyük yüzey alanlı büyük kapaklar ile toplamda daha büyük yüzey alanlar elde edilir. Yük sabit olduğu için bu işlemi yapmak kolay olur. Daha sonra araç tasarlanır. İki tane dondurma çubuğu alınır ve bunlar 300 g olan yükü koymak için zemin olarak kullanılır. Aracın ilerlemesi gerektiğinden dönme etkisini arttırmak için kapaklara geçirmek için de pipet kullanılır. Bunlar birbirine bantlanır. Daha sonra kumlu zemin ayarlayıp deneme sürüşleri yapılır. Denemeler sonunda</td></tr>
</table>

	kalan izler ölçülür. 
1. Grup'un tasarımı	 
2. Grubun tasarımı	 

INVESTIGATION OF UNIVERSITY CHEMISTRY STUDENTS' VIEWS ABOUT FLOW DIAGRAM USAGE IN ANALYTICAL CHEMISTRY LABORATORY I

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Abstract: Several graphical organizers can be used to enhance students' understanding in the laboratory and help students organize their thinking. One of these kinds of materials is a flow diagram. The aim of the study is to investigate the university chemistry students' thoughts about performing the qualitative analysis experiments with flow diagram in the context of Analytical Chemistry Laboratory I course. Twenty two Analytical Chemistry Laboratory-I course students participated in the study. Two questionnaires were developed by the authors to obtain university chemistry students' views about the flow diagram usage in the experiments related to qualitative analysis. The first questionnaire was administered at the beginning of laboratory course. The flow diagram instruction was fulfilled during a semester. Course subjects included qualitative analysis of group 1, 2, 3, 4, 5 cations, various selected anions and general analyses of aforementioned ions, respectively. At the end of the course, the second questionnaire was administered to investigate the effectiveness of the flow diagrams for qualitative analysis experiments. It was found that most of the chemistry students comprehended what the flow diagram was and how they were used in the qualitative analysis experiments. Besides, most of them indicated that the flow diagrams were useful for time management and all of them suggested the usage of flow diagrams in the forthcoming Analytical Chemistry Laboratory I course.

***Keywords*:** University chemistry students, flow diagram, analytical chemistry laboratory

ÜNİVERSİTE KİMYA ÖĞRENCİLERİNİN AKIŞ DİYAGRAMLARININ ANALİTİK KİMYA LABORATUVARI I DERSİNDEKİ KULLANIMINA YÖNELİK GÖRÜŞLERİNİN İNCELENMESİ

Özet: Laboratuvarlarda öğrencilerin anlamalarını olumlu yönde geliştirme ve düşünce yapılarını organize etmeye yardımcı olmak amacıyla çeşitli grafik düzenleyiciler kullanılabilir. Bu tür materyallerden biri de akış diyagramıdır. Çalışmanın amacı, üniversite kimya öğrencilerinin, Analitik Kimya Laboratuvarı I dersi kapsamında, nitel analiz deneylerini akış diyagramlarıyla yapmaya yönelik düşüncelerini araştırmaktır. Araştırmaya 22 Analitik Kimya Laboratuvarı I dersi öğrencisi katılmıştır. Üniversite kimya öğrencilerinin nitel analiz deneylerinde akış diyagramlarının kullanımına yönelik görüşlerini almak üzere yazarlar tarafından iki anket geliştirilmiştir. İlk anket laboratuvar dersinin başlangıcında uygulanmıştır. Akış diyagramlarının öğretimi bir dönem içinde tamamlanmıştır. Ders konuları sırasıyla grup 1, 2, 3, 4, 5 katyonları ile seçilmiş bazı anyonların nitel analizini ve bu iyonların genel analizini içermektedir. Dersin sonunda ikinci anket, nitel analiz deneylerinde akış diyagramı kullanımının ne derece etkili olduğunu araştırmak amacıyla uygulanmıştır. Kimya öğrencilerinin çoğunun akış diyagramının ne olduğunu ve nitel analiz deneylerinde nasıl kullanıldığını kavradığı bulunmuştur. Ayrıca birçoğu akış diyagramlarının zaman yönetimi açısından faydalı olduğunu belirtirken, tamamı sonraki Analitik Kimya Laboratuvarı I derslerinde kullanılmasını tavsiye etmiştir.

Anahtar Sözcükler: Üniversite kimya öğrencileri, akış diyagramı, analitik kimya laboratuvarı

Giriş

Deneysel çalışmalar ve labortuarlar fen öğretimin çok önemli bir parçasıdır. Özellikle fizik, kimya ve biyoloji gibi fen alanlarında öğretmenlik yapacak kişilerin iyi bir laboratuvar eğitimi almaları oldukça önemlidir. Bu nedenle laboratuar öğretimi ile laboratuar öğretiminde kullanılacak strateji, teknik ve yöntemler pek çok araştırmacının ilgisini çekmiştir. Laboratuarların yürütülmesinde strateji, yöntem ve tekniklerin yanı sıra çeşitli grafik düzenleyicilerin de kullanıldığı görülmektedir.

Grafik düzenleyiciler, öğrenme sürecinde kavramlar, gerçekler ve fikirler arasındaki ilişkiyi betimlemeyen görsel ve şekilsel gösterimler olarak tanımlanır (Hall, Strangman ve Meyer (2004). Laboratuar öğretiminde kullanılabilecek bir grafik düzenleyici *akış diyagramı*dır. *Akış diyagramı* herhangi bir sorunun çözümü için izlenmesi gerekli olan aritmetik ve mantıksal adımların görsel olarak simge ya da sembollerle ifade edilmiş şekline denir. Çeşitli alanlardaki işlemlerin yönetilmesi, belgelendirilmesi, tasarlanması ve çözümlenmesinde kullanılabilir. Akış diyagramları aynı zamanda deney öncesinde öğrencilerin laboratuar yönergelerini uygulamalarını sağlayacak şekilde tasarlanarak laboratuar öğretiminde de kullanılabilir (Davidowitz ve Rollnick, 2005). Akış diyagramlarının farklı uygulamaları bulunmasına rağmen fen laboratuarında kullanımına yönelik çok fazla çalışmaya rastlanmamaktadır. Davidowitz and Rollnick (2001), üniversite 1 ve 2. sınıf öğrencilerinin kimya laboratuarlarında akış diyagramı kullanmaları sonucu öğrencilerin akış diyagramına yönelik düşüncelerini incelemişlerdir. Çalışma sonunda öğrenciler, akış diyagramı kullanılarak deneyleri gerçekleştirmenin teori ve uygulama arasında bağlantı kurmalarını sağladığını belirtmişlerdir. Nakiboğlu, Şen, Akgün ve Fidan (2016), Genel Kimya Laboratuarı I dersi kapsamında yürütülen deneylerin akış diyagramı kullanılarak gerçekleştirilmesine yönelik öğretmen adaylarının görüşlerini incelemişlerdir. Çalışma sonunda öğretmen adaylarının neredeyse tamamının akış diyagramlarına laboratuarda yer vermenin deneyi yürütmeyi kolaylaştırdığını ve zaman açısından tasarruf sağladığını ifade ettikleri sonucuna ulaşılmıştır.

Analitik Kimya laboratuarları iki dönemlik ders şeklinde bütün üniversite kimya öğrencilerinin programlarında yer alır. Analitik Kimya Laboratuvarı I dersi ise nitel analiz derslerini içeren laboratuvar derslerinin en önemlilerindendir. Nitel analiz, bir örnekte bulunan katyonların tanınması veya anyon ve katyonların gruplandırılmasını kapsar. Akış diyagramları özellikleri açısından nitel analiz deneylerinde kullanılmaya çok elverişlidir. Bu nedenle çalışmada nitel analiz laboratuar deneyleri sırasında akış diyagramı kullanılarak öğrencilerin konuya yönelik düşünceleri incelenmiştir.

Yöntem

Çalışmanın Modeli

Bu araştırmada akış diyagramı ile ilgili öğrenci görüşlerinin belirlenmesi amacıyla nitel bir çalışma yürütülmüş ve nitel araştırma desenlerinden *durum çalışması modeli* kullanılmıştır. Yıldırım ve Şimşek'e (2006) göre, durum çalışması nitel veya nicel yaklaşımla yapılabilir ve her iki yaklaşımda da amaç belirli bir duruma ilişkin sonuçlar ortaya koymaktır.

Çalışmanın Örneklemi

Çalışmanın örneklemini Balıkesir Üniversitesi, Necatibey Eğitim Fakültesi Kimya Öğretmenliği programında 2016-2017 öğretim yılında öğrenim gören 22 Analitik Kimya Laboratuvarı I dersi alan üniversite ikinci sınıf öğrencisi oluşturmaktadır. Çalışma grubunun belirlenmesinde seçkisiz olmayan örnekleme yöntemlerinden uygun örnekleme yöntemi kullanılmıştır.

Ölçe Araçları

Nitel analiz deneylerinde akış diyagramlarının kullanımına yönelik görüşlerini almak üzere yazarlar tarafından iki anket geliştirilmiştir. İlk anket laboratuvar dersinin başlangıcında uygulanmıştır. Dersin sonunda ikinci anket, nitel analiz deneylerinde akış diyagramı kullanımının ne derece etkili olduğunu araştırmak amacıyla uygulanmıştır. *İlk görüş anketi (İGA)* toplam 4 açık uçlu soru içerirken, s*on görüş anketinde (SGA)* 9 soru yer almaktadır.

Veri Analizi

Çalışmada veri analizi *içerik analizi* kullanılarak gerçekleştirilmiştir. Kodlayıcılar arası güvenilirlik sağlanmıştır (%95).

Bulgular

İlk Görüş Anketine (İGA) İlişkin Bulgular

İGA'da yer alan ilk soru kimya öğretmenliği öğrencilerinin akış diyagramını daha önce duyup duymadıklarının belirlenmesi amacıyla, "Akış diyagramını daha önce duydunuz mu, duyduysanız ne olduğunu açıklar mısınız?" şeklindedir. Öğretmen adaylarının bir tanesi (ÖA7) hariç tamamı akış diyagramını daha önce duymadığını belirtmiştir. Öğretmen adaylarına İGA da ikinci soru olarak, "Akış diyagramını duymadınız ise ne olduğu konusunda tahminlerinizi yazınız?" sorusu yöneltilmiştir. Yanıtların "sıvı-akış, izlenecek basamak, şema ve değişim" şeklinde 4 tema altında toplandığı görülmüştür.

Son Görüş Anketine (SGA) İlişkin Bulgular

SGA'nin ilk sorusunda yaptığınız bu çalışma sonunda, "Akış diyagramının ne olduğunu anladığınızı düşünüyor musunuz? Şıklardan birini seçip, nedenini açıklayınız ?" şeklinde bir soru sorulmuştur. Bu soruya 22 öğretmen adayından 21'i evet şeklinde yanıt verirken bir öğretmen adayı (ÖA1) kısmen şeklinde yanıt vermiştir. SGA'nın ikinci sorusunda "Deney yaparken akış diyagramı kullanmak deney yapmanızı kolaylaştırdı mı yoksa zorlaştırdı mı? Şıklardan birini seçip, nedenini açıklayınız." Sorusu yöneltilmiştir. Öğrencilerin tamamının akış diyagramı kullanımının deneyin yürütülmesini kolaylaştırdığını düşündüğü belirlenmiştir. Bu öğrencilerden birine ait örnek ifade aşağıda verilmiştir.

> "*Bence deneyi yapmamızı kolaylaştırdı. Çünkü föyden yaptığımız zaman deneyler adım adım verilmediği için biraz daha karışıyor. Ama akış diyagramında yapacağımız her şey adım adım verildiği için deneyleri hem anlamak hem de doğru bir şekilde yapmak kolaylaştı* (Ö22)."

SGA'nın üçüncü sorusunda "Akış diyagramlarının kullanımı deneyi yaparken zaman yönetimi açısından: a)Yararlı oldu b)Zorlaştırdı c) İkisi arasında fark yok. Şıklardan birini seçip, nedenini açıklayınız." Şeklindedir. Bu soruda öğrencilerin %86'sı yararlı olduğunu söylerken, %5'i zorlaştırdığını ifade etmiş ve öğrencilerin %9'u ise ikisi arasında fark olmadığını belirtmiştir. Yararlı olduğunu söyleyen öğrencileri açıklamalarının analizi Tablo 1' de verilmiştir.

Tablo 1. Elektrokimya testine ait betimleyici istatistik bulguları

Temalar	Örnek İfadeler	Öğretmen Adaylarının Kodları	f	%
Hız	Daha hızlı hareket etmeyi sağladı.	ÖA1, ÖA17, ÖA19, ÖA20	4	18
	Adımlar belirli olduğu için, işlemler daha hızlı ve seri yapıldığı için	ÖA2, ÖA5, ÖA11, ÖA13	4	18
Yol gösterici	Adım adım ve belli bir sıraya göre olduğu için	ÖA4, ÖA22	2	9
	Ne yapılacağı düşünülmedi	ÖA7, ÖA16	2	9
	Tayin edilecek maddeler kolayca belirlendiği için	ÖA8, ÖA14	2	9
	Bütün deneyi bir arada görüp kitap defter karıştırılmadığı için	ÖA3, ÖA12	2	9
Anlaşılır	Kısa ve anlaşılır olduğu için	ÖA18	1	5
Kolaylaştırıcı	Kolaylaştırdığı için	ÖA10	1	5
Diğer	Zaman kazandırıcı	ÖA9	1	5

SGA'inin dördüncü sorusunda "Karmaşık ve uzun deneylerde akış diyagramı kullanımı ile ilgili düşünceniz aşağıdakilerden hangisi? a)Föylerden daha kullanışlıdır. b)Föyler daha kullanışlıdır. c)İkisi arasında fark yoktur." şeklinde sorulan soruya, öğrencilerin %90'u akış diyagramını föylerden daha kullanışlı buluyorken %5'i föyleri daha kullanışlı bulduğunu söylemiştir. Öğrencilerin %5'i ise ikisi arasında fark olmadığını belirtmiştir. Bu yanıtlardan her şıkka ait analizler ayrı ayrı yapılmıştır.

SGA'inin beşinci sorusunda "Size hazır verilen akış diyagramı ile deney yaparken, ilk deneyden itibaren kullanma açısından kendinizde bir değişiklik olduğunu düşünüyor musunuz? Şıklardan birini seçip, nedenini açıklayınız." Sorusu yöneltilmiştir. Bu soruya öğrencilerin % 90'ı gittikçe daha iyi anladım diye yanıt verirken 1 öğrenci (ÖA6), gittikçe daha sıkıcı olduğunu belirtmiştir. Bir öğrenci ise (ÖA19) bir fark olmadığını belirtmiştir. "Akış diyagramını kendiniz hazırlayarak deneyi yapmanızla akış diyagramının hazır verilmesi durumuna göre deneyi yapmanızda fark oldu mu?" şeklindeki altıncı soruda öğrencilerin %80'i fark olduğunu belirtmiştir. Yedinci soruda, "Akış diyagramlarını laboratuvara gelmeden önce öğrenci kendi mi hazırlamalı, yoksa hazır akış diyagramı mı verilmeli?" şeklinde sorulan soruya öğrencilerin %50'si hazır verilmeli diye yanıt verirken %38'i kendimiz hazırlamalıyız yanıtını vermiştir. Bir öğrenci "önce öğrenci hazırlamalı, sonrakiler hazır verilmeli" derken bir öğrencinin bunun tam tersini söylemiştir. Öğrencilerden bir tanesi ise birlikte hazırlanmasının daha uygun olacağını belirtmiştir.

Sekizinci soruda, "Analitik Kimya I Laboratuvarlarında deney yapılışı sırasında akış diyagramı kullanılmasını önerir misiniz?" şeklinde bir soru yöneltilmiştir. Bu soruya bir öğrenci (ÖA13) hariç, tüm öğrenciler "öneririm" yanıtını vermiştir. ÖA13, föyde zaten açıklayıcı bir şekilde verildiği için önermeyeceğini belirtmiştir. Dokuzuncu ve son soruda "Akış diyagramının kimya laboratuarlarında kullanılması ile ilgili eklemek istediğiniz başka bir düşünceniz var mı?" şeklinde bir soru yöneltilmiştir. Bu soruya yanıt olarak öğrenciler bazı önerilerde bulunmuştur. Bu önerilerden bazıları Tablo 2'de sunulmuştur.

Tablo 2. Öğretmen adaylarının akış diyagramının kimya laboratuarlarında kullanımına yönelik önerileri

Öğretmen Adaylarının Önerileri	**Öğretmen Adaylarının Kodları**
Kimyasal denklemler de eklenebilir.	ÖA7, ÖA8, ÖA16
Öğrenciye 2 saatlik bir ders verilip nelere dikkat edeceği konusunda ve nasıl yapabileceği konusunda bilgi verilmeli.	ÖA3
Profesyonel yardımla bireylerin kendilerine özgü diyagramlar hazırlaması ve özelleştirilmesi daha etkili olur.	ÖA5
(Laboratuarda) daha sık yer verilmesi gerektiğini düşünüyorum.	ÖA9
Akış diyagramı, tüm deneylerde föyün arkasında bulunabilir.	ÖA20
Biraz daha kolaylaştırılabilir. Bazen çok karışık geliyor. "çökelek al", "diğerini at" ve "diğer çökelekten devam et" gibi.	ÖA1
Oluşturulan akış diyagramları öğrencilere verilmeli ve yapılan deneyin gözlemleri tekrar kontrol edilebilmeli, eksik noktalar kavranmalıdır.	ÖA2:
Bence akış diyagramı öğrenciye dersten önce verilmeli, sonra da bakmadan yaptırılmalı.	ÖA6

Sonuç

- Çalışma sonunda çalışmaya katılan öğretmen adaylarının hemen hepsi akış diyagramının ne olduğu ve nasıl kullanıldığını öğrendiği,
- Tamamının akış diyagramı ile deney yapmanın işlerini kolaylaştırdığını düşündüğü,
- Yaklaşık %90'nının akış diyagramı ile deney yapmanın zaman yönetimi açısından yararlı olduğunu düşündüğü,
- %90'nının Nitel analiz laboratuarı için akış diyagramı kullanımının föylerden daha yararlı olduğunu düşündüğü,
- %50'sinin Nitel analiz laboratuarlarında akış diyagramının öğrenciye hazır verilmesinin daha uygun olduğunu düşünürken, %38'nin öğrenci tarafından hazırlanmasının daha uygun olduğunu düşündüğü,
- Neredeyse öğrencilerin tamamının Analitik Kimya I laboratuarlarının yürütülmesinde akış diyagramı kullanımını önerdiği sonuçlarına ulaşılmıştır.

Öneriler

Çalışmada ulaşılan sonuçlar doğrultusunda şu önerilerde bulunulabilir:

- Analitik Kimya I laboratuarları yapısı gereği bir süreçteki deneysel stratejiyi ve takip edilmesi gereken işlem basamakları içermesi nedeniyle Akış diyagramı kullanımının son derece yararlı olacağı laboratuvarlardır. Bu çalışma sonuçlarına da dayanarak gerek Eğitim Fakültesi kimya öğretmenliği gerekse Fen Fakültesi kimya bölümü öğrencilerinin Analitik Kimya I laboratuarlarında akış diyagramı kullanımı önerilir.
- Bu diyagramların kullanımından önce öğrencilere ne olduğu ve nasıl kullanıldığı öğretilmelidir.
- Akış diyagramları öğrencilere önce hazır olarak verilmeli ve gerekirse birlikte hazırlattırılmalı ancak mutlaka öğrencilerinin de bu diyagramları kendilerinin hazırlanmasına fırsat verilmelidir.

Kaynaklar

Davidowitz, B., & Rollnick, M. (2001). Effectiveness of flow diagrams as a strategy for learning in laboratories. *Australian Journal of Education in Chemistry, 57,*18-24.

Davidowitz, B., & Rollnick, M. (2005). Development and application of a rubric for analysis of novice students' laboratory flow diagrams. *International Journal of Science Education, 27*(1) ,43-59.

Hall, T., Strangman, N., & Meyer, A. (2003). *Differentiated instruction and implications for UDL implementation. National Center on Accessing the General Curriculum(NCAC): Effective classroom practices report*. Washington, DC: National Center on Accessing the General Curriculum.

Nakiboğlu, C., Şen, A. Z., Akgün, İ., & Fidan, M. (2016). Genel Kimya laboratuarında akış diyagramı kullanımına yönelik öğretmen adaylarının görüşlerinin incelenmesi. *Journal of The Turkish Chemical Society-C: Chemistry Education, 1*(1), 63-86.

Yıldırım, A. ve Şimşek, H. (2006). *Sosyal bilimlerde nitel araştırma yöntemleri*. Ankara: Seçkin Yayıncılık.

INVESTIGATION OF DEVELOPING SKILLS IN LEARNING COURSE WITH CREATIVE DRAMA METHOD

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Abstract: The aim of this research is to obtain student views on the use of creative drama in the teaching of granular structure unit of elementary science and technology course material. The Research was conducted with 6th grade student in the fall semester of the academic year 2008-2009. Creative drama was used at appropriate places throughout the unit. This method was applied to 6th grade students who participate in science lesson. The competencies of the students were given by frequency and percentage analysis. As well as opinions from randomly selected students are presented in quote form. As a result of the research, it has been revealed that creative drama is a way of developing creative thinking, critical thinking, communication, empathy, decision making and inquiry skills in the students who are working with the course.

***Keywords*:** Creative drama

YARATICI DRAMA YÖNTEMİ İLE DERS İŞLEYEN ÖĞRENCİLERDE GELİŞEN BECERİLERİN İNCELENMESİ

Özet: Bu araştırmanın amacı, ilköğretim fen ve teknoloji dersi maddenin tanecikli yapısı ünitesinin öğretiminde yaratıcı drama yöntemi kullanımı hakkında öğrenci görüşlerini almaktadır. Araştırma 2008-2009 öğretim yılı güz döneminde 6.sınıf öğrencileri ile yapılmıştır. Ünite boyunca uygun yerlerde yaratıcı drama yöntemi kullanılarak fen dersinin öğretimine katılan 6. sınıf öğrencilerinin bu yöntem ile ders işlendiğinde kazandıkları beceriler frekans ve yüzde analizi ile verilmiştir. Ayrıca random olarak seçilen öğrencilerden alınan görüşler alıntılar şeklinde çalışmada sunulmuştur. Araştırma sonuçları yaratıcı drama yöntemi ile ders işleyen öğrencilerde yaratıcı düşünme, eleştirel düşünme, iletişim, empati, karar verme, sorgulama becerilerinde gelişmeler olduğunu ortaya çıkarmıştır.

***Anahtar Sözcükler*:** Yaratıcı drama

Giriş

Çocuklar, doğal gelişimin bir unsuru olan keşfetme arzusu ile doğar ve kendini çevreleyen dünya hakkında her gün, neden böyle oldu?, onu değiştirmek için ne yapabilirim? tarzında sorular sorarlar. Bu sorulara okul döneminde fen öğretiminde cevap aranmaya çalışır. Fen öğretimi kısaca, çocukların hayatlarında karşılaştıkları nesneleri, olayları ve bunların ilişkilerini gözlemesi, incelemesi, araştırması ve sonuçlarına varması olarak tanımlanmaktadır (Gönen ve Dalkılıç 2000).

Fen öğretiminin başlangıç noktası, çocuğun doğal çevresi olmalıdır (Gürdal 1993). Çocukların fen ve doğa etkinliklerinde bulunmaları, onların çevrelerini daha iyi algılamalarına ve değer vermelerine, dolayısıyla yaşama daha sıkı sıkıya bağlanmalarına yol açmaktadır (Yaşar 1993). Çocuklar, yapılan fen çalışmaları sırasında gözlem yapma, iletişim kurma, soru sorma, fikir ileri sürme, sonucu tahmin etme, aktif katılım ile denemeler yapma, neden-sonuç ilişkisini deneyerek ve yaşayarak kavrayabilme fırsatlarını yakalamış olacaklardır (Bal 1993). Böylelikle çocukların fen becerileri gelişirken, gerçek hayattaki becerileri de artacak ve fenle birlikte diğer konuları da öğrenmeleri kolaylaşacaktır. Bunun sonucunda çocuklar öğrenmeyi öğrenir duruma gelmiş olacaklardır.

Her çocuğun farklı bir öğrenme stili olduğu unutulmamalıdır. İşte bu düşünceyle fen öğretimin de başarının artması için tüm çocukların fen konularını anlayabileceği yöntem ve tekniklerin işe koşulması gerekmektedir.

Çocukların kendi yaşantıları yoluyla öğrenmelerini sağlayacak ve yeni duyuşsal beceriler kazanabileceği en etkili yöntemlerden birisi de yaratıcı dramadır. Yaratıcı drama ile öğrenciler hem öğrenmeyi öğrenecek hem de farklı becerileri edinebileceklerdir.

Yaratıcı drama, tiyatro ve drama tekniklerinden yararlanılarak bir grup çalışması içinde doğaçlamayı merkeze alarak gerçekleştirilen; müzik, dans, resim, heykel, edebiyat gibi çeşitli sanat dallarına ilişkin etkinlikleri bünyesinde barındırması ve çağdaş insanın sahip olması gereken yaratıcılık özelliğini geliştirerek bireye estetik bir bakış açısı sağlaması ile tümel bir sanat eğitimi alanı; farklı yetenek ve zekalara dönük etkinlikleri aynı anda bünyesinde barındırması ve daha çok duyuları hedef almasıyla yaşantı yoluyla kalıcı öğrenmenin etkili bir yöntemi; kendini gerçekleştirme yolundaki çağdaş insana kendini, çevresini, olayları ve en geniş anlamıyla hayatı çok yönlü ve gerçekçi bir şekilde algılayarak, ihtiyaçlarını karşılama ve gizil güçlerini gerçekleştirmesi yönünde büyük destek verişiyle etkili bir kişisel/sosyal gelişim yöntemidir (Bozdoğan 2003).

Dramada, çocuklar gerçek dünyaya ait kendi gözlem ve deneyimlerini sanal bir dünya yaratmak için çizerler. Bu sanal dünyada, yaratarak, geliştirerek ve yansıtarak; kendileri, arkadaşları, aileleri ve içinde yaşadıkları gerçek dünyaya ait daha çok şeyi anlar hale getirirler. Çeşitli sosyal olayları inceleyerek, insanların farklı koşullarda nasıl davrandıklarını düşünebilirler (Fulford ve ark. 2001).

Yaratıcı dramadaki öğrenme, bir tür yeniden yapılandırmadır. Öğrencilerin, öğrendiklerini ve bilgilerini yeni bir bakış açısından değerlendirmesidir. Kazanılmış kavramların irdelenmesi, bu kavramlara yeni anlamlar yüklenmesi söz konusudur. Deneyim ve yaşantılar yeniden gözden geçirilir. Tüm bu süreçler doğal bir öğrenmeyi gerektirir.

Özetle yaratıcı drama; bireyin gözlem yetilerini geliştirir, kendine ve çevresine olan farkındalığını arttırır, kişileri kendilerine özgü nitelikleriyle kabul etme becerisini ve gerçeği çarpıtmadan farklı bakış açılarıyla algılayabilme yetisini geliştirir; kişilere kendiliğinden ve spontanlığı kazandırırken, kişilerin yaratıcı süreçler geliştirmesine ve toplumsal kalıpları sorgulama becerisini gösterebilmesine katkı sağlar (Bozdoğan 2003).

Okvuran (1993), Kaf (1999), Sözer (2006), Bertiz (2005), Heinig(1981), Farris ve Parke (1993), Flennoy (1992) ve Mc Naughton (2004) eğitimde yaratıcı dramanın öğrenci becerilerine etkisini çeşitli alanlarda yaptıkları araştırmalarla incelemişlerdir. Araştırmalar sonucunda yaratıcı drama yönteminin uygulandığı deney grubu öğrencilerinin yaratıcı düşünme, eleştirel düşünme, iletişim, empati, karar verme ve sorgulama becerileri başta olmak üzere bir çok becerilerinde gelişmeler olduğu ortaya çıkmıştır.

Yöntem

Model

Bu araştırma, ilköğretim 6. sınıf Fen ve Teknoloji dersinde maddenin tanecikli yapısı ünitesinin yaratıcı drama ile öğretiminde, yaratıcı drama yönteminin kullanımı hakkında öğrenci görüşlerini almak ve edindikleri tutum davranışları belirlemek amacıyla yapılmıştır. Yapılan çalışmada öğrencilerin, uygulama sonrasında yaratıcı drama ile öğretimin, öğrenmelerine ne kadar yardımcı olduğunu ve hangi kazanımları elde ettiklerini tespit etmek için bire bir mülakat yöntemi ve yarı yapılandırılmış sorular kullanılmıştır. Öğrencilerin bire bir mülakatlara ve yarı yapılandırılmış sorulara vermiş oldukları yanıtlar nitel veri analiz yöntemlerinden biri olan içerik analiz yöntemiyle derlenerek betimsel analiz yapılmıştır.

Çalışmanın Örneklemi

Bu çalışma, ilköğretim 6. sınıf Fen ve Teknoloji dersi programında yer alan "Maddenin Tanecikli Yapısı" ünitesindeki konuların öğretiminde, yaratıcı drama ile öğretimin öğrenci başarısına etkisinin araştırıldığı deney grubu olan ve Karaman ili Merkez Vali Ali Akan İlköğretim Okulu 6/A sınıfında öğrenim gören 32 öğrenci ve Karaman ili Morcalı Köyü İlköğretim Okulu 6/A sınıfında öğrenim gören 15 öğrencinin katılımıyla yapılmıştır. Örnekleme ilişkin veriler Tablo 1. de gösterilmiştir.

Tablo 1. Örnekleme ilişkin veriler

Örneklemler	Kız öğrenci sayısı	Erkek öğrenci sayısı	Toplam
Morcalı İlköğretim Okulu	8	7	15
Merkez Vali Ali Akan İlköğretim Okulu	13	19	32
Toplam	21	26	47

Veri Toplama Araçları

Çalışma verileri Merkez Vali Ali Akan İlköğretim Okulu ve Morcalı Köyü İlköğretim Okulunda bulunan öğrencilere yaratıcı drama ile öğretimin uygulama aşaması ve uygulama sonrasında elde ettikleri bilgi ve becerileri hakkındaki görüşlerini almak için yarı yapılandırılmış sorular yöneltilmiş ve içlerinden rastgele seçilen öğrencilerle bire bir mülakat yapılmıştır.

Verilerin Analizi

Araştırmada kullanılan nitel verilerin bir kısmı, öğrencilerinin uygulama sonundaki görüşlerini almak amaçlı olarak hazırlanmış olan yarı yapılandırılmış sorulara verdikleri cevapların değerlendirilmesi ile elde edilmiştir. Ayrıca nitel verilerin bir kısmı deney grubunda rastgele seçilen öğrencilerle yapılan birebir mülakatlarda elde edilmiştir. Elde edilen nitel veriler, nitel analiz yöntemlerinden biri olan içerik analiz yöntemi ile değerlendirilmiştir.

Bulgular

Ünite boyunca uygun yerlerde yaratıcı drama yöntemi kullanılarak fen dersinin öğretimine katılan 6. sınıf öğrencilerinin bu yöntem ile ders işlendiğinde kazandıkları beceriler frekans ve yüzde analizi ile verilmiştir.

Araştırma boyunca random olarak seçilen öğrencilerden alınan görüşler alıntılar şeklinde çalışmada sunulmuştur. Elde edilen nitel veriler, nitel analiz yöntemlerinden biri olan içerik analiz yöntemi ile derlenerek betimsel analiz yapılmıştır. Deney grubu öğrencilerinin uygulama sonunda elde ettikleri kazanımlarla ilgili frekans ve yüzde değerleri Tablo 2. de gösterilmiştir.

Tablo 2. Deney grubu öğrencilerinin uygulama sonunda elde ettikleri kazanımlarla ilgili frekans ve yüzde değerleri

MADDELER	f	%
Yaratıcı düşünme	40	85.10
İletişim	40	85.10
Empati	37	78.72
Eleştirel düşünme	30	63.82
Karar verme	28	50.57
Sorgulama	20	42.55

Uygulama sonunda deney grubu öğrencilerine sorulan sorulardan ilki “Uygulananyöntem (Yaratıcı Drama ile Öğretim Yöntemi) hakkındaki görüşleriniz nelerdir?” şeklindedir.

Öğrenci 1 uygulama sonunda elde ettiği becerileri şu şekilde sıralamıştır.

“Uygulama sonunda üstlendiğim görevler ve yaptığım çalışmalar sonunda doğaçlama, olayları sorgulama, eleştirel düşünme, iletişim, karar verme, takım çalışması ve yaratıcı düşünme becerilerimin geliştiğine inanıyorum.”

Öğrenci 2 ise yöneltilen soruyu şu şekilde yanıtlamıştır.

“Aslında çok iyi bir oyuncu olduğumu keşfettim. Kendimi oyunla ifade edebildiğimi yaptığımız uygulama sayesinde fark ettim. Ayrıca doğaçlamalar sırasında hızlı bir şekilde yeni fikirler üretebildiğimi gördüm. Aslında grup çalışmasının nasıl yapıldığını yaptığımız uygulama sonucunda öğrendim diyebilirim. Bu çalışmayla

Öğrenci 3, kendi duygu ve düşüncelerini şu sözlerle ifade etmiştir.

“Benim bu çalışma sonucundaki en büyük kazanımımın yaratıcılık becerisi ve doğaçlamalar sırasında ortaya koyduğumuz orjinal fikirler olduğuna inanıyorum. En önemli kazançlarımdan biride kendimi ifade etme becerimde olduğuna inanıyorum. Böyle bir uygulamayı başka bir zaman bir daha yaparsak hiç zorlanmadan ve severek yapacağıma inanıyorum. Farklı yöntemlerle ders işlemek çok güzel oluyor."

Öğrenci 4 ise uygulama sonunda bilgi ve elde ettiği beceriler açısından kazanımlarını şu şekilde açıklamıştır.

"Benim bu yöntemde en çok hoşuma giden taraf kendi yeteneklerimizi açığa vurarak konuyla alakalı bir şeyler öğrenmek oldu. Doğaçlamalar yaparak yeni bilgiler öğrendik. Ben ve arkadaşlarımın maddenin tanecikli yapısı ünitesinde bulunan tüm bilgileri kazandığımıza inanıyorum."

Araştırmanın bulguları doğrultusunda yapılan değerlendirme neticesinde aşağıdaki sonuçlara ulaşılmıştır:

1- Yaratıcı dramadaki öğrenme, bir tür yeniden yapılandırmadır. Öğrencilerin, öğrendiklerini ve bilgilerini yeni bir bakış açısından değerlendirmesidir. Kazanılmış kavramların irdelenmesi, bu kavramlara yeni anlamlar yüklenmesi söz konusudur. Deneyim ve yaşantılar yeniden gözden geçirilir. Tüm bu süreçler doğal bir öğrenmeyi gerektirir.

2- Araştırma sonucunda deney grubu öğrencilerinin uygulama sonrasında elde ettikleri kazanımların hem bilgi açısından hem de beceri açısından oldukça fazla olduğu söylenebilir.

3- Öğrencilerin yarı yapılandırılmış sorulara ve bire bir yapılan mülakatlara vermiş oldukları yanıtlar incelendiğinde, öğrencilerin uygulama sonrasında kalıcı bilgi ve kendilerini daha rahat ifade edebilme becerilerini kazandıklarını dile getirmişlerdir.

4- Öğrenciler uygulama sırasında aktif olmalarından dolayı bilgileri yaparak yaşayarak öğrenme becerilerinin geliştiği böylelikle de bilgiye nasıl ulaşacaklarını öğrendiklerini dile getirmişlerdir.

5- Öğrencilerin uygulama sonrasındaki diğer bir kazanımları ise doğaçlama yeteneklerinin ortaya çıkmaları olduğunu, daha önce sorumluluk almaktan kaçınan arkadaşlarının da sorumluluk alma alışkanlıklarının geliştiğini dile getirmişlerdir.

6- Araştırma sonucunda elde ettiğimiz bulgu ve veriler ışığında yaratıcı drama ile öğretimin uygulandığı öğrencilerin, yaratıcı düşünme, eleştirel düşünme, iletişim, empati, karar verme, sorgulama becerilerinde gelişmeler olduğu ortaya çıkmıştır.

Öneriler

Yapılmış olan bu araştırmanın bulguları ve sonuçları doğrultusunda şu önerilerde bulunulmuştur.

1- Yaratıcı drama ile öğretimin öğrenciler açısından sadece başarı elde etme olmadığı aynı zamanda birçok beceriyi de kazandıkları göz önünde bulundurulmalıdır.

2- Elde edilen sonuç bize yaratıcı drama ile öğretimin okul öncesinden başlayarak ilköğretimin bütün kademelerinde faydalanılması gerektiğinin bir göstergesidir.

3- Yaratıcı dramanın öğretmenlere tanıtılması ve rehber olması için Milli Eğitim Bakanlığınca hizmet içi kursları açılmalıdır.

4- Yüksek öğretimde yaratıcı drama, seçmeli veya zorunlu ders olarak öğretmen adaylarına verilmelidir. Bu sayede öğretmen adayları ileride derslerinde yaratıcı drama ile öğretimi uygularken zorluk çekmeyeceklerdir.

Not: Bu çalışma Selman TUNCEL'in"İlköğretim 6. Sınıf Fen ve Teknoloji Dersinde Maddenin Tanecikli Yapısı Ünitesinin Yaratıcı Drama ile Öğretiminin Öğrencilerin Başarısına Etkisi" isimli tez çalışmasından üretilmiştir.

Kaynaklar

Bozdoğan, Z. (2003). Okulda Rehberlik Etkinlikleri ve Yaratıcı Drama. İstanbul: Nobel Yayın Dağıtım.

Bal, S. (1993). Anaokullarında Fen Çalışmaları (9. Ya-Pa Okul Öncesi Eğitimi ve Yaygınlaştırma Semineri). Ankara: Ya-Pa Yayınları.

Fulford, J. ve ark. (2001). İlköğretimde Drama. Çeviren: Leyla Küçükahmet ve ark. İstanbul: Nobel Yayın Dağıtım.

Gönen, M., Dalkılıç, N. U. (2000). Çocuk Eğitiminde Drama Yöntem ve Uygulamalar. İstanbul: Epsilon Yayıncılık.

Gürdal, A. ve ark. (1993). Okul Öncesi dönemle ilgili Fen Faaliyetlerine Örnekler (9. Ya-Pa Okul Öncesi Eğitimi ve Yaygınlaştırma Semineri). Ankara: Ya-Pa Yayınları.

Yaşar, Ş. (1993). Okul Öncesi Eğitim Öğrencilerinde Fene Yönelik Duyuşsal Özellikleri Geliştirilmesi (9. Ya-Pa Okul Öncesi Eğitimi ve Yaygınlaştırma Semineri). Ankara: Ya-Pa Yayınları.

Tuncel, S. (2009). İlköğretim 6. Sınıf Fen ve Teknoloji Dersinde Maddenin Tanecikli Yapısı Ünitesinin Yaratıcı Drama ile Öğretiminin Öğrencilerin Başarısına Etkisi. Yüksek Lisans Tezi, Selçuk Üniversitesi Fen Bilimleri Enstitüsü, Konya.

INVESTIGATIONS OF PRE-SCHOOL TEACHERS' ATITUDE TOWARD PLANT

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Abstract: The aim of this research is to examine the attitudes of preschool teacher candidates towards the plants in terms of various variables. A total of 245 teachers trained in Kastamonu University were employed in this scope. The research was conducted using scanning model from quantitative research models. Data from the study were used by Fancovicova and Plant Attitude Questionnaire developed by Prokop (2010). As a result of the research, there was no statistically significant difference according to sex and class variables of teacher candidates. However, it was determined that the prospective teachers had a high level of positive attitude towards the students.

***Keywords*:** Plant, pre-school teacher candidate, attitude, plant attitude questionnair

OKUL ÖNCESİ ÖĞRETMEN ADAYLARININ BİTKİLERE YÖNELİK TUTUMLARININ ÇEŞİTLİ DEĞİŞKENLER AÇISINDAN İNCELENMESİ

Özet: Bu araştırmanın amacı okul öncesi öğretmen adaylarının bitkilere yönelik tutumlarının çeşitli değişkenler açısından incelenmesidir. Bu amaç kapsamında Kastamonu Üniversitesi'nde eğitim alan toplam 245 öğretmen adayıyla çalışılmıştır. Araştırma nicel araştırma modellerinden enlemsel tarama modeli kullanılarak yapılmıştır. Araştırmanın verileri Fancovicova ve Prokop (2010) tarafından geliştirilen Bitki Tutum Ölçeği (Plant Attitude Questionnair) kullanılmıştır. Araştırmanın sonucunda öğretmen adaylarının cinsiyet ve sınıf değişkeninine göre istatistiksel olarak anlamlı fark bulunamamıştır. Bununla birlikte öğretmen adaylarının bitkilere yönelik yüksek düzeyde olumlu tutum sergiledikleri belirlenmiştir.

Anahtar Kelimeler: Bitki, okul öncesi öğretmen adayı, tutum, bitkilere yönelik tutum ölçeği

Bitkiler biyosferdeki yaşamın devam etmesinde oldukça önemli etkiye sahip canlılardır. Bununla birlikte insanların beşeri ve ekonomik hayatlarında da oldukça önemli bir konumda bulunmaktadırlar. Bugün insanlar bitkilere dekorasyondan, inşaat sektörüne pek çok farklı alanda kullanmaktadırlar. Tüm bunların yanında bitkiler canlıların yaşamlarında ihtiyaç duydukları pek çok şeyin üretimini sağlayarak, biyosfere önemli katkı sağlarlar. İnsan yaşamında ve diğer canlı yaşamlarında yadsınamaz öneme sahip bitkilerin, önemi ve onlar hakkındaki bilgilerimiz yeterli düzeyde değildir.

Özellikle insanlık kendisinin dışında kalan tüm canlı yaşamına karşı büyük bir dikkatsizlik ve özensizlik içinde bulunmaktadır. İnsanların doğada yer alan başka canlılara yönelik tutumlarını inceleyen araştırmalar (Kaplan ve Kaplan, 1989; Lindemann-Matthies, 2005) yapılmıştır. Buna göre insanların hayvanlara yönelik tutumları bitkilere yönelik tutumlarından daha olumlu olduğu tespit edilmiştir. Kellert (1993) ve Wandersee ve Schussler (2001) insanların başka canlıların fiziksel ve davranışsal özelliklerinden etkilenerek onlara yönelik daha farklı tutumlar geliştirebileceğini belirtmişlerdir. Wandersee ve Schussler (1999) insanların hayvanlara bitkilerden daha fazla farkındalık geliştirdiklerini ve daha olumlu bir tutuma sahip olduklarını belirtmektedirler.

Eğitim-öğretim faaliyetlerinde bile bu durum açıkça ortaya konmaktadır. Wandersee (1986)'nin yaptığı araştırmada öğrencilerin önemli bir bölümü hayvanlar hakkında çok daha fazla bilgi, ilgi ve meraka sahipken, bitkilere ilgi ve merak duyan öğrencilerin sayısı oldukça azdır. Bununla beraber söz konusu durum her yaş grubuna genellenebilir niteliktedir (Balding & Williams, 2016). Wandersee ve Schussler (1999) bu durumun nedenlerini hayvanların göz teması kurma, ses çıkarma ve insanlarla etkileşime girebilme becerisine bağlarken, Morris ve Morris (1966) de hayvanların davranışları öğrenme ve sergileme becerilerine bağlı olarak insanlarla daha rahat etkileşime girebilmelerine bağlamaktadırlar.

Yukardaki paragrafta belirtilen nedenler Wandersee ve Schussler (1999, 2001)'in çalışmalarında ortaya koyduğu *"bitki körlüğü"* (plant blindless) kavramının ortaya çıkmasını sağlamıştır. Söz konusu kavram insanların çevresindeki bitkileri görememesi, bitkilerin biyosfer için öneminin farkına varamaması, bitkilerin benzersiz güzellik ve biyolojik özelliklerini anlayamama olarak tanımlanmaktadır (Wandersee ve Schussler, 1999). Bitki körlüğü olarak adlandırılan duruma neden olan farklı etmenler vardır. Uno (1994) insanların bitkilere yönelik tutumlarının istenilen düzeyde olmamasının nedenini eğitim sistemlerine bağlamaktadır. Ona göre gerek öğretmenler, gerekse ders kitapları bitkiler hakkında yeterli bilgiye sahip değillerdir. Link-Perez, Dollo, Weber ve Schussler (2010) de araştırmalarında ders kitapları içerisinde hayvanların bitkilerden çok daha fazla yer aldığını vurgulamaktadır. Eğitim ortamlarında bitkiler hakkında gerektiği ölçüde bilgi de sunulmadığında insanların bitkilere yönelik tutumlarının istenilen düzeyde olmaması anlaşılabilir bir hal almaktadır.

Herhangi bir şeye yönelik tutum, düşünce-davranış-duygu eğiliminin bütünleşmesidir. Tutumlar bireyin göstereceği davranışları tahmin etmede kesin sonuçlar vermese de, davranışın ortaya çıkması ile ilgili önemli ipuçları sağlar (Kağıtçıbaşı, 2010). Herhangi bir şeye yönelik tutumda olduğu gibi, bitkilere yönelik tutumunda istenilen düzeye gelebilmesi için yapılacak en önemli şeylerden birisi, mümkün olan en erken yaşta gerekli eğitimin verilmesidir. Bitkilere yönelik olumlu tutuma sahip bireylerin yetiştirilmesinde okul öncesi öğretmenleri önemli bir paydaştır. Geleceğin öğretmenleri olacak olan öğretmen adaylarının tutumlarını tespit etmek ise söz konusu adayların eğitim hayatları devam ettiğinden ayrıca önemlidir. Öğretmen adaylarının bitkilere yönelik tutumları tespit edilerek, gerekli düzenlemelerin yapılması ve bu sayede ilerleyen yıllarda öğretmen olarak çocuk eğitimine görev alacak kişilerin bitkilere yönelik tutumlarının istenilen düzeye gelmesi hedeflenmektedir. Yapılan araştırmalar (Balas ve Momsen, 2014; Fancovicova ve Prokop, 2010; Schussler ve Olzak, 2008; Wandersee, 1986) yaş ve cinsiyetin bitkilere yönelik tutumu etkileyen değişkenler olduklarını göstermektedir. Söz konusu araştırma Türk okul öncesi öğretmen adaylarının bitkilere yönelik tutumlarını tespit etmeyi amaçlamaktadır. Buna göre araştırmada aşağıdaki sorulara cevap aranmaktadır?

- Türk okul öncesi öğretmen adaylarının bitkilere yönelik tutumlarının düzeyleri nelerdir?
- Cinsiyet bitkilere yönelik tutum açısından anlamlı bir değişken midir?
- Yaş bitkilere yönelik tutumda anlamlı bir değişken midir?

Yöntem

Araştırma Modeli

Yapılan bu araştırma kesitsel tarama modeli kullanılarak gerçekleştirilen nicel bir çalışmadır. Kesitsel tarama deseni "bir zaman aralığında çok çeşitli örneklem grubundan veri toplamayı gerektiren geniş örneklem için kullanılan" bir tarama desenidir (Wiersma ve Jurs, s. 162).

Örneklem

Araştırmanın örneklemi kolay ulaşılabilir örnekleme tekniğiyle oluşturulmuştur. Kolay ulaşılabilir örnekleme tekniği katılımcılara ulaşmada ve ekonomiklikte güçlüyken, örneklemin sapmasına neden olabilmesi açısından da sınırlıdır. Araştırmanın evreni okul öncesi eğitimi öğretmen adaylarıdır. Örneklem ise Kastamonu Üniversitesi'nde eğitimlerine devam eden okul öncesi eğitimi öğretmen adaylarıdır. Araştırma kapsamında şu ana kadar 245 öğretmen adayı örnekleme dahil olmuştur.

Veri Toplama Aracı

Araştırmanın verilerini toplamak için Bitki Tutum Ölçeği (Plant Attitude Questionnair) kullanılmıştır. Söz konusu ölçek Fancovicova ve Prokop (2010) tarafından geliştirilmiş ve Selvi (2012) tarafından da Türkçe'ye uyarlaması yapılmıştır. Ölçek dört alt boyuttan oluşmaktadır. Ölçek alt boyutlarından *İlgi,* bitkilere yönelik ilgiyi tespit etmek, *Önem,* bitkilerin diğer canlılar ve insan yaşamı için önemini vurgulamak, *Şehir Ağaçları,* şehirlerde yer alan ağaçların maliyeti ve faydasına ilişkin görüşleri almak ve son alt boyut *Kullanım* ise endüstride bitkilerden yararlanılarak yapılan materyaller hakkında görüş almak amacıyla oluşturulmuştur.

Ölçek kapsamında elde edilen toplam puanlar ne kadar yüksekse, bitkilere yönelik tutumunda o derece yüksek olduğu şeklinde yorumlanmaktadır. Ölçekte toplam 29 madde yer almaktadır. Maddelerin bazıları olumsuz içerikli olup, söz konusu madde puanları ters çevrilerek kodlanmaktadır. Ölçek beşli Likert olarak derecelendirilmiştir. Ölçeğin orijinal versiyonunda (Fancovicova & Prokop, 2010) Cronbach Alpha değerleri ilgi, önem, şehir ağaçları ve kullanım alt boyutlarında sırasıyla .83, 078, 071 ve .70; Türkçe versiyonunda (Selvi, 2012) ise sırasıyla .76, .75, .58 ve .59 olarak hesaplanmıştır. Bu araştırma kapsamında ise sırasıyla .55, .59, .61 ve .53 olarak hesaplanmıştır. Ölçeğin tamamına ait Cronbach değeri de .70 olarak hesaplanmıştır.

Verilerin Toplanması

Araştırma kapsamında veri toplamak için öncelikle ilgili fakülte yönetiminden gerekli izinler alınmıştır. Araştırma örneklemini oluşturan okul öncesi öğretmen adayları toplam 20 şube olarak eğitim almaktadır. Her bir şube için ders programlarına uygun zaman dilimlerinde oturumlar düzenlenmiştir. Toplam 20 oturumda veriler toplanmıştır. Her bir oturum ortalama 20 dakika sürmüştür. Araştırmada katılım gönüllülük esasına dayandırılmıştır. Ölçeği doldurmak istemeyen öğretmen adaylarına ölçek verilmemiştir. Ölçek sonucunda herhangi bir not alınmayacağı ve eğitimlerine yönelik herhangi bir çıkarımda bulunulmayacağı öğretmen adaylarına bildirilmiştir.

Verilerin Analizi

Araştırma kapsamında elde edilen verilere yapılacak istatistiksel testler için normallik dağılımı hesaplamaları yapılmıştır. Katılımcıların 28 maddeden oluşan 5'li Likert tipli ölçekten aldıkları toplam puanların ortalaması M= 114.5'tir. %5'lik tıraşlanmış ortalama değeri M= 114.7'dir. *Skewness* değeri -.337 ve *Kurtosis* değeri de -.261 olarak hesaplanmıştır. Bununla birlikte Shapiro-Wilk normallik testi sonucu da .008 çıkmıştır. Buna göre elde edilen verilerin normal dağılım göstermedikleri söylenebilir. Bu sonuçlardan hareketle analizlerde paramatrik olmayan testlerin kullanılmasına karar verilmiştir. Araştırmanın bağımsız değişkenleri cinsiyet ve sınıftır. Her iki değişkende süreksizdir. Bağımlı değişken ise ölçekten elde edilen puanlardır ve sürekli bir değişkendir. Bu nedenle cinsiyet değişkeni üzerinde yapılan işlemlerde Mann-Whitney U Testi, sınıf değişkeniyle yapılan işlemlerde ise Kruskal-Wallis H Testi yapılmıştır. Her iki test için yapılan etki büyüklüğü katsayısı eta kare'yle hesaplanmıştır.

Bulgular

Araştırma kapsamında elde edilen bulgulara göre okul öncesi öğretmen adaylarının bitkilere yönelik tutumlarının yüksek olduğu sonucuna ulaşılmıştır (M= 114.5, SS= 8.27). Buna göre okul öncesi öğretmen adaylarının bitkilere yönelik olumlu tutum sergiledikleri sonucuna varılabilir. Yine ilgi (M= 38.43, SS= 4.21), önem (M= 39.43, SS= 2.45), şehir ağaçları (M= 20.88, SS= 3.31) ve kullanım (M= 11.29, SS= 1.77) açısından da okul öncesi öğretmen adaylarının tutumlarının yüksek olduğu söylenilebilir.

Elde edilen toplam puanlar öncelikle cinsiyet değişkeniyle testlere tabi tutulmuştur. Buna göre cinsiyetle bitkilere yönelik tutum ölçeği toplam puanları (U= 2356, z= -.89, p= .36, r= .05) ve ilgi (U= 2298, z= -1.07, p= .28, r=.05), önem (U= 2222, z= -1.32, p= 18, r= .08), şehir ağaçları (U= 2567, z= -.25, p= 79, r= .01) ve kullanım (U= 2632, z= -.62, p= 95, r= .03) alt boyutlarında istatistiksel olarak anlamlı fark tespit edilememiştir. r değerlerinin tamamı cinsiyetin bitkilere yönelik tutumu açıklamada düşük etkiye sahip olduğunu vurgulamaktadır. Mann-Whitney-U Testi sonuçları Tablo 2.'de gösterilmiştir.

Öğretmen adaylarının sınıf düzeyiyle bitkilere yönelik tutumları arasında da toplam puan (X^2 (3, n= 245)= 8.27, p= .97, r= .08) ve ilgi (X^2 (3, n= 245)= 4.21, p= .99, r= .06), önem (X^2 (3, n= 245)= 2.45, p= .43, r= .06), şehir ağaçları (X^2 (3, n= 245)= 3.31, p= .3, r= .05) ve kullanım (X^2 (3, n= 245)= 1.77, p= .87, r= .03) alt boyutları arasında istatistiksel olarak anlamlı fark tespit edilememiştir. Etki büyüklükleri düşük düzey çıktığından sınıf düzeylerinin bitkilere yönelik tutum açısından düşük etkiye sahip bir değişken olduğu sonucu çıkarılabilir. Kruskal Wallis H Testi sonuçları Tablo 3.'te gösterilmiştir.

Sonuç ve Tartişma

Araştırma kapsamında elde edilen bulgulara göre okul öncesi öğretmen adaylarının bitkilere yönelik yüksek düzeyde olumlu tutum sergiledikleri sonucuna ulaşılmıştır. Fancovicova ve Prokop (2010)'un yaptığı araştırmada da katılımcıların yüksek düzeyde olumlu tutum sergiledikleri sonucuna ulaşılmıştır. Selvi (2012)'nin yaptığı araştırmada ise her ne kadar ölçek uyarlama çalışması olsa da, katılımcıların ortalaması M= 111.45 çıkmıştır. Yani her iki araştırmanın bulgusu da bu araştırma bulgularını destekler niteliktedir.

Genel olarak botanik konuları, özelinde ise bitkiler genellikle erken yaş dönemlerinde öğrenciler tarafından yoğun bir ilgi ve motivasyonla karşılanmakta ve bu konulara yönelik cinsiyet faktörü açısından farklılık olmamaktadır (Thompson & Mintzes, 2002). Biyoloji konularına yönelik ilginin altında yatan en önemli neden konulara karşı duyulan olumlu tutumdur. Thompson ve Mintzes (2002)'in araştırmasında yaşla beraber artan bilgi düzeyinin olumlu tutum geliştirmede önemli bir etken olduğu vurgulanmaktadır.

Araştırma sonucunda okul öncesi öğretmen adaylarının cinsiyetleriyle bitkilere yönelik tutum arasında istatistiksel olarak anlamlı bir fark tespit edilememiştir. Bu benzer olarak alt boyutlar içinde geçerlidir. Fancovicova ve Prokop (2010)'un araştırmasında cinsiyet bitkilere yönelik tutumu etkileyen bir faktör olarak göze çarpmaktadır. Ancak bu araştırmada cinsiyetin anlamlı fark yaratan bir faktör olarak ortaya çıkmaması da tutumları etkileyen faktörlerin (örn sosyal çevre, kültür vb.) etkisinden kaynaklanabilir (Kağıtçıbaşı, 2010). Thompson ve Mintzes (2002) de biyolojik bilgiyle cinsiyet arasında ilişki bulunmadığını belirtmiştir. Araştırmanın yapıldığı il Türkiye'nin orman varlığı açısından en zengin illerinden birisidir. Öğretmen adayları gündelik hayatlarında bitkilerden normalden çok daha fazla karşılaştıklarından böyle bir sonuç ortaya çıkmış olabilir. Prokop, Prokop ve Tunnicliffe (2007) kız öğrencilerin botanikle daha ilgili olduklarını, biyoloji hakkında daha fazla merak sahibi olduklarını belirtmektedir.

Benzer olarak öğretmen adaylarının sınıf düzeyleriyle bitkilere yönelik tutumları arasında da istatistiksel olarak anlamlı fark tespit edilememiştir. Tunnicliffe ve Reiss (2000) bilgi düzeyi arttıkça botaniğe yönelik kavramlara ilginin arttığını belirtmektedir. Artan ilgi şüphesiz bitkilere yönelik tutumu da olumlu etkileyecektir. Araştırmadan elde edilen sonuçlardan hareketle;

- Alanyazında yapılacak yeni çalışmaların bitkilere yönelik tutumları etkileyen diğer faktörler üzerine yoğunlaşmasının önemli bir boşluğu dolduracağına inanılmaktadır. Bununla beraber örneklemler ve meslek grupları da çeşitlendirilebilir.
- Tutumlar o kavramla ilgili önemli unsurlar olmakla birlikte tek başına yeterli değildir. Tutumların davranış boyutunda gözlemlenmesi ve farklı bakış açılarıyla yeniden değerlendirilmesi gerekmektedir. Bu nedenle alanyazında bitkilerle ilgili daha fazla çalışmanın yapılması gerekmektedir.
- Her ne kadar araştırmada tutumlar yüksek çıksa da, eğitim aldıkça tutumların fazla değişmemesi de dikkat çekicidir. Eğitim müfredatlarının ve ortamlarının biyoloji ve botanik konularına yönelik olarak daha iyi tasarlanması gerektiği düşünülmektedir.

Kaynakça

Balas, B. & Momsen, J., L. (2014). Attention "blinks" differently for plants and animals. *CBE- Life Science Education, 13*, 437-443.

Balding, M. & Williams, K., J., H. (2016). Plant blindless and the implications for plant conservation. *Conservation Biology, 30*(6), 1192-1199.

Fancovicova, J. & Prokop, P. (2010). Development and initial psychometric assessment of the plant attitude questionnair. *Journal of Science Education & Techonology, 19,* 415-421.

Kağıtçıbaşı, Ç. (2010). *Günümüzde insan ve insanlar.* (12. Basım). İstanbul: Evrim Yayınevi.

Kaplan, R. & Kaplan, S. (1989). *The experience of natüre. A psychological perspective.* Cambridge: University Press.

Kellert, S., R. (1993). Attitudes towards animals: Age-related development among children. *The Journal of Environmental Education, 16,* 29-39.

Lindemann-Matthies, P. (2005). 'Lovable' mammals and 'lifeless' plants: How children's interest in common local organisms can be enhanced through observation of natüre. *International Journal of Science Education, 27*(6), 655-677.

Link-Perez, M., Dolo, V., H., Weber, K., M. & Schussler, E., E. (2010). What's in a name: Differential labelling of plant and animal photographs in two nationally syndicated elementary science textbook series. *International Journal of Science Education, 32*(9), 1227-1242.

Morris, R. & Morris, D. (1966). *Me and pandas.* London: Sphere.

Schussler, E., E. & Olzak, L., A. (2008). It's not easy being green: Student recall of plant and animal images. *Journal of Biological Education, 42*(3), 112-118.

Selvi, M. (2012). Adaptation into Turkish of the plant attitude questionnaire. *Journal of Baltic Science Education, 11*(2), 175-183.

Thompson, T., L. & Mintzes, J., J. (2002). Cognitive structure and the affective domain: On knowing and feeling in biology. *International Journal of Science Education, 24*(6), 645-660.

Uno, G., E. (1994). The state of precollege botanical education. *The American Biology Teacher, 56*(5), 263-267.

Wandersee, J., H. (1986). Plants or animals- Which do junior high school students prefer to study. *Journal of Research in Science Teaching, 23*(5), 415-426.

Wandersee, J., H. & Schussler, E., E. (1999). Preventing plant blindless. *The American Biology Theacher, 61*(2), 82-86.

Wandersee, J., H. & Schussler, E., E. (2001). Toward a theory of plant blindless. *Plant Science Bulletin, 47*(1), 2-8.

Wiersma, W. & Jurs, S. G. (2005). *Research methods in education.* (Eight Edition). Boston: Allyn and Bacon.

Tunnicliffe, S., D. & Reiss, M., J. (2000). Building a model of the environment: How do children see plants? *Journal of Biological Education, 34*(4), 172-177.

Prokop, P., Prokop, M. & Tunnicliffe, S., D. (2007). Is biology boring? Student attitudes toward biology. *Journal of Biological Education, 42*(1), 36-39.

INTERRELATIONS BETWEEN METACOGNITIVE AWARENESS AND CHEMISTRY PERCEPTIONS

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Abstract: The aim of this study is to examine the relationship between metacognitive awareness and chemistry perceptions. Study group consists of 1091 high school students who are enrolled at high schools in Turkey. Metacognitive awareness scale and chemistry perception questionnaire were used as a data collection tools in the study. At the end of the study, it was determined that there is a statistically meaningful relationship between high school students' metacognitive awareness and their chemistry perceptions levels. This result can be interpreted as high school students with high metacognitive awareness also having high chemistry perceptions.

***Keywords*:** Metacognitive awareness, chemistry perceptions, chemistry education.

ÜSTBİLİŞSEL FARKINDALIK VE KİMYA ALGI ARASINDAKİ İLİŞKİNİN İNCELENMESİ

Özet: Bu araştırmada bilişötesi farkındalık ve kimya algı arasındaki ilişkinin incelenmesi amaçlanmıştır. Araştırmanın çalışma grubunu Türkiye'de liselerde öğrenim gören 1091 lise öğrencisi oluşturmuştur. Araştırmada veri toplama aracı olarak Üstbilişsel Farkındalık Ölçeği ve Kimya Algı Ölçeği kullanılmıştır. Araştırma sonucunda üstbilişsel farkındalık ile kimya algı arasında istatistiksel olarak anlamlı bir ilişki olduğu belirlenmiştir. Bu sonuç bilişötesi farkındalığı yüksek düzeyde olan bireylerin kimya algılarının da yüksek olduğu şeklinde yorumlanabilir.

***Anahtar Sözcükler*:** Bilişötesi farkındalık, kimya algı, kimya eğitimi.

Giriş

Yaşadığımız bilgi çağında bireylerin, kendi bilişsel süreçleri hakkında bilgiye sahip olmaları neredeyse zorunlu hale gelmiştir. Bu nedenle bireylerin, bir şeyi nasıl öğreneceğini, öğrendiklerini ihtiyaç duyduğunda nasıl hatırlayacağını ve kendi öğrenmesini etkin bir şekilde nasıl kontrol edip yönlendireceğini bilmesi gerekmektedir. Değişim ve gelişimlere ayak uydurabilen, hızla artan bilginin içinden gerekli olanları seçip kullanabilen, yaşam boyu öğrenen bir birey olmanın en önemli etmeni; kişinin neyi bilip neyi bilmediğini bilme, düşünme süreçlerini sorgulama ve dolayısıyla düşüncelerini düzenleme ve değerlendirme yeteneği olan bilişötesi farkındalığa sahip olmasıdır. Ne bildiğini bilme yeteneği yani bilişötesi; bireyin algılama, hatırlama ve düşünmesinde yer alan zihinsel faaliyetlerin farkında olması ve bunları kontrol etmesi olarak tanımlanmaktadır (Hacker & Dunlosky, 2003). Garner ve Alexander (1989)'a göre, biliş, algılamayı, anlamayı, hatırlamayı ve buna benzer zihinsel süreçleri; üst biliş, insanın kendi algılamasını, anlamasını, hatırlamasını ve bunun gibi zihinsel süreçleri hakkında düşünmesini içeren yapılardır. Birey sahip olduğu üstbilişi genellikle, kendi bilişsel süreçleri hakkındaki bilgisini ve bu bilginin bilişsel süreçlerini kontrol etmek için kullanır (Flavell, 1987). Bilişin bir formu olan üstbiliş, bireyin kendi düşünme süreçlerini içsel olarak fark etmesi, izlemesi, kontrol etmesi, kendi bilişini düzenlemesi ve değerlendirmesidir. Üstbiliş, bilişsel süreçler üzerinde aktif kontrolü içeren yüksek düzey düşünme süreci olarak görülür. Üstbilişsel beceriler öğrenme sırasında etkin olarak öğrenmeyi izleme becerileridir ve birey bir soruya verdiği cevabı nasıl kontrol edeceğini, çalışma için ne kadar zaman ayıracağını, etkili öğrenme için nasıl bir yol izleyeceğini bilmezse öğrenme çok zor olabilmektedir (Boyacı, 2010). Dunslosky ve Thiede (1998)'e göre üstbiliş, kişinin öğrenmek için plan yapması, bir problemi çözmek için uygun strateji ve becerileri kullanması, performansına yönelik tahminlerde bulunması ve öğrenme boyutlarını ayarlaması gibi üst düzey zihinsel işlemleri öğrenme amaçlı kullanmasıdır. Bu bağlamda bilişsel süreçlerin farkındalığı özellikle eğitim alanında bireyin en çok kullandığı zihinsel aktivitelerden biridir. Öğrenciler öğrenirken, özellikle de bir dersi benimserken sahip oldukları algıları, onların zihinsel süreçlerinin kontrolünü etkiler. Hayatı geniş bir yelpazede inceleme imkanı sunan bilim dallarından biri olan kimya, atılan büyük bilimsel adımlarla gün geçtikçe daha da hızlı bir şekilde yaşamın bir parçası haline gelmesine rağmen, bu durum bireylerin kimya algılarında aynı ivme ile olumlu yönde değişim gösterememektedir. Bu durum kimya algısını etkileyen nedenler neler olabilir sorusunu akıllara getirmektedir. Bu nedenle çalışmada lise öğrencilerinin üstbilişsel farkındalıkları ve kimya algıları arasındaki ilişkinin incelenmesi amaçlanmıştır.

Yöntem

Çalışmanın örneklemini Türkiye'de öğrenim gören 1091 lise öğrencisi oluşturmuştur. Araştırmada veri toplama aracı olarak Wells (2003) tarafından geliştirilen ve Tosun (2013) tarafından Türkçeye uyarlanan "Kimya Algı Ölçeği" (α=0.74)ve Sperling, Howard, Miller ve Murphy (2002) tarafından geliştirilen, uyarlanması Karakelle ve Saraç (2007) tarafından yapılan "Üstbilişsel Farkındalık Ölçeği" (α=0.80) kullanılmıştır.

Bulgular

Tablo 1. Kimya algı ölçeğine ait bulgular

			Kesinlikle Katılmıyorum		Katılmıyorum		Kararsızım		Katılıyorum		Kesinlikle Katılıyorum		Analiz*	
			n	%	n	%	n	%	n	%	n	%	X	p
Cinsiyet	Kimya alanında erkekler, bayanlara göre daha iyidir.	**K**	301	52.5	129	22.5	62	10.8	64	11.2	17	3.0	101.	.00
		E	135	26.1	139	26.8	95	18.3	80	15.4	69	13.		
	Bayanların kimyada başarılı olması beklenmez.	**K**	305	53.2	130	22.7	56	9.8	41	7.2	41	7.2	42.7	.00
		E	174	33.6	172	33.2	70	13.5	50	9.7	52	10.		
	Kimya, erkeklere özgü bir bilim dalıdır.	**K**	287	50.1	124	21.6	81	14.1	40	7.0	41	7.2	55.4	.00
		E	148	28.6	171	33.0	86	16.6	63	12.2	50	9.7		
	Kimya, erkekler için daha kolaydır.	**K**	243	42.4	144	25.1	79	13.8	60	10.5	47	8.2	20.2	.00
		E	153	29.5	165	31.9	88	17.0	68	13.1	44	8.5		
	Kimya, bayanlar için daha zordur.	**K**	248	43.3	149	26.0	74	12.9	62	10.8	40	7.0	25.2	.00
		E	153	29.5	160	30.9	103	19.9	66	12.7	36	6.9		
Değer	Kimya, toplumu olumlu yönde etkilemektedir.	**K**	55	9.6	93	16.2	187	32.6	169	29.5	69	12.	14.1	.00
		E	78	15.1	75	14.5	130	25.1	175	33.8	60	11		
	Herkes, biraz kimya bilmelidir.	**K**	56	9.8	79	13.8	175	30.5	193	33.7	70	12.	8.51	.07
		E	67	12.9	84	16.2	122	23.6	178	34.4	67	12.		
	Kimya, yarardan çok zarar verir.	**K**	155	27.1	167	29.1	116	20.2	93	16.2	42	7.3	15.0	.00
		E	110	21.2	131	25.3	103	19.9	117	22.6	11.	99		
	Kimya yaşamımı iyileştirdi.	**K**	95	16.6	117	20.4	181	31.6	125	21.8	55	9.6	14.5	.00
		E	92	17.8	111	21.4	150	29.0	142	27.4	23	4.4		
	Kimya, yaşam problemlerini çözmek için yararlıdır.	**K**	79	13.8	106	18.5	174	30.4	156	27.2	58	10	6.72	.15
		E	87	16.8	105	20.3	142	27.4	149	28.8	35	6.8		
Tedirginlik	Labta araştırma yaparken yaralanmaktan korkuyorum.	**K**	175	30.5	185	32.3	112	19.5	70	12.2	31	5.4	21.7	.00
		E	179	34.6	205	39.6	53	10.2	54	10.4	27	5.2		
	Tehlikeli kimyasallara maruz kalabilirim diye korkuyorum.	**K**	148	25.8	163	28.4	132	23	86	15	44	7.7	.464	.97
		E	137	26.4	152	29.3	114	22	73	14.1	42	8.1		
	Kimya laboratuvarında çalışmak tedirgin ediyor.	**K**	157	27.4	153	26.7	104	18.2	100	17.5	59	10.	5.24	.26
		E	119	23.0	142	27.4	114	22.0	98	18.9	45	8.7		
Kimyanın	Kimya bilimi, çok fazla matematik içermektedir.	**K**	38	6.6	120	20.9	199	34.7	132	23.0	84	14.	5.42	.24
		E	46	8.9	99	19.1	198	38.2	116	22.4	59	11.		
	Kimya bilimi çok zordur.	**K**	83	14.5	146	25.5	173	30.2	111	19.4	60	10.	12.3	.01
		E	76	14.7	88	17.0	185	35.7	108	20.8	61	11.		
	Kimya biliminde çok fazla konu ve kavram vardır.	**K**	46	8.0	84	14.7	186	32.5	136	23.7	12	21.	2.56	.63
		E	49	9.5	69	13.3	157	30.3	139	26.8	10	20.		
	Kimya bilimi ilişkisiz birçok olguyu öğrenmeyi gerektirir.	**K**	72	12.6	149	26.0	157	27.4	124	21.6	71	12.	9.34	.05
		E	68	13.1	96	18.5	155	29.9	133	25.7	66	12.		
Eğilim	Kimya dersini ilginç buluyorum.	**K**	104	18.2	106	18.5	153	26.7	152	26.5	58	10.	5.12	.27
		E	114	22.0	102	19.7	142	27.4	119	23.0	41	7.9		
	İyi bir kimyacı olabilirim.	**K**	73	12.7	103	18.0	156	27.2	177	30.9	64	11.	11.6	.02
		E	93	18.0	84	16.2	121	23.4	141	27.2	79	15.		
	Kimyada yeterli matematik ön bilgisine sahip değilim.	**K**	134	23.4	155	27.1	128	22.3	116	20.2	40	7.0	7.24	.12
		E	109	21.0	118	22.8	114	22.0	136	26.3	41	7.9		

Tablo 1 incelendiğinde kız ve erkek öğrencilerin kimya algılarında anlamlı farklılaşmalar olduğu görülmektedir. Özellikle cinsiyet boyutunda genellikle erkek öğrenciler lehine anlamlı farklılaşmalar olduğu belirlenmiştir. Kimya biliminin erkeklere daha uygun olduğu yönündeki algıların belirgin olduğu bulgular da dikkat çekmektedir. Öğrencilerin kimya bilimine yönelik değer algıları irdelendiğinde, kız öğrencilerin kimyanın, toplumu olumlu yönde etkilediği ve yaşamı iyileştirdiği yönündeki algılarının erkek öğrencilere göre daha olumlu olduğu belirlenmiştir. Erkek öğrencilerin kimyanın, yarardan çok zarar verdiği yönündeki algılarının kız öğrencilere göre daha fazla olduğu ortaya çıkmıştır. Öğrencilerin tedirginlikleri sorgulandığında kız öğrencilerin erkek öğrencilere göre daha çok kimya laboratuvarlarında araştırma yaparken yaralanmaktan korktukları belirlenmiştir. Öğrencilerin kimyanın kapsamı konusundaki algıları incelendiğinde kız öğrencilerin kimyayı çok zor bir bilim olarak algıladıkları söylenebilir. Kimya bilimine yönelik eğilimlerin incelendiği veriler değerlendirildiğinde erkek öğrencilerin kimyaya daha eğilimli oldukları ortaya çıkmıştır.

Tablo 2. Üstbilişsel farkındalık ölçeğine ait bulgular

			Asla		Nadiren		Bazen		Sık Sık		Her Zaman		Analiz*	
			n	%	n	%	n	%	n	%	n	%	X	p
DENETLEME	Daha önce işime yaramış olan çalışma	K	41	7.2	64	11	141	24.6	228	39.8	99	17	7.8	.09
	yollarını kullanmaya uğraşırım.	E	48	9.3	63	12	154	29.7	176	34.0	77	14		
	Önemli bilgileri çok dikkatli	K	38	6.6	64	11	161	28.1	211	36.8	99	17	11.	.02
	dinlerim.	E	54	10.4	81	15	126	24.3	180	34.7	77	14		
	Şekil ve resimler çizmek bir konuyu	K	52	9.1	73	12	162	28.3	182	31.8	104	18	3.7	.44
	daha iyi anlamamı sağlar.	E	59	11.4	71	13	135	26.1	174	33.6	79	15		
	Bir problemi çözmek için birçok yol	K	44	7.7	89	15	176	30.7	183	31.9	81	14	3.9	
	düşünür. Aralarından iyisini seçerim.	E	52	10.0	83	16	136	26.3	175	33.8	72	13		.41
GÖREV	İhtiyacım olduğunda kendi kendime	K	31	5.4	79	13.	165	28.8	192	33.5	106	18	8.5	.07
	öğrenebilirim.	E	49	9.5	79	15	150	29	160	30.9	80	15		
	Konu hakkında daha önceden bir	K	38	6.6	70	12	125	21.8	226	39.4	114	19	3.1	.53
	şeyler biliyorsam daha iyi öğrenirim.	E	45	8.7	62	12	120	23.2	204	39.4	87	16		
	İlgimi çeken konuları daha iyi	K	29	5.1	59	10	122	21.3	198	34.6	165	28	9.6	.04
	öğrenirim.	E	42	8.1	71	13	106	20.5	178	34.4	121	23		
İZLEME	Yeni bir şey öğrenirken kendime ne	K	46	8	86	15	180	31.4	190	33.2	71	12	6.1	.18
	kadar öğrenebildiğimi sorarım.	E	60	11.6	85	16	138	26.6	175	33.8	60	11		
	Çalışmam sona erdiğinde kendime	K	50	8.7	91	15	166	29	182	31.8	84	14	3.0	.55
	öğrenmek istediğim konuyu öğrenip	E	54	10.4	76	14	144	27.8	180	34.7	64	12		
	öğrenemediğimi sorarım.													
	Çalışmaya başlamadan önce ne	K	41	7.2	85	14	181	31.6	187	32.6	79	13	9.3	.05
	öğrenmem gerektiğini düşünürüm.	E	59	11.4	65	12	156	30.1	183	35.3	55	10		
KİŞİS	Öğretmenin neyi öğrenmemi istediğini	K	42	7.3	85	14	195	34	193	33.7	58	10	10.	.03
	bilirim.	E	59	11.4	86	16	148	28.6	158	30.5	67	12		
	Bir şeyi anlayıp anlamadığımı	K	34	5.9	51	9	177	30.9	199	34.7	112	19	14.	.00
	bilirim.	E	45	8.7	71	13	172	33.2	140	27.0	90	17		

Tablo 2 incelendiğinde ölçeğin denetleme boyutunda kız öğrenciler lehinde anlamlı farklılaşmalara işaret eden değerler olduğu görülmektedir. Kız öğrencilerin özellikle daha önce kullandıkları çalışma yollarını kullanmaya ve önemli bilgileri dikkatli dinlemeye yönelik üstbilişsel farkındalıklarının daha iyi olduğu dikkat çekmektedir. Görev boyutunda da kız öğrencilerin kendi kendine öğrenme ve ilgilerini çeken konuları daha iyi öğrenmeye yönelik üstbilişsel farkındalıklarının istatistiksel olarak anlamlı bir şekilde farklılaştığı belirlenmiştir. İzleme boyutunda özellikle ne öğrenmesi gerektiğini düşünme konusunda da kız ve erkek öğrenciler arasında anlamlı farklılaşmalar olduğu söylenebilir. Öğrencilerin üstbilişsel farkındalıklarının kişisel boyutunda kız ve erkek öğrenciler arasında istatistiksel olarak anlamlı bir şekilde farklılaşma olduğu bulgusu ortaya çıkmıştır.

Tablo 3. Üstbilişşsel farkındalık ve kimya algı ölçeğinin ilişkisel değerleri

		Cinsiyet	Değer	Tedirginlik	Kimyanın Kapsamı	Eğilim
Denetleme	r	-.131	.237	.044	.124	.248
Görev	r	-.138	.214	-.009	.133	.223
İzleme	r	-.055	.265	.082	.086	.255
Kişisel Farkındalık	r	-.072	.176	.039	.137	.210

*p<0.05

Tablo 3'te üstbilişsel farkındalık ve kimya algı ölçeklerinin alt boyutları incelendiğinde anlamlı ilişkiler olduğu görülmektedir. Özellikle kimya algı ölçeğinin kimyanın kapsamı ve eğilim alt boyutlarıyla üstbilişsel farkındalık ölçeğinin bütün alt boyutları arasında anlamlı ilişkiler olduğu dikkat çekmektedir.

Sonuç

Bu araştırmada bilişötesi farkındalık ve kimya algı arasındaki ilişkinin incelenmesi amaçlanmıştır. Araştırma sonucunda genel olarak kızların üstbilişsel farkındalık düzeylerinin erkeklerden daha gelişmiş olduğu sonucuna ulaşılmıştır. Çalışmada kullanılan, "Üstbilişsel Farkındalık Ölçeği" üst bilişsel becerinin yüksek ya da düşük olduğuna karar vermek üzere, araştırma ya da tarama amaçlı kullanılabilecek yeterli psikometrik niteliklere sahip bir ölçektir (Karakelle & Saraç, 2007). Dolayısıyla kız ve erkek öğrencilerin üstbilişsel farkındalıkları elde edilen verilere göre yorumlanabilmektedir. Bu bağlamda bulgular üstbilişsel farkındalık ve kimya algı boyutunda yorumlanabilmiştir. Araştırmada öğrencilerin üstbilişsel farkındalıkları ayrı ayrı boyutlar ve madde bazında değerlendirilmiştir. Çünkü Karakelle ve Saraç (2007) tarafından da belirtildiği gibi, üst bilişsel süreçlerde olgunlaşmaya bağlı olmayan bireysel farklılıkların ve bilişsel, duygusal ve çevresel özelliklerin etkileşiminin incelenmesi konuya yeni boyutlar getirecektir. Araştırmada üstbilişsel farkındalık ölçeğinin denetleme boyutunda kız öğrenciler lehine anlamlı farklılaşmalar olduğuna dair bulgulara rastlanmıştır. Bulgular kız öğrencilerin daha önce kullandıkları çalışma yollarını kullanmaya ve önemli bilgileri dikkatli dinlemeye yönelik üstbilişsel farkındalıklarının erkek öğrencilere göre daha iyi olduğuna dair ipuçları sunmaktadır. Ayrıca öğrencilerin öğrenme görevini nasıl üstlendiklerini irdeleyen görev boyutunda kız ve erkek öğrenciler arasında istatistiksel olarak anlamlı farklılaşma olduğu belirlenmiştir. Garner (1987)'e göre, biliş ile üstbiliş arasında şöyle bir fark vardır: Biliş bir görevi yapmak için gerekli olan bilgi, üstbiliş ise bir görevin nasıl yapıldığının anlaşılması için gereken bilgidir (Schraw, 2001). Dolayısıyla öğrencilerin üstlendikleri misyonlarını anlama ve algılama biçimlerini onların sahip oldukları biliş haritaları da etkileyecek ve öğrenme yollarını bulmalarında rehberlik edecektir. Bu nedenle çalışmadan elde edilen kız ve erkek öğrenciler arasındaki bu farklılığın belirlenebilmesi için sonucun sadece üstbiliş boyutunda yorumlanması yerine kız ve erkek öğrencilerin bilişsel yapılarının da irdelenip yorumlanması gerekmektedir. Üstbilişsel farkındalık ölçeğinin izleme boyutunda öğrencilerin kendi öğrenmelerini izlemeleri değerlendirilmiş ve ne öğrenmesi gerektiğini düşünme konusunda kız ve erkek öğrenciler arasında anlamlı farklılaşmalar olduğu ortaya çıkmıştır. Üstbiliş, öğrenme için temel bir beceridir ve öğrencinin okuduğundan ya da dinlediğinden bir anlam çıkarmasını garanti eder. Bunu başarmak için öğrenci kendi düşünme süreçleri hakkında düşünebilmeli, en verimli işleyen öğrenme stratejilerini tanılayabilmeli ve bilinçli bir şekilde onları yönetebilmelidir (Akın, 2006). Kız öğrencilerin erkek öğrencilere göre bu boyutta öğrenmelerini izlemelerine yönelik daha olumlu dönütler vermeleri, kendilerinin öğrenme stratejilerini daha iyi tanımalarından kaynaklanabilir. Ayrıca üstbilişsel farkındalık ölçeğinin kişisel boyutunda da benzer şekilde kız ve erkek öğrenciler arasında istatistiksel olarak anlamlı bir farklılaşma olduğu bulgusu ortaya çıkmıştır. Melanlıoğlu, (2011)'na göre, üstbiliş, bireyin belli bir durumda kendi stratejik bilgisine nasıl başvuracağı ve bu stratejiyi nasıl verimli bir biçimde kullanacağı hakkında doğru çıkarımlarda bulunma becerisiyle bütünleşmelidir. Söz konusu bütünleşmenin kız ve erkek öğrencilerde aynı değerde gerçekleşmediği, kişisel farklılıkların bu bütünleşmeyi önemli ölçüde etkilediği düşünülmektedir.

Araştırmada kız ve erkek öğrencilerin kimya algılarında anlamlı farklılaşmalar olduğu belirlenmiştir. Kimya biliminin erkeklere daha uygun olduğu yönündeki algıların belirgin olduğu bulgular ortaya çıkmıştır. Genelde kimyanın erkeksi bir bilim olduğu düşünülür. Bu sebepten dolayı da cinsiyet alt boyutunda algı ifadelerinde anlamlı farklılaşmalar gözlenmiştir. Kimya dersine yönelik algıların bu boyutta irdelenmesi cinsiyetin kimya öğrenebilme becerisinde/kariyerinde başarılı olunup olunmayacağının belirlenmesi için önemlidir (Tosun, 2013). Öğrencilerin kimya bilimine yönelik değer algıları incelendiğinde, kız öğrencilerin kimyanın, toplumu olumlu yönde etkilediği ve yaşamı iyileştirdiği yönündeki algılarının erkek öğrencilere göre daha olumlu olduğu belirlenmiştir. Erkek öğrencilerin kimyanın, yarardan çok zarar verdiği yönündeki algılarının kız öğrencilere göre daha fazla olduğu ortaya çıkmıştır. Kimyanın değeriyle ilgili algıların anlaşılması önemlidir. Çünkü Wells (2003)'e göre, sadece kimyanın önemini/değerini alt boyut olarak ele alan hiçbir çalışmaya rastlanılmamaktadır (Tosun, 2013). Öğrencilerin tedirginlikleri sorgulandığında kız öğrencilerin erkek öğrencilere göre daha çok kimya laboratuvarlarında araştırma yaparken yaralanmaktan korktukları belirlenmiştir. Eddy (1996)'e göre, tedirginlik laboratuarlarda karşılaşılan gerçek doğa olayıdır. Nitekim yaptığı çalışmada da öğrencilerin kimya ve kimyasallar hakkındaki endişeleri arasında önemli bir ilişkinin olduğunu tespit etmiştir. Öğrencilerin kimyanın kapsamı konusundaki algıları incelendiğinde kız öğrencilerin kimyayı çok zor bir bilim olarak algıladıkları söylenebilir. Kimyanın doğası gereği bu bilimin çok zor bir bilim dalı olduğu algısı hep süregelmiştir. Lawrenz (1976), on iki ülkenin ortaöğretim öğrencileriyle yaptığı çalışmada fizik ve biyoloji derslerinden sonra en zor dersin kimya olduğunu belirlemiştir (aktaran, Wells, 2003; Tosun, 2013). Kimya bilimine yönelik eğilimlerinin incelendiği veriler değerlendirildiğinde erkek öğrencilerin kimyaya daha eğilimli oldukları ortaya çıkmıştır. Deboer (1987)'e göre, fen yeteneğine sahip olan öğrenciler, fen derslerini sürekli alma eğilimindedir (aktaran, Wells, 2003). Farklı grupların farklı düzeyde algı göstermesi nedeniyle kimya derslerine duyulan ilgi ve ön bilgilerle ilgili algıların belirlenmesi önemlidir (Tosun, 2013). Araştırmada üstbilişsel farkındalık ve kimya algı ölçeklerinin alt boyutları incelendiğinde anlamlı ilişkiler olduğu görülmüştür. Özellikle kimya algı ölçeğinin kimyanın kapsamı ve eğilim alt boyutlarıyla üstbilişsel farkındalık ölçeğinin bütün alt boyutları arasında anlamlı ilişkiler olduğu dikkat çekmiştir. Çalışmada denetleme, görev, izleme ve kişisel farkındalık alt boyutları ile öğrencilerin üstbilişsel farkındalıklarına erişim sağlama hedeflenmiştir. Denetleme, izleme ve değerlendirme bu kategoride öne çıkan becerilerdir. İzlemede kişi görev sırasında görevini nasıl yürüttüğünü takip eder. Değerlendirmede kişi performansını bir takım ölçülere göre inceleyerek yargıya varır. Birey bu stratejiler sayesinde üstbilişsel deneyim kazanır (Schraw & Moshman, 1995). Flavell (1979)'e göre üstbilişsel deneyim bilişsel bir süreçle ilgili duyuşsal deneyimlerdir. Hiç şüphesiz duyuşsal deneyimler arasında algı önemli bir yer tutar. Bu nedenle öğrencilerin üstbilişsel farkındalıkları yükseldikçe genel algılarının daha olumlu hale geldiği söylenebilir.

Kaynaklar

Akın, A. (2006). *Başarı amaç oryantasyonları ile bilişötesi farkındalık, ebeveyn tutumları ve akademik başarı arasındaki ilişkiler*. Yayımlanmamış Yüksek Lisans Tezi, Sakarya Üniversitesi Sosyal Bilimler Enstitüsü, Sakarya.

Boyacı, M. (2010). *Ortaöğretim öğrencilerinin temel yetenek düzeyleri ile bilişötesi öğrenme stratejileri uygulamaları ve yorumu (8. Baskı)*. Ankara: Pegem A Yayıncılık.

Deboer, G.E. (1987). Predicting continued participation in college chemistry for men and women. *Journal of Research in Science Teaching*, 24 (6), 527-538.

Dunslosky, J.& Thiede, K.W. (1998). What makes people study more? An evaluation of factors that affect self-paced study. *Acta Psychologica*, 98, 37-56.

Eddy, R. M. (1996). *Chemophobia in the college classroom: Extent, sources, and student characteristics. Unpublished doctoral dissertation*. University of Pittsburgh.

Flavell, J. H. (1979). Metacognition and cognitive monitoring: A new area of cognitivedevelopmental inquiry. *American Psychologist*, 34, 906-911.

Flavell, J. H. (1987) *Assumptions on the concept metacognition and on the development of metacognitions. Metacognition, motivation and understanding*. Erlbaum, Hillsdale, NJ.

Garner, R. (1987). *Metacognition and reading comprehension*. Norwood, NJ: Ablex.

Garner, R. & Alexander, P. A. (1989). Metacognition: Answered and unanswered questions. *Educational Psychologist*, 24(2), 143-158.

Hacker, D. J. & Dunlosky, J. (2003). Not all metacognition is created equal. *New Directions for Teaching and Learning*, 95, 73-79.

Karakelle, S. & Saraç, S. (2007). Validity and factor structure of Turkish versions of the metacognitive awareness inventory for children (Jr. MAI) - A and B forms. *Turkish Psychological Articles*, 10 (20), 87-103.

Lawrenz, F. (1976). Student perception of the classroom learning environment in biology, chemistry, and physics courses. *Journal of Research in Science Teaching*, 13 (4), 315-323.

Melanlioğlu, D. (2011). *Üstbiliş strateji eğitiminin ilköğretim ikinci kademe öğrencilerinin dinleme becerilerine etkisi*. Yayımlanmamış Doktora Tezi, Gazi Üniversitesi Eğitim Bilimleri Enstitüsü, Ankara.

Schraw, G. (2001). *Promoting general metacognitive awareness*. In H. J. Hartman (Ed.), metacognition in learning & instruction Dordrecht, The Netherlands: Kluwer Academic Publishers: (s. 3-16).

Schraw, G. & Moshman, D. (1995). Metacognitive theories. *Educational Psychology Review*, 7, 351-371.

Sperling, R. A., Howard, B. C. Miller, L. A., & Murphy, C. (2002). Measures of children's knowledge and regulation of cognition. *Contemporary Educational Psychology*, 27, 51-79.

Tosun, C. (2013). Açımlayıcı ve doğrulayıcı faktör analizi ile kimya algı ölçeği'nin türkçe'ye uyarlanması. *Necatibey Eğitim Fakültesi Elektronik Fen ve Matematik Eğitimi Dergisi*, 7(1), 142-165.

Wells, R.R. (2003). *The development of an instrument to assess chemistry perceptions*. Doctoral Dissertation. Texas Tech University.

VALIDITY AND RELIABILITY OF ACHIEVEMENT TEST DEVELOPED IN REPRODUCTION, GROWTH AND DEVELOPMENT IN PLANTS AND ANIMALS

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Abstract: This study has been conducted to prove the validity and reliability of the academic achievement test prepared within the achievements of the 6th grade Science lesson 'Reproduction,Growth and Development In Plants and Animals' unit. The test has been prepared in accordance with the outcomes defined in the Science Education Curriculum of the Ministry of National Education, Education and Training Board. At the same time,it has been attached importance to the homogeneity of the distribution of the questions in the test according to the outcomes. Content validity has been examined by four science teachers, two of them are doctoral students,one is graduate student and the other is undergraduate student,and one assessment and evaluation expert and one subject matter expert. One Turkish teacher has made the examination of the test consisting of 40 items in terms of writing and marking rules. Achievement test has taken its shape after the final corrections and necessary analyses have been made by applying it to 170 elementary students. First, the Kaiser-Meyer-Olkin test has been used to determine the suitability of the data for factor analysis. The result has been 0,776. According to the Kaiser-Meyer-Olkin (KMO) test, the sample has been sufficient. As in the classical test theory, 27% of the data have been defined as upper and lower group for item difficulty index and item discrimination index, and KR-20 value has been evaluated for reliability. The internal consistency (KR-20) of the test has been found to be 0.885, while the item difficulty index has been between 0.356-0.889 and the item discrimination effectiveness has been 0.222-0.711. As a result of the received results, there has been no need to distract any item from the test. As a result of all analyses,it has been accepted that this achievement test has acceptable psychometric features and its validity is high.

***Keywords*:** Achievement test, validity and reliability, science, curriculum, elementary school

BİTKİ VE HAYVANLARDA ÜREME, BÜYÜME VE GELİŞME ÜNİTESİNDE GELİŞTİRİLEN BAŞARI TESTİNİN GEÇERLİLİĞİ VE GÜVENİRLİĞİ

Özet: Bu çalışma, 6.sınıf Fen Bilimleri dersi 'Bitki ve Hayvanlarda Üreme, Büyüme ve Gelişme' ünitesi kazanımları dahilinde hazırlanan akademik başarı testinin geçerliliği ve güvenirliğinin ispatlanması amacıyla yapılmıştır. Test, Milli Eğitim Bakanlığı Talim ve Terbiye Kurulu Başkanlığı Fen Bilimleri Dersi Öğretim Programı'nda tanımlanan kazanımlara uygun bir şekilde hazırlanmıştır. Aynı zamanda testteki soruların kazanımlara göre dağılımının homojen olmasına dikkat edilmiştir. İçerik geçerliliği 2'si doktora, 1'i yüksek lisans öğrencisi ve 1'i lisans mezunu olan 4 Fen Bilimleri öğretmeni ile 1 ölçme değerlendirme uzmanı ve 1 alan uzmanı tarafından incelenmiştir. 40 maddeden oluşan testin yazım ve imla kuralları bakımından incelemesini 1 Türkçe öğretmeni yapmıştır. Gerekli düzeltmeler yapıldıktan sonra son şeklini alan başarı testi 170 ilköğretim öğrencisine uygulanarak gereken analizler yapılmıştır. İlk olarak verilerin faktör analizine ne derece uygun olduğunu belirlemeye yarayan Kaiser-Meyer-Olkin Testi uygulanmış ve sonuç 0,776 bulunmuştur. Kaiser-Meyer-Olkin (KMO) testine göre örneklemin yeterli olduğu sonucu elde edilmiştir. Klasik test teorisinde olduğu gibi madde güçlük indeksi ve madde ayırt edicilik gücü için verilerin ***%27'si*** alt ve üst grup olarak tanımlanmış ve güvenirlik için de KR-20 değerine bakılmıştır. Madde güçlük indeksi 0,356-0,889 arasında, madde ayırt edicilik gücü ise 0,222-0,711arasında değer alırken, testin iç tutarlılığı (KR-20) 0,885 bulunmuştur. Elde edilen sonuçlar doğrultusunda testten her hangi bir madde atılmasına gerek kalmamıştır. Tüm yapılan analizler sonucunda geliştirilen başarı testinin kabul edilebilir psikometrik özelliklere sahip olduğu ve geçerliliğinin yüksek olduğu görülmüştür.

***Anahtar Sözcükler*:** Başarı testi, geçerlilik ve güvenirlik, fen bilimleri, öğretim programı, ilköğretim

WiFi HOTSPOT BASED STUDENT ATTENADANCE CONTROL SYSTEM ON ANDROID PLATFORM

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Abstract: In this study a smartphone application that is developed on Android platform ensures controlling the student attendance to the lesson without the instructor effort. For the first registration of the related lesson attendance sheet students use their smartphones which are connected on Wireless Fidelity (WiFi) hotspot then every student is added with their identifying Media Access Control (MAC) addresses to the sheet. The next lesson students only connect to the hotspot to join the lesson attendance sheet. In the background just then developed smartphone application compare MAC addresses of the connecting students to the hotspot with MAC addresses of the attendance sheet that used to register students to the lesson for the first time. Then matching MAC addresses are added to the daily attendance sheet of the related lesson for verifying the identities of the students who are in the classroom. At the end of the lesson, attendance sheet that is within easy reach can be controlled by the instructor of the lesson using that application on her/his smartphone. Thanks to developed smartphone application instructor does not waste of time and effort taking attendance. It provides efficiency and effectiveness.

***Keywords*:** Student attendance system, wifi hotspot, education, smartphone application.

ANDROID PLATFORMU ÜZERİNDE WiFi HOTSPOT TABANLI ÖĞRENCİ DEVAM KONTROL SİSTEMİ

Özet: Bu çalışmada öğretim üyesi uğraşısı olmadan Android platformu üzerinde öğrencilerin ders devam kontrolünü sağlayan akıllı telefon uygulaması geliştirilmiştir. Öğrenciler ilgili dersin devam yoklamasına ilk kayıt için WiFi hotspot üzerinden ağa bağlı akıllı telefonlarını kullanırlar sonrasında her öğrenci cihazlarını belirleyen Ortam Erişim Kontrol (MAC) adresleriyle yoklamaya eklenir. Öğrenciler bir sonraki ders yoklamaya katılmak için sadece hotspota bağlanır. O sırada arka planda, geliştirilen akıllı telefon uygulaması hotspota bağlı olan öğrencilerin MAC adresleriyle, ilk defa öğrenci kaydetmek için kullanılan yoklamadaki öğrencilerin MAC adreslerini karşılaştırır. Sonra eşleşen MAC adresleri ilgili dersin günlük yoklama listesine sınıfta olan öğrencileri belirlemek için eklenir. Ders sonunda kolaylıkla erişilebilen yoklama listesi, dersin öğretim üyesi tarafından akıllı telefonundaki bu uygulama ile kontrol edilebilir. Geliştirilen akıllı telefon uygulaması sayesinde öğretim üyesi yoklama almak için zaman ve çaba harcamaz. Uygulama verimlilik ve etkinlik sağlar.

Anahtar Sözcükler: Öğrenci yoklama sistemi, wifi hotspot, eğitim, akıllı telefon uygulaması.

Giriş

Öğrenci ders devam kontrollerinin düzenli yapılması hem öğrenci başarısı hem de ders verimliliğinin arttırılması açısından önemlidir. Rençber yaptığı çalışma sonucunda öğrenci başarısı ile derse devam sayısı arasında doğrusal bir ilişki olduğunu göstermiştir (Rençber, 2017). Ayrıca literatürde öğrencilerin ders devamsızlık nedenlerinin araştırılması üzerine yapılmış birçok çalışma bulunmaktadır (Türnüklü vd., 2001; Gençtürk, 2001; Silah, 2003). Bu çalışmalarda öğrenci devamsızlıklarının aile, çevre, kişisel, okul ve arkadaş grubu kaynaklı nedenlerden ortaya çıktığı verilmiştir. Ayrıca Rençber (2017) çalışmasında bu nedenler üzerinde daha ayrıntılı çalışmaların yapılması gerektiği üzerinde durmuştur.

Öğrenci ders devam takibinin yapılması için genellikle öğrencilerden imza alma yöntemi kullanılır ancak öğrenci sayısının fazla olduğu büyük sınıflarda imza alma yöntemi uygun değildir (Bayılmış ve Özdemir, 2016). Özellikle üniversitelerde ders devam kontrollerinin yapılması öğretim üyesi açısından hem zaman kaybı hem de verimlilik düşüklüğü olarak değerlendirilebilir (Çakır ve Kaygısız, 2011).
Literatürde yoklama alma işleminden kaynaklanan zaman kayıplarının azaltılması için geliştirilmiş çalışmalar mevcuttur. Silva vd. (2008) öğrencilerin derse katılımının otomatik olarak kontrol edildiği Ethernet üzerinden dağıtık RFID (Radio Frequency Identification-Radyo Frekanslı Tanıma) kullanan sistem geliştirmişlerdir.

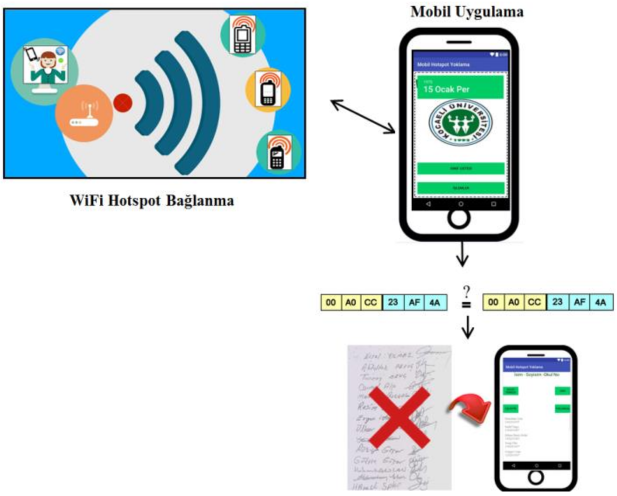
Moksin ve Yasin (2009) sınav esnasında yoklama alabilen kablosuz öğrenci yoklama sistemi geliştirmişler ayrıca uygulamaya elde ettikleri verileri depolama analiz etme özellikleri eklemişlerdir. Çakır ve Kaygısız da (2011) çalışmalarında RFID teknolojisini kullanarak okulun tüm sınıflarında otomatik olarak yoklama alabilen bir sistem önermişlerdir. Patel vd. (2012) RFID teknoloji kullanan çevrimiçi ders takip sistemi geliştirmişlerdir. Zavrak ve arkadaşları (2014) uzaktan eğitim ile yapılan çevrimiçi ders sırasında bilgisayar karşısındaki öğrencilerin görüntülerini alarak bu görüntüleri işleyen yüz tanıma tabanlı öğrenci yoklama sistemi önermişlerdir. Ayu ve Ahmad (2014) çalışmalarında NFC (Near Field Communication-Yakın Alan Haberleşmesi) teknolojisini kullanarak üniversiteler için akıllı yoklama sistemi önermiştir. Bilen vd. (2015) öğrencilerin ders devam kontrollerinin yapılması için etkileşimli ve gerçek zamanlı mobil uygulama geliştirmişler ayrıca öğrenci koordinatlarının belirlenmesi ve bu koordinatlara en yakın binanın tespiti için KNN (K Nearest Neighbour-K En Yakın Komşu) algoritmasından yararlanmışlardır. Kurt Pehlivanoğlu ve Duru (2015) parmak izi okuyucu cihaz kullanarak üniversite öğrencilerinin ders devam kontrolünün yapıldığı bir uygulama geliştirmişlerdir. Bayılmış ve Özdemir (2016) Bluetooth düşük enerji (Bluetooth Low Energy-BLE) teknolojisine sahip cihaz ve akıllı telefon kullanarak otomatik yoklama alan bir sistem önermişlerdir. Literatürdeki çalışmalar incelendiğinde ders devam yoklamasından kaynaklı süre kayıplarının azaltılması için RFID, NFC, BLE gibi birçok teknolojiyi kullanan öğrenci devam kontrollerinin otomatik olarak yapıldığı sistemlerin geliştirildiği görülmüştür.

Bu çalışmada Android platformunda WiFi hotspot üzerinden öğrenci yoklaması alan mobil uygulama geliştirilmiştir. WiFi, popüler ismiyle kablosuz yerel ağ IEEE (Institute of Engineers and Everyone Else-Elektrik ve Elektronik Mühendisleri Enstitüsü) 802.11b standardıdır (Henry ve Luo, 2002). Aynı çalışmada yer alan bir diğer veriye göre; WiFi, öncesinde her ne kadar sadece özel uygulamalar için tasarlansa da sonraları WiFi özellikli cihazlara sahip kullanıcıların geniş bantlı alanlar elde edebildiği hotspot denilen alanları oluşturmak için, kamuya açık yerlerde konuşlandırılmıştır. WiFi hotspot bölgeleri sayesinde WiFi özellikli cihazlara kolay ve genellikle ücretsiz internet erişimi sağlanır.

Geliştirilen mobil uygulama sayesinde dersin öğretim üyesi cep telefonunun WiFi hotspot özelliğini kullanarak derse katılan öğrencilerin kendi akıllı telefonlarıyla bağlanabileceği bir ağ oluşturur. Bu ağ üzerinden internet bağlantısı paylaşımı yapılır, böylece her öğrenci öğretim üyesinin paylaştığı ağa bağlanır. Ağa bağlı her öğrenciye ait telefonun MAC adresleri uygulama tarafından çekilerek derse ait sınıf listesi oluşturulur. Sonraki derslerde öğrenciler sadece ağa bağlanır. Bu sırada mobil uygulama, ilk derste oluşturulan sınıf listesiyle o derste oluşturulan sınıf listesindeki MAC adreslerini karşılaştırır. Eşleşmeyen MAC adresleri derste olmayan öğrenci listesine eklenir böylece derse ait yoklama alınmış olur.

Çalışmanın "Materyal ve Metod" bölümünde geliştirilen mobil uygulamanın özellikleri ve sistem mimarisi ayrıntılı olarak verilmiştir. "Sonuç ve İleriki Çalışmalar" bölümünde ise çalışma esnasında elde edilen bulgular tartışılarak uygulamadan çıkarılan sonuçlar verilmiş ve ileride yapılması planlanan çalışmalardan bahsedilmiştir.

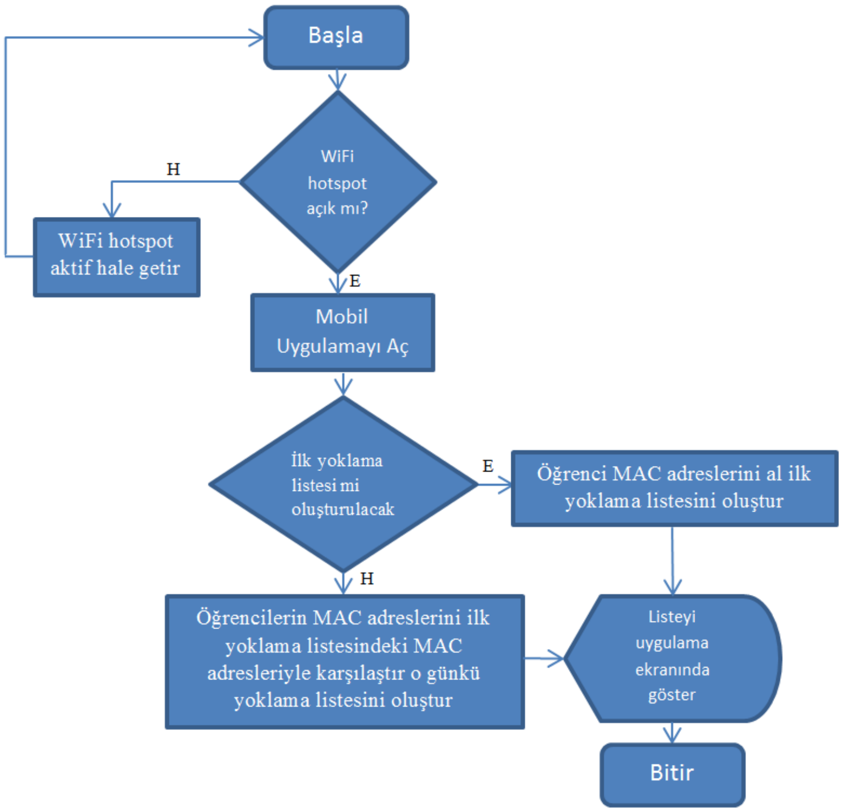
Materyal ve Metod



Şekil 1. Geliştirilen sistemin mimarisi

Geliştirilen mobil uygulamaya ait sistem mimarisi Şekil 1'de verilmiş olup mimari temelde iki ana işlem adımı içerir. Bunlardan ilki WiFi hotspota bağlanma işlemidir. Dersin öğretim üyesi mobil uygulamayı her kullandığında kendi akıllı telefonundaki WiFi hotspot özelliğini aktif hale getirmelidir ki öğrencilere internet erişimi açabilmiş olsun. Diğer bir işlem adımı ise mobil uygulamadır bu adım yoklama alma işleminin gerçekleştirilmesi için kullanılmalıdır. Şekilden de görüleceği gibi bu adım sonunda geleneksel imza kâğıdı yerine mobil uygulamada yoklama listesi çıkarılmış olur.

Mobil uygulama Android işletim sistemi üzerinde Java programlama dili kullanılarak geliştirilmiştir. Uygulamaya ait akış diyagramı Şekil 2'de verilmiştir.



Şekil 2. Mobil uygulama akış diyagramı

Şekil 2'den de görüleceği gibi uygulamanın kullanılabilmesi için öncelikle akıllı telefondaki WiFi hotspot özelliğinin aktif hale getirilmesi gerekmektedir. Bu nedenle eğer WiFi hotspot aktif değilse bu özellik aktif hale getirilmelidir. Öğrenciler WiFi hotspot üzerinden bağlanma işlemini gerçekleştirdiklerinde, mobil uygulamada ilk yoklama listesi mi yoksa sonraki derslerde alınacak yoklama listesi mi sorusunun cevabına bağlı olarak farklı işlem adımları uygulanır. Eğer ilk yoklama listesi diğer bir deyişle o dersi alan öğrencilere ait sınıf listesi oluşturulacaksa öğrencilerin MAC adresleri öğrenci numarası, ad soyadı bilgileriyle kaydedilir. Bu işlem adımı sınıf mevcudu fazla olan sınıflar için iş yükü gibi görülebilir ancak bir kez yapıldığından göz ardı edilebilir. Derse ait sonraki yoklamalarda ise sınıf listesindeki MAC adresleriyle ders sırasında hotspot üzerinden ağa bağlı öğrencilerin MAC adresleri karşılaştırılarak yoklama alınır ve oluşturulan yoklama listesine uygulama üzerinden erişilebilir.

Mobil Uygulama

Uygulama temelde üç temel işlem yapmaya izin verir. Bunlar öğrencilerin ders yoklama sistemine kayıt edilmesi, sınıf listesinin oluşturulması ve yoklama alınması işlemleridir.

Öğrencilerin Ders Yoklama Sistemine Kayıt Edilmesi

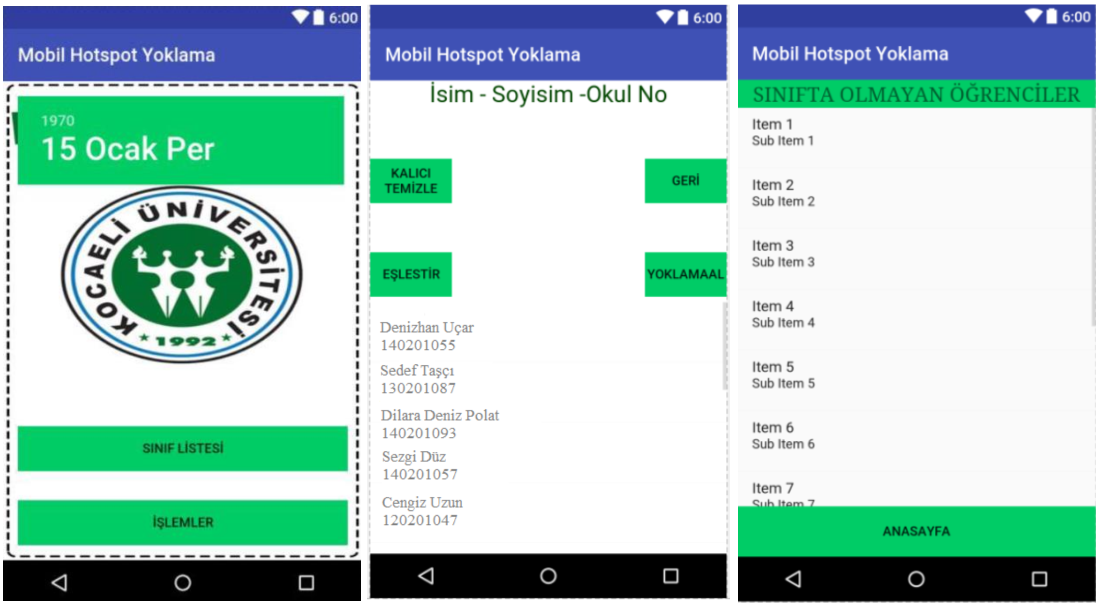
Geliştirilen uygulamanın kullanıcısı dersin öğretim üyesidir bu nedenle tüm işlemler ilgili öğretim üyesi tarafından yapılır bu da kontrol mekanizması olması düşüncesini destekler. Bu sayede öğrencilerin birbirlerinin yerine imza atması ya da imza atılmaması gibi olumsuz durumların önüne geçilir. Öğrencilerin sisteme kayıt edilme işlemi mobil uygulamadaki 'SINIF LİSTESİ' butonuna basılarak gerçekleştirilir (Şekil 3(a)).

Sınıf Listesinin Oluşturulması

Temelde '*Öğrencilerin Ders Yoklama Sistemine Kayıt Edilmesi*' işleminin sonucu bu adımın girdisini oluşturur. Sınıf listesi oluşturma işlemi her ders için sadece bir kez yapılır. Öğrencilerin cihazlarının MAC adreslerini kaydetme işlemi bu adımda gerçekleştirilir.

Yoklama Alınması

2. adımda oluşturulan sınıf listesi uygulamanın hafızasında kayıtlıdır. Ayrıca bu liste uygulamada yer alan 'KALICI TEMİZLE' butonu kullanılarak silinebilir. Yoklama alınması işlemi için ilgili dersin sonraki derslerinde sadece WiFi hotspot açma işlemi tekrarlanır. Uygulamadaki 'EŞLEŞTİR' butonu ile MAC adresleri karşılaştırılır, 'YOKLAMAAL' butonu ise sınıfta olan öğrencileri veri tabanına kaydetmeye yarar ve sonrasında sınıfta olmayan öğrenciler listelenir (Şekil 3 (b)). Ayrıca mobil uygulama içinde sınıfta olmayan öğrencilerin listelendiği bir ara yüz tasarlanmıştır (Şekil 3(c)).



(a). **(b).** **(c).**

Şekil 3. Mobil uygulama ekran görüntüleri

Sonuç ve İleriki Çalişmalar

Bu çalışmada devamsızlık kontrolünün doğru ve hızlı gerçekleştirilebilmesi için mobil uygulamaya sahip etkili bir sistem önerilmiştir. Devamsızlık kontrolü için yoklama alınması işlemi akıllı telefonlara ait MAC adresleri üzerinden gerçekleştirilmiştir. Uygulamanın kullanılabilirliği yirmi beş farklı akıllı telefonun hotspota bağlanmasıyla test edilmiştir. Test aşamasında uygulama tüm cihazların MAC adreslerini tespit etmiş ve sınıf listesi kaydını başarıyla gerçeklemiştir. Daha sonra bu cihazların on yedisi tekrar hotspota bağlanmış yoklama alma işlemi uygulamadan gerçekleştirildiğinde; ağa bağlı cihazların hepsi başarıyla tespit edilmiş, bağlı olmayan cihazların tümü 'Sınıfta Olmayan Öğrenciler' ara yüzünde listelenmiştir.

Uygulama ders içinde yoklama alınması için geçen sürenin verimli bir şekilde kullanılmasını ve iş yükünün azaltılmasını amaçlar. Yoklama kâğıdı üzerinde imza alma yöntemi düşünüldüğünde kâğıt israfının, yoklama kayıplarının ve öğrencilerin birbirleri yerine imza atmalarının önüne geçilmiş olur. Öğretim üyesi için WiFi hotspot özelliğine sahip cihaz kullanılması, internet bağlantısının olması zorunluluğu ve her öğrencinin akıllı telefona sahip olamama durumları olumsuz durumlar olarak düşünülebilir. Ancak üniversiteler tarafından her öğretim üyesine Android işletim sistemine sahip WiFi hotspot özelliği olan bir telefon alınması harcanacak kâğıt miktarı, zaman ve verimlilik söz konusu olduğunda maliyetli değildir. Üniversitelerdeki internet erişim hizmetleri uygulamanın internet bağlantısı olduğunda çalışmasını durumumu için bir avantajdır. Akıllı telefonu olmayan öğrenciler MAC adresine sahip farklı bir cihaz (bilgisayar vb.) ile de sınıf yoklamasına kayıt yaptırabilirler ancak bu cihazı her derste beraberinde getirmeleri gereklidir.

Geliştirilen uygulamanın olumlu yönleri düşünüldüğünde; uygulama ilköğretim ve ortaöğretim kurumlarında da kullanılabilir. Hatta bu kurumlardaki ders saatinin üniversitedeki ders saatine kıyasla daha kısa olduğu düşünüldüğünde, uygulamanın kullanımı kazanımlar açısında son derece faydalıdır. İleriki çalışmalar için uygulama kapsamının ve eklentilerinin geliştirilmesi ile ilk ve ortaöğretim kurumları için; E-Okul yönetim bilgi sistemine öğrencinin günlük devam bilgilerinin aktarımı otomatik olarak gerçekleştirilebilir.

Kaynaklar

Ayu, M., & Ahmad, B. İ. (2014). TouchIn: an NFC supported attendance system in a university environment. *International Journal of Information and Education Technology*, *4*(5), 448-453.

Bayılmış, C., & Özdemir, M. (2016). Bluetooth düşük enerji teknolojisine sahip işaretçi ve akıllı telefon temelli öğrenci yoklama sistemi, *Bilişim Teknolojileri Dergisi*, *9*(3), 249-254.

Çakır, A., & Kaygısız, H. (2011). Kablosuz öğrenci yoklama sistemi. *6th International Advanced Technologies Symposium (IATS'11)*, Elazığ, Türkiye.

Gençtürk, Ö. (2001). Meslek ve anadolu meslek liselerinde öğrenci başarısını etkileyen faktörler. Yayınlanmış Yüksek Lisans Tezi, Marmara Üniversitesi, İstanbul, Türkiye.

Henry, P. S., & Luo, H. (2002). WiFi: what's next?. *IEEE Communications Magazine*, *40*(2), 66-72.

Kurt Pehlivanoğlu, M., & Duru, N. (2015). Üniversite öğrencilerinin devamlılığının parmak izi okuyucu cihaz kullanılarak izlenmesi. *Türkiye Bilişim Vakfi Bilgisayar Bilimleri ve Mühendisliği Dergisi*, *8*(2), 9-15.

Moksin, M. I., & Yasin, N. M. (2009). The implementation of wireless student attendance system in an examination procedure, *International Association of Computer Science and Information Technology - Spring Conference*, Singapore.

Patel, R., Patel, N., Gajjar, M. (2012). *Online students'attendance monitoring system in classroom using radio frequency ıdentification technology: a proposed system framework*, *International Journal of Emerging Technology and Advanced Engineering*, *2*, 61-66.

Rençber, B. A. (2017). Üniversite öğrencilerinin akademik başarılarını etkileyen faktörler. *Çankırı Karatekin Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, *3*(1), 191-198.

Silah, M. (2003). Üniversite öğrencilerinin akademik başarılarını etkileyen çeşitli nedenler arasındaki süreksiz durumluluk kaygısının yeri ve önemi. *Eğitim Araştırmaları Dergisi*, *10*, 102-115.

Silva, F., Filipe, V., & Pereira, A. (2008). Automatic control of students' attendance in classrooms using RFID, *The Third International Conference on Systems and Networks Communications*, Sliema, Malta.

Tüknüklü, A., Zoroğlu, Y., & Gemici, Y. (2001). İlköğretim okullarında okul yönetimine yansıyan disiplin sorunları. *Kuram ve Uygulamada Eğitim Yönetim Dergisi*, *27*, 417-441.

Zavrak, S., Salman, M. E., Çetin, Ö. (2014). Uzaktan eğitimde çevrimiçi ders için bir yoklama sisteminin tasarımı. *International Conference on Education in Mathematics, Science & Technology (ICEMST 2014)*, Konya, Türkiye.

DETERMINATION OF LEARNING STYLE BASED ON GREGORC LEARNING STYLE MODEL : FACULTY OF ENGINEERING

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Abstract: It is very important for individuals to know way of learning so that the lifelong learning process can be carried out efficiently, quickly and easily. For this reason, different models and learning styles have been developed by considering different characteristic features and abilities of individuals. One of these learning style models is Gregorc Learning Style Model which categorizes learning style into four groups: Abstract Sequential, Concrete Sequential, Abstract Random and Concrete Random. In this research, it was tried to determine the learning styles of the engineering faculty students and academicians. Within the scope of the study, Gregorc Learning Style Inventory and Personal Information Form were applied to 26 academicians and 60 engineering faculty students. The frequencies and percentages of the obtained data are calculated and presented. The dominant learning styles were determined according to the gender, age, department and academic degree criteria of students and instructors.

***Keywords*:** Learning style, gregorc learning style model, engineering education

GREGORC ÖĞRENME STİLİ MODELİ İLE ÖĞRENME STİLİ TESPİTİ: MÜHENDİSLİK FAKÜLTESİ ÖRNEĞİ

ÖZET: Yaşam boyu devam eden öğrenme sürecinin verimli, hızlı ve kolay gerçekleşebilmesi için, bireylerin nasıl öğrendiğini bilmesi çok önemlidir. Bu nedenle bireylerin sahip olduğu farklı özellikler ve yetenekler dikkate alınarak farklı modeller ve öğrenme stilleri geliştirilmiştir. Bu öğrenme stili modellerinden biri de Gregorc Öğrenme Stili Modelidir. Gregorc Öğrenme Stili Modeli, öğrenme stillerini Somut Ardışık, Soyut Ardışık, Somut Random ve Soyut Random olmak üzere dörde ayırır. Bu araştırmada, mühendislik fakültesi öğretim elemanlarının ve lisans öğrencilerinin öğrenme stilleri belirlenmeye çalışılmıştır. Çalışma kapsamında, 26 öğretim elemanı ve 60 lisans öğrencisine Gregorc Öğrenme Stili Envanteri ve Kişisel Bilgi Formu uygulanmıştır. Elde edilen verilerin frekans ve yüzdeleri hesaplanarak sunulmuştur. Öğrenci ve öğretim elemanlarının cinsiyet, yaş, bölüm ve akademik derece kriterlerine göre baskın öğrenme stilleri belirlenmiştir.

***Anahtar Sözcükler*:** Öğrenme stili, gregorc öğrenme stili modeli, mühendislik eğitimi

Giriş

Günümüzde bilim ve teknolojide çok hızlı bir değişim gerçekleşmektedir. Bu hızlı değişim, bilginin çabuk, kolay ve etkili bir şekilde öğrenilmesini gündeme getirmektedir. Hayat boyu devam eden ve yaşamımızda çok büyük bir öneme sahip olan öğrenme eyleminin en etkili şekilde gerçekleşebilmesi için bireylerin farklı özelliklerinin dikkate alınması gerekir(Lau & Yuen, 2010). Bireylerin bu farklı özellikleri, onların öğrenme tercihleri üzerinde önemli bir etkiye sahiptir(Arslan & Uslu, 2014). Her bireyin öğrenirken yaptığı farklı tercihler, bireylerin öğrenme stillerini belirler(Bakir & Mete, 2014).

Öğrenme stilleri ile ilgili yapılan pek çok çalışma bulunmaktadır. Bu çalışmalarda, bireylerin sahip olduğu öğrenme stilleri belirlenmiş ve bu öğrenme stillerine en uygun öğrenme ortamları oluşturularak başarıya etkisi araştırılmıştır. Bu araştırmalarda, bireylerin başarıları ile öğrenme stilleri arasında anlamlı bir ilişki olduğu görülmektedir. Yani, bireylerin kendi öğrenme ve düşünme biçimlerinin farkında olmaları, öğrenme ortamlarının bireylerin bilişsel ve duyuşsal özelliklerine en uygun şekilde hazırlanması başarılı olmaları için önemli ve gereklidir (Numanoğlu & Şen, 2007).

Birçok bilim adamı, benimsedikleri kuramsal temelleri ve kullanılan ölçme araçlarını dikkate alarak farklı öğrenme stili modelleri geliştirmiştir. Bu modellerden birisi de Anthony F. Gregorc'un geliştirdiği Gregorc Öğrenme Stili Modelidir. Çalışmamızda Gregorc Öğrenme Stili Modeli kullanılarak mühendislik fakültesi öğrenci ve öğretim elemanlarının öğrenme stilleri belirlenmiş ve çeşitli değişkenler açısından incelenmiştir. Çalışmanın devamındaki bölümlerde ilgili çalışmalardan, Gregorc Öğrenme Stili Modelinden, yöntemden ve bulgulardan bahsedilmektedir.

İlgili Çalışmalar

Öğrenme, yaşam boyu devam eden bir süreçtir. Gelişen teknolojinin de etkisiyle hızla artan bilgiyi nasıl daha kolay, hızlı ve etkili öğrenebileceğimiz, araştırmacılar tarafından merak edilmiş ve bu alanda pek çok araştırma yapılmıştır.

Biedenbender 2012 yılında yaptığı çalışmada, ilköğretim 4. Sınıf öğrencilerine müzik dersi veren öğretmenlerin öğrenme stillerini belirlemiş ve öğretmenlerin kendi öğrenme stillerinin kullandıkları öğretme stillerini etkileyip etkilemediğini araştırmıştır. Araştırma sonucunda, öğretmenlerin çoğunun egemen öğrenme stilini egemen öğretme stili olarak kullandığı sonucuna ulaşmıştır(Biedenbender, 2012).

Huang, Yoo ve Choi üniversite öğrencileri ile yaptıkları çalışmada, öğrencilerin öğrenme stilleri ile teknoloji kabulü arasındaki ilişkiyi araştırmışlardır. 108 üniversite öğrencisinin katıldığı çalışmada Gregorc Öğrenme Stili Modeli ve Web 2.0 uygulamaları kullanılmış, öğrenme stilleri ile teknoloji kabulü arasında anlamlı korelasyonel ilişkiler bulunmuştur(Huang, Yoo, & Choi, 2008).

Calderwood ise 2007 yılında yaptığı araştırmada, kırsal kesimdeki lise öğrencilerinin Dunn&Dunn Öğrenme Stili Modeline göre öğrenme stillerini belirlemiş ve öğrenme stillerinin başarı ve tutuma etkisini incelemiştir(Calderwood, 2007).

Ekici, betimsel tarama modelindeki çalışmasında öğretmen adaylarının öğrenme stillerini Gregorc ve Kolb öğrenme stili modellerine göre belirlemiş, 297 öğretmen adayının öğrenme stilini akademik başarı ve cinsiyete göre incelemiştir(Ekici, 2013).

Nasreen, Bangladeş'teki ortaokul öğrencilerinin öğrenme stillerini belirmeye yönelik olarak yaptığı çalışmada, 500 öğrenciye bir anket uygulamış ve sonuçları çeşitli değişkenler açısından incelemiştir(Nasreen, 2014).

Dunn ve arkadaşları çalışmalarında, Dunn Öğrenme Stili Modeli ile öğrencilerin öğrenme stillerini belirlemiş, Pizzo tarafından tasarlanan tutum anketiyle de tutumlarını belirleyerek öğrenme stilinin başarıya etkisini incelemiştir(Dunn, Giannitti, Murray, Rossi, Geisert, Quinn, 1990).

Ekici 2002 yılında yaptığı çalışmada, Gregorc Öğrenme Stili Modeli Ölçeği kullanarak lise öğrencilerinin öğrenme stillerini belirleyerek çeşitli değişkenler açısından incelemiştir(Ekici, 2002).

Gregorc Öğrenme Stili Modeli

Gregorc'a göre her şeyin bir stili olduğu gibi öğrenmenin de bir stili vardır(Christensen, 2015). Gregorc Öğrenme Stili Modeli öğrenmenin bilişsel boyutunu öne çıkarır(Cornet C.E, 1983). Bu öğrenme Stili Modeline göre, bilgiyi algılama ve düzenleme arasındaki ilişki bireylerin öğrenmesinde çok önemlidir(Terry, 2002). Gregorc Öğrenme Stiline göre bireyler algılama yeteneklerine göre Somut Algılayanlar ve Soyut Algılayanlar, algıladıkları verileri düzenleme yeteneklerine göre Ardışık ve Random Düzenleyenler olmak üzere toplam dört gruba ayrılırlar(Ekici, 2002). Bu gruplar bireylerin öğrenme stillerini oluşturur. Bu öğrenme stilleri bireylerde farklı oranlarda bulunabilirler. Bazı bireylerde birkaç tanesi birlikte görülebilirken bazılarında ise sadece biri baskın olabilmektedir. Bu dört öğrenme stiline ait özellikler şunlardır(Ekici, 2002).

Somut Ardışık Öğrenme Stili

Son derece gelişmiş duyu organlarıyla öne çıkan bu öğrenme stiline sahip olan bireyler, yaparak ve yaşayarak öğrenmeyi tercih ederler. Laboratuvarlarda veya proje çalışmalarında somut materyallere dokunarak çalışmayı severler. Bu bireylere bilgiler, basitten karmaşığa doğru verilmeli ve adım adım hiyerarşik bir sıra izlenmelidir(Ekici, 2003).

Soyut Ardışık Öğrenme Stili

Bu öğrenme stiline sahip olan bireyler için şekil ve sembollere, kelimelerden çok daha fazla değer verirler. Zihinlerinde, öğrenecekleri konuyla ilgili boş bir çerçeve oluştururlar. Bilgileri adım adım düzenli olarak alıp, bu boş çerçevenin içinde uygun yere yerleştirirler. Böylece konuyla ilgili zihinlerinde bir harita veya resim oluştururlar ve konunun bütününü bu şekilde kavrarlar(Ekici, 2002).

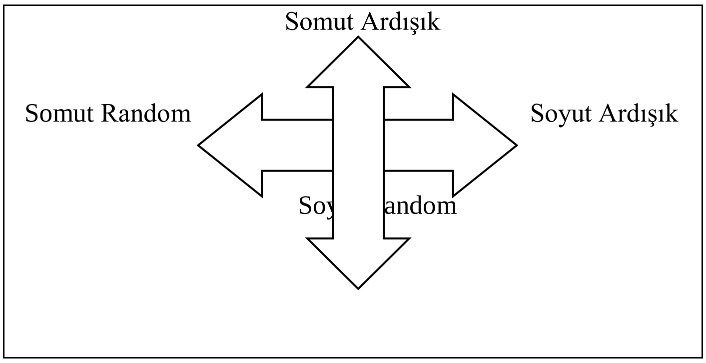
Somut Random(Rastgele) Öğrenme Stili

Küçük gruplarla veya bağımsız çalışmayı tercih eden bu öğrenme stiline sahip bireyler, çalışırken müdahale edilmesinden hoşlanmazlar. Bilginin sistematik bir şekilde kendilerine verilmesine gerek duymayan araştırmacı kişilikleriyle bilgiye ulaşabilirler. Problem çözmede yüksek kabiliyetleri vardır(Ekici, 2003).

Soyut Random(Rastgele) Öğrenme Stili

Bu öğrenme stiline sahip bireyler, bilgiyi öğrenmek için hiyerarşik bir düzene ihtiyaç duymazlar. Karışık ve düzensiz bir şekilde kavramları algılayabilirler. Bilgiyi özgürce istedikleri gibi organize etmeyi seven bu bireyler kuralları pek sevmezler(Ekici, 2002). Bu öğrenme stiline sahip olan bireyler için grup çalışmaları, diğerleriyle rahatça iletişim kurabildikleri ve fikirlerini özgürce paylaşabildikleri uygun öğrenme ortamlarıdır(Veznedaroğlu & Özgür, 2005).

Bireylerin öğrenme sürecinde, sadece bir öğrenme stiline değil bütün öğrenme stillerine yer verilmeli ve her bir öğrenme stilinin kendine özel süreçlerinin kullanılması gerekmektedir (Babadoğan, C., 2000). Gregorc'un dört öğrenme stili Şekil 1'de kısaca gösterilmiştir.



Şekil 1. Gregorc'un öğrenme (Butler, 1988)

Yöntem

Araştırmanın Amacı

Mühendislik fakültesi öğrenci ve öğretim elemanlarının öğrenme stillerinin belirlenmesi, bu çalışmanın amacını oluşturmaktadır.

Araştırmanın Problem Cümlesi

Mühendislik fakültesi öğrenci ve öğretim elemanlarının öğrenme stilleri nelerdir?

Alt Problemler

- Öğretim elemanlarının öğrenme stilleri ile cinsiyetleri arasında bir ilişki var mıdır?
- Öğretim elemanlarının öğrenme stilleri ile yaş grupları arasında bir ilişki var mıdır?
- Öğretim elemanlarının öğrenme stilleri ile akademik dereceleri arasında bir ilişki var mıdır?
- Öğrencilerin öğrenme stilleri ile cinsiyetleri arasında bir ilişki var mıdır?
- Öğrencilerin öğrenme stilleri ile okudukları bölüm arasında bir ilişki var mıdır?

Araştırma Modeli

Bu araştırma mühendislik fakültesi öğrenci ve öğretim elemanlarının baskın öğrenme stillerini belirlemeye yönelik, genel tarama modelinde betimsel bir çalışmadır. Var olan durumun betimlenmesiyle bir durum tespiti yapılmıştır.

Çalışma Grubu

Bu çalışma Mühendislik Fakültesi öğrencileri ve öğretim elemanları ile gerçekleştirilmiştir. Çalışma kapsamında 26 öğretim elemanına ve 60 öğrenciye ulaşılmıştır.

Veri Toplama Araçları

Yapılan araştırmada öğrenci ve öğretim elemanlarına kişisel bilgi formu ve Gregorc Öğrenme Stili Envanteri uygulanmıştır. Gregorc Öğrenme Stili Envanteri 20 sorudan oluşmaktadır.

1-5-9-13-17 sorularına verilen toplam puan Somut Random,
2-6-10-14-18 sorularına verilen toplam puan Somut Ardışık,
3-7-11-15-19 sorularına verilen toplam puan Soyut Random,
4-8-12-16-20 sorularına verilen toplam puan Soyut Ardışık Öğrenme Stiline aittir.

Verilerin Analizi

Mühendislik Fakültesi öğrenci ve öğretim elemanlarına dağıtılan anket formundaki her bir soru için, karşısındaki kutuya 1, 2 veya 3 değerleri verilmiştir. Her bir ifade için “Düşük Seviye” seçeneğine 1 puan, “Orta Seviye” seçeneğine 2 puan ve “Yüksek Seviye” seçeneğine 3 puan verilerek puanlama yapılmıştır.

Bulgular

Bu bölümde, kişisel bilgi formu ve Gregorc Öğrenme Stili Envanterinin Mühendislik Fakültesi öğrenci ve öğretim elemanlarına uygulanmasıyla elde edilen verilerle yapılan istatistiksel işlemlerin sonuçlarına ilişkin tablolar verilmiş ve açıklamaları yapılmıştır.

Tablo 1. Mühendislik fakültesi öğrencilerinin cinsiyet ve bölüm değişkenlerine göre dağılımları

	Değişkenler	**N**	**%**
Cinsiyet	Kız	22	36,7
	Erkek	38	63,3
	Toplam	60	100,0
Bölüm	EEM	37	61,7
	İNŞ	23	38,3
	Toplam	60	100,0

Tablo 1’e göre ankete katılan toplam 60 lisans öğrencisinin 22’si (%36,7) kız öğrenci, 38’i (%63,3) erkek öğrencidir. Katılımcıların 37’si (%61,7) Elektrik Elektronik Mühendisliğinde(EEM), 23’ü (%38,3) İnşaat Mühendisliğinde(İNŞ) öğrenim görmektedir.

Tablo 2. Öğretim elemanlarının cinsiyet ve yaş değişkenlerine göre dağılımları

	Değişkenler	**N**	**%**
Cinsiyet	Kadın	11	42,3
	Erkek	15	57,7
	Toplam	26	100,0
Yaş	20 – 29 Yaş	13	50,0
	30 – 40 Yaş	13	50,0
	Toplam	26	100,0

Tablo 2’ye göre ankete katılan toplam 26 öğretim elemanının 11’i (%42,3) kadın, 15’i (%57,7) erkektir. Katılımcıların 13’ü (%50) 20 – 29 yaş aralığında, 13’ü (%50) 30 – 40 yaş aralığındadır.

Tablo 3. Öğretim elemanlarının cinsiyete göre öğrenme stilleri

	Öğrenme Stili	**%**
Kadın	Somut Ardışık	54.54
	Somut Random	9.10
	Soyut Ardışık	18.18
	Soyut Random	18.18
Erkek	Somut Ardışık	85.71
	Somut Random	14.29
	Soyut Ardışık	0
	Soyut Random	0

Tablo 3'te mühendislik fakültesi öğretim elemanlarının cinsiyete göre Gregorc öğrenme stili modeli özellikleri için elde edilen sonuçlar verilmiştir. Tablo 3'teki sonuçlar incelendiğinde, Gregorc öğrenme stili modeline göre erkek öğretim elemanları için en iyi öğrenme stili %85.71 oran ile Somut Ardışık iken, en iyi ikinci öğrenme stili %14.29 ile Somut Random çıkmıştır. Erkek öğretim elemanlarında Soyut Ardışık ve Soyut Random öğrenme stiline sahip öğretim elemanı bulunmadığı görülmektedir. Kadın öğretim elemanlarında ise en iyi öğrenme stili %54.54 oranla Somut Ardışık, en iyi ikinci öğrenme stili %18.18 ile Soyut Ardışık ve Soyut Random, en iyi üçüncü öğrenme stili % 9.10 ile Somut Random çıkmıştır.

Tablo 4. Öğretim elemanlarının yaş gruplarına göre öğrenme stilleri

	Öğrenme Stili	**%**
Grup A 20 – 29 Yaş	Somut Ardışık	85.71
	Somut Random	14.29
	Soyut Ardışık	0
	Soyut Random	0
Grup B 30 – 40 Yaş	Somut Ardışık	92.3
	Somut Random	0
	Soyut Ardışık	8.70
	Soyut Random	0

Tablo 4'te öğretim elemanlarının yaş gruplarına göre Gregorc Öğrenme Stili Modeli için elde edilen sonuçlar verilmiştir. Grup A'daki 20-29 Yaş için en iyi öğrenme stili %85.71 ile Somut Ardışık iken, en iyi ikinci öğrenme stili Somut Random çıkmıştır. Grup A'da Soyut Ardışık ve Soyut Random öğrenme stiline sahip öğretim elemanı bulunmamaktadır. Grup B'deki 30-40 Yaş için de en iyi öğrenme stili yine Somut Ardışık iken, en iyi ikinci öğrenme stili Soyut Ardışık çıkmıştır. Grup B'de ise Somut Random ve Soyut Random öğrenme stiline sahip öğretim elemanı çıkmamıştır.

Tablo 5. Öğretim elemanlarının akademik derecelerine göre öğrenme stilleri

	Öğrenme Stili	**%**
Araştırma Görevlisi	Somut Ardışık	60
	Somut Random	20
	Soyut Ardışık	13.33
	Soyut Random	6.67
Öğretim Üyesi	Somut Ardışık	80
	Somut Random	0
	Soyut Ardışık	10
	Soyut Random	10

Tablo 5'te öğretim elemanlarının akademik derecelerine göre Gregorc Öğrenme Stili Modeli için elde edilen sonuçlar verilmiştir. Tablo 5'teki sonuçlar incelendiğinde, araştırma görevlileri için en iyi öğrenme stili %60 oran ile Somut Ardışık, en iyi ikinci öğrenme stili %20 ile Somut Random, daha sonra %13.33 ile Soyut Ardışık ve en son da %6.67 ile Soyut Random çıkmıştır. Öğretim üyeleri için ise en iyi öğrenme stili %80 ile Somut Ardışık, en iyi ikinci öğrenme stilleri %10 oran ile Soyut Ardışık ve Soyut Random çıkmıştır. Örneklemde Somut Random öğrenme stiline sahip öğretim üyesi bulunmamaktadır.

Tablo 6. Mühendislik fakültesi öğrencilerinin cinsiyete göre öğrenme stilleri

	Öğrenme Stili	**%**
Kız	Somut Ardışık	34.21
	Somut Random	31.58
	Soyut Ardışık	21.05
	Soyut Random	13.16

Erkek	Somut Ardışık	22.72
	Somut Random	18.18
	Soyut Ardışık	50
	Soyut Random	9.1

Tablo 6'da mühendislik fakültesi öğrencilerinin cinsiyete göre Gregorc Öğrenme Stili Modeli için elde edilen sonuçlar verilmiştir. Tablo 6'daki sonuçlar incelendiğinde, kız öğrenciler için en iyi öğrenme stili %34.21 oran ile Somut Ardışık iken, erkek öğrenciler için en iyi öğrenme stili %50 ile Soyut Ardışık'tır. Kız öğrenciler için en iyi ikinci öğrenme stili %31.58 ile Somut Random, erkek öğrenciler için en iyi ikinci öğrenme stili %22.72 ile Somut Ardışık'tır. Kız öğrenciler %21.05 ile Soyut Ardışık ve %13.16 ile Soyut Random iken, erkek öğrenciler %18.18 ile Somut Random ve %9.1 ile Soyut Random çıkmıştır.

Tablo 7. Mühendislik fakültesi öğrencilerinin bölüme göre öğrenme stilleri

	Öğrenme Stili	**%**
EEM	Somut Ardışık	16.21
	Somut Random	29.74
	Soyut Ardışık	37.84
	Soyut Random	16.21
İNŞ	Somut Ardışık	43.48
	Somut Random	34.77
	Soyut Ardışık	17.4
	Soyut Random	4.35

Tablo 7'de mühendislik fakültesi öğrencilerinin öğrenim gördükleri bölüme göre Gregorc Öğrenme Stili Modeli için elde edilen sonuçlar verilmiştir. Tablo 7'deki sonuçlar incelendiğinde, EEM bölümü öğrencileri için en iyi öğrenme stili %37.84 oran ile Soyut Ardışık iken İNŞ bölümü öğrencileri için %43.48 ile Somut Ardışık'tır. EEM bölümü öğrencileri için en iyi ikinci öğrenme stili %29.74 ile Somut Random, İNŞ bölümü öğrencileri için %34.77 ile Somut Random'dır. EEM bölümü öğrencileri %16.21 oranla Somut Ardışık ve Soyut Random öğrenme stiline sahip iken, İNŞ bölümü öğrencileri %17.4 ile Soyut Ardışık, %4.35 ile de Soyut Random çıkmıştır.

Sonuç ve Öneriler

Öğrenme, herkes için yaşam boyu süren bir süreçtir. Bireylerin nasıl öğrendiğini bilmesi bu süreçte onlara büyük kolaylık sağlayacaktır. Hangi öğrenme stiline sahip olduğunu ve nasıl öğrendiğini bilmek, hem öğrenen hem de öğreten açısından önemlidir. Çalışma kapsamında mühendislik fakültesi öğrencileri ve öğretim elemanlarının öğrenme stilleri Gregorc Öğrenme Stili Modeline göre belirlenmeye çalışılmıştır. Mühendislik fakültesinden 60 lisans öğrencisine ve 26 öğretim elemanına ulaşılmıştır. Kişisel Bilgi Formu ve Gregorc Öğrenme Stili Envanteri uygulanmıştır. Elde edilen verilerin analizinde ulaşılan sonuçlar aşağıda belirtilmiştir.

Gregorc Öğrenme Stili Modeli için öğretim elemanlarının baskın öğrenme stilleri cinsiyete göre incelendiğinde, kadın ve erkek öğretim elemanlarının ikisinde de baskın öğrenme stilinin Somut Ardışık olduğu görülmektedir. Öğretim elemanlarının yaş değişkenine ve akademik derecelerine göre baskın öğrenme stilleri incelendiğinde de hepsinde yine Somut Ardışık Öğrenme Stilinin baskın olduğu görülmektedir.

Mühendislik fakültesi lisans öğrencilerinin Gregorc Öğrenme Stili Modeli için cinsiyete göre baskın öğrenme stilleri incelendiğinde, kız öğrenciler için Somut Ardışık, erkek öğrenciler için ise Soyut Ardışık olduğu görülmektedir. Öğrencilerin bölüme göre baskın öğrenme stili incelendiğinde, EEM öğrencilerinin Soyut Ardışık, İNŞ öğrencilerinin ise Somut Ardışık olduğu sonucuna ulaşılmıştır.

Mühendislik fakültesi öğrenci ve öğretim elemanlarının öğrenme stillerini Gregorc Öğrenme Stili Modeli ile belirlemeye yönelik olarak yapılan bu çalışmadan elde edilen bulgular doğrultusunda yeni çalışmalara ilişkin aşağıdaki önerilere yer verilebilir.

- Çalışma mühendislik fakültesinde öğrenim gören 60 lisans öğrencisi ve aynı fakülteden 26 öğretim elemanı ile sınırlıdır. Sonraki araştırmalarda farklı katılımcılarla çalışılabilir.
- Araştırmada Gregorc Öğrenme Stili Modeline ile cinsiyet, yaş, akademik derece ve bölüm değişkenleri seçilmiştir. Farklı öğrenme stilleri ve değişkenlerle başka çalışmalar yapılabilir.

Kaynaklar

Arslan, H., & Uslu, B. (2014). Öğretmen Adaylarının Öğrenme Stilleri ile Liderlik Yönelimleri Arasındaki İlişki. *Eğitim ve Bilim*, *39*(173).

Babadoğan, C., (2000). Öğretim Stili Odaklı Ders Tasarımı Geliştirme. *Milli Eğitim Dergisi*, Sayı:147, 61-63-

Bakir, S., & Mete, H. (2014). Ortaokul Öğrencilerinin Öğrenme Stilleri: Burdur İli Örneği*. *Ahi Evran Üniversitesi Kırşehir Eğitim Fakültesi Dergisi*, *15*(3).

Biedenbender, A. J. (2012). An Exploratory Study of Learning Styles in the Elementary Music Classroom. *University of Michigan.*

Butler, K. A. (1988). Learning and Teaching Style: In Theory and Practice (2 Rev Sub edition). *Columbia, CT: Learners Dimension.*

Calderwood, E. M. (2007). Effect(s) of Traditional Versus Learning-style Instructional Strategies on the Achievement and Attitudes of High School Advanced Placement Psychology Students. *ProQuest.*

Christensen, J. (2015). The Relationship Between Creativity and Learning Style Preference, Age, and Educational Achievement. Retrieved from https://etd.auburn.edu/handle/10415/4882

Cornet C. E. (1983). What you should know about teaching and learning styles. *Eric Docunıent Reproduclion Service*.

Dunn, R., Giannitti, M. C., Murray, J. B., Rossi, I., Geisert, G., & Quinn, P. (1990). Grouping students for instruction: Effects of learning style on achievement and attitudes. *The Journal of social psychology*, *130*(4), 485-494.

Ekici, G. (2002). Öğrenme Stiline Dayalı Biyoloji Öğretiminin Analizi. *Eğitim ve Bilim*, *27*(126).

Ekici, G. (2002). Gregorc Ögrenme Stili Ölçegi. *Egitim ve Bilim*. Cilt:27, Sayı:123, s.42-47.

Ekici, G. (2003). Uzaktan eğitim ortamlarının seçiminde öğrencilerin öğrenme stillerinin önemi. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi*, *24*(24).

Ekici, G. (2013). Gregorc ve Kolb Öğrenme Stili Modellerine göre Öğretmen Adaylarının Öğrenme Stillerinin Cinsiyet ve Genel Akademik Başarı Açısından İncelenmesi. *Eğitim ve Bilim,* 38(167)

Huang, W. D., Yoo, S. J., & Choi, J. H. (2008). Correlating college students' learning styles and how they use Web 2.0 applications for learning. In *Proceedings of World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education* (pp. 2752-2759). Chesapeake, VA: AACE.

Lau, W. W. F., & Yuen, A. H. K. (2010). Promoting conceptual change of learning sorting algorithm through the diagnosis of mental models: The effects of gender and learning styles. *Computers & Education*, *54*(1), 275–288. https://doi.org/10.1016/j.compedu.2009.08.014

Nasreen, S. (2014). Learning style preferences of junior school students in Bangladesh. *BRAC University*. Retrieved from http://123.49.46.157/handle/10361/3564

Numanoğlu, G., & Şen, B. (2007). Bilgisayar ve öğretim teknolojileri eğitimi bölümü öğrencilerinin öğrenme stilleri. *Ahi Evran Üniversitesi Kırşehir Eğitim Fakültesi Dergisi*, *8*(2).

Terry, M. (2002). Translating Learning Style Theory into Developmental Education Practice: An Article Based on Gregorc's Cognitive Learning Styles. *Journal of College Reading and Learning*, *32*(2), 154–176. https://doi.org/10.1080/10790195.2002.10850295

Veznedaroğlu, R. L., & Özgür, A. O. (2005). Öğrenme Stilleri: Tanımlamalar, Modeller ve İşlevleri. *İlköğretim Online*, *4*(2). https://doi.org/10.17051/io.76089

TEACHING QUADRANGLE SUBJECTS THROUGH MIND MAPPING TECHNIQUE

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Abstract: Learning, which is a lifelong process, is very important, especially for students in formal education. It is important for students to learn easily, quickly, effectively and permanently. There are many different learning methods and techniques to achieve this. One of these is the mind mapping technique. The mind mapping technique, which is a visual technique in which the main element to learn is located in the center and other items spread out from the center, is an effective technique that allows even the most complex structures to be understood easily. There are studies in the literature about the use of the technique in different lessons and the determination of its effects. The purpose of the proposed study is to determine the students' views on the practice using the mind mapping technique in high school mathematics. In the study, firstly, high school 10th grade students were given information about mind mapping technique. Following this, they are asked to create their own mind maps about the quadrangle subject. At the end of the course, the mind maps they have created are examined and the opinions of the students who participated in the application are evaluated.

Keywords**:** Mind map, quadrangle

DÖRTGENLER KONUSUNUN ZİHİN HARİTALAMA TEKNİĞİ İLE ÖĞRETİMİ

Özet: Yaşam boyu devam eden bir süreç olan öğrenme, özellikle de örgün öğretimdeki öğrenciler için çok önemlidir. Öğrenciler bilgiyi kolay, hızlı, etkili ve kalıcı öğrenmek isterler. Bunu sağlamak için farklı öğrenme yöntem ve teknikleri vardır. Bunlardan birisi de zihin haritalama tekniğidir. Öğrenilecek ana öğenin merkezde yer aldığı ve diğer öğelerin de merkezden çıkarak etrafa yayıldığı görsel bir teknik olan zihin haritalama tekniği, en karmaşık yapıların bile kolayca anlaşılmasını sağlayan etkili bir tekniktir. Tekniğin farklı derslerde kullanılması ve etkilerinin belirlenmesine yönelik literatürde çalışmalar mevcuttur. Önerilen çalışmanın amacı, lisede matematik dersinde zihin haritalama tekniğini kullanarak öğrencilerin uygulamaya ilişkin görüşlerini belirlemektir. Çalışmada, öncelikle lise 10. Sınıf öğrencilerine zihin haritalama tekniği ile ilgili bilgi verilmiştir. Daha sonra, dörtgenler konusu ile ilgili kendi zihin haritalarını oluşturmaları istenmiştir. Öğrencilere tanınan sürenin sonunda oluşturdukları zihin haritaları incelenmiş ve uygulamaya katılan öğrencilerin uygulama ile ilgili görüşleri alınmıştır.

Anahtar Sözcükler**:** Zihin haritası, dörtgenler

Giriş

Çağımızda, bilim ve teknolojide çok hızlı bir değişim yaşanmaktadır. Bu değişimle başa çıkabilecek nitelikli insan gücüne ihtiyaç vardır. Araştıran, düşünen ve sorgulayan bireyler yetiştirmek gerekmektedir. Bunun yolu da eğitimden geçmektedir (Güçlüer, 2006: 1). Yaşanan değişimin eğitime uyarlanması amacıyla, eğitim öğretim faaliyetleri ve kullanılan materyaller yenilenmektedir (Ocak ve Ocak, 2002: 20). Böylece, bireylerin beklentileri ve ihtiyaçları karşılanmakta, zengin bir öğrenme ortamı sunulmaktadır.

Teknolojik ilerlemeler, büyük bir bilgi yoğunluğuna da sebep olmuştur. Bu yoğunluk bilgiyi kısa zamanda, hızlı, etkili ve kalıcı şekilde öğrenme ihtiyacını ortaya çıkarmıştır. Çağdaş öğretim yöntem ve teknikleriyle zenginleştirilmiş öğrenme ortamları, kalıcı ve anlamlı öğrenmenin sağlanması açısından önemlidir (Seyihoglu ve Kartal, 2010). Eğitimciler tarafından, ezbercilikten uzak, bilgiyi anlamlandırarak öğrenmeye yönelik öğretim yöntemleri tercih edildiğinde, hiyerarşik bir yapıyla oluşan bilgi uzun süreli hafızaya daha kolay yerleşmektedir (Erdamar & Demirel, 2008; Yurdakul, 2008; Duman & İkiel, 2002). Zihin Haritalama Tekniği, bu öğretim yöntemlerinden bir tanesidir. Karmaşık yapıların kolayca anlaşılmasında oldukça etkili olan görsel bir tekniktir. Literatürde, tekniğin farklı derslerde uygulanmasına yönelik çalışmalar bulunmakta ve genellikle olumlu sonuçlar alındığı görülmektedir.

Zihin haritalama tekniğinin kullanıldığı bu çalışma, lise 10. Sınıf öğrencileriyle matematik dersinde gerçekleştirilmiştir. Öncelikle öğrencilere teknikle ilgili bilgi verilmiş, daha sonra kendi zihin haritalarını yapmaları istenmiştir. Çalışma sonunda öğrencilerin görüşleri alınmıştır. Çalışmanın devamındaki bölümlerde ilgili çalışmalardan, Zihin Haritalama Tekniğinden, yöntemden ve bulgulardan bahsedilmektedir.

İlgili Çalişmalar

Literatürde zihin haritası tekniğinin kullanımına yönelik çalışmalar bulunmaktadır. Çalışmanın bu bölümünde, yurt içinde ve yurt dışında yapılmış ilgili çalışmalar bulunmaktadır.

Derelioğlu (2005), sınıf öğretmenliği ana bilim dalı öğrencileriyle gerçekleştirdiği çalışmada zihin haritalama tekniğini kullanmıştır. Nitel gözlem yapılarak elde edilen sonuçlara göre, tekniğin öğrencilerin yaratıcılıkları ve düşünme becerileri üzerinde olumlu etkileri olmuştur.

Kahveci (2004), yüksek lisans çalışmasında az gören 3 öğrenciye zihin haritası tekniği kullanarak öğretim yapmıştır. Çalışma sonucunda uygulanan tekniğin,7 sınıf seviyesindeki öğrencilerin öğrenmesi üzerinde yüksek seviyede etkili olduğunu bulmuştur.

Aslan (2006), ilköğretim dördüncü sınıf öğrencileri ile yaptığı deney ve kontrol gruplu çalışmada, zihin haritası tekniği ile geleneksel öğretimi karşılaştırmıştır. Çalışma sonunda zihin haritası tekniğinin anlama, hatırlama ve özetleme becerileri üzerinde daha etkili olduğu sonucunu elde etmiştir.

Demir ve Gedikoğlu (2007), 11 okuldan gönüllü olarak çalışmaya katılan öğrencilere 15 saatlik seminer vermiştir. Kuantum konulu seminerde zihin haritalama tekniği kullanılmıştır. Deneysel modelde yapılan çalışma sonucunda tekniğin öğrencilerin akademik başarısına olumlu etkisi olduğu ve yaratıcılıklarını geliştirdiği bulunmuştur.

Geçit, Şeyihoğlu ve Kartal (2011), çalışmalarında Hayat Bilgisi dersi için çalışma yaprakları hazırlamışlardır. İçinde zihin haritası tekniğiyle hazırlanan etkinliklerin de bulunduğu çalışma yaprakları, ilköğretim 3. Sınıf öğrencileri tarafından doldurulmuştur. Çalışmada, etkinliğin akademik başarıyı arttırdığı sonucuna ulaşılmıştır.

Kan (2012), iki deney bir kontrol gruplu çalışmasında zihin haritası tekniği ile geleneksel yöntemi başarı ve kalıcılık açısından karşılaştırmıştır. Çalışma sonucunda deney grubu öğrencilerinin akademik başarılarının daha yüksek olduğunu bulmuştur. Kalıcılık puanlarına göre ise gruplar arasında anlamlı bir fark bulamamıştır.

Bütüner ve Gür (2008) matematik dersinde zihin haritaları ve Vee diyagramları kullanarak 40 öğrenciyle gerçekleştirdikleri deney ve kontrol gruplu çalışmalarında, deney grubu lehine anlamlı bir fark bulmuşlardır.

Çakır ve Altun (2011), ilköğretim 5. sınıf öğrencileriyle bilgisayar destekli zihin haritaları tekniği kullanarak çalışmışlardır. 62 öğrenciyle gerçekleştirilen çalışmada, uygulamanın akademik başarıya, fene ve bilgisayara yönelik tutuma etkisi araştırılmıştır. Çalışma sonunda, tekniğin akademik başarıyı arttırdığı bulunmuştur.

Trevino (2005) zihin haritası ve özetleme yöntemlerini karşılaştırdığı çalışmasını 6 farklı ilköğretim okulundan 183 öğrenci ile gerçekleştirmiştir. Çalışma sonunda özetleme yapan grubun akademik başarısı, zihin haritası yapan gruptan daha yüksek bulunmuştur. Fakat öğrenciler zihin haritası yöntemini severek ve eğlenerek uyguladıklarını belirtmişlerdir.

Pollard (2010) doktora çalışmasında, 14 üniversite öğrencisiyle zihin haritası tekniğini kullanmıştır. Çalışma sonucunda öğrencilerin akademik başarılarında bir fark bulunamamıştır. Ayrıca, öğrenciler tekniğin yararlı olduğunu ama çok zaman alan uğraştırıcı bir teknik olduğunu belirtmişlerdir.

Zihin Haritalama Tekniği

Zihin Haritalama Tekniği, 1970'li yıllarda İngiliz beyin araştırmacısı, matematikçi ve psikolog Tony Buzan tarafından geliştirilmiştir (Bütüner, 2007: 2). Bilgilerin beyne kaydedilmesi için kullanılan teknik ilgi çekici, etkili ve kısa sürede not almayı sağlayan özel bir tekniktir (Buzan, 2003a:16). Ayrıca yaratıcılığı geliştiren, zor ve karmaşık bilgilerin sistematik bir biçimde basitçe düzenlenmesini sağlayan zihin haritalama tekniği etkili bir hatırlama tekniğidir (Aktaş, 2012).

Zihin Haritalama Tekniği, merkezde hedef konunun yer aldığı, bu hedef konunun dallara ayrıldığı, her bir dalın da alt dallara ayrılarak yayıldığı, anahtar kelimelerin, resimlerin ve renklerin kullanıldığı görsel bir tekniktir (Buzan ve Buzan, 2013). Bilgilerin organize edilmesini sağlar ve hatırlatıcı öğeler içerir (Kara, 2014). Bütün derslerde kullanılabilen zihin haritaları matematik dersinde de oldukça etkili bir şekilde kullanılabilir. Bütün konuyu çok kısa bir şekilde görsel öğelerle birlikte özetleme imkânı tanımasının yanı sıra kavramlar arasındaki önemli ilişkilerin kurulmasını da sağlar (Entrekin, 1992).

Ünver (2005)'e göre, zihin haritası hazırlama sürecinde öğrenciler konuyla ilgili tam olarak kavrayamadıkları yerleri ve eksik kalan bilgileri fark ederek tamamlama yoluna gidebilirler. Böylece bilgilerindeki eksiklikleri tamamlama ve kavramlar arasındaki ilişkileri fark etme şansı elde ederler. Konuyu bir bütün olarak görürler ve konuya hâkimiyetleri artar (Aktaş, 2012).

Yöntem

Bu çalışmanın amacı, lise 10. Sınıf matematik müfredatında yer alan dörtgenler konusunda zihin haritalama tekniğini kullanarak öğrencilerin uygulama hakkındaki görüşlerini belirlemektir. Çalışma sırasında öncelikle çalışmaya katılan 24 öğrenciye zihin haritalama tekniği ile ilgili bilgi verilmiş ve örnek uygulamalar yapılmıştır. Daha sonra, öğrencilerden kendilerine tanınan süre içinde dörtgenler konusuyla ilgili kendi zihin haritalarını oluşturmaları istenmiştir. Hazırlanan zihin haritaları incelenmiş ve öğrencilere geri bildirim yapılmıştır. Uygulama sonunda öğrencilerin görüşlerini almak üzere 8 tane açık uçlu sorudan oluşan bir anket uygulanmıştır. Öğrencilerin sorulara verdikleri cevaplar içerik ve betimsel analize tabi tutularak tablolar halinde sunulmuştur.

Bulgular

Bu bölümde, öğrencilerin her bir soruya verdiği cevaplara göre uygulamaya ilişkin görüşleri tablolar halinde sunularak yorumlanmıştır.

Tablo 1. Öğrencilerin "zihin haritası tekniğini kullanmanın size neler kazandırdığını düşünüyorsunuz?" sorusuna verdikleri cevapların analizi

Kodlamalar	Frekans
Kolay Öğrenme	8
Tekrar yapmış olma	9
Hatırlatıcı	5
Matematiği sevme	2

Tablo 1'de öğrencilerin "Zihin haritası tekniğini kullanmanın size neler kazandırdığını düşünüyorsunuz?" sorusuna verdikleri cevapların analiz sonuçları verilmiştir. Tablo 1'e göre, çalışmaya katılan 8 öğrenci konuyu daha kolay öğrendiğini, 9 öğrenci tekrar yapmış olduğunu, 5 öğrenci tekniğin hatırlatıcı olduğunu ve 2 öğrenci de tekniğinin matematiği sevmesine sebep olduğunu belirtmiştir. Öğrencilerin bu soruya verdikleri cevapların frekansları incelendiğinde, zihin haritası tekniğinin tekrar yapmayı ve kolay öğrenmeyi sağladığı söylenebilir.

Tablo 2. Öğrencilerin "zihin haritası tekniği sizce matematik dersinde kullanılmalı mı?" sorusuna verdikleri cevapların analizi

Kodlamalar	Frekans
Evet	18
Hayır	6

Tablo 2'de öğrencilerin "Zihin haritası tekniği sizce matematik dersinde kullanılmalı mı?" sorusuna verdikleri cevapların analiz sonuçları verilmiştir. Tablo 2'ye göre, 18 öğrenci "evet" cevabını vererek zihin haritası tekniğinin matematik dersinde kullanılması gerektiğini, 6 öğrenci "hayır" cevabını vererek zihin haritası tekniğinin matematik dersinde kullanılmaması gerektiğini belirtmişlerdir.

Tablo 3. Öğrencilerin "zihin haritası tekniğini uygularken en çok ne hoşunuza gitti?" sorusuna verdikleri cevapların analizi

Kodlamalar	Frekans
Resim çizmek	7
Renkli kalem kullanmak	6
Özgür olmak	3
Yaratıcı hissetmek	8

Tablo 3'te öğrencilerin "Zihin haritası tekniğini uygularken en çok ne hoşunuza gitti?" sorusuna verdikleri cevapların analiz sonuçları verilmiştir. Tablo 3'e göre, çalışmaya katılan 8 öğrenci en çok yaratıcı hissetmekten, 7 öğrenci en çok resim çizmekten, 6 öğrenci en çok renkli kalem kullanmaktan, 3 öğrenci de en çok özgür olmaktan hoşlanmıştır.

Tablo 4. Öğrencilerin "zihin haritası tekniğini uygularken hangi sıkıntılarla karşılaştınız?" sorusuna verdikleri cevapların analizi

Kodlamalar	Frekans
Sıkıntıyla karşılaşmadım	14
Şekilleri yerleştirmek zordu	4
Konuya yeniden çalışmak zorunda kaldım	6

Tablo 4'te öğrencilerin "Zihin haritası tekniğini uygularken hangi sıkıntılarla karşılaştınız" sorusuna verdikleri cevapların analiz sonuçları verilmiştir. Tablo 4'e göre, çalışmaya katılan 14 öğrenci hiçbir sıkıntıyla karşılaşmadığını, 4 öğrenci şekilleri yerleştirmenin zor olduğunu ve 6 öğrenci de konuya yeniden çalışmak zorunda kaldığını belirtmiştir.

Tablo 5. Öğrencilerin "zihin haritası tekniğini uyguladıktan sonra matematik hakkındaki düşünceleriniz değişti mi?" sorusuna verdikleri cevapların analizi

Kodlamalar		Frekans
	Daha çok sevdim	5
Değişti	Eğlenceli hale geldi	6
	Kolaylaştı	4
	Sadece değişmedi	3
Değişmedi	Matematik aynı matematik	4
	Hâlâ zorlanıyorum	2

Tablo 5'te öğrencilerin "Zihin haritası tekniğini uyguladıktan sonra matematik hakkındaki düşünceleriniz değişti mi?" sorusuna verdikleri cevapların analiz sonuçları verilmiştir. Tablo 5'e göre, matematik hakkındaki düşüncesinin değiştiğini söyleyen toplam 15 öğrenciden 5'i daha çok sevdiğini, 6'sı eğlenceli hale geldiğini ve 4'ü kolaylaştığını belirtmiştir. Düşüncesinin değişmediğini söyleyen 9 öğrenciden 4'ü matematiğin aynı matematik olduğunu, 2'si hâlâ zorlandığını, 3'ü ise sadece değişmediğini belirtmişlerdir.

Tablo 6. Öğrencilerin "zihin haritası tekniğinin başka hangi derslerde kullanılabileceğini düşünüyorsunuz?" sorusuna verdikleri cevapların analizi

Kodlamalar	Frekans
Fizik	1
Kimya	2
Sözel derslerde	9
Sadece matematik	2
Bütün derslerde	10

Tablo 6'da öğrencilerin "Zihin haritası tekniğinin başka hangi derslerde kullanılabileceğini düşünüyorsunuz?" sorusuna verdikleri cevapların analiz sonuçları verilmiştir. Tablo 6'ya göre, 1 öğrenci tekniğin fizik dersinde, 2 öğrenci kimya dersinde, 9 öğrenci sözel derslerde, 2 öğrenci sadece matematik dersinde ve 10 öğrenci bütün derslerde kullanılabileceğini belirtmişlerdir.

Tablo 7. Öğrencilerin "zihin haritası tekniğini başka nerelerde kullanabilirsiniz?" sorusuna verdikleri cevapların analizi

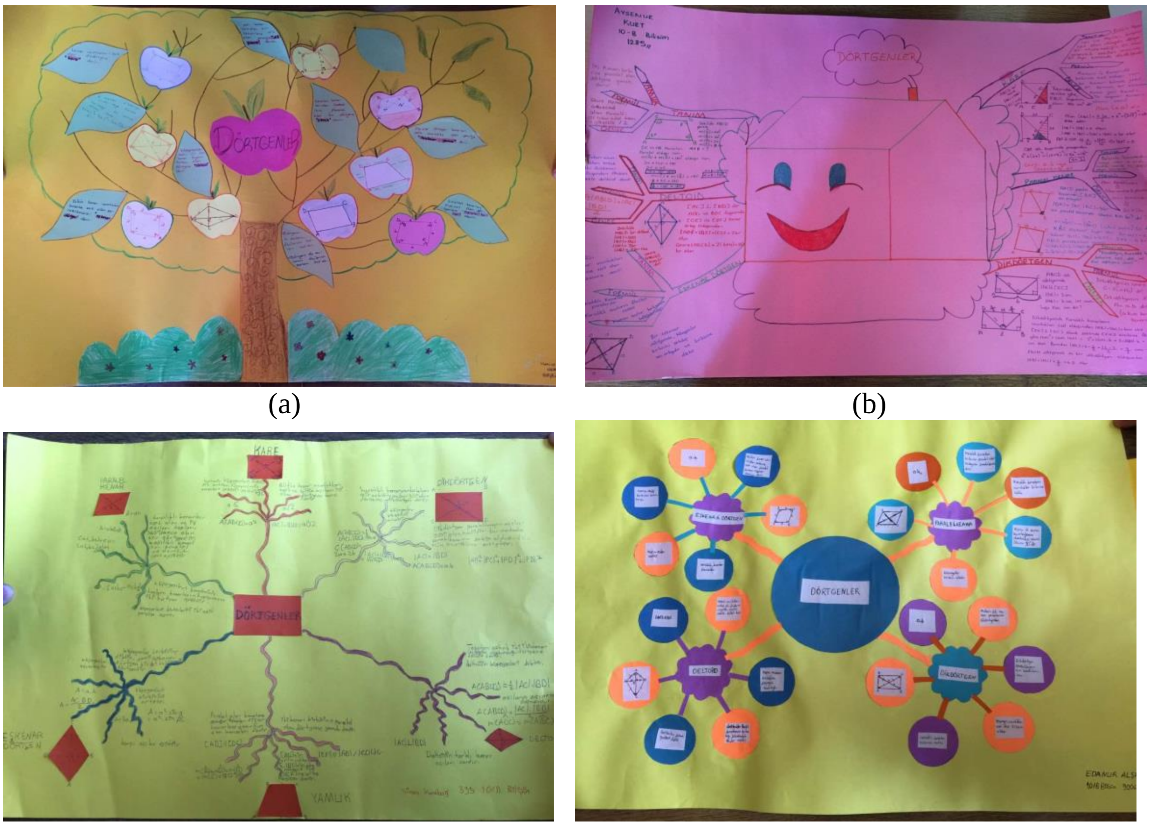
Kodlamalar	Frekans
Hiçbir yerde	8
İş hayatında	6
Proje hazırlarken	6
Sunumlarda	4

Tablo 7'de öğrencilerin "Zihin haritası tekniğini başka nerelerde kullanabilirsiniz?" sorusuna verdikleri cevapların analiz sonuçları verilmiştir. Tablo 7'ye göre, 8 öğrenci tekniği başka hiçbir yerde kullanamayacağını, 6 öğrenci iş hayatında kullanabileceğini, 6 öğrenci proje hazırlarken, 4 öğrenci sunumlarda kullanabileceğini belirtmiştir.

Tablo 8. Öğrencilerin "zihin haritası tekniğinin avantajları ve dezavantajları nelerdir?" sorusuna verdikleri cevapların analizi

Kodlamalar		Frekans
Avantajları	Konuyu çok iyi kavratıyor	7
	Ders tekrarı sağlıyor	9
	Pratik olması	2
	Eğlenceli	6
Dezavantajları	Çok zaman alıyor	8
	Çok uğraştırıyor	7
	Dezavantajı yok	9

Tablo 8'de öğrencilerin "Zihin haritası tekniğinin avantajları ve dezavantajları nelerdir?" sorusuna verdikleri cevapların analiz sonuçları verilmiştir. Tablo 8'e göre, zihin haritası tekniğinin avantajları olarak, 7 öğrenci konuyu çok iyi kavrattığını, 9 öğrenci ders tekrarı sağladığını, 2 öğrenci pratik olduğunu ve 6 öğrenci de eğlenceli olduğunu belirtmiştir. Tekniğin dezavantajları olarak, 8 öğrenci çok zaman aldığını, 7 öğrenci çok uğraştırdığını ve 9 öğrenci de dezavantajının olmadığını belirtmiştir.



(a) (b)

(c) (d)

Şekil 1. Öğrencilerin hazırladığı zihin haritası örnekleri

Sonuç ve Öneriler

Bu çalışma lise 10. sınıf öğrencilerinin, matematik dersinde uygulanan zihin haritalama tekniğine ilişkin görüşlerini belirlemek amacıyla yapılmıştır. 24 öğrenciyle yapılan uygulama sonunda 8 açık uçlu sorudan oluşan anket uygulanmıştır. Elde edilen bulgular incelendiğinde aşağıdaki sonuçlara ulaşılmıştır. Zihin haritası tekniği ile öğrencilerin neler kazandığına bakıldığında, en çok tekrar yapmış olmayı ve kolay öğrenmeyi sağladığı sonucuna ulaşılmıştır. Öğrencilerin çoğu (18 öğrenci) zihin haritası tekniğinin matematik dersinde kullanılması gerektiğini düşünürken 6 öğrenci ise kullanılmaması gerektiğini düşünmüştür. Zihin haritası tekniğinin uygulanması sırasında öğrencilerin en çok hoşuna giden şey yaratıcı olmak, daha sonra resim çizmek, renkli kalem kullanmak ve özgür olmak olarak belirlenmiştir. Öğrencilere zihin haritası tekniğini uygularken karşılaştıkları sorunlar sorulduğunda, öğrencilerin çoğu (14 kişi) bir sıkıntıyla karşılaşmadığını, 4 öğrenci şekilleri yerleştirmenin zor olduğunu ve 6 öğrenci de konuya yeniden çalışmak zorunda kaldığını belirtmiştir. Zihin haritası tekniğini uyguladıktan sonra 15 öğrencinin matematik hakkındaki düşünceleri olumlu yönde değişmiş, 9 öğrencinin ise değişmemiştir. Zihin haritası tekniğinin sadece matematik dersinde kullanılabileceğini düşünen öğrencilerin sayısı 2 iken, 1 öğrenci fizik dersinde, 2 öğrenci kimya dersinde, 9 öğrenci sözel derslerde, 10 öğrenci ise bütün derslerde kullanılabileceğini düşünmektedir. 8 öğrenci tekniğin başka hiçbir yerde kullanılamayacağını düşünürken, 6 öğrenci iş hayatında, 6 öğrenci proje hazırlarken, 4 öğrenci de sunumlarda kullanabileceğini düşünmektedir.

Öğrencilerden, zihin haritası tekniğinin avantajlarının ve dezavantajlarının neler olduğunu yazmaları istenmiştir. Tekniğin avantajları olarak, 7 öğrenci konuyu çok iyi kavrattığını, 9 öğrenci ders tekrarı sağladığını, 6 öğrenci eğlenceli olduğunu belirtirken sadece 2 öğrenci pratik olduğunu belirtmiştir. Nitekim öğrencilerin tekniğin dezavantajlarına verdiği yanıtlar incelendiğinde 8 öğrenci çok zaman aldığını, 7 öğrenci de çok uğraştırdığını belirtmiştir. 9 öğrenci ise dezavantajının olmadığını belirtmiştir. Bu soruya verilen yanıtlar incelendiğinde, zihin haritası tekniği öğrenciler için zahmetli ve uğraştırıcı olmuştur.

Lise 10. sınıf öğrencilerinin matematik dersinde uygulanan zihin haritalama tekniğine ilişkin görüşlerini belirlemeye yönelik olarak yapılan bu çalışmadan elde edilen bulgulara göre yeni çalışmalar için aşağıdaki önerilere yer verilebilir.

- Çalışma lise 10. sınıfta öğrenim gören 24 öğrenci ile sınırlıdır. Sonraki araştırmalarda farklı sınıf seviyelerinde ve daha fazla katılımcıyla çalışılabilir.
- Araştırmada zihin haritalama tekniği ve dörtgenler konusu seçilmiştir. Farklı tekniklerle ve farklı konularda başka çalışmalar yapılabilir.

Kaynaklar

Aktaş,Ö. (2012). *İlköğretimde Kavram ve Zihin Haritaları İle Desteklenmiş Fen ve Teknoloji Eğitiminin Öğrenme Ürünleri Üzerindeki Etkileri* Yüksek Lisans Tezi, Dokuz Eylül Üniversitesi, Eğitim Bilimleri Enstitüsü, İzmir.

Aslan, A. (2006). *İlköğretim okulu 4.sınıf öğrencilerinin bilgilendirici metinleri anlama özetleme ve hatırlama becerileri üzerinde zihin haritalarının etkisi.* Yayınlanmamış yüksek lisans tezi, Gazi Üniversitesi Eğitim Bilimleri Enstitüsü.

Buzan, T. (2003a). Hızlı Okuma. (Çev. Hür Güldü). İstanbul: Alfa Yayıncılık.

Buzan, Tony ve Buzan, Barry (2013). *Zihin Haritaları.(3.Baskı)* (Çeviren: Güntülü Tercanlı). İstanbul: Alfa Yayınları.

Bütüner, S.Ö. (2007) Grafiksel Bilgi Gösterimi- Matematik Eğitiminde Etkili Araçlar Olarak Zihin ve Kavram Haritaları**,** İlköğretim Online, 6(1), 1-11 [Online]:http://ilköğretim-online.org.tr.

Bütüner, S. Ö. ve Gür, H. (2008). Açılar ve Üçgenler Konusunun Anlamlı Öğrenme Araçlarından Vee Diyagramları ve Zihin Haritaları Kullanılarak Öğretimi. *Necatibey Eğitim Fakültesi Elektronik Fen ve Matematik Eğitimi Dergisi* (EFMED). Cilt 2, sayı 1, 1-18.

Çakır, H. Ç. ve Altun, E. (2011). Bilgisayar Destekli Zihin Haritalama Tekniğinin İlköğretim 5. Sınıf Öğrencilerinin Fen ve Teknoloji Dersindeki Akademik Başarılarına ve Tutumlarına Etkisi. *Eğitim Teknolojileri Araştırmaları Dergisi*. Cilt 2, sayı 4.

Demir, S. , Gedikoğlu, T. (2007). Kuantum öğrenme modelinin ortaöğretim öğrencileri üzerindeki etkisi. *Doğu Anadolu Bölgesi Araştırmaları, 5(2).* http://web.firat.edu.tr/daum/default.asp?id=82

Derelioğlu, Y. (2005). Hayat Bilgisi ve Sosyal Bilgiler Öğretimi Dersinde Akıl Haritasının Kullanımı. *Eğitimde İyi Örnekler Konferansı* 12 Mayıs 2005 Batman Çalıştayı, Bildiri.

Duman, B. & İkiel, C. (2002). Yapıcı öğrenme kuramına göre sosyal bilgiler öğretimi. *Fırat Üniversitesi Sosyal Bilimler Dergisi, 12(2),* 245-262.

Entrekin, V. (1992). Mathematical Mind Mapping. *The Mathematics Teacher*, 85(6).

Erdamar, G. & Demirel, M. (2008). Yapılandırmacı öğrenme yaklaşımının duyuşsal ve bilişsel öğrenme ürünlerine etkisi. *Türk Eğitim Bilimleri Dergisi, 6(4),* 629-661.

Geçit, Y., Şeyihoğlu, A., Kartal, A. (2011). Hayat bilgisi dersinde çalışma yapraklarının öğrenci açısından değerlendirilmesi ve başarıları üzerine etkisi. *Uluslararası Avrasya Sosyal Bilimler Dergisi*, 2(2). 15-24.

Güçlüer, E. (2006). İlköğretim Fen Bilgisi Eğitiminde Kavram Haritaları İle Verilen Bilişsel Desteğin Başarıya Hatırda Tutmaya ve Fen Bilgisi Dersine İlişkin Tutuma Etkisi. Yayınlanmamış Yüksek Lisans Tezi. Dokuz Eylül Üniversitesi, *Eğitim Bilimleri Enstitüsü*.

Kahveci, G. (2004). *Az Görenlerde zihin haritası yöntemi ile özet çıkarmanın okuduğunu anlamaya etkisi*. Yayınlanmamış yüksek lisans tezi, Gazi Üniversitesi Eğitim Bilimleri Enstitüsü.

Kan, A., Ü. (2012). *Sosyal bilgiler dersinde bireysel ve grupla zihin haritası oluşturmanın öğrenci başarısına, kalıcılığa ve öğrenmedeki duyuşsal özelliklere etkisi.* Yayınlanmamış doktora tezi, Fırat Üniversitesi Eğitim Bilimleri Enstitüsü.

Kara, M. (2014). *İlköğretim 6. Sınıf öğrencilerinin eşlik benzerlik ve dönüşüm geometrisi konusundaki imajlarının fenomenografik yaklaşımla ele alınıp zihin haritaları ile gelişiminin incelenmesi.* Yayınlanmamış yüksek lisans tezi, Erciyes Üniversitesi, Eğitim Bilimleri Enstitüsü.

Ocak, İ. ve Ocak, G. (2002). Bilgisayar Destekli Sunumun Sınıf Öğretiminden Bağımsız Olarak Canlılar Çeşitlidir Ünitesinde Akademik Başarı ve Kalıcılığı Etkileme Düzeyi. *Kırşehir Eğitim Fakültesi Dergisi*. Cilt 3, sayı 2, 19- 27.

Pollard, E. L. (2010). *Meeting the demands of professional education: A study of mind mapping in a professional doctoral physical therapy education program.* Unpublished Dissertation for Doctor of Philosophy, Capella University.

Seyihoglu, A., & Kartal, A. (2010). The Views of the Teachers about the Mind Mapping Technique in the Elementary Life Science and Social Studies Lessons Based on the Constructivist Method. *Educational Sciences: Theory and Practice*, *10*(3), 1637-1656.

Trevino, C. (2005). *Mind mapping and outlining: comparing two types og graphic organizers for learning seventh-grade life science.* Unpublished Dissertation of Doctor of Philosophy, Texas Tech University, USA.

Ünver, G. (2005) Eğitimde Yeni Yönelimler. Yayınlandığı Kitap. Özcan Demirel (Editör), *Yansıtıcı Düşünme* (138) Ankara: Pagem A Yayıncılık

Yurdakul, B. (2008). Yapılandırmacı öğrenme yaklaşımının sosyal bilişsel bağlamda bilgiyi oluşturmaya katkısı**.** *Balıkesir Üniversitesi Sosyal Bilimler Enstitüsü Dergisi,11(20),*39-67.

A DESIGN OF EDUCATIONAL COMPUTER GAME

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Abstract: Nowadays, computer-assisted games have become a popular activity, especially for young people and children. It is expected that using computer games for educational purposes will make learning fun and amusing for every age of individuals. In this study, an educational computer game is designed especially to help students learn amusingly. The designed game can be used either individually or by teachers in the classroom environment and can easily be adapted to each course and topic. The questions in the game can be easily updated. In the study, questions for mathematics lesson is designed and used.

***Keywords*:** Educational game, educational computer game, mathematics game, game design

EĞİTSEL BİLGİSAYAR OYUNU TASARIMI

Özet: Günümüzde bilgisayar destekli oyunlar, özellikle gençler ve çocuklar için vazgeçilmez bir etkinlik haline gelmiştir. Her yaştaki bireylerin eğlenerek oynadığı bilgisayar oyunlarını eğitsel amaçla kullanmanın, öğrenmeyi sevimli ve eğlenceli hale getirmesi beklenmektedir. Bu çalışmada, özellikle öğrencilerin eğlenerek öğrenmelerine yardımcı olmak amacıyla eğitsel bir bilgisayar oyunu tasarımı gerçekleştirilmiştir. Tasarlanan oyun, bireysel olarak kullanılabileceği gibi öğretmenler tarafından, sınıf ortamında da kullanılabilmekte ve kolaylıkla her ders ve konuya uyarlanabilmektedir. Oyundaki sorular kolayca değiştirilerek güncellenebilmektedir. Çalışmada, matematik dersi için soruların yüklendiği bir versiyonu tasarlanmış ve kullanılmıştır.

Anahtar Sözcükler: Eğitsel oyun, eğitici bilgisayar oyunu, matematik oyunu, oyun tasarımı

Giriş

Geçmişten günümüze kadar günlük hayatın her alanında karşımıza çıkan matematik, aynı zamanda diğer bütün bilimlere kaynaklık eden bir bilim dalıdır. Bu sebeple, tarih boyunca matematiğin öğrenilmesine ve öğretilmesine büyük önem verilmiştir. Matematik öğretiminin etkili bir biçimde yapılması, matematiğin anlaşılması, öğrenilmesi, yorumlanması ve kullanılması için çok önemlidir (Fırat, 2011).

Genel olarak soyut kavram ve kurallardan oluşan matematiğin öğrenilmesi ve öğretilmesinde pek çok zorluk yaşanmaktadır (Ekinözü ve Şengül, 2007). Teknolojinin gelişmesiyle artan imkânlar, bu zorlukların aşılması için yeni yöntem ve teknikler geliştirilmesine olanak sağlamaktadır. Bilgisayar teknolojileri kullanılarak, soyut kavramlar somutlaştırılabilmekte, öğrenme ve öğretme faaliyeti daha kalıcı, daha etkili, daha anlamlı ve daha eğlenceli hale gelmektedir.

Günümüz gençlerinin büyük çoğunluğu, zamanlarını bilgisayar başında oyun oynayarak geçirmektedir (Kafai, 2001). Lise çağındaki gençlerin çok keyif alarak oynadıkları oyun aktivitesini, öğrenme aktivitesine dönüştürmenin, anlamlı ve kalıcı öğrenmeyi sağlaması beklenmektedir. Literatürde bilgisayar oyunlarının eğitimde kullanılmasıyla ile ilgili yapılmış çalışmalar bulunmaktadır.

Bu çalışmada bir eğitsel oyun tasarımı gerçekleştirilmiştir. Sınıf ortamında veya bireysel olarak oynanabilecek şekilde tasarlanan oyun matematik dersinde uygulanmıştır. Çalışmanın sonunda öğrencilerin görüşleri alınmıştır. Çalışmanın devamındaki bölümlerde ilgili çalışmalardan, Eğitsel bilgisayar oyunlarından, Tasarlanan eğitsel bilgisayar oyunundan, yöntemden ve bulgulardan bahsedilmektedir.

İlgili Çalışmalar

Literatürde eğitsel bilgisayar oyunlarına yönelik çalışmalar bulunmaktadır. Çalışmanın bu bölümünde, yurt içinde ve yurt dışında yapılmış ilgili çalışmalar bulunmaktadır.

Nuhoğlu, Tüzün, Kaya ve Çınar (2011), bir eğitsel oyun tasarım modeli geliştirmişlerdir. Eğitsel oyunla ilgili yaptıkları alan yazın incelemesi sonucunda geliştirdikleri modelin eğitsel oyun tasarım sürecinde kullanılmasının faydalı olacağını belirtmişlerdir.

Bakar, Tüzün ve Çağıltay (2008), eğitsel bilgisayar oyunlarının örgün eğitimdeki derslerde kullanılmasıyla ilgili sosyal bilgiler dersinde yaptıkları çalışmada, 6. sınıf öğrencilerinin görüşlerini belirlemişlerdir. 9 hafta boyunca 24 öğrenci ile gerçekleştirdikleri çalışma sonucunda, derste eğitsel bir oyun ortamının öğrenciler tarafından olumlu karşılandığını bulmuşlardır.

Offenbach (1964) okul öncesi ve ilköğretim 4. Sınıf seviyesindeki öğrencilerle gerçekleştirdiği çalışmasında, olasılık konusuyla ilgili bir oyun tasarlamış ve öğrenme üzerindeki etkilerini belirlemeye çalışmıştır. Her iki yaş grubunun farklı yaklaşımlar sergilediğini ve büyük yaştaki çocukların daha kuralcı davrandığını tespit etmiştir.

Brown (2000), iki yıl süren araştırmasında, bilgisayar destekli öğretimin ilk ve orta kademedeki öğrenciler üzerindeki etkisini incelemiştir. 214 öğrenciyle gerçekleştirdiği çalışma sonunda, uygun bir biçimde kullanıldığında bilgisayar destekli öğretimin öğrencilerin öğrenmesine çok büyük katkı sağlayabileceğini belirlemiştir.

Öztürk (2005), bilgisayar destekli öğretim tasarımı gerçekleştirmiş ve permütasyon ve olasılık konusu üzerinde çalışmıştır. Konunun etkinlik ve simülasyonlarla sunulduğu yazılımda, konu sonlarında çoktan seçmeli sorular da yer almaktadır.

Gürbüz ve Birgin (2012), olasılık konusuyla ilgili öğrencilerin kavram yanılgılarını gidermek için yaptıkları çalışmada bilgisayar destekli öğretim yapıp etkilerini incelemişlerdir. Çalışma sonunda, bilgisayar destekli öğretimin geleneksel öğretime göre daha etkili olduğunu tespit etmişlerdir.

Eğitsel Bilgisayar Oyunlari

Hayatımızın her alanına giren bilgisayar teknolojilerinin eğitim alanında da kullanılması kaçınılmazdır. Özellikle de matematik dersi gibi soyut kavramların bulunduğu derslerin teknoloji desteği ile zenginleştirilmesi gerekmektedir. Bilgisayar teknolojileri kullanılarak soyut kavramların görselleştirilmesi ve somutlaştırılmasıyla, öğrencilerin daha etkili, kalıcı ve anlamlı öğrenmesi sağlanmaktadır (Hewson, 1985; Novak ve diğerleri, 1983; Thornton ve Sokoloff, 1990 ve 1998). Öğrenme ortamına aktif bir şekilde katılan öğrenci, bilgiyi daha iyi öğrenmektedir (Bayraktar, 2002).
Günümüz gençleri bilgisayar başında çok fazla zaman geçirmektedir. Bu zamanın büyük bir bölümünde oyun oynamaktadırlar. Son derece keyifli ve motive edici olan bilgisayar oyunlarının eğitsel amaçla kullanılması eğitim öğretim faaliyetlerinin veriminin ve kalitesinin arttırılması bakımından faydalı olabilir (Squire, 2011). Klasik öğrenme ortamında sıkılan ve derslere karşı isteksiz olan öğrencilerin, eğitsel bilgisayar oyunlarıyla zenginleştirilmiş öğrenme ortamlarında eğlenerek öğrenmeleri sağlanabilir. Özellikle de, öğrencilerin gruplar şeklinde organize edilerek oyuna katılmaları halinde, işbirliği içinde davranarak öğrenmeleri teşvik edilebilir. Nitekim eğitsel bir oyunla desteklenmiş öğrenme ortamlarında, öğrenciler konuyu veya problemi daha fazla önemsemekte ve derse daha iyi konsantre olmaktadırlar (Çakmak, 2000).

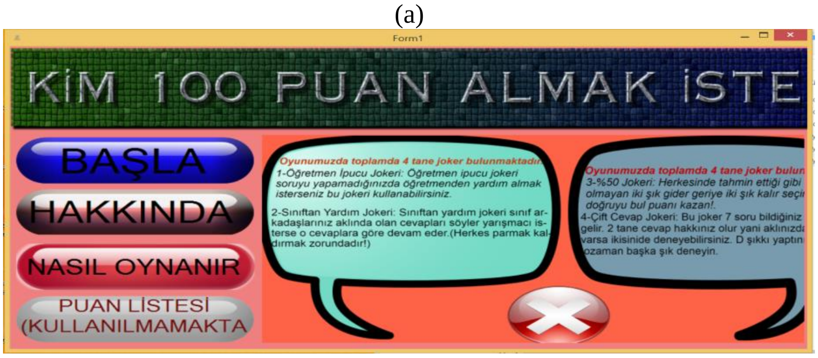
Tasarlanan Eğitsel Bilgisayar Oyunu

Öğrenme ortamında kullanılan eğitsel bilgisayar oyunları uygun tasarlandığında, öğrencilerin öğrenme sürecine aktif bir şeklide katılmasını sağlar (Whelan, 2005). Öğretmen merkezli öğrenme ortamında pasif bir şekilde sadece dinleyerek öğrenmeye çalışan öğrenci, oyun sırasında aktiftir, yetki sahibidir ve motivasyonu yüksektir (Whelan, 2005).

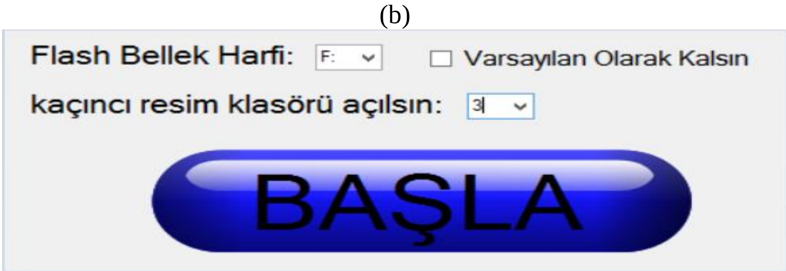
Çalışma kapsamında tasarlanan eğitsel bilgisayar oyununun amacı da öğrencinin sınıf ortamında aktif şekilde öğrenme sürecine katılımını sağlamaktır. Tasarlanan eğitsel bilgisayar oyununa "Kim 100 Puan Almak İster" adı verilmiştir. Şekil 1'de eğitsel bilgisayar oyununun ekran görüntüleri yer almaktadır.


Form1
KİM 100 PUAN ALMAK İSTER
BAŞLA
HAKKINDA
NASIL OYNANIR
PUAN LİSTESİ (KULLANILMAMAKTA

(a)


Form1
KİM 100 PUAN ALMAK İSTE
BAŞLA
HAKKINDA
NASIL OYNANIR
PUAN LİSTESİ (KULLANILMAMAKTA

(b)


Flash Bellek Harfi:
F:
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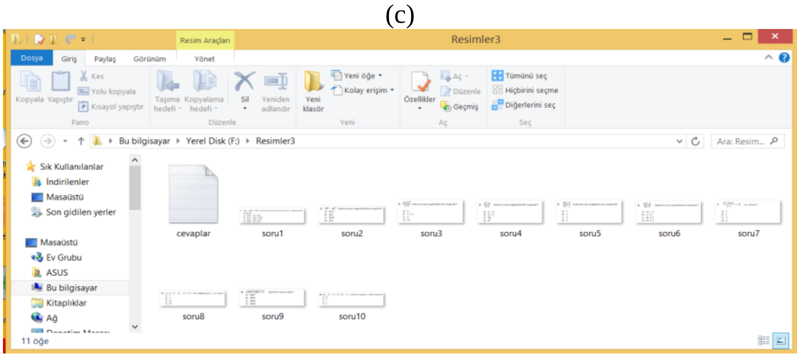
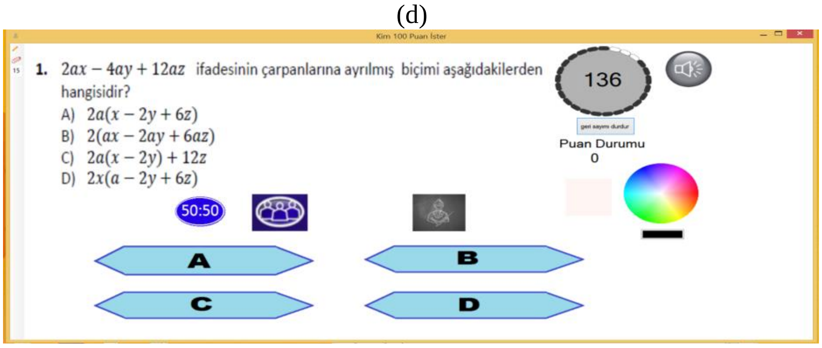
kaçıncı resim klasörü açılsın:
3
BAŞLA

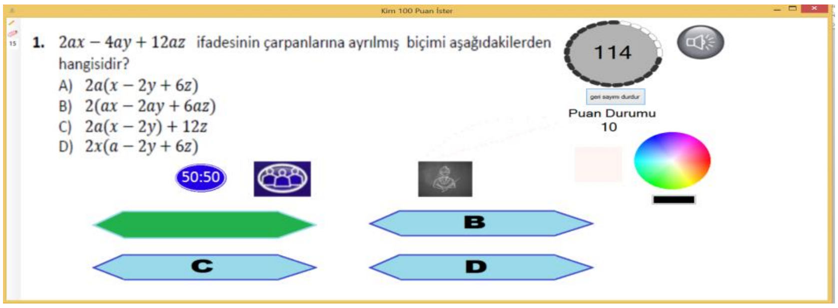
(c)


Resimler3
Bu bilgisayar › Yerel Disk (F:) › Resimler3
cevaplar
soru1
soru2
soru3
soru4
soru5
soru6
soru7
soru8
soru9
soru10
11 öğe

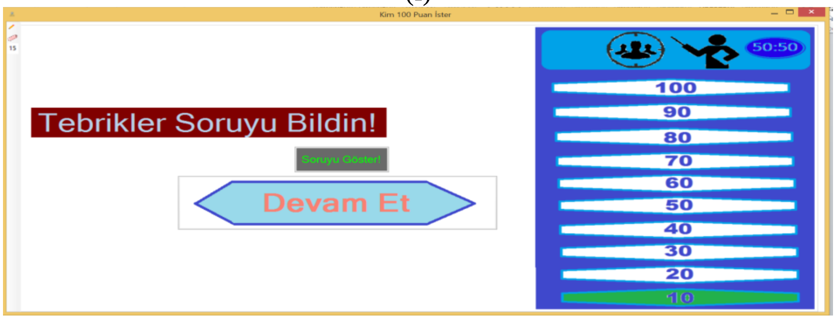
(d)


Kim 100 Puan İster
1. $2ax - 4ay + 12az$ ifadesinin çarpanlarına ayrılmış biçimi aşağıdakilerden hangisidir?
A) $2a(x - 2y + 6z)$
B) $2(ax - 2ay + 6az)$
C) $2a(x - 2y) + 12z$
D) $2x(a - 2y + 6z)$
136
Puan Durumu
0
50:50
A
B
C
D

(e)


Kim 100 Puan İster
1. $2ax - 4ay + 12az$ ifadesinin çarpanlarına ayrılmış biçimi aşağıdakilerden hangisidir?
A) $2a(x-2y+6z)$
B) $2(ax-2ay+6az)$
C) $2a(x-2y)+12z$
D) $2x(a-2y+6z)$
114
Puan Durumu
10
50:50
B
C
D

(f)

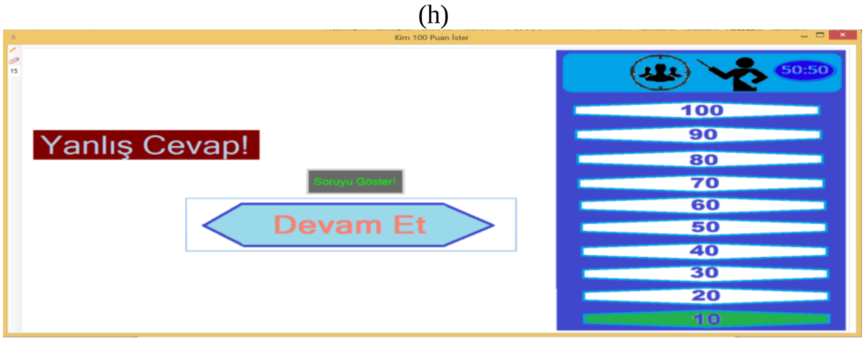

Kim 100 Puan İster
Tebrikler Soruyu Bildin!
Soruyu Göster!
Devam Et
50:50
100
90
80
70
60
50
40
30
20
10

(g)

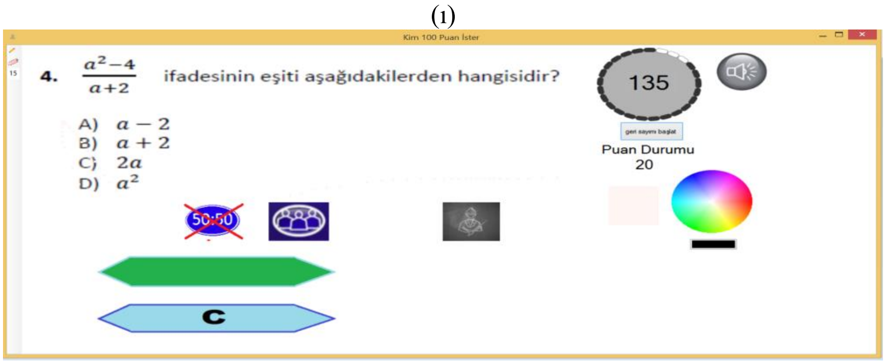

Kim 100 Puan İster
2. $58^2 - 42^2$ ifadesinin eşiti aşağıdakilerden hangisidir?
A) 5842
B) 160
C) 1600
D) 196
144
Puan Durumu
10
50:50
A
D

e

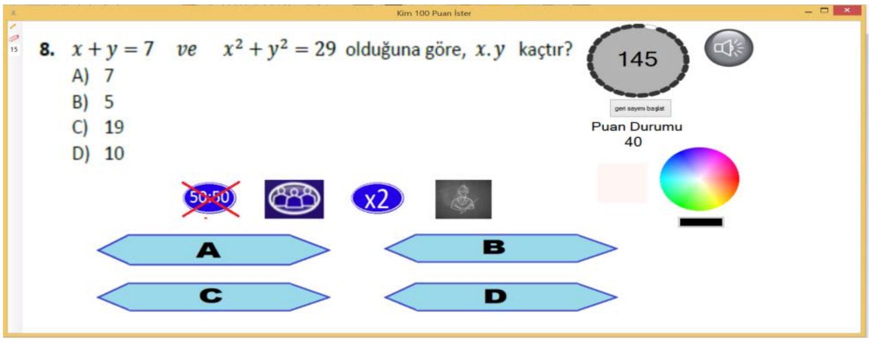
(h)


Kim 100 Puan İster
Yanlış Cevap!
Soruyu Göster!
Devam Et
50:50
100
90
80
70
60
50
40
30
20
10

(ı)


Kim 100 Puan İster
4. $\frac{a^2-4}{a+2}$ ifadesinin eşiti aşağıdakilerden hangisidir?
A) $a-2$
B) $a+2$
C) $2a$
D) a^2
135
Puan Durumu
20
50:50
C

(i)



(j)

(k)

Şekil 1. Geliştirilen eğitsel bilgisayar oyununun ekran görüntüleri

Şekil 1.a'da, tasarlanan eğitsel bilgisayar oyununun ilk açıldığındaki ekran görüntüsü yer almaktadır. Şekil 1.b ise, "Nasıl Oynanır" butonu tıklandığında açılan bilgilendirmenin ekran görüntüsüdür. "Başla" butonu tıklandığında, oyun oynanırken kullanılacak soruların bulunduğu sürücü ve klasör seçimi yapmaya yarayan pencere ekrana gelir (Şekil 1.c). Sorular, dersin öğretmeni tarafından önceden hazırlanmış ve Şekil 1.d'deki gibi resim formatında kaydedilerek bir klasörde toplanmıştır. Bu şekilde farklı sorulardan oluşan birkaç klasör hazırlanıp, üst üste farklı oyunlar oynanabilmektedir. Şekil 1.e'de görüldüğü gibi, oyunda yüzde elli jokeri, sınıfa sormak istiyorum jokeri ve öğretmen ipucu jokeri bulunmaktadır. 8. Sorudan itibaren çift cevap jokeri de gelmektedir (Şekil 1.j). Öğrencinin soruyu cevaplamak için 140 saniyesi vardır. Fakat gerekirse öğretmen süreyi durdurabilir. Oyunda ayrıca cevabın doğru ya da yanlış olduğu, puan durumu, soruyu çözerken kullanmak için kalem ve silgi, kalem için renk paleti ve heyecanı arttırmak için ses efektleri bulunmaktadır (Şekil 1.e,f,g,h,k).

Yöntem

Bu çalışmanın amacı eğitsel bir bilgisayar oyunu tasarımı gerçekleştirerek, öğrencilerin daha iyi öğrenmesine yardımcı olmaktır. Çalışma kapsamında, eğitsel bir bilgisayar oyunu tasarımı gerçekleştirilmiştir. Matematik dersinde sınıf ortamında bütün öğrencilerin katılımıyla oynanan oyun sonunda çalışmaya katılan öğrencilerle yarı yapılandırılmış görüşmeler yapılmıştır. Bu görüşmeler kayıt altına alınarak yazılı hale getirilmiş ve daha sonra analiz edilmiştir.

Bulgular

Araştırmanın bu bölümünde, dersin öğretmeninin oyun sırasındaki gözlemleri, kayıtlar ve görüşme sonuçlarından elde edilen veriler ışığında, öğrencilerin uygulamaya ilişkin görüşleri ile ilgili bulgular açıklanmıştır.

Yapılan görüşmelerde öğrencilerin tamamı oynadıkları eğitsel bilgisayar oyunundan çok keyif aldıklarını belirtmişlerdir. Örneğin öğrencilerden bir tanesi, "*Oyundan çok keyif aldım. Çünkü soru çözerken bir taraftan da gerçek yarışmadasınız gibi oluyor. Tatlı bir heyecanla eğlenerek soru çözmek çok güzel.*" şeklinde görüşünü belirtirken başka bir öğrenci, "*Çok keyifli bir oyundu. Matematik sorusu çözmek zevkli, eğlenceli ve heyecan verici bir hale geldi.*" demiştir. Çok sayıda öğrenci oyunda soruları çözüp puan kazandıkça mutlu olduklarını, hiç sıkılmadıklarını ve tekrar tekrar oynamak istediklerini belirtmişlerdir. Hatta bir öğrenci, "*Matematik dersi hiç bu kadar zevkli olmamıştı. Hep oyun oynayalım istiyorum. Sorular hiç bitmesin istiyorum.*" demiştir.

Öğrencilerin büyük bir kısmı, derste eğitsel oyun oynamanın ders başarısına katkısı olacağını düşündüğünü söylemiştir. Bir öğrenci, "*Oyunda daha fazla puan kazanabilmek için evde soru çözdüm.*" Derken başka bir öğrenci, "*Matematik dersini pek sevmezdim, yapamazdım. Ama artık yapmak istiyorum. Çünkü oyunda ben de puan kazanmak istiyorum*" demiştir.

Birçok öğrenci, oyunun sınıf ortamında ve bütün sınıfın katılımıyla oynanmasını çok sevdiğini söylemiştir. Bu konuyla ilgili öğrencilerden bir tanesi, "*Her soruyu 2 veya 3 kişilik gruplar halinde çözmek çok güzel. Arkadaşımla beraber soru çözmüş oluyoruz. Bir yerde takılınca arkadaşımın fikrini soruyorum. Böylece öğrenmiş de oluyorum. Hem sınıfa puan kazandırdığım için de kendimle gurur duyuyorum. Arkadaşlarım beni tebrik ediyor."* şeklinde görüşünü belirtmiştir.

Tasarlanan eğitsel bilgisayar oyununun oynanması sırasında öğretmenin yaptığı gözlemlere göre de olumlu bulgulara ulaşılmıştır. Öğretmen sınıfta dayanışmaya ve yardımlaşmaya dayalı işbirlikçi bir öğrenme ortamı oluştuğunu, oyun oynarken öğrencilerin aktif katılımıyla heyecanlı ve eğlenceli bir ders geçtiğini gözlemlemiştir. Ayrıca, öğrencilerin tekrar tekrar oyun oynamak ve dolayısıyla daha fazla soru çözmek için ısrar ettiğini belirtmiştir.

Sonuç ve Öneriler

Bu çalışmada eğitsel bir bilgisayar oyunu tasarımı gerçekleştirilmiş ve sınıf ortamında oynanan oyunla ilgili öğrencilerin görüşleri belirlenmiştir. Çalışma sonucunda elde edilen bulgular incelendiğinde aşağıdaki sonuçlara ulaşılmıştır.

Hem dersin öğretmeninin gözlemleri hem de uygulamaya katılan öğrencilerle yapılan görüşme sonuçları incelendiğinde, matematik dersinde eğitsel bilgisayar oyunu oynamanın olumlu sonuçları olduğu görülmektedir. Tasarlanan eğitsel bilgisayar oyununun öğrencilerin derse aktif katılımını sağlaması, öğrenci merkezli öğrenme açısından çok önemlidir.

Özellikle matematik gibi derslerde öğrencilerin sıkılmadan soru çözmelerini ve hatta soru çözmekten keyif almalarını sağlamak oldukça zordur. Oyun sırasında keyif alarak, eğlenerek ve zevkle soru çözdüğünü söyleyen öğrenciler, aynı zamanda hiç sıkılmadıklarını ve tekrar tekrar oynamak istediklerini belirtmişlerdir. Bütün sınıfın tek bir takım olarak puan kazanmaya çalışması, soruyu çözdüklerinde arkadaşları tarafından tebrik edilmek, çözemediğinde destek ve teselli görmek öğrenciler tarafından olumlu karşılanmıştır.

Sonuç olarak, öğrencilerin klasik tarzda bir matematik dersi yerine oyun tabanlı bir dersi tercih ettikleri görülmüştür. Öğretmen de öğrencilerinin eğlenerek ve isteyerek, dayanışma içinde soru çözdüğünü görmekten mutlu olmuş ve uygulamayı olumlu bulmuştur. Bu çalışmada eğitsel oyun, uygulamaya katılan öğrencilerin matematik dersine ilgi göstermelerine büyük katkı sağlamıştır. Dahası, öğrenciler bütün derslerde benzer şekilde ders işlenmesini istediklerini belirtmişlerdir.

Bu çalışmadan elde edilen bulgulara göre yeni çalışmalar için aşağıdaki önerilere yer verilebilir.

- Araştırma lise öğrencileriyle gerçekleştirilmiştir. Farklı sınıf seviyelerinde başka çalışmalar yapılabilir.
- Tasarlanan eğitsel bilgisayar oyunu matematik dersinde uygulanmıştır. Başka derslerde de uygulanarak, öğrenciler üzerindeki etkileri belirlenebilir.
- Araştırma verileri yarı yapılandırılmış görüşmeler ve gözlem sonucu elde edilmiştir. Farklı veri toplama yöntem ve teknikleri kullanarak başka çalışmalar yapılabilir.
- Eğitsel bilgisayar oyunu tasarımı içeren daha fazla çalışma yapılabilir. Ülkemizde bu konuda çok az sayıda çalışma yapılmaktadır.
- Oyun tasarımı yapılırken eğitimcilerle işbirliği içinde hareket edilerek oyunlara eğitsellik katılabilir.

Kaynaklar

Akgün, E., Nuhoğlu, P., Tüzün, H., Kaya, G. & Çınar M. (2011). *Bir eğitsel oyun tasarımı modelinin geliştirilmesi*. Eğitim Teknolojisi Kuram ve Uygulama, 1(1), 41- 61.

Bakar, A., Tüzün, H., & Çağıltay, K. (2008). *Öğrencilerin Eğitsel Bilgisayar Oyunu Kullanımına İlişkin Görüşleri: Sosyal Bilgiler Dersi Örneği*. Hacettepe Üniversitesi Eğitim Fakültesi Dergisi (H. U. Journal of Education) 35: 27-37

Bayraktar, B. B. (2002). Bilgi Sistemleri ve Yönetim Bilgi Sistemi Olarak Yüksek Performans Yönetim Modeli. Endustri İliskileri ve İnsan Kaynakları Dergisi. Cilt 4, Say. 2.

Brown, F., 2000. Computer Assisted Instruction in Mathematics Can Improve Students' Test Scores: A Study, Nabse Journal, p. 18.

Çakmak, M. (2000). İlköğretimde matematik öğretimi ve aktif öğrenme teknikleri. Gazi Üniversitesi Eğitim Fakültesi Dergisi, 20(3), 111-118.

Ekinözü, İ. ve Şengül, S. 2007. Permütasyon ve olasılık konusunun öğretiminde canlandırma kullanılmasının öğrenci başarısına etkisi. Kastamonu Eğitim Dergisi, 15(1), 251–258.

Fırat, S. (2011). *Bilgisayar destekli eğitsel oyunlarla gerçekleştirilen matematik öğretiminin kavramsal öğrenmeye etkisi.* Yüksek Lisans Tezi, Adıyaman Üniversitesi Fen Bilimleri Enstitüsü, Adıyaman.

Gürbüz, R. ve Birgin, O. 2012. The effect of computer-assisted teaching on remedying misconceptions: The case of the subject "probability". Computers & Education 58, s. 931–941

Hewson, P.W. (1985). "Diagnosis and Remediation of an Alternative Conception of Velocity Using a Microcomputer Program". American Journal of Physics. 53,684-690.

Kafai, Y. B. 2001. The educational potential of electronic games: From games-to-teach to games-to learn. Playing by the rules. https://culturalpolicy.uchicago.edu/sites/culturalpolicy.uchicago.edu/files/kafai.pdf Erişim Tarihi: 10.01.2017

Novak, J.D., Gowin, D.B. ve Johansen, G.T., (1983), "The Use of Concept Mapping and Knowledge Vee Mapping With Junior High Science Students". Science Education, 67(5), 625-645.

Offenbach, S. I. 1964. Studies of Children's Probability Learning Behavior: I. Effect of Reward and Punishment at Two Age Levels. Child Development, 35(3), 709- 771.

Öztürk, G. 2005. İlköğretim 8. Sınıf Düzeyinde Permutasyon ve Olasılık Ünitesinin Bilgisayar Destekli Öğretim Tasarımı. Yüksek Lisans Tezi. Balıkesir Üniversitesi, Balıkesir.

Squire, K. (2011). Video Games and Learning: Teaching and Participatory Culture in the Digital Age. Technology, Education--Connections (the TEC Series). Teachers College Press. 1234 Amsterdam Avenue, New York, NY 10027.

Thornton, R.K. ; Sokoloff, D.R. (1998), "Assesing Students Learning of Newton's Laws: The Force and Motion Conceptual Evaluation of Active Learning Laboratory and Lecture Curricula". American Journal of Physics. 66,338-352.

Thornton, R.K., Sokoloff, D.R. (1990), "Learning Motion Concepts Using Real-Time Microcomputer-Based Laboratory(MBL) Activities to Help Students Overcome Some Common Conceptual Difficulties in Kinematics". American Journal of Physics. 58,858-867.

Ural, M. N. (2009). Eğitsel bilgisayar oyunlarının eğlendirici ve motive edici özelliklerinin akademik başarıya ve motivasyona etkisi. *Doktora Tezi, Anadolu Üniversitesi Eğitim Bilimleri Enstitüsü, Eskişehir*.

Whelan, D.L. (2005). Let the games begin. *School Library Journal, 51*(4), 40-43.

A DESIGN OF WEB BASED LEARNING ENVIRONMENT

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Abstract: Technological developments have influenced the field of education as every field of life. Learning and teaching methods and techniques change and develop with the new technologies. Researchers are developing new methods and approaches that are compatible with technology to ensure the most effective learning way. Web based learning environments prepared by utilizing the possibilities of internet technology are also one of these approaches. Web-based learning environments that can support traditional methods are expected to have a positive impact on the learning of students. In this study, a web-based learning environment is designed in which the exercises related to the subjects in the 10th grade mathematics curriculum are included. A questionnaire is applied to get the opinions of the 58 students studying in vocational high school.

***Keywords*:** Web based learning, web based mathematic, web design

WEB TABANLI ÖĞRENME ORTAMI TASARIMI

Özet: Teknolojik gelişmeler, hayatın her alanına olduğu gibi eğitim alanına da etki etmiştir. Öğrenme ve öğretme yöntem ve teknikleri, yeni teknolojilerle birlikte değişmekte ve gelişmektedir. Eğitimciler, en etkili öğrenmeyi sağlamak için teknolojiyle uyumlu yeni yöntemler ve yaklaşımlar geliştirmektedir. İnternet teknolojisinin imkânlarından faydalanarak hazırlanan web tabanlı öğrenme ortamları da bunlardan birisidir. Geleneksel yöntemlere destek olabilecek web tabanlı öğrenme ortamlarının, öğrencilerin öğrenmesine olumlu yönde etki etmesi beklenmektedir. Bu çalışmada, 10. sınıf matematik müfredatında yer alan konularla ilgili alıştırmaların bulunduğu bir web tabanlı öğrenme ortamı tasarlanmıştır. Meslek lisesinde okuyan 58 öğrenciyle gerçekleştirilen çalışma sonunda öğrencilerin görüşlerini almak üzere bir anket uygulanmıştır.

Anahtar Sözcükler: Web tabanlı öğrenme, web tabanlı matematik, matematik

Giriş

Teknolojinin gelişmesiyle birlikte, birçok alanda olduğu gibi eğitim alanında da değişimler yaşanmaktadır. Özellikle de öğretim yöntem ve tekniklerinde yaşanan değişim sayesinde, öğrenme zamandan ve mekândan bağımsız duruma gelmektedir(Başaran, 2010). İnternet kullanımının artmasıyla, öğrencilerin öğrenmesine katkı sağlayan eğitim içerikli web siteleri yaygınlaşmaktadır(Yiğit, Yıldırım, & Özden, 2000). Ses ve görüntüyle desteklenen, etkileşimli materyallere yer veren interaktif uygulamalar, öğrenmekte zorluk çekilen ders ve konuların öğrenilmesini kolaylaştırmaktadır. Teknolojinin eğitim alanına katkıları sayesinde, öğrenciler kendi seviyelerinde ve kendi öğrenme biçimlerine uygun eğitim alma imkânına kavuşmaktadır.

Web tabanlı öğrenme ile ilgili literatürde yapılmış çalışmalar bulunmaktadır. Sheard ve Lynch, 20 üniversite öğrencisi ile yaptıkları çalışmada öğrencilere web destekli uzaktan eğitim vermişler ve olumlu sonuç elde etmişlerdir (Sheard ve Lynch, 2003). Uzunboylu, öntest-sontest kontrol gruplu çalışmasında, ingilizce dersini web destekli olarak hazırlamış, başarı ve tutuma etkisini araştırmıştır (Uzunboylu, 2004). Leonard ve Smita, matematik dersini web destekli olarak çevrimiçi alan öğrencilerin klasik eğitim alanlara göre daha başarılı olduğunu belirlemişlerdir (Leonard ve Smita, 2001). Gordon, Nevada Üniversitesi'nde yaptığı çalışmasında web tabanlı eğitim ile klasik eğitimi tutum, başarı ve motivasyon açısından karşılaştırmış ve anlamlı farklılıklar bulamamıştır (Gordon, 2003). Mumcu ve Yıldız, öğretmen adayları ile yaptıkları çalışmada web tabanlı öğretim materyalinin öğrenmeyi sağlamada etkili olduğu sonucuna ulaşmışlardır(Mumcu & Yıldız, 2015).

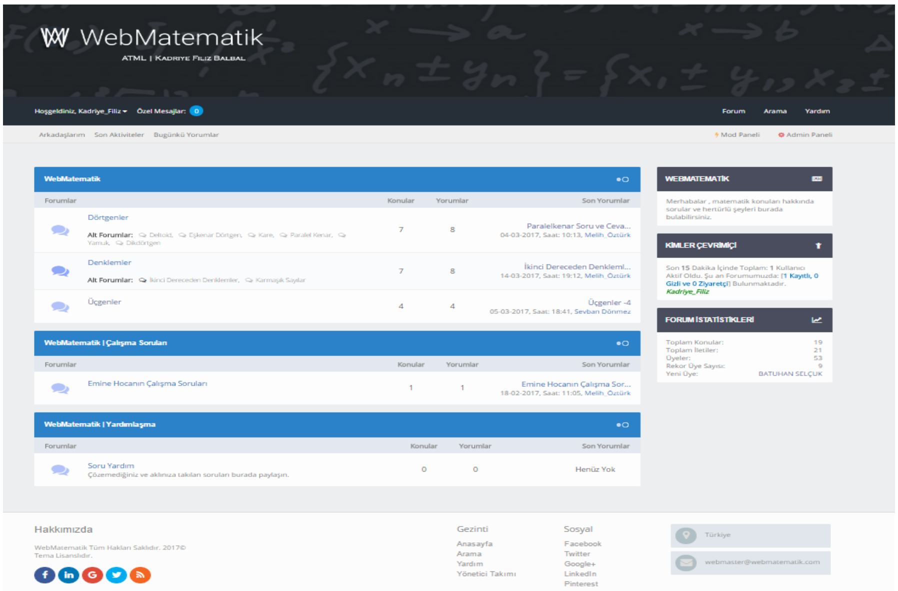
Bu çalışmada, 10. sınıf matematik öğretim programında yer alan konularla ilgili soruların bulunduğu bir Web sitesi hazırlanmış ve uygulanan Web Tabanlı Öğrenme ile ilgili anket ile öğrencilerin görüşleri alınmıştır.

Web Tabanli Öğrenme

İnternet teknolojisinin gelişmesiyle web ortamında bilgi paylaşımının sağladığı avantajlar, bu ortamın eğitim alanında kullanılmasına imkân tanımıştır. Web ortamında, klasik eğitimin sahip olduğu pek çok sınırlılık yoktur. Belli bir zamanda belli bir mekânda olma zorunluluğunun olmaması, web tabanlı öğrenmenin en önemli avantajlarındandır (Trollip ve Alessi, 2001). Web tabanlı öğrenme ortamında öğrenciler, istediği zaman istediği yerde istediği kadar tekrar ederek çalışma özgürlüğüne sahiptir (Bachman , 2002). Öğrenciye, kendi seviyesine uygun eğitsel içerikler sunulabilmesi ve öğrencinin kendi ilgi ve ihtiyaçları doğrultusunda bireysel eğitim olanağına kavuşması web tabanlı öğrenme ortamlarının bir diğer avantajıdır (Khan, 1997). Ayrıca web ortamları, zengin eğitsel içerikler sunmak için de imkânlara sahiptir. Ses, görüntü, animasyon, grafik, etkileşim gibi olanaklar, öğrenmeyi zevkli ve kolay hale getirmektedir (Khan, 1997). Öğrenciler, diğer öğrenenlerle tartışma, sohbet etme, bilgi paylaşımı gibi etkinliklerde bulunarak öğrenmelerini zenginleştirip pekiştirebilmektedirler (Arslan, 2002).

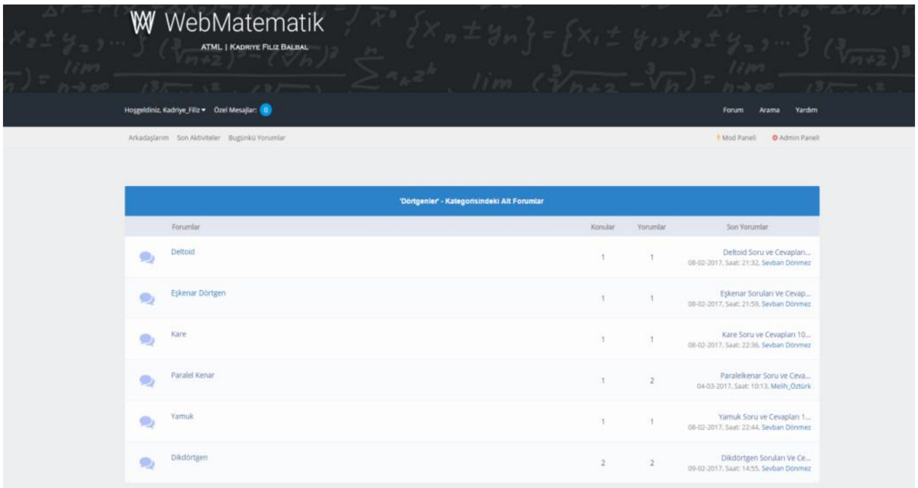
Geliştirilen Web Tabanli Öğrenme Ortami

Çalışma kapsamında, pek çok avantaja sahip olan Web Tabanlı Öğrenme ortamının, öğrencilerin öğrenmesine olumlu etkisi olacağı düşüncesiyle, *webmatematik.com* adlı bir web sitesi hazırlanmıştır. Hazırlanan web sitesinde, 10.sınıf matematik dersinde anlatılan konularla ilgili alıştırma soruları bulunmaktadır. Meslek lisesi öğrencilerinin hazır bulunuşluk düzeyi dikkate alınarak, dersin öğretmeni tarafından hazırlanan özgün sorular öğrencilere, soru çözerek tekrar yapma fırsatı vermektedir.



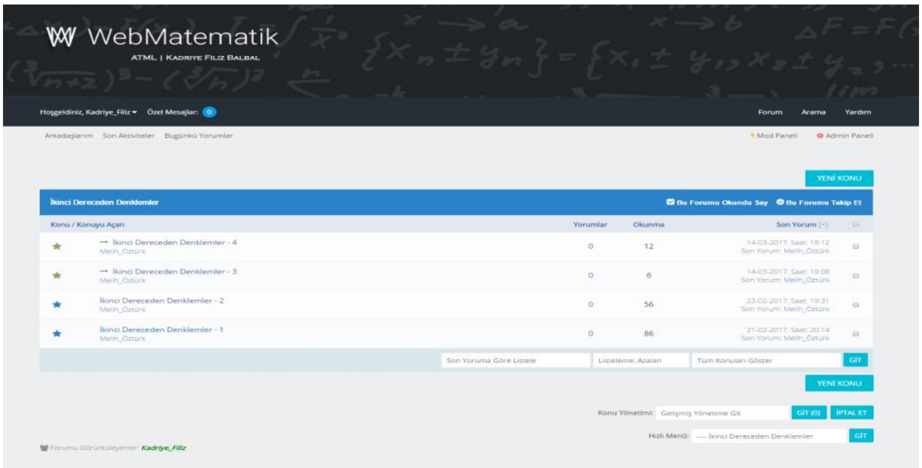
Şekil 1. Web sitesinin ana sayfa ekran görüntüsü

Şekil 1'de, çalışma kapsamında hazırlanan Webmatematik.com adlı web sitesinin ana sayfa ekran görüntüsü yer almaktadır. Öğrenciler, web sitesine ister misafir olarak, isterlerse de üye olarak giriş yapabilirler. Her iki durumda da soruları çözebilir ve buldukları sonuçları sitede verilen doğru cevaplarla karşılaştırabilirler. Çalışma sırasında öğrencilerin web sitesine üye olmaları teşvik edilmiştir. Bunun sebebi, üyeliğin sağladığı bazı avantajlardan yararlanabilmeleridir. Öğrenciler üye girişi yaptıklarında, forumda kendi sınıflarındaki ve diğer sınıflardaki arkadaşlarıyla sohbet etme ve tartışma fırsatı elde etmektedirler. Ayrıca, üye olan öğrenciler yardımlaşma forumunda konuyla ilgili anlamadıkları yerleri sorabilmekte ve çözemedikleri soruları paylaşabilmektedirler. Öğrencilerin web sitesine üye girişi yapmalarının öğretmen açısından avantajı ise öğrencilerin giriş çıkışları ve ne yaptıkları ile ilgili bilgi sahibi olmasına imkân vermesidir.



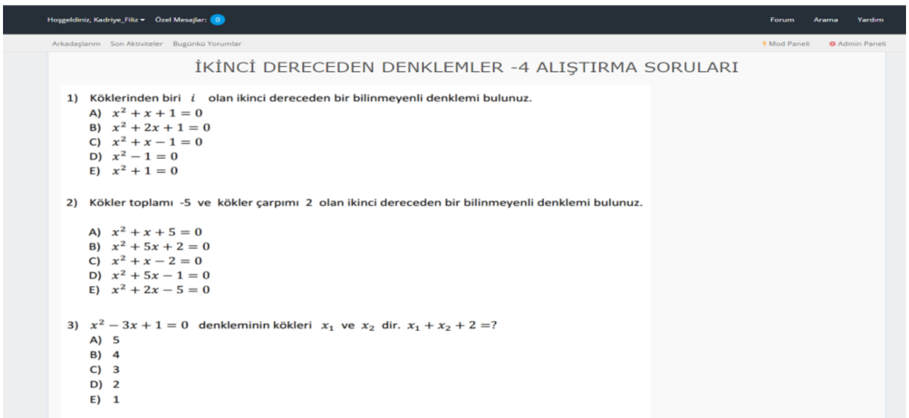
Şekil 2. Web sitesindeki dörtgenler konusunun alt başlıkları ekran görüntüsü

Şekil 2'de, lise 10. Sınıf matematik dersi müfredatında yer alan dörtgenler konusunun alt başlıklarının ekran görüntüsü yer almaktadır. Her bir alt başlığa tıklandığında, o konuyla ilgili sorular görülebilmektedir.



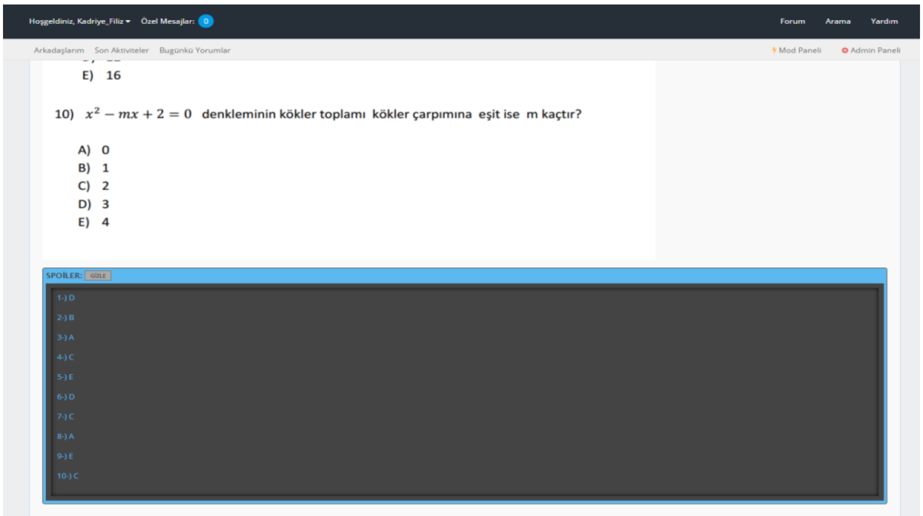
Şekil 3. Web sitesindeki ikinci dereceden denklemler konusunun ekran görüntüsü

Şekil 3'de, çalışma kapsamında hazırlanan web sitesindeki ikinci dereceden denklemler konusunun ekran görüntüsü bulunmaktadır. Öğrenciler, istedikleri testi tıklayıp soruları çözebilmektedirler.



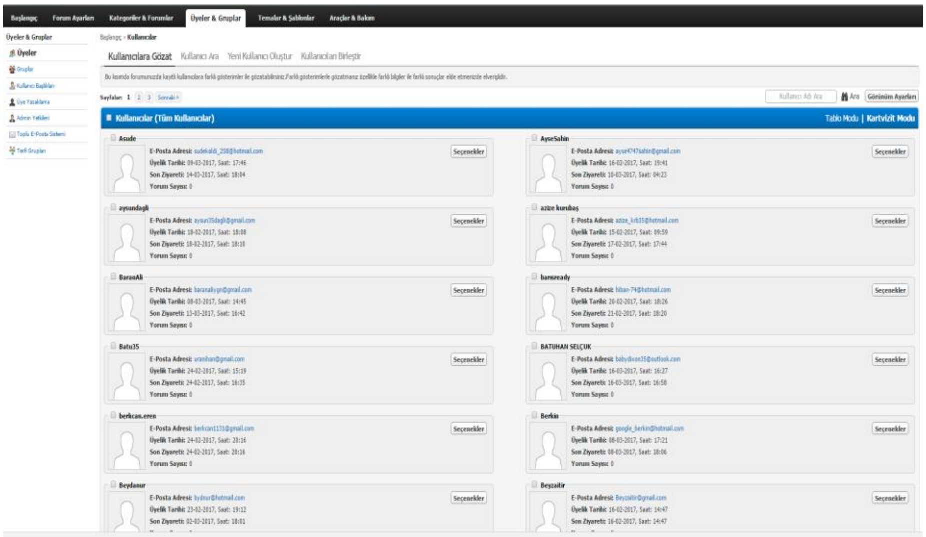
Şekil 4. Web sitesindeki ikinci dereceden denklemler-4 alıştırma soruları ekran görüntüsü

Şekil 4'de, çalışma kapsamında hazırlanan web sitesindeki ikinci dereceden denklemler-4 alıştırma soruları ekran görüntüsü bulunmaktadır. Dersin öğretmeni tarafından hazırlanan özgün sorulardan oluşan testler, öğrencilerin seviyelerine uygundur ve sürekli güncellenerek yeni sorular eklenmektedir. Öğrenciler, derste gördüğü konularla ilgili kendi düzeyinde yapabileceği sorularla, korkmadan ve bıkmadan matematik çalışmaktadır.



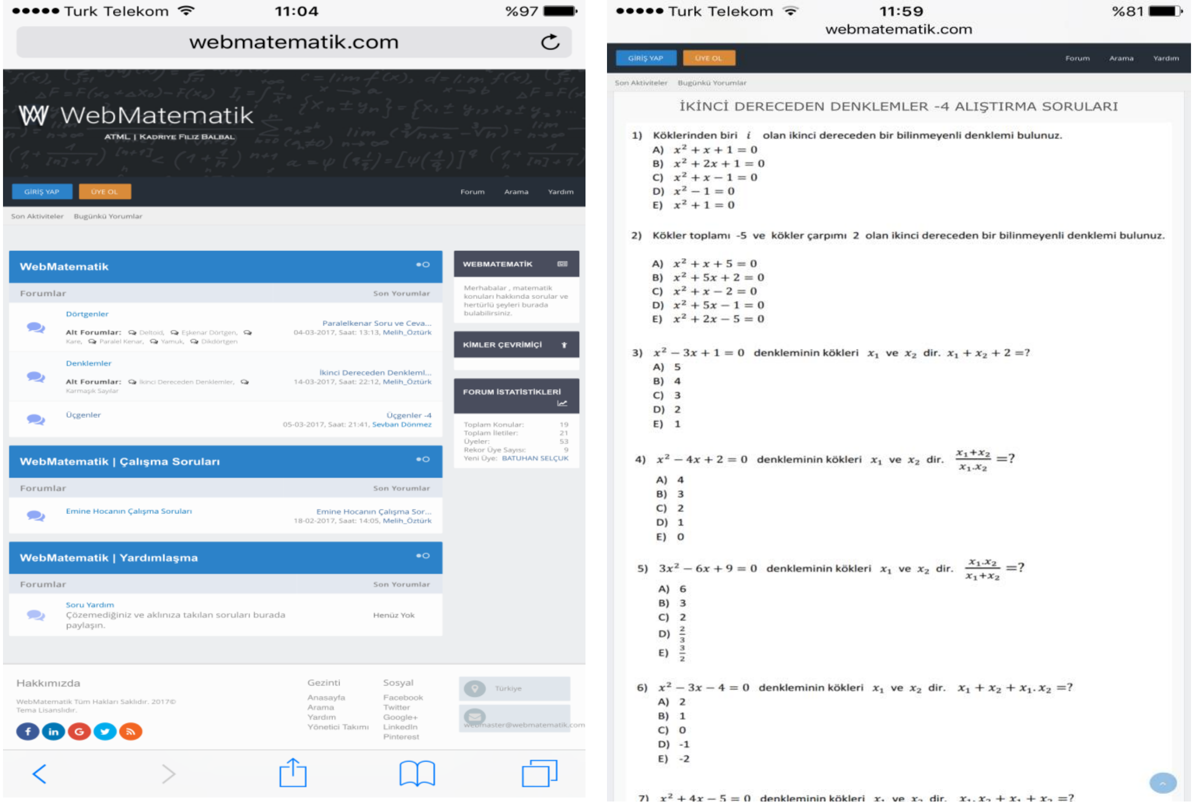
Şekil 5. Web sitesindeki ikinci dereceden denklemler-4 sorularının cevapları ekran görüntüsü

Şekil 5'te, çalışma kapsamında hazırlanan web sitesindeki ikinci dereceden denklemler-4 sorularının cevaplarının ekran görüntüsü bulunmaktadır. Öğrenci testi ilk açtığında cevap anahtarı gizli durumdadır. Testi çözüp bitirdiğinde tıklayarak cevapları açabilir ve dersin öğretmeni tarafından eklenen cevaplarla kendi cevaplarını karşılaştırabilmektedirler.



Şekil 6. Web sitesinin öğretmen (yönetici) paneli ekran görüntüsü

Şekil 6'da çalışma kapsamında hazırlanan web sitesinin öğretmen (yönetici) paneli ekran görüntüsü yer almaktadır. Dersin öğretmeni web sitesine yönetici girişi yaparak, üye olan öğrencilerin isimleri, ne zaman üye oldukları, en son ne zaman web sitesine giriş yaptıkları, ne kadar süre aktif kaldıkları ve hangi konuları inceledikleri gibi ayrıntıları görebilmektedir. Ayrıca, öğrencilere mail yoluyla birebir ulaşabilmektedir.



(a) **(b)**

Şekil 7. Web sitesinin cep telefonundan açıldığındaki ekran görüntüsü

Şekil 7'de çalışma kapsamında hazırlanan web sitesinin cep telefonundan açıldığındaki ekran görüntüsü yer almaktadır. Öğrenciler, bilgisayar başındayken web sitesinde yaptıklarının tamamını cep telefondan giriş yaparak da gerçekleştirebilmektedirler.

Yöntem

Çalışmada bir web tabanlı öğrenme ortamı tasarımı gerçekleştirilmiş ve matematik eğitimindeki etkileri belirlenmeye çalışılmıştır. Bu amaçla, meslek lisesi 10. sınıfta öğrenim gören 58 öğrencinin görüşleri araştırılmıştır. Tek gruplu gerçekleştirilen çalışmada, öğrencilere Kişisel Bilgi Formu ve Yorgancı(2015) tarafından geliştirilen Görüş Belirleme Ölçeği uygulanmıştır.

Bulgular

Bu bölümde, kişisel bilgi formu ve Görüş Belirleme Ölçeği ile elde edilen verilerle yapılan istatistiksel işlemlerin sonuçlarına ilişkin tablolar verilmiş ve açıklamaları yapılmıştır.

Tablo 1. Öğrencilerin demografik özelliklerine göre dağılımları

	Değişkenler	**N**	**%**
Cinsiyet	Kız	20	34,5
	Erkek	38	65,5
İnternete Erişim	Nadiren	6	10,3
	Bazen	8	13,8
	Her gün	44	75,9

Tablo 1'e göre çalışmaya katılan toplam 58 öğrencinin 20'si (%34,5) kız öğrenci, 38'i (%65,5) erkek öğrencidir. Öğrencilerin internete erişim durumuna bakıldığında ise, 44(%75,9) öğrencinin her gün internet kullandığı, 8(%13,8) öğrencinin bazen internet kullandığı ve 6(%10,3) öğrencinin ise nadiren internet kullandığı görülmektedir.

Tablo 2. Öğrencilerin web tabanlı matematik öğretimine ilişkin görüşleri

Web Tabanlı Matematik Öğretimi	**Kesinlikle Katılıyorum**		**Katılıyorum**		**Kararsızım**		**Katılmıyorum**		**Kesinlikle Katılmıyorum**	
	f	**%**	**f**	**%**	**f**	**%**	**f**	**%**	**f**	**%**
1. Web tabanlı öğrenme ortamında matematik dersini çok iyi öğrendim.	5	8,6	24	41,4	25	43,1	3	5,2	1	1,7
2. Web tabanlı eğitim, matematiği öğrenmek için çok elverişli bir yöntemdir.	16	27,6	30	51,7	9	15,5	2	3,4	1	1,7
3. Web tabanlı öğrenme ortamında matematik dersi bir zaman kaybıdır.	2	3,4	5	8,6	8	13,8	24	41,4	19	32,8
4. Web tabanlı öğrenme ortamında matematik dersi eğlenceliydi.	6	10,3	30	51,7	13	22,4	7	12,1	2	3,4
5. Matematik dersi yalnızca yüz yüze sınıf ortamında öğrenilebilir.	5	8,6	5	8,6	16	27,6	20	34,5	12	20,7
6. Web tabanlı öğrenme ortamında matematik dersine daha fazla ilgi duyuyorum.	6	10,3	12	20,7	24	41,4	11	19,0	5	8,6
7. Web tabanlı öğrenme ortamında matematik öğrenmek sıkıcıydı.	3	5,2	7	12,1	9	15,5	27	46,6	12	20,7
8. Matematik öğrenmede, web tabanlı eğitim yöntemlerinden tekrar yararlanmak isterim	13	22,4	22	37,9	17	29,3	4	6,9	2	3,4
Web Tabanlı Eğitim										
9. Web tabanlı eğitim, geleneksel yöntemlerden daha verimlidir.	8	13,8	18	31,0	24	41,4	6	10,3	2	3,4
10. Web tabanlı eğitim yönteminin tüm derslerde kullanılması gerektiğini düşünüyorum.	18	31,0	24	41,4	7	12,1	6	10,3	3	5,2
11. Web tabanlı öğrenme ortamında geleneksel sınıf ortamındaki etkileşim sağlanamaz.	7	12,1	19	32,8	19	32,8	8	13,8	5	8,6
12. Web tabanlı eğitim yöntemi, geleneksel yöntemlere göre daha zengin içerikli ve daha planlıdır.	13	22,4	18	31,0	18	31,0	7	12,1	2	3,4
13. Web tabanlı eğitim yöntemi, daha çok bireysel öğrenme için uygundur.	18	31,0	32	55,2	6	10,3	1	1,7	1	1,7
14. Web tabanlı öğrenme ortamında öğrendiklerim daha kalıcıdır	6	10,3	12	20,7	27	46,6	9	15,5	4	6,9
15. Web tabanlı eğitimin etkili bir yöntem olduğunu düşünmüyorum	2	3,4	15	25,9	13	22,4	18	31,0	10	17,2
16. Web tabanlı öğrenme ortamında, konuyu istediğim zaman istediğim yerden tekrar etmek çok yararlı.	27	46,6	25	43,1	4	6,9	1	1,7	1	1,7

Tablo 2 incelendiğinde, öğrencilerin web tabanlı öğrenme ortamında matematik dersini çok iyi öğrendiği (%41.4), web tabanlı eğitimin matematiği öğrenmek için çok elverişli bir yöntem olduğu (%51.7), web tabanlı öğrenme ortamında matematik dersinin eğlenceli olduğu (%51.7), matematik öğrenmede, web tabanlı eğitim yöntemlerinden tekrar yararlanmak istediği(%37.9) görülmektedir. Tablo 2'deki verilere göre, öğrencilerin web tabanlı eğitim ile ilgili düşünceleri de olumludur. 27 (%46,6) öğrenci "Web tabanlı öğrenme ortamında, konuyu istediğim zaman istediğim yerden tekrar etmek çok yararlı." ifadesine Kesinlikle Katılmakta ve 25 (%43,1) öğrenci Katılmaktadır.

Sonuç ve Öneriler

Bu çalışmada, web tabanlı öğrenme ortamı tasarımı çerçevesinde bir web sitesi hazırlanmıştır. Öğrenciler, web sitesinde yer alan 10. Sınıf matematik konularıyla ilgili soruları çözerek tekrar yapma fırsatı bulmuştur. Web ortamında kendi seviyelerine uygun soruları çözerek derste öğrendikleri bilgileri pekiştiren öğrenciler, matematiği web üzerinden çalışmaya ilgi duymuşlardır. Çalışma sonunda öğrencilerin görüşlerini almak için bir anket uygulanmıştır. Anket verilerine göre, öğrenciler web ortamında matematik öğrenmek ile ilgili olumlu görüş bildirmişlerdir.

Daha sonraki çalışmalarda, eğitsel içerikli web sayfalarında etkileşimli materyallere ve ders anlatım videolarına yer verilebilir. Öğrencilerin birbirlerine web üzerinden soru sormaları teşvik edilebilir. Daha fazla öğrenciyle ve başka dersler için de benzer çalışmalar yapılabilir.

Kaynaklar

Arslan, A. (2002). *Web destekli bilgisayar ögretiminde tasarım kriterlerinin degerlendirilmesi*. Yayımlanmamıs yüksek lisans tezi, Marmara Üniversitesi Fen Bilimler Enstitüsü.

Bachman, K. (2002). *Corporate e-learning: Exploring a new frointer*. WR Hambrecht Co Issues E-Learning Industry Report, San Francisco.

Başaran B. (2010). *Web Tabanlı Sistemlerde Scorm Uyumlu Whiteboard Movie Tekniğinin Öğrencilerin Fizik Derslerindeki Başarı ve Tutumlarına Etkisinin Araştırılması* (Doktora Tezi). Dicle Üniversitesi Fen Bilimleri Enstitüsü, Diyarbakır.

Gordon, D. (2003). Learning effectiveness: a comparative study between web-based and traditional on-campus courses. Yayımlanmamis doktora tezi, University of Nevada.

Khan, B. H. (1997). *Web based instruction.* Education Technology Publication. Englewood Cliffs, NJ.

Leonard, J. ve Smita, G. (2001). Education at the crossroads: Online teaching and students' perspectives on distance learning. *Journal of Research on Technology in Education*, Cilt: 34, No:1.

Mumcu, H. Y., & Yıldız, S. (2015). Uzamsal Düşünmeyi Destekleyici Web-Tabanlı Öğretim Materyali Geliştirme, Uygulama ve Değerlendirilmesi. *İlköğretim Online*, 14(4). Retrieved from http://dergipark.ulakbim.gov.tr/ilkonline/article/view/5000105682

Sheard, J. ve Lynch, J. (2003). Accommodating leaner diversity in web-based learning environments for future development. *International Journal of Computer Processing of Oriental Languages,* Cilt: 16, Sayı: 4, 243-260.

Trollip, S.R. ve Alessi, S.M. (2001). *Multimedia for learning: methods and development.* Allyn & Bacon, Massachusetts.

Uzunboylu, H. (2004). The effectiveness of web assisted english language instruction on the achievement and attitude of the students. *World Conference on Educational Multimedia Hypermedia and Telecommunications,* Cilt: 2004, Sayı: 1, s.727- 733.

Yiğit, Y., Yıldırım, S., & Özden, Y. (2000). Web tabanlı internet öğreticisi: Bir durum çalışması [Web based internet tutorial: A case study]. *Hacettepe University Journal of Education*, 19, 166–176.

Yorgancı, S. (2015). Web Tabanlı Uzaktan Eğitim Yönteminin Öğrencilerin Matematik Başarılarına Etkileri. Kastamonu Eğitim Dergisi, 23(3), 1401-1420.

DETERMINATION OF PRE-SERVICE SCIENCE TEACHERS' AWARENESS OF SCIENTISTS IN THE FIELD OF ELECTRICITY/MAGNETISM

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Abstract: The study was carried out with first year Science Teaching students studying at Education Faculty in Muğla Sıtkı Koçman University in the spring term of 2016-2017 academic year and total 74 students participated in the study. A form was designed by the researcher to determine pre-service science teachers' awareness of scientists who carried out studies about electricity and magnetism. The form aims at identifying scientists carrying out studies in the field of electricity and magnetism and their contributions to the discipline in the history of science. The pre-service teachers' responses who only completed the scientist section or the contribution of scientists to the field section in the form were not included in the evaluation for the data analysis. The frequencies and percentages of the pre-service teachers who responded correctly to both sections in the data collection tool were determined. It can be stated from the responses of the pre-service teachers that such scientists as Edison (invention of light bulb), Michael Faraday (A Faraday cage and laws of electrolysis), Benjamin Franklin (day light saving time, kite experiment, + and – electrical loads), Coulomb (the effects of electrical loads on one another) and George Simon Ohm (Ohm's Law) stand out.

Keywords: Awareness of scientist, pre-service science teachers, electricity/magnetism

FEN BİLGİSİ ÖĞRETMEN ADAYLARININ ELEKTRİK/MANYETİZMA ALANLARINDA ÇALIŞMA YAPAN BİLİM İNSANI FARKINDALIKLARININ BELİRLENMESİ

Özet: Bu çalışma 2016-2017 eğitim öğretim yılı bahar döneminde Muğla Sıtkı Koçman Üniversitesi Eğitim Fakültesi Fen Bilgisi Öğretmenliği birinci sınıf öğrencileri ile gerçekleştirilmiş olup, çalışmaya 74 öğretmen adayı katılmıştır. Fen bilgisi öğretmen adaylarının, elektrik ve manyetizma konularında çalışma yapmış, bilim insanı farkındalıklarını belirlemek için araştırmacı tarafından bir form hazırlanmıştır. Form bilim tarihinde, elektrik/manyetizma alanlarında çalışma yapan bilim insanları ve bilim insanlarının alana katkılarını belirlemeye yöneliktir. Verilerin analizinde sadece bilim insanı kısmını dolduran veya sadece bilim insanının alana katkısı bölümünü dolduran öğretmen adaylarının formu değerlendirmeye dahil edilmemiştir. Veri toplama aracında, her iki bölüme de doğru cevap veren öğretmen adaylarının frekans ve % değerleri belirlenmiştir. Öğretmen adaylarının verdikleri cevaplarda Edison (ampulün icadı), Mıchael Faraday (Faraday kafesi ve elektroliz yasaları), Benjamin Franklin (yaz saati uygulaması, uçurtma deneyi, + ve – elektrik yükleri), Coulomb (elektrik yüklerinin birbirine etkisi- Colulomb yasası) ve George Simon Ohm (ohm kanunu)gibi bilim insanlarının ön plana çıktığı söylenebilir.

Anahtar Sözcükler: Bilim insanı farkındalığı, fen bilgisi öğretmen adayı, elektrik /manyetizma.

Giriş

2013 fen bilimleri dersi öğretim programı vizyonu "Tüm öğrencileri fen okuryazarı birey olarak yetiştirmek" şeklinde ifade edilmiştir. Fen okuryazarı bireyden beklenen, fen bilimlerine ilişkin bilgi, beceri, olumlu tutum, algı ve değere; fen bilimlerinin teknoloji toplum çevre ile olan ilişkisine yönelik anlayışa ve psikomotor becerilere sahip olmasıdır (MEB, 2013).

2013 programının öğrenme alanları ise "Bilgi, beceri, duyuş, fen teknoloji toplum çevre" şeklinde belirlenmiş olup, bilimin doğası FTTÇ öğrenme alanında yer alan altı alt boyuttan biridir. Taşar (2003)'a göre "Bilimin doğası, bilimin ne olduğunu, rolünün ne olduğunu, bilim insanlarının kim olduğu ve ne rol oynadıklarını, doğru bilimsel kanıtı, gözlemleri, gerçekleri, kuralları, yasaları, bilimsel metodu ve bilimin nasıl yapıldığını içermektedir". Öğrencilerin bilimin doğası hakkındaki kavramlarını geliştirmek için, öncelikle öğretmen adayı ve öğretmenlere odaklanılması gereklidir (Lederman, 1992). Fen bilgisi veya fen grubu öğretmenlerinin öğretim metodları takip edilecek olursa, öğretmenlerin genelde fen bilgisi derslerini kendilerinin bilimi nasıl anlıyorlarsa ve öğrendilerse o şekilde öğrettikleri görülmektedir (Palmquist & Finley, 1997 akt: Türkmen & Yalçın, 2001).

Türkiye'de akademik anlamda bilim tarihi disiplini 1955 yılında Ord. Prof. Dr. Aydın Sayılı'nın girişimi ile başlamış (Unat, 2010) ancak Eğitim fakültelerinin lisans programlarında 2006 yılında gerçekleştirilen değişiklik ile bilim tarihine yer verilmeye başlanmış ve "Bilimin doğası ve bilim tarihi" dersi fen bilgisi öğretmenliği programında yer almıştır. Dersin programda yer alması fen bilgisi öğretmen adaylarının bilim insanı algılarının artması ve bilgi düzeylerinin geliştirilmesi açısından önemlidir.
Bu noktadan hareketle çalışmamızın amacı; fen bilgisi öğretmenliği birinci sınıf öğrencilerinin, elektrik ve manyetizma konularında çalışma yapmış bilim insanı farkındalıklarını belirlemek şeklinde ifade edilebilir.

Yöntem

Bu araştırmada tarama modeli kullanılmıştır. Tarama modeli geçmişte ya da halen var olan bir durumu var olduğu şekliyle betimlemeyi amaçlayan araştırma yaklaşımıdır (Cohen ve Manion,1994; Çepni, 2009).

Çalışma grubu

Bu çalışma 2016-2017 eğitim öğretim yılı bahar döneminde Muğla Sıtkı Koçman Üniversitesi Eğitim Fakültesi Fen Bilgisi Öğretmenliği birinci sınıf öğrencileri ile gerçekleştirilmiş olup, çalışmaya 74 öğretmen adayı katılmıştır.

Veri toplama aracı

Fen bilgisi öğretmen adaylarının, elektrik ve manyetizma konularında çalışma yapmış, bilim insanı farkındalıklarını belirlemek için araştırmacı tarafından bir form hazırlanmıştır (EK 1). Form bilim tarihinde, elektrik/manyetizma alanlarında çalışma yapan bilim insanları ve bilim insanlarının alana katkılarını belirlemeye yöneliktir. Veri toplama aracı, 3 fen eğitimi uzmanının görüşleri doğrultusunda düzenlenmiş ve ifadelerin kullanışlılığını tespit etmek için 10 öğrenciden oluşan bir grupta pilot uygulama yapılmıştır. Pilot uygulamada 20 dakikalık bir sürenin yeterli olduğu gözlenmiş, asıl uygulamada da bu süreye uyulmuştur.

Verilerin Analizi

Öğretmen adaylarına, uygulama esnasında, formda yer alan her iki bölümü de doldurmaları gerektiği hatırlatılmış, buna rağmen sadece bilim insanı kısmını dolduran veya sadece bilim insanının alana katkısı bölümünü dolduran öğretmen adaylarının formu değerlendirmeye dahil edilmemiştir. Veri toplama için hazırlanan formda, her iki bölüme de doğru cevap veren öğretmen adaylarının frekans ve % değerleri belirlenmiştir.

Bulgular

Bu bölümde, araştırmanın amacı doğrultusunda toplanan verilerin istatistiksel çözümlemeleri sonucunda elde edilen bulgulara yer verilmiştir. Tablo 1'de Fen bilgisi öğretmenliği birinci sınıf öğrencilerinin, elektrik ve manyetizma konularında çalışma yapmış bilim insanı farkındalıkları görülmektedir. Tablo 1 incelendiğinde öğretmen adayları tarafından, veri toplama aracında en çok ifade edilen bilim insanı Edison olmuştur. Çalışmaya katılan 74 öğretmen adayından 34'ü Edison'un alana katkısını "ampulün icadı" olarak ifade etmiştir. 34 öğretmen adayından 1 öğretmen adayı Edison'un tam ismi olan "Thomas Alva Edison"u belirtmişken, 1 öğretmen adayı da sadece "Thomas Edison" şeklinde ifade etmiştir.

Tablo 1 incelendiğinde ikinci sırayı Mıchael Faraday'ın aldığı gözlenmektedir. Çalışmaya katılan 74 öğretmen adayından 31 tanesi Faraday'ı elektrik/manyetizma alanına katkı sağlamış bilim insanı olarak ifade etmiştir. Otuz bir öğretmen adayından sadece bir kişi Faraday'ın alana katkısını "elektroliz yasaları", üç öğretmen adayı "anot-katot-iyon gibi kavramları hayatımıza kazandırmıştır", dört öğretmen adayı "amperi kesin olarak tanımlamıştır." ifadesini kullanmıştır. Yirmi dört öğretmen adayı ise Faraday'ın alana katkısını "Faraday kafesi" olarak ifade etmiştir.

Tablo 1 incelendiğinde üçüncü sırada yirmi yedi öğretmen adayı ile Nichola Tesla'nın yer aldığı görülmektedir. Yirmi yedi öğretmen adayından bir öğretmen adayı Tesla'nın alana katkısını "Tesla bobini", 2 öğretmen adayı alana katkısını “alternatif akım”, yirmi dört öğretmen adayı da “elektriğin kablosuz taşınması” şeklinde ifade etmiştir.

Tablo 1 incelendiğinde Benjamin Franklin’i elektrik/manyetizma alanında çalışma yapan bilim insanları arasına dahil eden yirmi iki öğretmen adayı bulunmaktadır. Bu öğretmen adaylarından bir tanesi Franklin’in alana katkısını “Yaz saati uygulaması”, üç öğretmen adayı “Uçurtma deneyi- şimşeğin elektriksel olay oluşu”, on dokuz öğretmen adayı ise “Elektrik yükleri” şeklinde ifade etmiştir.
Tablo 1 incelendiğinde Colulomb’u elektrik/manyetizma alanında çalışma yapan bilim insanları arasına dahil eden yirmi iki öğretmen adayı bulunmaktadır. Öğretmen adayları Coulomb’un alana katkısını “Coulomb kanunu” şeklinde ifade etmiştir.

Elektrik/manyetizma alanında çalışma yapan bilim insanları arasına dahil edilen bir diğer bilim insanı da George Simon Ohm’dur. On beş öğretmen adayı George Simon Ohm’un alana katkısını “Ohm kanunu” olarak ifade etmiştir.

Öğretmen adayları tarafından daha az ifade edilen bilim insanları; Andre Marie Amper; alana katkısı elektromanyetizma alanındaki çalışmaları, Thales; alana katkısı elektron kavramı, Weber; alana katkısı mıknatısın iki kutba sahip olması, Joseph Henry: alana katkısı, elektromıknatıs ile ilgili çalışmalar, James Watt; alana katkısı buhar motoru, Gauss; alana katkısı, Gauss kanunu şeklindedir.
Tablo 1’de belirtilen bilim insanı ve alana katkıları dışında “Einstein, Newton, Planck, De Broglie, Rutherford, Wilson” gibi bilim insanları da öğretmen adayları tarafından belirtilmiştir.

Tablo 1:Fen bilgisi öğretmenliği birinci sınıf öğrencilerinin, elektrik ve manyetizma konularında çalışma yapmış bilim insanı farkındalıkları

Bilim İnsanı	**Alana Katkısı**	**f**	**%**
Edison	Ampulun icadı	34	45,94
Michael Faraday	Amper’i açıklama	31	41,89
	Faraday kafesi		
	Anot-katot-iyon kavramları		
	Elektroliz yasası		
Nicola Tesla	Tesla bobini	27	36,48
	Alternatif akım		
	Elektriğin kablosuz taşınması		
Benjamin Franklin	Elektrik Yükleri	22	29,72
	Uçurtma deneyi		
	Yaz saati uygulaması		
Coulomb	Coulomb kanunu	22	29,72
George Simon Ohm	Ohm Kanunu	15	20,27
Andre Marie Amper	Elektromanyetizma	6	8,10
Thales	Elektron kavramı	3	4,05
Weber	Mıknatısın iki kutba sahip olması	2	2,70
Joseph Henry	Elektromıknatıs ile ilgili çalışmalar	2	2,70
James Watt	Buhar motoru	1	1,35
Gauss	Gauss kanunu	1	1,35

Sonuç ve Öneriler

Bilimin gelişiminin, bu gelişimi etkileyen faktörlerin, bilim insanlarının çalışma şekillerinin anlaşılması bilimin (Monk & Osborne, 1997) ve bilimin doğasının (Lin & Cheng, 2002) anlaşılmasını da beraber getirecektir. Bilim tarihi aracılığıyla öğrenciler, bilimsel bilginin nasıl geliştiğini, tarihi, felsefi ve teknolojik bağlamın bu gelişimi nasıl etkilediğini anladıklarında, bilimle ilgili daha kapsamlı görüşe sahip olacaklar, dolayısıyla fen öğrenimine daha ilgili olacaklardır (Justi & Gilbert, 2000 akt: Lacin şimşek, 2011)

Bu çalışma kapsamında fen bilgisi öğretmenliği birinci sınıf öğrencilerinin elektrik/manyetizma alanında çalışma yapmış bilim insanı farkındalıklarının belirlenmesi amaçlanmıştır. Elde edilen bulgular doğrultusunda fen bilgisi öğretmen adaylarının elektrik/manyetizma alanında çalışma yapmış bilim insanı farkındalıklarının yeterli düzeyde olmadığı söylenebilir. Öğretmen adayları tarafından bu alanda çalışma yapmış on iki bilim insanı ifade edilmiştir. Çalışmadan elde edilen sonuçlara göre, öğretmen adayları tarafından ifade edilen bilim insanları arasında; Edison, Michael Faraday, Nicola Tesla, Benjamin Franklin, Coulomb, George Simon Ohm üst sıralarda yer alırken, Andre Marie Amper, Thales, Weber, Joseph Henry, James Watt ve Gauss daha az öğretmen adayı tarafından ifade edilen bilim insanları olmuşlardır. Çalışma kapsamında Edison'un isminin ilk sırada yer alması literatürde yer alan çalışmalar ile uyumludur (Lacin Şimşek, 2011; Korkmaz & Kavak, 2010; Demirbaş, 2009).

Yapılan birçok çalışmada; öğretmen davranışlarının, öğretmenin öğrencilerine sunduğu örneklerin ve öğrenme ortamının, öğrencilerin bilime yönelik algılarını, tutumlarını ve bilim insanlarına yönelik imajlarını etkilediği vurgulanmaktadır (Christidou, 2011; Milford & Tippett; 2013). Bu durum, öğretmenlerin derslerinde bilimsel çalışmaların doğasına, bilimsel süreç becerilerine, bilim insanlarına ve onların çalışma ortamlarına eşitlik, cinsiyet, kültürel özgeçmiş vb. unsurlardaki çeşitliliği dikkate alarak yer vermesi gerektiğini göstermektedir (Korkmaz & Gürçay, 2016). Özellikle derslerde yapılacak uygulamalar ile öğretmen adaylarının bilim insanı algılarının arttırılması sağlanabilir. Öğretmen adaylarının bilimin herkes için ulaşılabilir olduğunu algılamaları ve bilimsel düşünceyi yaşamlarının bir parçası haline getirmeleri için derslerde projeler hazırlanabilir. Çalışma sonucunda elde edilen bulgulara göre öğretmen adaylarının Türk-İslam bilginlerine ve kadın bilim insanlarına yer vermediği gözlenmiştir. Eğitim öğretim faaliyetleri çerçevesinde farklı tarihsel dönemlerden, farklı cinsiyet ve kökenden bilim insanlarına yer verilebilir. Gerçekleştirilen çalışma sadece Fen bilgisi öğretmenliği birinci sınıf öğrencileri ile gerçekleştirilmiş olup, benzer çalışmalar farklı örneklemler ile de gerçekleştirilebilir.

Kaynaklar

Christidou, V. (2011). Interest, attitudes and ımages related to science: combining students' voices with the voices of school science, teachers, and popular science. *International Journal of Environmental and Science Education*, 6(2), 141-159.

Cohen, L. & Manion, L. (1996). *Research methods in education*. London: Routledge (4. Baskı).

Çepni, S. (2009). *Araştırma ve Proje Çalışmalarına Giriş* (4. Baskı). Trabzon: Celepler Matbaacılık.

Demirbaş, M. (2009). Türkiye'deki bilim ve sanat merkezlerinde öğrenim gören üstün yetenekli öğrencilerin bilim adamı imgeleri. *Journal of Qafqas Education*, 28: 197-207.

Justi, R. & Gilbert, J. (2000). "History and philosophy of science through models: some challenges in the case of 'the atom". *International Journal of Science Education*, 22(9): 993- 1009.

Korkmaz, H. & Kavak, G. (2010). İlköğretim öğrencilerinin bilime ve bilim insanına yönelik imajları. *İlköğretim Online*, 9(3), 1055-1079.

Korkmaz, H. & Gürçay, D. (2016). Öğretmen Adaylarının Fizik Çalışan Bilim İnsanlarına Yönelik İmajları: Öğretmen Eğitimi Açısından Doğurguları, *Kastamonu Eğitim Fakültesi Dergisi*, 24,2, 655-672.

Ledreman, N. G. (1992). Students and teacher conceptions of the natüre of science. A rewiev of the research. *Journal of Research in Science Teaching*, 29 (4), 331-359.

Lin, H. & Cheng, C-C. (2002). Promoting preservice chemistry teachers' understanding about the nature of science through history. *Journal of Research in Science Teaching*, 39(9), 773–792.

MEB. (2013). İlköğretim Kurumları (İlkokullar ve Ortaokullar) Fen Bilimleri Dersi (3, 4, 5, 6, 7 ve 8. Sınıflar) Öğretim Programı, Ankara: *MEB Yayınevi*.

Millford, T. & Tippett, C.D. (2013). Preservice Tecahers' Images of Scientists: Do prior Science Experiences Make a Difference? *Journal of Science Teacher Education*. 24: 745-762

Monk, M. & Osborne, J. (1997). Placing the history and philosophy of science on the curriculum: a model for the development of pedagogy. *Science Education*, 81, 405–424.

Palmquist, B. C. & Finley, F. N. (1997). Preservice teachers, views of the nature of science during a postbaccalaureate science teaching program. *Journal of Research in Science Teaching*, 34, 595-615.

Laçin-Şimşek, C. (2011). Bilimin Doğası ve Bilim Tarihi Dersinde Yapılan Çalışmaların Öğrencilerinin Bilim Tarihi İle İlgili Bilgi Düzeylerine Etkisi, *Necatibey Eğitim Fakültesi Dergisi*, 5, 1, 116-139.

Taşar, M. F. (2003)."Teaching history and the nature of science in science teacher education programs.'' *Pamukkale Üniversitesi Eğitim Dergisi,* 13(1): 31-41.

Türkmen, L. & Yalçın M. (2001). Bilimin Doğası ve Eğitimdeki Önemi. *AKU Sosyal Bilimler Dergisi*, 3 (1), 189-195.

Unat, Y. (2010) Osmanlılarda Bilim ve Teknoloji, *Nobel yayıncılık.* Ankara.

THE EXAMINATION OF SCIENCE TEACHERS' ATTITUDES TOWARDS EDUCATIONAL RESEARCHES

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Abstract: Scientists conduct many educational researches about various topics to improve the quality of the education. On the other hand teachers are expected to apply the findings of these researches into practices. The attitude of the teachers towards these researches plays an important role on the usage of the results of educational researches. The research was designed according to scanning model. Scanning model, which allow the determination of the current situation, was used because it was descriptive type. 137 science teachers who voluntarily participated in the study. The distribution of the teachers according to discipline was: 48 physics teachers, 33 chemistry teachers and 56 biology teachers. The scale used in the study to determine the attitude of the teachers towards educational researches was "Attitude towards Educational Researches Scale (AERS)", which is a 5-points Likert type scale developed by İlhan, Şekerci, Sözbilir and Yıldırım (2013). The validity and reliability tests of the scale were performed by İlhan, Şekerci, Sözbilir and Yıldırım (2013). Arithmetic mean, standard deviation, percentages, t-test and one-way variance analysis were used to analyze the data obtained within the study. According to the result of the analysis, it has been found that the mean scores obtained from the dimensions of AERS did not differentiated according to gender, type of the secondary education, and attended trainings.

***Keywords*:** Science teachers, attitudes towards educational researches scale, scanning model

FEN BİLİMLERİ ÖĞRETMENLERİNİN EĞİTİM ARAŞTIRMALARINA YÖNELİK TUTUMLARININ İNCELENMESİ

Özet: Eğitimin kalitesini arttırmak amacıyla araştırmacılar tarafından farklı konularda birçok eğitim araştırması yapılmaktadır. Öğretmenlerin de bu araştırma sonuçlarına dayanarak uygulamalar yapmaları beklenmektedir. Öğretmenlerin eğitim araştırmalarından yararlanmalarında bu araştırmalara karşı tutumları önemli bir yer tutmaktadır. Bu çalışmada fen bilimleri öğretmenlerinin eğitim araştırmalarına yönelik tutumlarının incelenmesi amaçlanmıştır. Bu araştırmada var olan durumu saptamaya yönelik tarama modeli kullanılmıştır. Çalışmaya 2014-2015 eğitim-öğretim yılı Eskişehir ili merkez ilçelerinde Milli Eğitim Bakanlığı'na bağlı liselerde görev yapan 48 fizik, 33 kimya, 56 biyoloji olmak üzere toplam 137 fen bilimleri öğretmeni katılmıştır. Bu çalışmada İlhan, Şekerci, Sözbilir ve Yıldırım (2013) tarafından geliştirilen öğretmenlerinin eğitim araştırmalarına karşı tutumlarının belirlenmesine yönelik "Eğitim Araştırmalarına Yönelik Öğretmen Tutum Ölçeği (EAÖTÖ)" olarak adlandırılan 5'li likert Likert tipi bir ölçek kullanılmıştır. Araştırmada elde edilen verilerin çözümlenmesinde aritmetik ortalama, standart sapma, yüzde, t-testi ve tek yönlü varyans analizi kullanılmıştır. Analiz sonuçlarına göre eğitim araştırmalarına yönelik tutum ölçeğinin tüm alt boyutlarından alınan puan ortalamalarının cinsiyete, ortaöğretimin türüne, eğitim araştırmalarına yönelik eğitim alma durumuna ve branşlara göre anlamlı bir farklılık göstermediği bulunmuştur.

Anahtar Sözcükler: Fen bilimleri öğretmenleri, eğitim araştırmalarına yönelik tutum ölçeği, tarama modeli

Giriş

Eğitimin ilerlemesinde eğitim araştırmaları önemli bir rol oynamaktadır. Bununla beraber, eğitimin gelişmesinde öğretmenler önemli bir yere sahiptir. Eğitimin kalitesini arttırmak amacıyla bilim insanları tarafından farklı konularda birçok eğitim araştırması yapılmaktadır. Öğretmenlerden de bu araştırma sonuçlarına dayanarak uygulamalar yapmaları beklenmektedir. Ancak, araştırmalar öğretmenlerin genel olarak eğitim araştırmalarından uzak olduklarını, mevcut eğitim çalışmalarından gereği kadar faydalanmadıklarını, yeteri kadar araştırma yapmadıklarını ve mevcut araştırmalara karşı bazı olumsuz tutumlara sahip olduklarını ortaya koymaktadır (Costa, Marques, ve Kempa, 2000; Çepni ve Küçük, 2003; De Jong, 2004; Ekiz, 2006; Pajares, 1992).

Tutumlar bireyin davranışlarında yönlendirici bir etkiye sahip olduğundan, dolayısıyla olumlu ya da olumsuz davranışlara yol açabilir (Tavşancıl, 2010, s.72). Tutumlar hem sosyal algımızı hem de davranışlarımızı etkilemektedir. Tutum, bir bireye atfedilen ve onun bir psikolojik obje ile ilgili düşünce, duygu, ve davranışlarını düzenli biçimde oluşturan bir eğilimdir (Kağıtçıbaşı, 1999). Tutumlar nesneler, insanlar ya da olaylar hakkında olumlu ya da olumsuz değerleme ifadeleridir. Tutumlar, insanın bir şey hakkında ne hissettiğini ifade etmektedir (Robbins, 1994). Tutumların psikolojik bir objeye ilişkin olduğu, tepki vermeye hazır olmayı içerdiği, güdüleme gücüne sahip olduğu, durağan olabileceği, değerlendirme içerdiği, bireyin gözlenebilen davranışlarından çıkarsama yapılarak bireye atfedilen bir eğilim olduğu vurgulanmaktadır (Kağıtçıbaşı, 1999; Sakallı, 2001). Bir insanın birçok durum ve uyarana karşı birçok tutumu olabilmektedir. İnsanlar, çevrelerinde tutum objesi olabilecek her şeye karşı deneyimleriyle, anne-baba, arkadaş çevresi, kitle iletişim araçları, diğer bireylerin etkisi ve koşullanma yoluyla birçok tutumu öğrenebilirler (Üstüner, 2006).

Son yıllarda özellikle fen eğitimi alanında yapılan araştırmalarda bir artışın olmasına rağmen (Chang, Chang ve Tseng, 2010; Sozbilir, Kutu ve Yasar, 2012; Tsai ve Wen, 2005), bu araştırmalardan eğitim-öğretim uygulamalarında yararlanma oranı düşük kalmaktadır (De Jong, 2004; Everton, Galton, ve Pell, 2000; Vanderlinde ve van Braak, 2010). Öğretmen adaylarının, öğretmenlerin ve eğitimcilerin eğitim araştırmalarına yönelik tutumlarını ortaya koyan çalışmalarda; ya genel olarak bilimsel araştırmalara yönelik tutumlar (Cousins ve Walker, 2000; Korkmaz, Şahin, ve Yeşil, 2011a; Walker, 2010) ya da sadece eğitim araştırmalarına karşı tutumlar (Everton, Galton, ve Pell, 2002; Öztürk, 2010; Yavuz, 2009) incelenmiştir. Eğitim araştırmalarına yönelik tutumlar, daha çok betimsel ve nitel çalışmalarla belirlenmiştir (Ekiz, 2006; Korkmaz, Şahin, ve Yeşil, 2011b; Vanderlinde ve van Braak, 2010). Öğretmenlerin eğitim araştırmalarının bulgularından yararlanmalarında bu araştırmalara karşı tutumları önemli bir yer tutmaktadır. Bu açıdan öğretmenlerin yapılan çalışmaların faydasına, kullanılabilirliğine inanmaları onlardan daha fazla yararlanmalarını etkileyebileceği söylenebilir. Öğretmenlerin eğitim araştırmalarına yönelik tutumlarının araştırılması bu açıdan önemlidir. Bu çalışmada bireylerin davranışlarının incelenmesinde davranışın belirleyicilerinden birisi olarak tutumlar araştırmaya ve incelenmeye değer görülmektedir. Bu nedenle bu çalışmada uygulamalı derslerden olan fen bilimleri (fizik, kimya ve biyoloji) dersine giren öğretmenlerin eğitim araştırmalarına yönelik tutumları incelenmek istenmiştir. Bu çalışmada fen bilimleri öğretmenlerinin eğitim araştırmalarına yönelik tutumlarının incelenmesi amaçlanmıştır. Bu amaç doğrultusunda şu sorulara yanıt aranmıştır: Fen bilimleri öğretmenlerinin eğitim araştırmalarına yönelik tutumları cinsiyet, ortaöğretimin türü ve eğitim alma durumu değişkenlerine göre farklılık göstermekte midir? Fen bilimleri öğretmenlerinin eğitim araştırmalarına yönelik tutumları branş ve kıdem değişkenlerine göre farklılık göstermekte midir?

Yöntem

Araştırmanın Modeli

Betimsel nitelikte olan bu araştırmada var olan durumu saptamaya yönelik tarama modeli kullanılmıştır. Tarama araştırmaları, grupların karakteristik özelliklerini belirlemeyi amaçlamaktadır. Tarama araştırmaları ölçülebilir değişkenlere ilişkin cevapların alınması; araştırmacının değişkenleri ve değişkenlere ait göstergeleri aynı anda çeşitli sorularla inceleyebilmesi açısından güçlü bir yaklaşım olarak öne çıkmaktadır (Neuman, 2012).

Çalışma Grubu

Çalışmanın evrenini 2014-2015 eğitim-öğretim yılı Eskişehir ili merkez ilçelerinde Milli Eğitim Bakanlığı'na bağlı 46 lisede görev yapan 352 fen bilimleri (fizik, kimya, biyoloji) öğretmeni oluşturmuştur. Araştırmada örneklem seçimine gidilmemiş, evrenin tamamına ulaşılmak istenmiştir. Ancak 137'sına ulaşılmıştır. Ölçeklerin geri dönüş oranı 137.100/352'dir. Çalışmada evrenin %39'una ulaşılarak çalışmaya katılmaya gönüllü olan 137 fen bilimleri öğretmeni ile çalışma tamamlanmıştır. Araştırmaya 48 fizik, 33 kimya, 56 biyoloji olmak üzere toplam 137 fen bilimleri öğretmeni katılmıştır. Bu öğretmenlerin 83'ü (%52.9) kadın, 53'ü (%33.8) erkek öğretmenlerden oluşmaktadır. Öğretmenlerin 95'i (60.5) genel ortaöğretimde, 42'si (26.8) ise meslek ve teknik liselerde görev yapmaktadır. Öğretmenlerin 72'sı (45.9) eğitim araştırmalarına yönelik herhangi bir eğitim almazken, 56'sı (35.7) eğitim araştırmalarına yönelik herhangi bir eğitim aldıklarını belirtmiştir.

Veri Toplama Aracı

Bu çalışmada İlhan, Şekerci, Sözbilir ve Yıldırım (2013) tarafından geliştirilen öğretmenlerinin eğitim araştırmalarına karşı tutumlarının belirlenmesine yönelik "Eğitim Araştırmalarına Yönelik Öğretmen Tutum Ölçeği (EAÖTÖ)" olarak adlandırılan Likert tipi bir ölçek kullanılmıştır. "Eğitim Araştırmalarına Yönelik Öğretmen Tutum Ölçeği (EAÖTÖ)" 5'li likert şeklinde; (1) Hiç katılmıyorum, (2) Katılmıyorum, (3) Kararsızım, (4) Katılıyorum ve (5) Tamamen Katılıyorum olarak puanlanmıştır.

Ölçeğin geçerlik ve güvenirlik çalışmaları İlhan, Şekerci, Sözbilir ve Yıldırım (2013) tarafından yapılmıştır. Ölçeğin tüm boyutları için (20 madde) Cronbach's Alpha katsayısı 0,881 olarak hesaplanmıştır. Bu değerlere göre ölçeğin güvenilir olduğu kabul edilebilir (Büyüköztürk, 2002; Ho, 2006; Field, 2009). Ölçeğin her bir boyutunda yer alan maddeler göz önünde bulundurularak faktörler sırasıyla eğitim araştırmalarının gerekliliği, eğitim araştırmalarına değer verme, eğitim araştırmalarının uygulanabilirliği şeklinde adlandırılmıştır.

Ölçeğin geçerliğini sınamak ve faktör yapısını incelemek için açımlayıcı faktör analizi kullanılmıştır. Örneklemin yeterliliğini değerlendirmek üzere hesaplanan KMO katsayının (.875) oldukça yüksek ve faktör analizinin geçerliliğini sınayan Bartlett testi sonucunun ise anlamlı (1054.979, $p < .001$) olması nedeniyle faktör analizinin yapılabileceği görülmüştür. Temel Bileşenler Analizi sonucunda toplam varyansın % 55.725'inü açıklayan ve öz değeri 1'in üstünde olan 3 faktör elde edilmiştir. Boyutlara ait varyanslar sırasıyla % 20, % 19 ve % 16'dır. Eğitim araştırmalarına yönelik tutumların alt boyutlarına ait maddelerin faktör yükleri 0.50'den büyüktür. Ölçeğin toplam güvenirliği .90 ve sırasıyla üç alt boyuta ait güvenirlik katsayıları .85, .85 ve .81'dir. Bu değerler yüksek iç tutarlığın göstergesidir (Hair, Anderson, Tahtam, & Black, 1998).

Bu araştırmada da EAÖTÖ üç boyutlu olarak ele alınmıştır. Öğretmen adaylarının vermiş olduğu yanıtlar, olumlu ifadeler için 5, 4, 3, 2, 1 şeklinde ve olumsuz ifadeler için yine aynı kategoriden başlanarak 1, 2, 3, 4, 5 şeklinde puanlanmıştır. Buna göre ölçekte yedişer madde ile ölçülen 2. ve 3. boyutlarda en fazla 35, en az 7 puan alınabilmiştir. Altışar maddeden oluşan 1. boyutta ise puanlar 6 ile 30 arasında değişmiştir. Tüm boyutlar bir bütün olarak ele alındığında ise EAÖTÖ'nün genelinden maksimum 100, minimum 20 alınması mümkündür. Bu puanlama sistemine göre yüksek puan alan öğretmenler, eğitim araştırmalarına yönelik yüksek tutuma sahip olmaktadır.

Verilerin Analizi

Öğretmenlere uygulanan EAÖTÖ'nin elde edilen sonuçlar SPSS 21.0 istatistik paket programından yararlanılarak analiz edilmiştir. Araştırmada elde edilen verilerin çözümlenmesinde aritmetik ortalama, standart sapma, yüzde, t-testi ve tek yönlü varyans analizi kullanılmıştır. Varyansların homojen olduğu belirlendikten sonra; fen bilimleri öğretmenlerinin eğitim araştırmalarına yönelik tutumlarının cinsiyet, ortaöğretimin türü ve eğitim alma durumu değişkenlerine göre farklılık gösterip göstermediğini belirlenmek için bağımsız gruplar için t-testi, branş ve kıdem değişkenlerine göre farklılık gösterip göstermediğini belirlenmek için ise Tek Yönlü Varyans Analizi (ANOVA) ile gruplar arası farklılığı belirlemek için de LSD testi yapılmıştır.

Bulgular

Bu çalışmada fen bilimleri öğretmenlerinin eğitim araştırmalarına yönelik tutumlarının incelenmesi amaçlanmıştır. Fen bilimleri öğretmenlerinin eğitim araştırmalarına yönelik tutumlarının cinsiyet, ortaöğretimin türü, eğitim alma durumu, branş ve kıdem değişkenlerine göre incelenmesine ilişkin bulgular aşağıda yer almaktadır.

Fen bilimleri öğretmenlerinin, eğitim araştırmalarına yönelik öğretmen tutum ölçeğinin alt boyutlarından aldıkları puan ortalamalarının cinsiyete göre farklılaşıp farklılaşmadığı bağımsız gruplar için t-testi ile tespit edilmiştir. T-testi sonuçları Tablo 1'de yer almaktadır.

Tablo 1: Öğretmenlerinin uygulanan EAÖTÖ alt boyutlarından aldıkları puan ortalamalarının cinsiyete göre bağımsız gruplar için t-testi sonuçları

Değişken	**Cinsiyet**	**N**	$\bar{X}$	**S**	**sd**	**t**	**p**
Eğitim Araştırmalarının Gerekliliği	Kadın	79	27.22	3.989	129	.495	.626
	Erkek	52	27.58	4.244			
Eğitim Araştırmalarına Değer Verme	Kadın	77	25.79	3.346	125	.082	.935
	Erkek	50	25.84	3.139			
Eğitim Araştırmalarının Uygulanabilirliği	Kadın	76	22.57	5.068	124	.371	.711
	Erkek	50	22.90	4.862			

Analiz sonuçlarına göre EAÖTÖ'nin alt boyutlarından alınan puan ortalamalarının cinsiyete göre anlamlı bir farklılık göstermediği bulunmuştur (t= .495; p= .626, p> .05, t= .082; p= .935, p> .05, t= .371; p= .711, p> .05). Fen bilimleri öğretmenlerinin, eğitim araştırmalarına yönelik öğretmen tutum ölçeğinin alt boyutlarından aldıkları puan ortalamalarının ortaöğretimin türüne göre farklılaşıp farklılaşmadığı bağımsız gruplar için t-testi ile tespit edilmiştir (Tablo 2).

Tablo 2: Öğretmenlerinin uygulanan EAÖTÖ alt boyutlarından aldıkları puan ortalamalarının ortaöğretimin türüne göre bağımsız gruplar için t-testi sonuçları

Değişken	**Cinsiyet**	**N**	$\overline{X}$	**S**	**sd**	**t**	**p**
Eğitim Araştırmalarının Gerekliliği	Genel ortaöğretim	90	27.37	4.273	130	.209	.835
	Meslek ve Teknik Liseler	42	27.21	3.719			
Eğitim Araştırmalarına Değer Verme	Genel ortaöğretim	88	25.90	3.343	126	.653	.515
	Meslek ve Teknik Liseler	40	25.50	3.121			
Eğitim Araştırmalarının Uygulanabilirliği	Genel ortaöğretim	86	22.58	4.808	125	.201	.841
	Meslek ve Teknik Liseler	41	22.78	5.401			

Analiz sonuçlarına göre EAÖTÖ'nin alt boyutlarından alınan puan ortalamalarının ortaöğretimin türüne göre anlamlı bir farklılık göstermediği bulunmuştur (t= .209; p= .835, p> .05, t= .653; p= .515, p> .05, t= .201; p= .841, p> .05). Fen bilimleri öğretmenlerinin, eğitim araştırmalarına yönelik öğretmen tutum ölçeğinin alt boyutlarından aldıkları puan ortalamalarının eğitim araştırmalarına yönelik eğitim alma durumuna göre farklılaşıp farklılaşmadığı bağımsız gruplar için t-testi ile tespit edilmiştir (Tablo 3).

Tablo 3: Öğretmenlerinin uygulanan EAÖTÖ alt boyutlarından aldıkları puan ortalamalarının eğitim araştırmalarına yönelik eğitim alma durumuna göre bağımsız gruplar için t-testi sonuçları

Değişken	**Cinsiyet**	**N**	$\overline{X}$	**S**	**sd**	**t**	**p**
Eğitim Araştırmalarının Gerekliliği	Eğitim Aldım	56	26.91	4.222	123	.732	.468
	Eğitim Almadım	69	27.45	3.976			
Eğitim Araştırmalarına Değer Verme	Eğitim Aldım	53	25.40	3.254	119	1.010	.315
	Eğitim Almadım	68	26.00	3.274			
Eğitim Araştırmalarının Uygulanabilirliği	Eğitim Aldım	51	22.61	4.784	117	.287	.775
	Eğitim Almadım	68	22.87	5.019			

Analiz sonuçlarına göre EAÖTÖ'nin alt boyutlarından alınan puan ortalamalarının eğitim araştırmalarına yönelik eğitim alma durumuna göre anlamlı bir farklılık göstermediği bulunmuştur (t= .732; p= .468, p> .05, t= 1.010; p= .315, p> .05, t= .287; p= .775, p> .05). Branşlara göre öğretmenlerin EAÖTÖ'nin alt boyutlarından aldıkları puanlar ANOVA ile test edilmiş, farkındalıklar arasında farklılığın olup olmadığı ise Scheffe testi ile tespit edilmiştir (Tablo 4).

Tablo 4: Öğretmenlerin EAÖTÖ alt boyutlarına ait puanlarının branşlara göre ANOVA sonuçları

Değişken	**Sınıf Düzeyi**	**N**	$\overline{X}$	**S**	**sd**	**F**	**p**
Eğitim Araştırmalarının Gerekliliği	Fizik	46	27.52	4.471	2-129	.255	.776
	Kimya	32	26.88	4.353			
	Biyoloji	54	27.41	3.627			

Eğitim Araştırmalarına Değer Verme	Fizik	47	25.72	3.728	2-125	.283	.754
	Kimya	27	26.19	2.718			
	Biyoloji	54	25.61	3.129			
Eğitim Araştırmalarının Uygulanabilirliği	Fizik	43	22.98	4.693	2-124	.196	.823
	Kimya	29	22.72	4.208			
	Biyoloji	55	22.35	5.615			

Analiz sonuçlarına göre branşlar, öğretmenlerin eğitim araştırmalarına yönelik tutumlarını alt boyutlarda etkilememektedir. Bir başka ifadeyle öğretmenlerin 'eğitim araştırmalarının gerekliliği' [F (2, 129) = .255, p= .776], 'eğitim araştırmalarına değer verme' [F (2, 125) = .283, p= .754] ve 'eğitim araştırmalarının uygulanabilirliği' [F (2, 124) = .196, p= .823] boyutlarına ait tutumlarında bir farklılık bulunmamaktadır.

Sonuç

Bu çalışmada lise öğretmenlerinin eğitim araştırmalarına yönelik tutumlarının incelenmesi amaçlanmıştır. Bu amaç doğrultusunda 2014-2015 eğitim öğretim yılında Eskişehir'de görev yağan 137 fen bilimleri öğretmenine Eğitim Araştırmalarına Yönelik Öğretmen Tutum Ölçeği uygulanmıştır.

Araştırmanın bulgularına göre öğretmenlerin, eğitim araştırmalarına yönelik tutum ölçeğinin boyutlarına ait görüşlerinin cinsiyete, ortaöğretimin türüne ve eğitim araştırmalarına yönelik eğitim alma durumuna göre farklılaşıp farklılaşmadığı t-testi ile tespit edilmiştir. Analiz sonuçlarına göre eğitim araştırmalarına yönelik tutum ölçeğinin tüm alt boyutlarından alınan puan ortalamalarının cinsiyete, ortaöğretimin türüne ve eğitim araştırmalarına yönelik eğitim alma durumuna göre göre anlamlı bir farklılık göstermediği bulunmuştur. Bu bulgu, öğretmenlerin eğitim araştırmalarına yönelik herhangi bir farkındalıkları olmadığını düşündürmektedir.

Branşlara göre öğretmenlerin EAÖTÖ'nin alt boyutlarından aldıkları puanlar ANOVA ile test edilmiş, eğitim araştırmalarına yönelik tutumları arasında farklılığın olup olmadığı ise Scheffe testi ile tespit edilmiştir. Analiz sonuçlarına göre branşlar, öğretmenlerin eğitim araştırmalarına yönelik tutumlarını alt boyutlarda etkilememektedir. Farklı branşlar olmasına rağmen öğretmenlerin eğitim araştırmalarına yönelik tutumlarında herhangi bir farklılık olmaması öğretmenlerin bulundukları branşların onlarda eğitim araştırmalarına yönelik tutumlara ilişkin farkındalık geliştirmeye yönelik bir işlevden yoksun olduğunu düşündürmektedir.

Sonuç olarak, öğretmenlerin ya da öğretmen adaylarının bilimsel araştırmalara ve araştırmacılara ilişkin tutumlarının belirlenmesine dönük çalışmalara alanyazında rastlanılmaktadır (Ekiz, 2006; Everton, Galton, ve Pell, 2002; Korkmaz, Şahin, ve Yeşil, 2011b; Öztürk, 2010; Vanderlinde ve van Braak, 2010; Yavuz, 2009). Ancak bu çalışmaların daha çok betimsel, nitel ve ölçek geliştirme çalışmaları olduğu görülmektedir.

Öneriler

Öğretmenlerin eğitim araştırmalarına yönelik tutumlarının farklı değişkenler açısından incelendiği, farklı yöntemlerin ve veri toplama araçlarının kullanıldığı çalışmalara ihtiyaç duyulmaktadır. Yine bununla birlikte öğretmenlere araştırma süreçlerinin nasıl olduğuna yönelik eğitimler düzenlenebilir ve böylece eğitim araştırmalarına yönelik bir farkındalık oluşturulabilir.

Kaynaklar

Büyüköztürk, S., (2002). *Sosyal Bilimler için Veri Analizi El Kitabı.* Ankara: Pegem Yayınları.

Chang, Y. H., Chang, C. Y., & Tseng, Y. H. (2010). Trends of science education research: An automatic content analysis. *Journal of Science Education and Technology.* (4), 315-331.

Costa, N., Marques, L., & Kempa, R. (2000). Science teachers' awareness of findings from education research. *Research in Science & Technological Education, 18*(1), 37-44.

Cousins, J., & Walker, C. (2000). Predictors of educators' valuing of systematic inquiry in schools. *Canadian Journal of Program Evaluation, 15*(Special issue), 25-52.

Çepni, S. ve Küçük, M. (2003). Eğitim araştırmalarının fen bilgisi öğretmenlerinin uygulamaları üzerindeki etkilerinin belirlenmesi: Bir örnek olay çalışması. *Eğitim Araştırmaları, (2),* 75-84.

De Jong, O. (2004). Mind your step: Bridging the research-practice gap. *Australian Journal of Education in Chemistry*, 5-9.

Ekiz, D. (2006). Sınıf öğretmenlerinin eğitim araştırmalarına karşı tutumları. *Kuram ve Uygulamada Eğitim Bilimleri Dergisi, 6*(2), 373-402.

Everton, T., Galton, M., & Pell, T. (2000). Teachers' perspectives on educational research: Knowledge and context. *Journal of Education for Teaching: International research and pedagogy*, *26*(2), 167-182.

Everton, T., Galton, M., & Pell, T. (2002). Educational research and the teacher. *Research Papers in Education, 17*(4), 373-401. doi:10.1080/0267152022000031388.

Field, A. (2009). *Discovering statistics using SPSS* (Third Ed.). London: SAGE.

Hair, J. F., Anderson R. E., Tahtam, R. L., & Black, W. C. (1998). *Multivariate Data Analysis*. New Jersey: Pearson Education.

Ho, R. (2006). *Handbook of univariate and multivariate data analysis and interpretation with SPSS*. Florida: Chapman ve Hall/CRC.

İlhan, N., Şekerci, A. R., Sözbilir, M., ve Yıldırım, A. (2013). Eğitim araştırmalarına yönelik öğretmen tutum ölçeğinin geliştirilmesi: Geçerlik ve güvenirlik çalışması. *Batı Anadolu Eğitim Bilimleri Dergisi, 4*(8), 31-56.

Kağıtçıbaşı, Ç. (1999). *Yeni İnsan ve İnsanlar.* İstanbul. Evrim Yayınevi.

Korkmaz, Ö., Şahin, A., ve Yeşil, R. (2011a). Bilimsel araştırmaya yönelik tutum ölçeği geçerlilik ve güvenirlik çalışması. *İlköğretim Online, 10*(3), 961-973. [Online]: http://ilkogretim-online.org.tr.

Korkmaz, Ö., Şahin, A., ve Yeşil, R. (2011b). Öğretmenlerin bilimsel araştırmalara ve araştırmacılara ilişkin düşünceleri. *Kuramsal Eğitimbilim, 4*(2), 109-127.

Neuman, W. L. (2012). *Toplumsal Araştırma Yöntemleri: Nitel ve Nicel Yaklaşımlar,* (5. Baskı). Cilt I,(Çev. Sedef Özge), Ankara: Yayın Odası.

Özturk, M. A. (2010). An exploratory study on measuring educators' attitudes toward educational research. *Educational Research and Reviews, 5*(12), 758-769.

Pajares, M. F. (1992). Teachers' beliefs and educational research: Cleaning up a messy construct. *Review of educational research*, *62*(3), 307-332.

Robbins, S. (1994). *Örgütsel Davranışın Temelleri* (Çev: Sevgi Ayşe Öztürk) Eskişehir ETAM Basım Yayın.

Sakallı, N. (2001). *Sosyal Etkiler: Kim Kimi Nasıl Etkiler*. Ankara: İmge Kitabevi.

Sozbilir, M., Kutu, H., & Yasar, M. D. (2012). Science education research in Turkey: A content analysis of selected features of papers published. In D. Jorde ve J. Dillon (Eds). *Science Education Research and Practice in Europe: Retrospective and Prospective* (pp.341-374). Rotterdam: Sense Publishers.

Tavşancıl, E. (2010). *Tutumların ölçülmesi ve SPSS ile veri analizi* (3.Baskı) Ankara: Nobel.

Tsai, C. C., & Wen, L. M. C. (2005). Research and trends in science education from 1998 to 2002: A content analysis of publication in selected journals. *International Journal of Science Education*, 27(1), 3-14.

Üstüner, M. (2006). Öğretmenlik mesleğine yönelik tutum ölçeğinin geçerlik ve güvenirlik çalışması. *Kuram ve Uygulamada Eğitim Yönetimi Dergisi*, *12*(1), 109-127.

Vanderlinde, R., & van Braak, J. (2010). The gap between educational research and practice: views of teachers, school leaders, intermediaries and researchers. *British Educational Research Journal*, *36*(2), 299-316.

Walker, D. A. (2010). The attitudes toward research scale. *Multiple Linear Regression Viewpoints, 36*(1), 18-26.

Yavuz, M. (2009). Eğitim araştırmaları ile ilgili öğretmen ve yönetici görüşlerinin analizi. *Selçuk Üniversitesi Ahmet Keleşoğlu Eğitim Fakültesi Dergisi, 27*, 143-158.

AN EVALUATION OF INSTRUCTIONAL INTEGRATION OF BOTANY, CHEMISTRY AND ART FOR TEACHING ABOUT PLANTS IN VIEW OF STUDENTS' PERSPECTIVES

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Abstract: An instruction integrating biology, chemistry, and art was designed and implemented to teach plants to children aged between 10 and 12 in this study. The purpose of this study is to evaluate the instruction from students' perspectives. The instruction designed was carried out within the context of A Journey to Botanical World 2 numbered 213B510 which was founded by Nature Education and Science Schools Program of Scientific and Technological Research Council of Turkey. The educational activities of the project were implemented in June, 2014. 11 biology activities, three chemistry activities and seven art activities were carried out during the instruction which lasted nine days. 37 people participated in the instruction. The data of the study were obtained from the participants' journals. Thematic content analysis was used to analyse the qualitative data. The data were coded and sub-themes were generated under each theme. The participants' views about the instruction they were exposed to were categorized into five themes: feelings, learning, awareness, attitude, and commitment to nature. Each theme and sub-themes belonging to these themes were presented in separate tables. Based on the findings of the study, it was concluded that the instructional integration of biology, chemistry, and art for teaching about plants made contributions to the participants' realizing their plant blindness. Moreover, as a result of the instruction, the participants wanted to engage in plant care and they enjoyed spending time with plants. The instruction also promoted participants' awareness about conservation of environment and their attitudes towards science and plants.

***Keywords*:** Plant, integration of disciplines, botany, chemistry, art.

BOTANİK, KİMYA VE SANATIN BİR ARAYA GETİRİLMESİ YOLUYLA BİTKİ ÖĞRETİMİNİN ÖĞRENCİLERİN BAKIŞ AÇILARIYLA DEĞERLENDİRİLMESİ

Özet: Bu çalışmada 10-12 yaş öğrencilerine bitkiler hakkında öğretmek için biyoloji, kimya ve sanatın birbirine entegre edildiği bir öğretim tasarlamış ve uygulanmıştır. Bu çalışmanın amacı bu öğretimi öğrenci bakış açısıyla değerlendirmektir. Tasarlanan öğretim Türkiye Bilimsel ve Teknolojik Araştırma Kurumu'nun Doğa Eğitimi ve Bilim Okulları programı tarafından desteklenen 213B510 numaralı Botanik Dünyasına Yolculuk 2 projesi kapsamında hayata geçirilmiştir. Projenin öğretim etkinlikleri 2014 yılı Haziran ayında uygulanmıştır. Dokuz gün süren öğretim boyunca 11 adet Biyoloji, üç adet Kimya, yedi adet Sanat etkinliği yapılmıştır. Öğretime 37 kişi katılmıştır. Çalışmanın verileri katılımcı günlüklerinden elde edilmiştir. Elde edilen nitel verilerin analizinde tematik içerik analizi kullanılmıştır. Veriler kodlanımş, tema ve her tema altında alt temalar oluşturulmuştur. Katılımcıların maruz kaldıkları öğretim hakkındaki görüşleri duygu, öğrenme, farkındalık, tutum, doğaya bağlılık olmak üzere beş tema altında kategorize edilmiştir. Her bir tema ve bu temaya ait alt temalar ayrı tablolar halinde sunulmuştur. Çalışmanın bulgularına dayalı olarak biyoloji, kimya ve sanatın birbirine entegre edilmesi yoluyla bitki öğretiminin katılımcıların kendilerinin bitki körü olduğunu fark etmelerine katkı sağladığı sonucuna varılmıştır. Ayrıca, öğretimin katılımcıların bitki bakımı ile uğraşmak istemelerine, bitkilerle zaman geçirmekten hoşlanmalarına katkı sağladığı sonucuna varılmıştır. Öğretim katılımcıların çevre koruma bilincini, fene yönelik tutum ve bitkilere yönelik tutumlarını desteklemiştir.

Anahtar Sözcükler: Bitki, disiplinlerin bir araya getirilmesi, botanik, kimya, sanat.

Giriş

Bitkiler ekosistemler için hayati öneme sahiptir. Bitkiler fotosentez yaparak kendi yaşamsal faaliyetlerini sürdürebilmek için gerekli olan enerjiyi üretirler. Bitkilerin ürettiği bu besin ekosistemlerdeki besin zincirinin ilk halkasıdır. Buna ek olarak fotosentez doğadaki karbon-oksijen döngüsü için kilit öneme sahiptir. Diğer bir ifadeyle bütün canlıların beslenme ve solunum gibi iki temel canlılık faaliyeti için bitkilere gereksinimleri vardır. Ayrıca bitkiler bazı canlıların örneğin bazı kuşlar, böcekler vb. yuvasıdır. Bitkiler erozyonu önler, rüzgarların çevreye verdiği zararı azaltır. İnsanoğlu birçok hastalığın çaresini de yine bitkilerde bulmuştur. Dünya sağlık örgütü verilerine göre tüm dünyada yaklaşık 20.000 çeşit bitki tıbbi amaçlı kullanılmaktadır (Toksoy, Ayyıldız ve Gümüş, 2003). Sabun, vernik, yağlı boya, krem ve birçok sanayi alanının hammaddesi bitkilerdir. Bütün bu sebeplerden dolayıdır ki "bütün yaşam bitkilere bağlıdır" bir slogan haline gelmiştir (Wandersee, Clary ve Guzman, 2006).

Dünya'nın hemen her yerinde birçok bitki türü ormanların tahrip edilmesi, hava, su ve toprak kirliliği, bilinçsiz sanayileşme, aşırı otlatma, hızlı nüfus artışı gibi sebeplerden dolayı ciddi tehdit altındadır. Dünya Doğayı Koruma Birliği'nin (The International Union for Conservation of Nature [IUCN]) 2012 yılında yayınladığı "Yaşayan Gezegen Raporu"na göre ise 1970–2008 yılları arasında dünyamızın biyo çeşitliliği %30 azalmıştır (Living Planet Report, 2012). IUCN nin en son 2006 yılında güncellediği listeye göre bütün dünyada 16.118 canlı türü tehlike altındadır ve bunlardan 8.390 tanesi bitkidir. 19. ve 20. yüzyılda Türkiye 13 den fazla bitki türünün nesli tükenmiştir ve bunlardan sekizi endemiktir. 250 bitki türünün ise nesli tükenmek üzeredir (Çevre Bakanlığı, 2001; İskender, Zeynalov, Ozaslan, İncik ve Yayla, 2006). Bu veriler dünyamızın ve ülkemizin giderek yaşanmaz bir yer haline geldiğini göstermektedir. Hükümetler, ulusal ve uluslararası organizasyonlar çevreyi korumak için stratejiler geliştirmektedirler. Fakat Fancovicova ve Prokop (2011)'un da belirttiği gibi bir toplum etrafındaki floristik zenginliğin farkında değilse, o doğal zenginliği sevmesi ve koruması neredeyse imkansızdır. Literatürde yapılan birçok çalışma göstermektedir ki çoğu çocuk ve yetişkin çevresindeki bitkilerin farkında değildir (Gatt, Tunnucliffe, Borg ve Lautier, 2007; Patrick ve Tunnicliffe, 2011; Yorek, Şahin ve Aydın, 2009). Wandersee ve Schussler (2001) bitkilerin etrafımızda yaygın olarak bulunmasına rağmen onları göz ardı etmemizi "bitki körlüğü" olarak adlandırmaktadır. Ayrıca, yapılan çalışmalar çocukların bitkilere yönelik tutumunun nötr olduğunu (Fancovicova ve Prokop, 2010), botaniği öğrenilmesi zor bir disiplin olarak düşündüklerini (Prokop, Prokop ve Tunnicliffe, 2007) rapor etmektedir. O'Brien (2010)'nın ifade ettiği gibi kişilerin doğa hakkındaki bilgileri, bu bilgilerin derinliği, doğaya karşı tutumları ve ilgileri doğayı hangi yollarla öğrendiklerine bağlıdır. Bitkiler sunumlardan, resim üzerinden yapılan açıklamalardan, kitaplardan öğrenilecek bir konu değildir. Bitkiler sınıf dışında kendi doğal ortamlarında en iyi öğretilebilir. Sınıf dışı etkinlikler bir botanik bahçesine veya bir parka düzenlenen gezilerin yanı sıra bitkilerle zaman geçirme, bitki ekip dikme, çiçekleri inceleme, bitkilere ve tohumlara dokunma gibi bütün duyu organlarının kullanımını gerektirecek etkileşimler içermelidir (Dopico ve Garcia-Vazquez, 2011; Frank ve Vore, 2010; Gatt vd., 2007; Jewell 2002; Kirby, 2008; Tunnicliffe, 2001;Patrick ve Tunnicliffe, 2011). Bütün bunlara ek olarak etkili bitki öğretimi için bitkilere farklı perspektiflerden yaklaşan öğrenme ortamlarına ihtiyaç bulunmaktadır (Strgar, 2007).

Bu çalışmada tasarlanan ve uygulanan öğretim çeşitli disiplinlerin bir araya getirilmesi yaklaşımına dayanmaktadır. Bitkiler temel olarak biyolojinin konusudur. Fakat bitkiler farmakoloji, kimya, sanat gibi başka bir çok disiplinde kullanılmaktadır. Disiplinlerin birbirine entegre edildiği bir öğretim boyunca öğrenciler bitkiler hakkında çoklu perspektifleri keşfedebilir ve onları birbirine bağlayabilirler. Bu çalışmada çocukların bitki farkndalığını arttırmak, bitkilere yönelik pozitif tutumlarını desteklemek için botanik, kimya ve sanat birbirine entegre edilmiştir. Botanik temelli etkinliklerde öğrencilerin bütün duyu organlarıyla bitkileri keşfetmeleri amaçlanmştır. Kimya temelli etkinliklerde öğrencilerin bitkilerden yağ, koku, renk elde edilmesini ve elde edilen bu ürünlerin kullanımını deneyimleri amaçlanmıştır. Sanat temelli etkinliklerde ise bitkilerden elde edilen renklerin sanatsal ve kültürel değerlere yansıması üzerine odaklanılmıştır. Bu öğretimin bitki farkındalığı ve bitkilere yönelik tutum üzerine etkileri başka yerlerde yayınlanmıtşır (Çil, 2015; Çil, 2016). Bu çalışmada ise botaniğin kimya ve sanatla enetgre edildiği öğretim bu öğretime maruz kalanların bakış açılarıyla değerlendirilmiştir. Bu çalışma bir kaç sebepten dolayı önemlidir. Çeşitli disiplinlerin birbirine entegre edilmesi yoluyla öğretim bazı fen kavramlarının öğretilmesinde kullanılmıştır (örneğin; Clay, Fox, Grunbaum ve Jumars, 2008; Furlan, Kitson ve Andes, 2007; Morrison, 2012). Bu öğretim yaklaşımı bitkilerin öğretiminde de kullanılmıştır (örneğin; Radwanski ve Ward, 2007). Fakat bu çalışmalar çok sayıda değildir. Ayrıca öğretimin ona maruz kalanların bakış açısıyla değerlendirilmesi öğretimin güçlü ve zayıf yönlerinin anlaşılmasını sağlayabilir. Öğretimin daha iyi hale getirilmesine katkı sağlayabilir.

Yöntem

Bu çalışmada nitel araştırma yöntemlerinden durum çalışması kullanılmıştır. Durum çalışmasında araştırmacı bir programı, bir olayı, bir etkinliği, bir süreci, bir grubu veya bir bireyi derinlemesine keşfeder. Durum çalışmalarında küçük örneklemden açık uçlu ve detaylı veriler elde edilir (Creswell, 2003). Bu çalışmada araştırmacı tarafından tasarlanan bir öğretim, o öğretime maruz kalanların açık uçlu yazımları yoluyla değerlendirildiği için çalışmada durum çalışması yöntemi kulanılmıştır.

Çalışmanın Bağlamı

Öğretim etkinlikleri Muğla ilinde gerçekleştirilmiştir. Muğla kısa mesafelerde ani yükseklik farkı, kıyılardan iç kesimlere doğru iklim değişikliği, Avrupa ve Asya arasındaki konumundan dolayı zengin bitki ve örtüsü ve yüksek endemizme sahiptir. Muğla merkez florasında 86 familya, 327 cins ve 555 tür tespit edilmiştir. Muğla florasında bulunan bazı bitkiler boyacılıkta kullanılmaktadır. Kök boya ve dokumacılık yörenin sanat, kültür ve turizminde önemli bir yere sahiptir (Etikan, Sevinç ve Balcı, 2009). Muğla florasındaki birçok bitkiden yağ üretilmektedir. Bu yağlar ilaç yapımında, sabun, krem vb. yapımında kullanılmaktadır. Örneğin Muğla'nın endemik bitkilerinden biri olan sığla ağacından elde edilen sığla yağı eczacılık ve kozmetik özellikle parfüm ve sabun endüstrisinde kullanılmaktadır (Küçükala, Durmuşkahya ve Koray, 2010). Bütün be sebeplerden dolayı Muğla ili bitkilerin çeşitli disiplinlerin bir araya getirilmesi yoluyla öğretilmesi için son derece uygun bir yerdir. Çalışma TÜBİTAK Doğa Eğitimi ve Bilim Okulları programı tarafından desteklenen Botanik Dünyasına Yolculuk 2 projesi kapsamında gerçekleştirilmiştir. Öğretim 2014 yılı Haziran ayında gerçekleştirilmiştir. Öğretimin yürütüldğü bu tarihlerde Muğla merkez florasındaki çoğu bitki türünü bütün organlarıyla örneğin çiçekli bitkileri çiçekli olarak gözlemlemek mümkündür. Öğretim dokuz gün sürmüştür. Katılımcılar sekiz gece Muğla'da konaklamışlardır.

Çalışma Grubu

Çalışma 10-12 yaş öğrencileri için tasarlanmıştır. Çünkü çocukların bitkilerin kendi doğal habitatları içindeki rollerine ilişkin farkındalıklarının gelişmesinde 10–15 yaş kritik dönemdir (Fancovicova ve Prokop, 2010). 2013-2014 eğitim öğretim yılında 5. sınıfta öğrenim görmekte olan çocuklar çalışmanın hedef kitlesini oluşturmuştur. Projeye katılmak üzere başvuru yapan okullar arasından beş tanesi katılımcı okul olarak kabul edilmiştir. Çalışmaya katılan okullar Denizli il merkezi, Denizli ili Kale ilçesi, Muğla'nın Yatağan ve Seydikemer ilçelerinde bulunmaktadır. Okulların seçiminde Muğla iline ulaşım kolaylığı, düşük veya orta sosyo ekonomik düzeye sahip ailelerin çocuklarına eğitim veriyor olma, daha önce benzer bir projeye katılmamış olma kriterlerine göre karar verilmiştir. Her bir okuldan altı öğrenci olmak üzere toplam 30 öğrenci projeye katılımcı olarak seçilmiştir. Çocukların seçiminde öğretmenlerinin görüşleri, öğrencilerin akademik başarıları, ailelerinin soyo ekonomik durumları gibi kriterlere dayalı olarak seçim yapılmıştır. Proje etkinlikleri boyunca çocukların ailelerinden uzak bir yerde kalacak olmaları, projenin yapılacağı yere ulaşmak için yapacakları seyahatlerden dolayı projeye öğretmenleri ile bilirkte katılmalarının uygun olacağı düşünülmüştür. Projeye katılmak için okulu adına başvuru yapan öğretmenler ve onların meslektaşları projeye davet edilmiştir. Her okuldan bir ila üç öğretmen projeye katılmaya gönüllü olmuştur. Yedi öğretmen projeye katılmıştır. Öğretmenler projenin öğretim etkinliklerini birer öğrenen olarak yapmışlardır. Çalışmanın verileri 37 kişiden elde edilmiştir.

Öğretim

Öğretim boyunca 11 adet Biyoloji, üç adet Kimya, yedi adet Sanat etkinliği gerçekleştirilmiştir.

Biyoloji Temelli Etkinlikler

Öğretim boyunca gerçekleştirilen Biyloji temelli etkinlikler şunlardır: Herbaryum Tanıma, Herbaryum Tekniklerine Uygun Bitki Toplama, Herbaryum Presleme, Preslenmiş Bitkilerin Yapıştırılması ve Etiketlenmesi, Hatıra Ormanı, Kimlik Kartı, Flora Kataloğu, Sulak Alan Bitkileri, Herkesin Bitkisi Olsun, Bitkilere Üç Boyutlu Bakış, Botanik Gezisi.

Kimya Temelli Etkinlikler

Öğretim boyunca gerçekleştirilen KİmyA temelli etkinlikler şunlardır: Bitkisel Sabun, Yumurtam Rengarenk, Bitkiler ile Kimayasal Analiz.

Sanat Temelli Etkinlikler

Öğretim boyunca gerçekleştirilen Sanat temelli etkinlikler şunlardır: Endemik Bitkiler, Bitki Hırsızlığı, Ebru, Sanat Yolculuğu, Motif Tasarlama, Kilim ve Halı Dokuma, Göster Yaratıcılığını.

Veri Toplama Aracı

Çalışmanın verileri katılımcı günlükleri ile toplanmıştır. Projenin ilk günü katılımcıların her birine günlük defter verilmiştir. Katılımcılardan her günün sonunda o günkü etkinlikler hakkındaki duygu ve düşüncelerini yazmaları istenmiştir.

Verilerin Analizi

Katılımcı günlüklerinden elde edilen nitel verilerin analizinde tematik içerik analizi kullanılmıştır. Tematik içerik analizinde nitel veri içindeki önemli temalar ortaya çıkarılır (Braun ve Clarke, 2006). Bu analizde temalar araştırmacı tarafından empoze edilmez onlar verinin içinden doğar (Fereday ve Muir-Cochrane, 2006). Verilerin analiz sürecinde veriler kodlanmış, temalar ve alt temalar oluşturulmuş, tema ve alt temalara isim verilmiştir. Tema ve alt temaların frekans ve yüzde dağılımı hesaplanmıştır.

Bulgular

Verilerin analizinden duygu, öğrenme, farkındalık, tutum, doğaya bağlılık olmak üzere beş tema ortaya çıkmıştır. Bu temaların her biri için elde edilen alt temalar ayrı tablolar halinde sunulmuştur.

Tablo 1. Duygu teması altında tespit edilen alt temalar ve bu duyguların gerekçeleri

Alt tema	Duygunun gerekçesi	Katılımcı cümlelerinden örnekler	f	%
Üzgün	Kendisinin bitki körü olması	“Günlük yaşantımda hemen her yerde bitkilerle karşılaşıyorum. Ne güzelmiş diyorum. Fakat onların isimlerini, özelliklerini bilmiyorum. Ne güzel diyorum ama tanımıyorum ne tezat.” (Katılımcı 1)	16	43,2
	İnsanların bitkilere zarar vermesi	“Ülkemizde çok sayıda endemik bitki var. Ama maalesef biz onları koruyamıyoruz. Hatta insanoğlu turizm, tarım vb. sebeplerle onlara zarar veriyor ne üzücü.” (Katılımcı 2)	10	27
Mutlu	Öğrenme	“Projedeki günler benim hayatımın en mutlu günleri. Çünkü burada çok şey öğreniyorum. Özellikle bitkiler hakkında öğreniyorum. Sadece bitkiler değil fen, sanat vb. hakkında da çok şey öğreniyorum.” (Katılımcı 3)	31	83,7
	Doğaya katkı sağlama	“Bugün fidan diktik. Birçoğumuz daha önce hiç fidan dikmemişti. Bir tane diktikten sonra insan başka bir tane daha dikmek istiyor. Biz 16 fidan diktik. Çok mutluyuz çünkü doğaya bir şey kattık. Tüketici olarak yaşadığımız dünyaya bir katkı sağlamanın mutluluğunu yaşadım.” (Katılımcı 4)	30	81
	Etkinliklerde oluşturulan ürünler	“Sabun yaptık, flora kataloğu yaptık, motif tasarladık, halı dokuduk. Bunların hepsi benim ürünlerim. Onlar her zaman benim hayatımda olacak. Daha önce hiç böyle şeylerim olmamıştı. Bu nedenle mutluyum.” (Katılımcı 5)	18	48,6
	Bitki farkındalığının artması	“Bu projeyle bitki farkındalığım arttı. Ben daha önce Köyceğiz yolundan geçtim. Ama yol üzerindeki sığla ormanlarını hiç fark etmemişim. Bu projede sığla ormanlarında durunca bunu anladım. Artık bitkilerin yapraklarına, çiçeklerine daha yakından ve dikkatli bakıyorum. Çınar ve sığlayı ayırt edebiliyorum. Bu beni mutlu ediyor.” (Katılımcı 4)	18	48,6
Hayranlık	Bitkilerin özellikleri	“Bitki dünyası ne kadar müthiş, keşfedilmeyi bekleyen ne kadar çok şey varmış. Biyoloji laboratuvarında bitkileri mikroskopla inceledik. Küçücük bir yaprağın, küçücük bir çiçeğin içindeki kocaman dünyayı gördüm. Bitkileri olan hayranlığım arttı.” (Katılımcı 6)	11	29,7
	Bitki çeşitliliği	“Bugün Muğla Sıtkı Koçman Üniversitesi kampüsünün flora kataloğunu hazırladık. Flora kataloğu yapmak için kampüsteki bitkilerin fotoğraflarını çektik. Sadece kampus içinde ve sadece bir iki saat içinde onlarca bitki türü gözlemledik. Onların her biri farklı renkte, farklı kokuda, farklı özelliklere sahipler. Bu çeşitliliğe hayran olmamak mümkün değil.” (Katılımcı 4)	14	37,8
Merak	Bitkilerin özelliklerini keşfetme	“Mikroskopla bitkilere baktığımda orada apayrı bir dünya olduğunu düşündüm. Mikroskop altında muhteşem görüntüler vardı. Sıradan olarak gördüğüm	14	37,8

		bitkilerden böyle görüntülerle karşılaşmak çok şaşırtıcı. Bitkileri daha çok merak ediyorum ve onlar hakkında daha çok öğrenmek istiyorum." (Katılımcı 1)		
Memnuniyet	Öğrenme etkinlikleri	"Bugün bilgi yarışması yaptık. Yarışmadaki her şeyi ben burada öğrendim. Laden, yabani havuç, sığla, mikroskop, mezür kullanma vb. Daha önce bunların hiç birini bilmiyordum. Yarışmada birinci oldum. Demek ki benim için proje amacına ulaşmış. Ne çok öğrenmişim burada. Her soru burada yaptığımız etkinliklerdendi. Ben hiç not tutmadım etkinliler boyunca. Ama yarışmada bunları hemen hatırladım. Çünkü hepsini kendimiz bizzat yaptık. Her şeyi kendimiz yaparak öğrendik." (Katılımcı 7)	34	91,8
	Öğrenme ortamı	"Burada günler dolu dolu geçiyor. Her gün birçok etkinlik yapıyoruz. Drama etkinlikleri, laboratuvarda yaptığımız deneyler, arazide yaptığımız etkinlikler boyunca çok eğleniyoruz. Hem eğleniyoruz hem öğreniyoruz. Hiç görmediğimiz bitkileri gözlemleyebiliyoruz. Gün bittiğinde yoruluyoruz. Ama yurda geldiğimizde yorgunluk hemen geçiyor yarın neler yapacağız diye düşünmeye başlıyoruz." (Katılımcı 8)	32	86,4
Sorumluluk	Bitki farkındalığını topluma yayma	"Okulumda Botanik Gazetesi hazırlamayı düşünüyorum. Botanik Dünyasını okulumdaki herkes tanımalı. (Katılımcı 4) Ben burada çok güzel şeyler öğrendim. Bitkilerin dünyasını tanıdım. Çevremdeki insanların bitkileri tanıması, bitkilere saygı duymasını istiyorum. Bunun için okulumda projeler yapmalıyız." (Katılımcı 6)	9	24,3

Tablo 2. Öğrenme teması altında tespit edilen alt temalar

Alt tema	Katılımcı cümlelerinden örnekler	f	%
Bitkiler hakkında öğrenme	"Artık birçok bitkiyi gördüğümde onun adını söyleyebiliyorum. Artık sadece ağaç demiyorum. Ladin, çınar, sığla diyorum." (Katılımcı 9)	32	86,4
Psikomotor öğrenme	"Nasıl fidan ekildiğini öğrendim. Mikroskop kullanmayı öğrendim. Bir yapraktan kesit alabilir, onu mikroskopta inceleyebilirim." (Katılımcı 10)	10	27
Bilimsel yöntem hakkında öğrenme	"Araziden bitki toplamak, arazi defterine bitkiler hakkında bilgiler kaydetmek, bitkileri tasnif etmek ve preslemek tam bir düzen içerisinde. Bilimsel yöntemi harika bir düzen içinde uyguladık." (Katılımcı 11)	5	13,5
Fen kavramlarını öğrenme	"Burada yeni şeyler öğrendim herbaryum, endemik bitki, tıbbi ve aromatik bitki, indikatör, pigment gibi." (Katılımcı 12)	20	54
Muğla'nın florası ve kültürü hakkında öğrenme	"Sığla Muğla'nın endemik bir bitkisi. Özellikle Muğla'nın Köyceğiz ilçesi civarlarında yetişiyor. Milas halıları Muğla'nın kültürel değerlerinden biridir. Milas halılarında kullanılan iplikler bitkilerle boyanıyor. Örneğin Milas halısının sarı rengi kantaron bitkisinden geliyor." (Katılımcı 13)	10	27
Bitki repertuvarını genişletme	"Bugün daha önce hayatımda hiç görmediğim bitkileri gördüm. Onların renklerini, kokularını, isimlerini öğrendim." (Katılımcı 14)	10	27
Disiplinler arası düşünmeyi öğrenme	"Bugün yumurtaları bitki kabukları ve yaprakları ile boyadık. Yumurta kabuklarının bitkilerle inanılmaz renklere dönüşmesi beni şaşırttı. Sonra bu kabuklardan mozaik çalışması yaptık. Bugünkü etkinlikler dizisi hem çok yaratıcı hem de çok ilginçti. Bitkilerin içindeki pigmentlerle boyama yaptık. Sonra onları sanat eserine dönüştürdük. Bitki, kimya ve sanat hep birlikteydi. Bundan sonra karşılaştığım olay, durum vb. bu pencereden bakacağım." (Katılımcı 6)	14	37,8

Tablo 3. Doğaya bağlılıkteması altında tespit edilen alt temalar

Alt tema	Katılımcı cümlelerinden örnekler	f	%

Bitkilerin ekosistem içindeki önemini fark etme	"Bitkiler bizim her şeyimiz. Çünkü onlar primer üretici. Yani fotosentez yapıyorlar. Bütün diğer canlıların yaşamının kaynağı bitkilerdir. Bitkiler olmazsa diğer canlılar da olmaz. Yani yaşam olmaz." (Katılımcı 2)	25	67,5
Bitkilerle zaman geçirmeyi sevme	"Bugün sulak alan bitkilerini gözlemledik. Etkinlik boyunca sazlıkları, kamışları gözlemledik. İnsan onlara bakarken başka her şeyi unutuyor." (Katılımcı 4)	15	40,5
Bitki bakımı ile uğraşma	"Bugün çok heyecanlıyım. Çünkü bugün fidan diktik. Toprağı kazmak, fidanı toprağın içine yerleştirmek, ona can suyu vermek çok zevkli. Bundan sonrada fidan dikmek istiyorum. Diktiğim fidanları sulamak ve büyüdüklerini görmek istiyorum." (Katılımcı 15)	15	40,5
Çevre koruma bilinci	"Bugün öğrendiklerime dayalı şunu söyleyebilirim insanoğlu öncelikle bitkileri ve daha sonra bütün doğayı korumalı. Bunun için hepimizde düşen görevler var. Çimlere basmamak, çiçekleri koparmamak bile onları korumaya katkı sağlayabilir." (Katılımcı 16)	12	32,4

Tablo 4. Farkındalık teması altında tespit edilen alt temalar

Alt tema	Katılımcı cümlelerinden örnekler	f	%
Bitki körü olduğunu fark etmek	"Bugün sulak alan bitkilerini gözlemek amacıyla bir etkinlik yaptık. Bu etkinlikte Muğla ilinin Akyaka beldesindeki Azmak nehri içerisinde tekne turu aldık. Ben daha önce Azmak nehrinde tekne turu yaptım. Fakat o tekne turu boyunca su içindeki bitkileri göz ardı ettiğimi itiraf etmeliyim." (Katılımcı 4)	18	48,6
Bitki farkındalığının artması	"Bugün flora kataloğu hazırlamak için bitki fotoğrafları çektik. Bazı bitkileri daha önce görmüştüm. Ama onların isimleri, özellikleri üzerine hiç düşünmemiştim. Hatta birçoğunun isimlerini bile bilmiyordum. Sadece bakıp geçtiğim ama ihmal ettiğim bitkilerin ne kadar güzel, ne kadar değerli olduklarını fark ettim." (Katılımcı 2)	14	37,8

Tablo 5. Tutum teması altında tespit edilen alt temalar

Alt tema	Katılımcı cümlelerinden örnekler	f	%
Bitkilere yönelik tutum	"Bitkileri çok seviyorum." (Katılımcı 17)	6	16,2
Fene yönelik tutum	"Yaptığımız bitkisel sabunla ellerimi yıkadım. Ellerim yumuşacık oldu. Artık kimyaya olumlu bakıyorum. Çünkü Kimya dendiğinde hep yapay ve zararlı maddeleri düşünürdüm. Oysaki bizim sabunumuzda hemen her şey doğal." (Katılımcı 6)	5	13,5

Sonuç

Çeşitli disiplinlerin bir araya getirilmesi yoluyla öğretim boyunca katılımcıların genellikle olmlu duygular yaşadığı sonucuna varılabilir. Öğretimin katılımcıların bitkilerin estetik ve eşsiz özelliklerini takdir etmesine, bitkiler hakkında merak duygularının uyanmasına, halkın bitki farkındalığının iyileştirilmesi için sorumluluk hisstemelerine katkı sağladığı söylenebilir. Katılımcılar kendilerinin bitki körü olduğunu fark edebilmişler ve bundan üzüntü duymuşlardır. Ayrıca insanoğlunun bitki türlerini koruyamaması bitkilere zarar vermesi katılımcıları üzmüştür. Öğretim boyunca katılımcıların çeşitli fen kavramlarını, bilimsel yöntemi, Muğla'nın doğal ve kültürel özelliklerini, bir kavram/olay/olgu vb farklı perspektiflerden bakmayı öğrendikleri söylenebilir. Öğretim boyunca katılımcıların bitkilerin ekosistem içindeki önemini fark ettiği söylenebilir. Öğretim katılımcıların bitki bakımı ile uğraşmak istemelerine, bitkilerle zaman geçirmekten hoşlanmalarına katkı sağlamıştır. Ayrıca öğretim katılımcıların çevre koruma bilincini desteklemiştir. Bütün bunlara ek olarak botaniğin kimya ve sanatla entegre edildiği öğretimin katılımcıların fenne ve bitkilere yönelik pozitif tutumlarını desteklediği sonucuna varılabilir. Çeşitli disiplinlerin bir araya getirilmesi yoluyla öğretim etkinlikerinin katılımcı memnuniyetini sağladığı sonucuna varılabilir.

Öneriler

Bu çalışmada uygulanan öğretim disiplinlerin bir araya getirilmesi yoluyla öğretim yaklaşımına dayanmaktadır. Bu çalışmada bitki öğretimi için botanik, kimya ve sanat birbirine entegre edilmiştir. Katılımcıların bakış açısına göre bu öğretimin farkındalık, tutum, bilişsel öğrenmeler üzerine olumlu etkileri vardır. Bu nedenle öğretmenler bu tür öğretimleri kendi sınıflarında uygulayabilirler. Bitkiler farmakoloji, tarım gibi başka disiplinlerle de ilişkilidir. Bitki öğretimi için farklı disiplinler bir araya getirilebilir ve bu öğretimlerin etkileri değerlendirilebilir.

Teşekkür

Bu çalışmada sunulan bulgular Türkiye Bilimsel ve Teknolojik Araştırma Kurumu'nun (TÜBİTAK), Doğa Eğitimi ve Bilim Okulları programı tarafından desteklenen 213B510 numaralı Botanik Dünyasına Yolculuk 2 projesinde elde edilmiştir. TÜBİTAK'a, Muğla Sıtkı Koçman Üniversitesi'ne, proje ekibine ve katılımcılarına teşekkür ederim.

Kaynaklar

Braun, V., & Clarke, V. (2006). Using Thematic Analysis in Psychology. *Qualitative Research in Psychology, 3*(2), 77-101.

Clay, T. W., Fox, J. B., Grunbaum, D., & Jumars, P. A. (2008). How Plankton Swim: An Interdisciplinary Approach for Using Mathematics & Physics to Understand the Biology of the Natural World. *The American Biology Teacher, 70*(6), 363-370.

Creswell, J.W. (2003). *Research Design: Qualitative, Quantitative and Mixed Methods Approaches*. Second Edition. Thousand Oaks, CA: SAGE Publications.

Çevre Bakanlığı (2001). Ulusal Biyolojik Çeşitlilik Stratejisi ve Eylem Planı, Ankara: Çevre Bakanlığı.

Çil, E. (2015). Integrating Botany with Chemistry & Art to Improve Elementary School Children's Awareness of Plants. *The American Biology Teacher, 77*(5), 348–355.

Çil, E. (2016). Instructional Integration of Disciplines for Promoting Children's Positive Attitudes Towards Plants. *Journal of Biological Education, 50*(4), 366-383.

Dopico, E., & Garcia-Vazquez, E. (2011). Leaving the classroom: a didactic framework for education in environmental sciences, *Cultural Studies of Science Education, 6*, 311–326.

Etikan, S., Sevinç, B., ve Balcı, N. (2009). Muğla Florasında Doğal Olarak Bulunan ve Boyacılıkta Kullanılan Bazı Bitkilerden Elde Edilen Renkler ve Bu Renklerin Yün Halı İplikleri Işık Ve Sürtünme Haslıkları. Muğla Üniversitesi Rektörlük Yayınları 72.

Fancovicova, J., & Prokop, P. (2010). Development and initial psychometric assessment ofthe plant attitude questionnaire. *Journal of Science Education and Technology, 19*, 415-421.

Fancovicova, J., & Prokop, P. (2011). Plants have a chance: outdoor educational programmes alter students' knowledge and attitudes towards plants. *Environmental Education Research, 17*(4), 537–551.

Fereday, J., & Muir-Cochrane, E. (2006). Demonstrating Rigor Using Thematic Analysis: A Hybrid Approach of Inductive and Deductive Coding and Theme Development. *International Journal of Qualitative Methods, 5*(1), 80-92.

Frank, M., & Vore, R. (2010). How to Make a Plant Field Guide. *Science and Children, January* 21-25.

Furlan, P. Y., Kitson, H., & Andes, C. (2007). Chemistry, Poetry, and Artistic Illustration: An Interdisciplinary Approach to Teaching and Promoting Chemistry. *Journal of Chemical Education, 84*(10), 1625-1630.

Gatt, S., Tunnucliffe, S.D., Borg, K., & Lautier, K. (2007). Young Maltese children's ideas about plants, *Journal of Biology Education, 41*(3), 117–121.

İskender, E., Zeynalov, Y. Ozaslan, M., İncik, F., & Yayla, F. (2006). Investigation and Introduction of Some Rare and Threatened Plants from Turkey. *Biotechnology & Biotechnology Equipment, 20*(3), 60-68.

Jewell, N. (2002). Examining Children's Model of Seed. *Journal of Biological Education, 36*(3), 116–122.

Kirby, T. (2008). A Garden of Learning Money doesn't have to be an obstacle to valuable scientific learning experiences, *Science and Children, Summer*, 28-31.

Küçükala, A., Durmuşkahya, C., ve Koray. Z. (2010). Sığla Ağacının Korunmasına Yönelik Eğitim Çalışmaları Projesi Sonuç Raporu, ÖÇKK Başkanlığı Ankara.

Living Planet Report (2012). Retrieved December 2, 2012 from www.panda.org/lpr

Morrison, K. (2012). Integrate Science and Arts Process Skills in the Early Childhood Curriculum. *Dimensions of Early Childhood, 40*(1), 31-38.

O'Brien, CM. (2010). Do they really "know nothing"? An inquiry Into ethnobotanical knowledge of students In Arizona, USA. *Ethnobotany Research & Applications, 8*, 35-47.

Patrick, P., & Tunnicliffe, S. D.(2011). What Plants and Animals Do Early Childhood and Primary Students' Name? Where Do They See Them?. *Journal of Science Education and Technology, 20*, 630–642.

Prokop, P., Prokop, M., & Tunnicliffe, S. D. (2007). Is biology boring? Student attitudes toward biology. *Journal of Biologial Education,* 42(1)*,* 36-39.

Radwanski, E. R., & Ward, M.J. (2007). Plants and Poetry Integrating Science, Fine Arts, and a Library's Special Collection. *Children and Libraries, Spring* 28-31.

Strgar, J. (2007). Increasing the interest of students in plants. *Journal of Biological Education*, *42*(1), 19-23.

The International Union for Conservation of Nature (2006). The IUCN Red List of Threatened Species: Summary Statistics, Retrieved December 6, 2010 from http://www.iucnredlist.org/info/tables/table1.

Toksoy, D., Gümüş, C., ve Ayyıldız, H. (2003). Türkiye'de Orman Kaynaklarının Durumu ve Tıbbi Bitkilerin Ticareti Üzerine Bir Değerlendirme. *Orman ve Ekonomi Dergisi, 2(8).*

Tunnicliffe, S. D. (2001). Talking about plants-comments of primary school groups looking at plants exhibits in a botanical garden. *Journal of Biological Education, 36*(1), 27- 34.

Wandersee, J.H., & Schussler, E.E. (2001) Preventing plant blindness. *American Biology Teacher, 61* 84-86.

Wandersee, J. H., Clary, R.M. & Guzman, S.M. (2006). A Writing Template for Probing Students' Botonical Sense of Place. *The American Biology Teacher*, *68*(7), 419–422.

Yorek, N., Şahin, M., & Aydın, H. (2009). Are Animals 'More Alive' than Plants? Animistic-Anthropocentric Construction of Life Concept. *Eurasia Journal of Mathematics, Science & Technology Education, 5*(4), 369–378.

DEVELOPING WEB BASED PHP LEARNING ENVIRONMENT

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Abstract: Web-based PHP Learning Environment, an application developed to improve the success of university students in the PHP Programming Language, is discussed in this study. Research studies show that the lack of study and practice is one of the most important cause of failure of the students on programming languages. Therefore, the developed application has been designed to allow the students to practice by logging in through any computer connected to the Internet, without depending on any time or place constraint. It has been designed as a web based application. The application has been designed to have separate interfaces for both the instructor and the students. A number of exercise questions have been prepared for the students on the topics covered by the application. Also, the lecture summaries are included to remind the students of the forgotten topics during exercising. There are interfaces for the instructor to add new contents (lecture, exercise) and a bulletin board. The 3rd grade undergraduate students who take Internet Based Programming Course, have been made to use the developed application and the opinions of the students about the application have been received. Students have stated that the interface of the application was simple and practical, and that the exercises, as the content, were useful for them. Because the use of the application is very practical, the students have also explained that they have been running and testing their own codes, as well as the exercises in the application, in this environment. Also, they have stated that the application could be improved by some enhancements in the lecture section such as video lecturing of complex and detailed examples.

Keywords**:** Programming teaching, php, material development

WEB TABANLI PHP ÖĞRENME ORTAMININ GELİŞTİRİLMESİ

Özet: Bu çalışmada üniversite öğrencilerinin PHP programlama dilindeki başarılarını arttırmak için geliştirilen bir uygulama olan Web Tabanlı PHP Öğrenme Ortamından bahsedilmektedir. Araştırmalar göstermektedir ki öğrencilerin programlama dillerindeki başarısızlığının en büyük sebeplerinden biri çalışma ve uygulama yapma eksikliğidir. Bunun için geliştirilen uygulamanın, öğrencilerin herhangi bir zaman ya da mekâna bağlı kalmadan, internete bağlı herhangi bir bilgisayardan giriş yaparak alıştırma yapmalarını sağlayacak şekilde olması düşünülmüştür. Uygulama web tabanlı olarak tasarlanmıştır. Uygulamada hem derse giren öğretim elemanı hem de öğrenciler için ayrı ayrı arayüzler tasarlamıştır. Öğrenciler için uygulamada yer alan konularla ilgili çok sayıda alıştırma sorusu hazırlanmıştır. Ayrıca öğrencilerin alıştırma yaparken unuttuğu bir nokta olursa hatırlaması için özet konu anlatımları eklenmiştir. Öğretim elemanı için ise yeni içerikler ekleyebileceği (konu anlatımı, alıştırma) ekranlar ile duyuru panosu mevcuttur. Hazırlanan uygulama İnternet Tabanlı Programlama dersi alan 3. sınıf lisans öğrencilerine kullandırılarak, öğrencilerin uygulama hakkındaki görüşleri alınmıştır. Öğrenciler uygulamanın arayüzünün sade ve kullanışlı olduğunu, içerik olarak alıştırmaların kendileri için yararlı olduğunu belirtmişlerdir. Öğrenciler, uygulamanın kullanımının pratikliği sebebiyle uygulamada yer alan alıştırmaların dışında, kendi çalışmalarından kodları da bu ortamda çalıştırıp, test ettiklerini açıklamışlardır. Bunun yanında konu anlatımı kısmında karmaşık ve ayrıntılı örneklerin video ile anlatılması gibi birtakım eklemelerle uygulamanın çok daha iyi duruma getirilebileceğini ifade etmişlerdir.

Anahtar Sözcükler: Programlama öğretimi, php, materyal geliştirme

Giriş

Bilimsel ve teknolojik gelişmeler bütün dünyada büyük bir değişime sebep olmaktadır. Bu değişim her alanda (üretim, ticaret, sağlık, güvenlik vb.) kendini göstermektedir. Örneğin, üretim bandında insan emeğinin yerini alan otomasyon sistemleri sayesinde 7 gün 24 saat aralıksız üretim mümkün olmakta, bu sayede verimlilik artmakta, daha az emekle daha fazla ve daha hızlı üretim mümkün olmaktadır. E-ticaret sayesinde evde otururken, dünyanın diğer ucunda yer alan bir mağazadan sipariş verip, istenilen ürün satın alınabilmektedir. Bilim ve teknolojideki gelişmeler insanların günlük hayatlarında da önemli değişikliklere sebep olmaktadır. Eskiden sadece konuşmak için kullanılan cep telefonları, bugün insanların hayatlarının vazgeçilmez bir parçası haline gelmiştir. Kamera ve internet özelliklerinin yanında mobil uygulamalar ile cep telefonları birer eğlence aracı, hesap makinesi, alarm ya da takvim olabilmektedir. Bu gelişmeleri sağlayan önemli unsurlardan birisi de programlama alanında ulaşılan ileri seviyedir.

Program ya da daha genel ifadeyle yazılım, elektronik araçların belirli bir işi yapabilmesini sağlayan komutlar bütünüdür. Günümüzde kullanılan tüm elektronik araç ve makinelerde yazılımlar bulunmaktadır. Kalkınmayı hedefleyen, bilimsel ve teknolojik gelişmeler ışığında üretimini artırmayı hedefleyen ülkelerin, programlama eğitimine gereken önemi vermesi kaçınılmaz bir zorunluluktur.

Programlama eğitiminin öğrenciler üzerinde göz ardı edilemeyecek, önemli bir katkısı bulunmaktadır. Programlama öğrenmenin, öğrencilerin bakış açılarını değiştirdiği, yaratıcı düşünme, olaylar arasındaki ilişkileri görebilme, problemlerin çözüm yolları konusunda çözüm üretme ve sistematik düşünme becerilerini geliştirme gibi olumlu bir etkisinin olduğu bilinmektedir (Akpınar ve Altun, 2014).

Programlamanın önemi ülkemizde de fark edilmiş ve ilköğretim çağından itibaren öğrencilere temel oluşturabilecek konular müfredata eklenmiştir. Ortaöğretim ve yükseköğrenim kurumlarında çeşitli bölüm ve programlarda programlama dilleri dersleri verilmektedir. Hem ülkemizde hem de dünyada programlama dilleri dersi, özellikle giriş seviyesindeki öğrenciler tarafından zor bulunmaktadır (Aşkar ve Davenport, 2009). Program yazabilmek için hem programlama dilinin kural ve yapılarını bilmenin hem de problemi analiz etme, problemin çözümü için en uygun çözüm yollarını bulma ve çözümü programlama dilinin kural ve yapılarını doğru bir şekilde kullanarak programa dönüştürmek gerekmektedir. Çeşitli araştırmalarda öğrencilerin bilgisayar programlamadaki başarısızlığının başlıca sebebi olarak çalışma ve uygulama yapma eksikliği olduğu belirtilmektedir (NG, Choy, Kwan ve Chan, 2005; Hawi, 2010; Uzun ve Özkılıç, 2012). Problem çözme beceresi üst seviye bilişsel becerilerdendir ve bu beceri problem çözdükçe gelişmektedir. Sadece ders saatlerinde yapılan uygulamalar bir programlama dilini öğrenmek için yeterli değildir. Öğrencilerin ders etkinlikleri dışında da uygulama yapabilmeleri için gerekli tedbirleri almak gerekmektedir.

Öğrencilerin belirtilen eksikliklerini giderebilmek için çeşitli yöntemlerden yararlanarak öğretim materyalleri geliştirmişlerdir. Geliştirilen materyaller incelendiğinde pek çoğunun karma öğrenme yöntemine uygun olarak hazırlandığı görülmektedir. Karma Öğrenme (Harmanlanmış Öğrenme) ile bir yöntemin zayıf ve eksik kalan yönlerini, diğer yöntemin güçlü yönleri ile tamamlayarak daha etkili ve verimli bir öğrenme ortamı elde etmek amaçlanmaktadır (Yolcu, 2015). Vural ve Taşdelen (2014), web tasarımı ve programlama dersi için tasarladıkları web tabanlı öğrenme modülü ile Hadjerrouit (2008) lisans düzeyinde okutulan programlama dersi (Java) için içerik yönetim sistemi (LMS) ile çevrimiçi kaynakların bulunduğu bir öğrenme ortamı oluşturduğu çalışmalar örnek olarak verilebilir.

Bu çalışmada, lisans düzeyinde okutulan PHP programlama dili için web tabanlı, öğrencilerin konularla ilgili çeşitli uygulama örnekleri bulabilecekleri, kendi kendilerine uygulama yapabilecekleri ve yaptıkları uygulamalarla ilgili aldıkları hata mesajlarının olası sebepleri konusunda kendi dillerinde ipuçları alabilecekleri bir ortam geliştirilmiştir. Oluşturulan bu ortam ile öğrencilerin ders saatleri dışında, istedikleri mekânda programlama çalışmalarını sağlamak amaçlanmaktadır.

Yöntem

Bu bölümde Web Tabanlı PHP Öğrenme Ortamının geliştirilme sürecinden ve özelliklerinden bahsedilmiştir.

Web Tabanlı Php Öğrenme Ortamının Geliştirilmesi

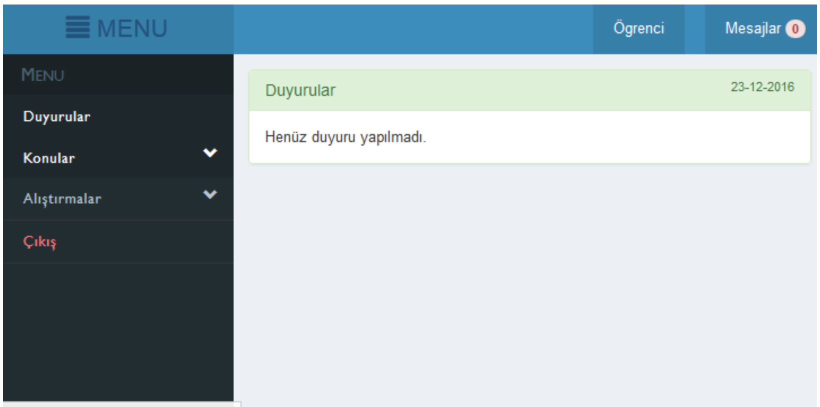
Web Tabanlı PHP Öğrenme Ortamı, PHP web programlama dilinde geliştirilmiş, verilerin kaydedilmesi için MYSQL veritabanı yönetim sistemi kullanılmıştır.

Sistem Altyapısı

Yazılımın çalıştırılması için iki adet sunucu kurulmuştur. Sunucularda Ubuntu Server 14.04.03 sürümü kullanılmaktadır. Sunuculardan birinde istemcilerin login olarak çalışmalarını yaptıkları program (web yazılımı) çalışmaktadır. Diğer sunucuda ise öğrencilerin yazdıkları kodların işlenip sonucunun gönderildiği program çalışmaktadır. Böylece öğrencilerin istemeden, yani test etmeye çalıştıkları komutların nasıl bir işlem yapacağını tam kestirememeleri ya da kişilerin hacking konusundaki bilgilerini test etmeye çalışmaları sonucunda sunucuları çökertmelerinin önüne geçilmiştir.

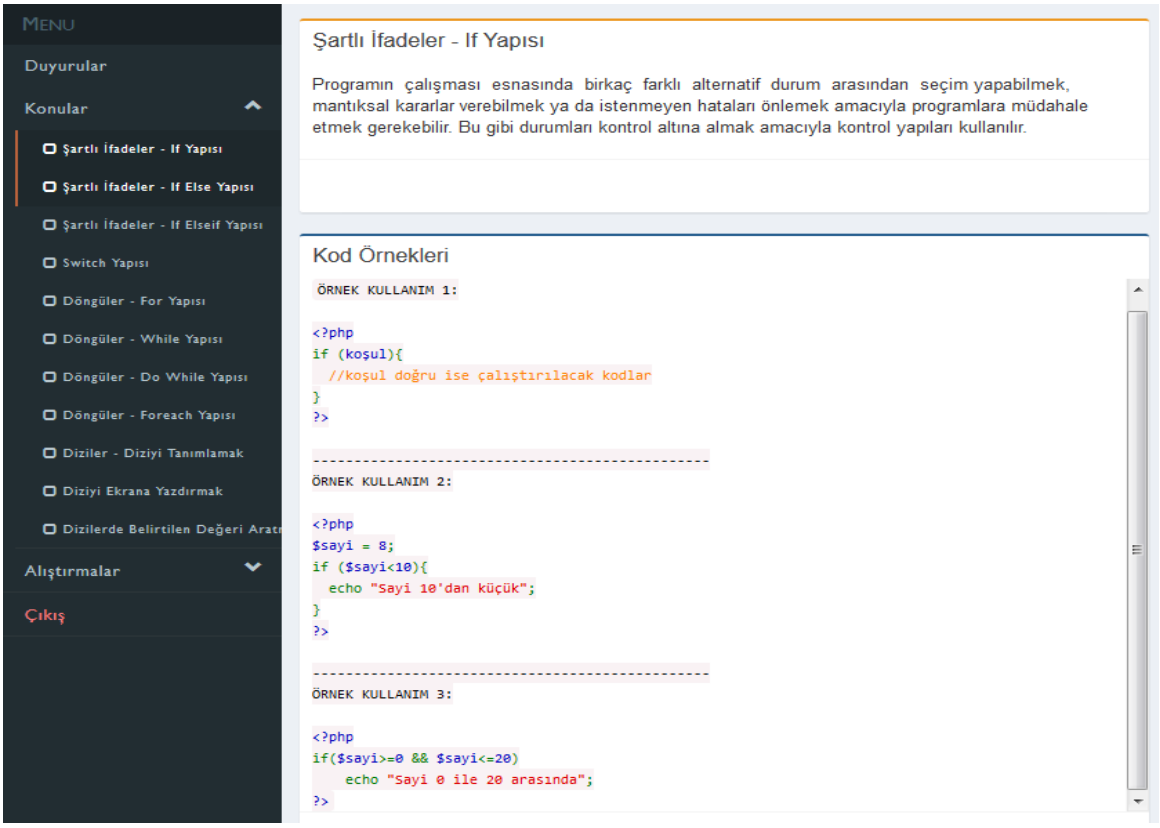
Öğrenciler için Kullanıcı Arayüzleri

Web Tabanlı PHP Öğrenme Ortamı için sade, basit bir arayüz oluşturulmuştur. Kullanıcı adı ve şifresiyle giriş yapan öğrenci, ilk olarak duyuru ekranıyla karşılaşmaktadır. Duyurular en son yapılan duyurudan daha eskiye doğru sıralanarak verilmiştir.



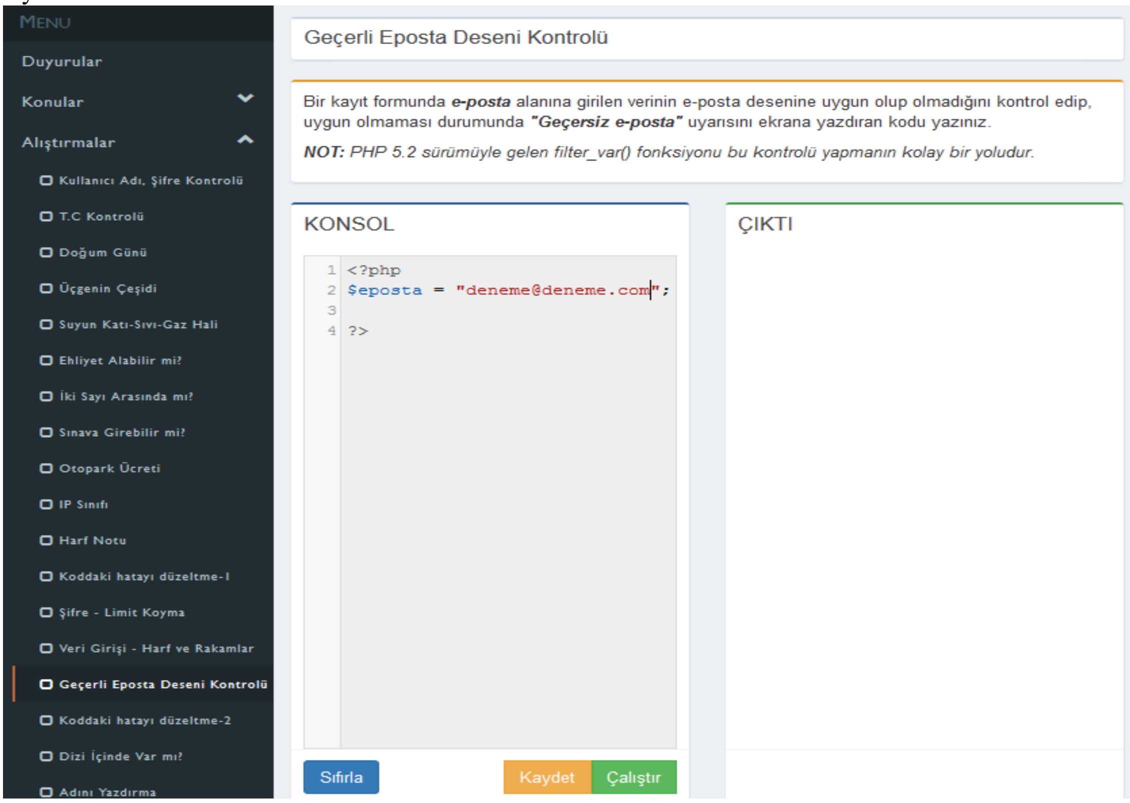
Şekil 1. Duyurular ekranı

Sisteme giriş yapan öğrenciler, menüde yer alan *konular* başlığı altında PHP programlama diline ait kavram ve yapılara ait kısa bir bilgi ve bu yapıların kullanımına dair örnekler bulabilmektedirler. Bu bölümde yer alan örnekler öğrenciler tarafından değiştirilememekte ya da çalıştırılıp sonuçları görüntülenememektedir. Bu bölümün amacı, öğrenci alıştırma yaparken takıldığı noktada ilgili kavram ya da yapıların kullanımına bakabilmesi için kolay ulaşılır bilgiler sunmaktır.



Şekil 2. Konular ekranı

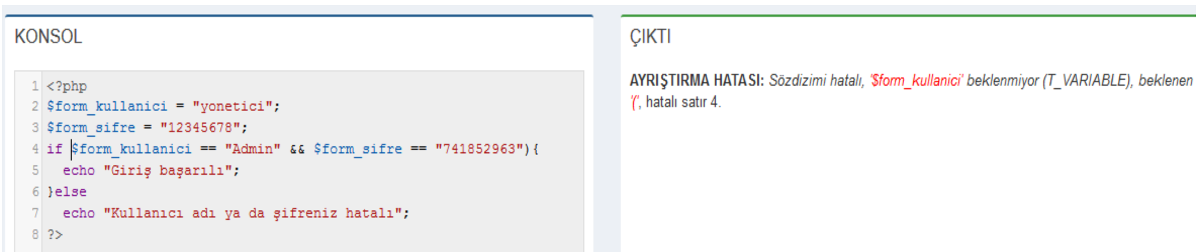
Alıştırmalar başlığı altında ise öğrencilerin programlama çalışmalarını sağlayacak çok sayıda alıştırma sorusu yer almaktadır. Öğrenci istediği alıştırmayı açtığında, ekranın üst tarafında alıştırma sorusuna ait başlık ve başlığın altında da sorunun içeriği yer almaktadır. Sorunun altında ise ekran ikiye bölünmüştür. Sol tarafta öğrencinin kodlarını yazabileceği Konsol alanı, sağ tarafta ise kodları çalıştırdığında sonuçları görebileceği Çıktı alanı yer almaktadır.



Şekil 3. Alıştırmalar ekranı

Konsol ve Çıktı alanlarının altında yer alan düğmelerden Sıfırla kod yazma alanını temizlemek, Kaydet yapılan çalışmayı kaydetmek ve Çalıştır da yazılan kodların çalıştırılması için kullanılmaktadır.

Öğrencilerin programlama çalışırken en çok zorlandıkları durumlardan biri yazdıkları koddaki hatayı tespit etmede yaşadıkları zorluktur. Hata ayıklamada yaşadıkları zorluk, özellikle acemi öğrencilerin çalışma isteklerini kaybetmelerine sebep olmaktadır. Bu sebeple öğrencilere bu süreçte kolaylık sağlamak üzere Web Tabanlı PHP Öğrenme Ortamında hata mesajları mümkün olduğu ölçüde Türkçe 'ye çevrilmiştir. Bunun yanında yanlış kullanılan işaretler gibi vurgulanmak istenen bazı noktalar kırmızı renkle vurgulanmıştır.

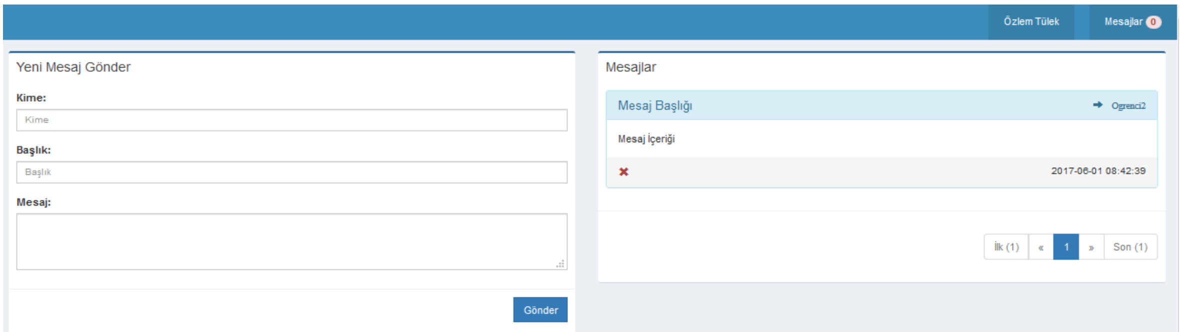


Şekil 4. Hata çıktısı

Öğretim Elemanı için Kullanıcı Arayüzleri

Web Tabanlı PHP Öğrenme Ortamında öğretim elemanları için bir yönetim menüsü bulunmaktadır. Bu menüde *duyurular, tüm içerikler, yeni içerik ekle, kullanıcılar, yeni kullanıcı ekle* seçenekleri bulunmaktadır. Sisteme giriş yapan öğretim elemanı öğrencilere yönelik duyuru girebilir, mevcut duyuruları düzenleyebilir ya da silebilir, yeni içerik (konu anlatımı, alıştırma sorusu) girişi yapabilir, bu içerikleri düzenleyebilir ya da silebilir veya kullanıcılar ekleyebilir, kullanıcılarla ilgili düzenleme ya da silme işlemlerini yapabilir.

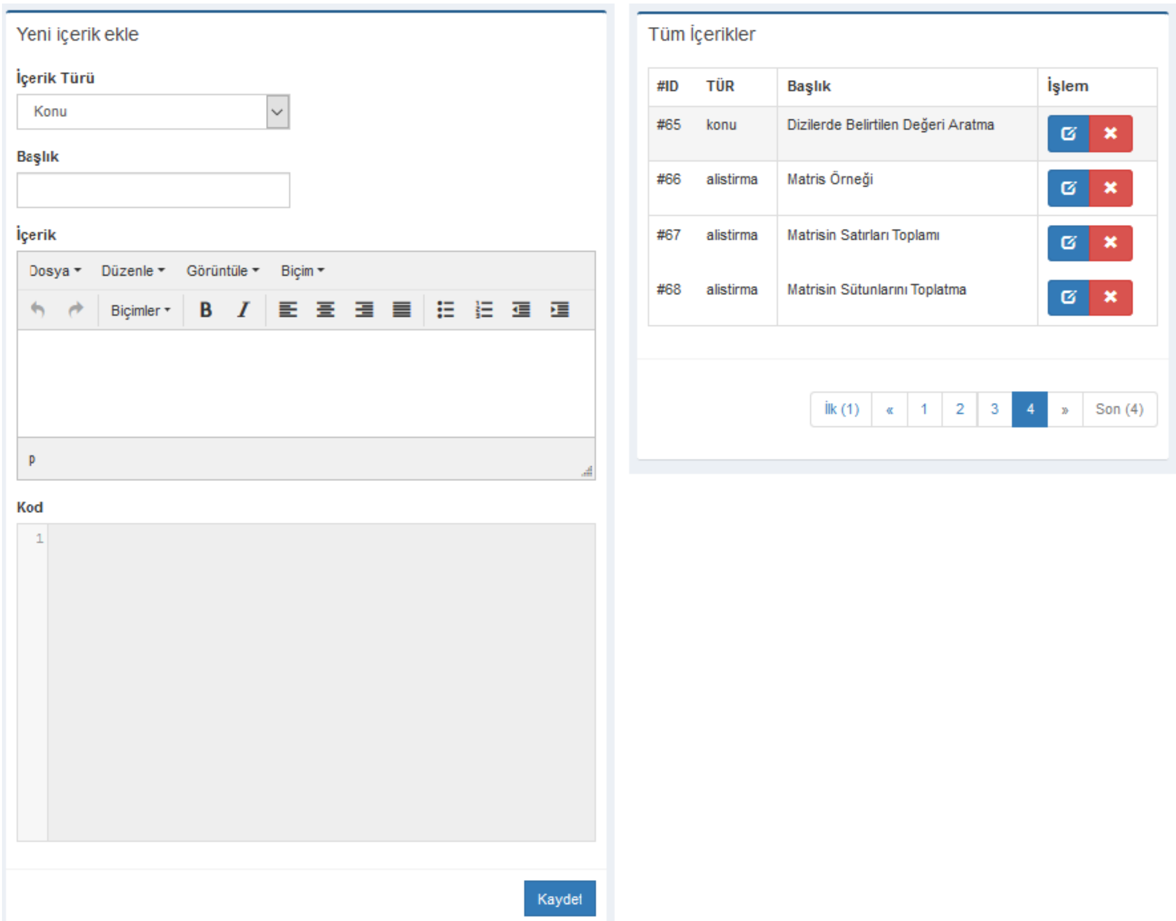
Öğretim elemanının eklediği duyuru tüm öğrenciler tarafından görüntülenmektedir. Sadece bir öğrenci ile iletişim kurulmak istenirse mesaj gönderme özelliği kullanılabilmektedir.



Şekil 5. Mesaj ekranı

Öğretim elemanı öğrencilere mesaj gönderebildiği gibi, öğrenciler de öğretim elemanı ya da diğer öğrencilere mesaj gönderebilmektedir.

Öğretim elemanı yeni içerik eklerken öncelikle içeriğin türünü konu ya da alıştırma şeklinde seçmektedir. Sonra içeriğin başlığı ve içerik metni girilmektedir. Ayrıca bu pencerede kod yazma alanı bulunmaktadır. İçerikte herhangi bir PHP kodu verilmek istendiğinde kod yazma alanına yazılmaktadır.



Şekil 6. İçerik ekleme ve eklenmiş içeriklerin listelendiği ekranlar

Öğretim elemanı yeni öğrencileri tek tek ekleyebileceği gibi csv dosyasından toplu olarak da ekleyebilmektedir. Eklenen kullanıcılar listesi yönetim menüsünde yer alan *kullanıcılar* seçeneği ile görüntülenebilmektedir. Bu ekranda kullanıcılar ile ilgili düzenleme ve silme işlemlerinin yanında kullanıcıların sisteme giriş-çıkış saatleri, içerik sayfalarında kalma süreleri gibi istatistiki bilgiler de görüntülemek mümkündür.

Oturum Bilgileri (Son 10 oturum bilgisi)

Oturum Başlangıç	Son Aktivite	Toplam Süre
10-11-2016 11:43:45	10-11-2016 12:30:02	46 dakika
10-11-2016 08:03:38	10-11-2016 10:51:06	167 dakika
18-10-2016 10:40:19	18-10-2016 10:40:49	1 dakika
11-10-2016 15:15:52	11-10-2016 15:27:43	12 dakika
06-10-2016 09:19:47	06-10-2016 09:42:00	22 dakika
06-10-2016 08:18:04	06-10-2016 08:47:06	29 dakika
05-10-2016 12:38:27	05-10-2016 12:38:40	0 dakika
27-09-2016 16:42:11	27-09-2016 18:01:04	79 dakika

Şekil 7. Oturum bilgileri

Şekil 8. Sayfalarda geçirilen süre

Sonuç ve Öneriler

Programlama eğitiminde yüz yüze yapılan derslerdeki sınırlı süre ve sınıfların kalabalık olması, öğrencilerin programlama dilini öğrenebilmesi için yetersiz kalmaktadır. E-öğrenme ortamlarının sağladığı iletişim ve etkileşim ortamları sayesinde öğrenci-öğretmen iletişimi sınıf dışında da devam edebilmektedir. Ayrıca öğrenciler, dersle ilgili kaynaklara istedikleri zaman ulaşabilmekte ve konuları istedikleri kadar tekrar etme fırsatını bulabilmektedir. Yapılan araştırmalar bu ders için hazırlanmış karma öğrenme ortamlarının öğrencilerin derse olan ilgi ve isteğini arttırdığı ve programcılık performansını arttırmada destek olduğunu ifade etmektedir (Ersoy, 2003; Hadjerrouit, 2008; Yurdagül ve Gültekin, 2009; Dehmenoğlu, 2015). Bu çerçevede yapılan bu çalışma ile üretilen Web Tabanlı PHP Öğrenme Ortamının öğrencilerin programlama çalışabilmeleri için yararlı bir araç olacağı düşünülmektedir.

Kaynaklar

Akpınar, Y., & Altun, A. (2014). Bilgi Toplumu Okullarında Programlama Eğitimi Gereksinimi. *İlköğretim Online*, 1-4.

Aşkar, P., & Davenport, D. (2009). An Investigation of Factors Related to Self-Efficacy for Java Programming Among Engineering Students. *The Turkish Online Journal of Educational Technology, TOJET, 8(1)*, 26-32.

Dehmenoğlu, C. (2015). Programlama temelleri dersine yönelik mobil öğrenme aracının geliştirmesi, Yüksek Lisans Tezi. Bahçeşehir Üniversitesi, İstanbul.

Ersoy, H. (2003). Blending online instruction with traditional instruction in the programming language course: A case study, Yüksek Lisans Tezi. Orta Doğu Teknik Üniversitesi, Ankara.

Hadjerrouit, S. (2008). Towards a Blended Learning Model for Teaching and Learning Computer Programming: A Case Study. *Informatics in Education*, 7(2), 181–210.

Hawi, N. (2010). Causal Attributions of Success and Failure Made by Undergraduate Students in an Introductory-Level Computer Programming Course. *Computers & Education*, 1127–1136.

NG, S. C., Choy, S. O., Kwan, R., & Chan, S. F. (2005). A Web-Based Environment to Improve Teaching and Learning of Computer Programming in Distance Education. *International Conference on Web-based Learning*, 279-290.

Uzun, A., & Özkılıç, R. (2012). Programlama Dilleri Dersi için Hazırlanan Karma Öğrenme Ortamına İlişkin Öğrenci Görüşleri. *e-Journal of New World Sciences Academy*, 638-646.

Vural, H. G., & Taşdelen, K. (2014). Web Tasarımı ve Programlama Dersi İçin Web Tabanlı Eğitimin Öğrenme Üzerine Etkisi. International Conference on Education in Mathematics, Science & Technology, 248-252. Konya.

Yolcu, H. H. (2015). Harmanlanmış (Karma) Öğrenme ve Uygulama Esasları. The Journal of Academic Social Science Studies, 33, 255-260.

Yurdugül, H., & Gültekin, K. (2009). Çokluortamın Bilgisayar Programlama Başarısı Üzerine Etkisi. *9th International Educational Technology Conference*, 449-457. Ankara.

INVESTIGATION OF SECONDARY SCHOOL STUDENTS' COMPETENCIES REGARDING 21ST CENTURY SKILLS AND ETHICAL USE OF IT

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Abstract: In this study, it is aimed to explore secondary schools' 21st century skills related to the science lesson by measuring their skills at cognitive, affective and socio-cultural domains and to identify attitudes of students towards ethical use of IT. The 21st century Skills Scale, designed by Kang, Kim, Kim and You (2012), and translated into Turkish by Karakas (2015), was used as main the data collection tool. In the study, in order to identify attitudes of students towards ethical use of IT, "IT Ethics with Real Life Case Studies Scale" which was adapted to Turkish and has been proved to be valid and reliable by Duymaz (2013) was used. According to the findings, the students were found to have high 21st century skills at the cognitive, affective and socio-cultural domains.

Keywords**:** 21st century skills, information technology (IT), IT ethics with real life case studies.

ORTAOKUL ÖĞRENCİLERİNİN 21. YÜZYIL BECERİLERİNE VE BİLİŞİM ETİĞİNE İLİŞKİN YETERLİKLERİNİN İNCELENMESİ

Özet: Bu araştırmada, ortaokul öğrencilerinin Fen Bilimleri dersine yönelik 21. yüzyıl becerilerine sahip olma düzeylerinin belirlenmesi ile bilişsel, duyuşsal ve sosyokültürel boyutlarda ölçülmesi ve bilişim teknolojilerinin etik kullanımlarına yönelik tutumlarını belirlemek amaçlanmaktadır. Araştırmada Kang, Kim, Kim ve You (2012) tarafından geliştirilen ve Karakaş (2015) tarafından Türkçeye uyarlanan "21. Yüzyıl Becerileri Ölçeği" ölçme aracı olarak kullanılmıştır. Araştırmada katılımcıların bilişim teknolojilerinin etik kullanımlarına yönelik tutumlarını belirlemek için Duymaz (2013) tarafından Türkçeye uyarlanan, geçerlik ve güvenirlik çalışması yapılan "Gerçek Yaşam Durum Senaryolarıyla Bilişim Etiği Ölçeği" kullanılmıştır. Araştırma bulgularına göre; öğrencilerin 21.yüzyıl becerilerinin bilişsel, duyuşsal ve sosyokültürel boyutlarına yüksek düzeyde sahip olduğu bulunmuştur.

Anahtar Sözcükler: 21.yüzyıl becerileri, bilişim teknolojileri, gerçek yaşam durum senaryolarıyla bilişim etiği.

Giriş

Bilişim teknolojileri günümüzde kendine özgü bir alan ve kültür olarak her alanda kendini hissettirmektedir. Bu kültür beraberinde yeni ve önemli etik sorunların varlığını ve yeni etik çözümler geliştirilmesi gerekliliğini de gündeme getirmektedir. Sanal ortamlardaki gelişmeler ve yenilikler devamlı olarak toplumun sahip olduğu etik normların malesef geride kalmasına yol açabilmektedir. Bu durumda toplumda sürekli olarak beklenmeyen etik sorunlar doğması kaçınılmaz olmaktadır. Geleneksel sosyal doku ve ahlaki sorumluluklar elektronik ortamda gerçekleştirilen her türlü etkileşimin güvenliği konusunda yetersiz kalmaktadır (Johnson, 2000; Duymaz, 2013). Bu durum bilişim etiği konusunun ne kadar da önemli olduğunu gün geçtikçe daha da çok gözler önüne sermektedir. Al-Tai, (2010)'e göre etik, doğru hareketi yapmaya karar vermeyi sağlayan kurallar bütünüdür. Etik ahlaklı insanlar tarafından oluşturulmuş olup ahlaki değerler ve ahlaki seçimler içeren bir sistemdir. Bilişim etiği de bilişim alanında hizmet sunanların ve alanların davranışlarını inceleyen bir felsefe dalı olup; etiğin uygulamalı bir alt alanıdır. Bilişim etiğinin temel konuları bilgisayar ile internet kullanımına bilişim sistem ve ağ yönetimine, yazılım geliştirmeye, adli ve yönetsel ve son kullanıcıya yönelik etik kurallar olarak gruplandırılabilir (Türkiye Bilişim Derneği, 2010).

Sokrates için etik ve eğitim, ayrılmaz bir bütün oluşturur ve etik bilgiler eğitim anlayışını yönlendirir. Ona göre, gerçek erdem öğrencinin içindedir ve bu erdemi meydana çıkaracak şekilde öğrencinin eylem ve davranış potansiyelini yönlendirmek gerekmektedir (Pieper, 1999). Bu nedenledir ki Sokrates'ten günümüze, 21. yüzyıla, kadar bireyin davranışları, potansiyelleri başka bir ifadeyle becerileri mutlaka irdelenmesi gereken değişkenler olarak görülmektedir. Bu yüzyılın öğrenenleri için öğretme ve öğrenme ortamı özellikle üstün bilgisayar ve internet teknolojilerinden etkilenmektedir. Yeniçağın öğrenenlerinin temel yetkinlikleri doğrultusunda; gelecek öğrencileri değişen çağa uyumlu hale getirmek ve uygun eğitimi hazırlamak için, 21. yüzyıl becerileri ile ilgili araştırma yapmak gerekmektedir (Kang, Kim, Kim & You, 2010). Günümüzde, akademik performans standartları bilgi ve iletişim teknolojisinin hızlı gelişimi ve küresel ekonominin hızlı büyümesine paralel olarak değişmektedir. Bu yüzden 21. yüzyıl becerileri için bilgi okuryazarlık becerilerini, yeterliliklerini belirleme ve günümüz öğrencilerini gelecek için hazırlamak adına büyük çabalar gösterilmektedir (Kim & Yoon, 2008). 21. yüzyıl becerileri yaşam boyu öğrenme için gerekli beceri ve yeterlilikleri içermesi nedeniyle ortaokul öğrencilerinin bu becerileri kazanmaları önemli hale gelmiştir (Shin & Lee, 2008). Ortaokul, örgün eğitimin en temel aşamalarından biridir. Eğitimcilerin bu basamakta öğrenim gören öğrencilerin özelliklerini ortaya çıkarma ve 21. Yüzyıl becerilerini geliştirme sorumluluğu vardır. Çocukların etkili fen eğitimini ortaokulda öğrenmeye başladıkları ve oluşturdukları düşünülürse ortaokul öğrencilerinin 21. yüzyıl becerilerinin ölçülmesi oldukça önemlidir (Karakaş, 2015). Kaya ve Tuna, (2010)'ya göre, ilköğretim çağından itibaren teknolojilerle olan yoğun etkileşiminin etik ve yasal çerçevede gelişmesine yapılacak katkılar gelecekteki olası problemleri de önleyebilecektir. Çünkü aile, okul, toplumsal çevre ve kitle iletişim araçları sayesinde sürekli bir sosyalleşme süreci içerisinde olan ilköğretim çağındaki çocuklar popüler kültürden ve bilgisayar, internet gibi popüler kültür ürünlerinden en çok etkilenen kesimlerden birini oluşturmaktadır. Bilgi ve iletişim teknolojileri gibi dinamik ve karmaşık bir alan için etik kuralların varlığı bireylere etik davranış ve bilinç kazandırmak için tek başına yeterli değildir. Bilişim teknolojilerindeki etik dışı davranışların en aza indirmek öncelikle bilişim etiği konusunda farkındalık yaratmak, etik bir anlayışın geliştirilmesini sağlamakla mümkün olabilir. Bu farkındalık ve anlayışın küçük yaşlarda sağlanması önem taşımaktadır (Duymaz, 2013). Bu nedenle çalışmada, ortaokul öğrencilerinin 21. yüzyıl becerilerine sahip olma düzeylerinin belirlenmesi ile bilişsel, duyuşsal ve sosyokültürel boyutlarda ölçülmesi ve bilişim teknolojilerinin etik kullanımlarına yönelik tutumlarının belirlemesi amaçlanmıştır.

Yöntem

Tarama modelinde gerçekleştirilen araştırmanın katılımcıları 2016-2017 eğitim öğretim yılında Ankara ilinde bulunan bir devlet ortaokulunda 6. sınıfta öğrenim görmekte olan 28 kız, 22 erkek toplam 50 öğrenciden oluşmaktadır. Araştırmada Kang, Kim, Kim ve You (2012) tarafından geliştirilen ve Karakaş (2015) tarafından Türkçeye uyarlanan "21. Yüzyıl Becerileri Ölçeği" ölçme aracı olarak kullanılmıştır. Ölçek bilişsel, duyuşsal ve sosyokültürel olmak üzere üç ana ve 12 alt boyuttan oluşmaktadır. Ayrıca çalışmada katılımcıların bilişim teknolojilerinin etik kullanımlarına yönelik tutumlarını belirlemek için Yoon'un (2011)tarafından geliştirilen ve Duymaz (2013) tarafından Türkçeye uyarlanan, "Gerçek Yaşam Durum Senaryolarıyla Bilişim Etiği Ölçeği" kullanılmıştır. Ölçek internet üzerinde etik ikilemler yaratan gerçek yaşam durumları içeren senaryolar ve bu senaryolara göre cevaplanacak 17 maddeden oluşan likert tipi bir ölçektir. Ölçek adalet, görecelik, egoizm, görev bilgisi (deontoloji) ve faydacılık olmak üzere beş ahlak felsefesi değişkeni temel alınarak oluşturulmuştur. Ölçekte internet üzerinde etik ikilemler yaratan gerçek yaşam durumları içeren dört senaryo kullanılmıştır. Bu senaryolar yapısal eşitlik ilkesi ile geliştirilmiş ve deneysel olarak test edilmiştir. Birinci senaryo gizlilik ihlali (mahremiyet) ile ilgili, ikinci senaryo müstehcen içeriği sağlıksız bir şekilde yaygınlaştırmak (ifade özgürlüğü) ile ilgili, üçüncü senaryo yazılım korsanlığı fikri mülkiyet ihlali ile ilgili, dördüncü senaryo yanlış bilgilerin yayılması (doğruluk) ile ilgilidir (Duymaz, 2013).

Bulgular

Tablo 1. Bilişsel alan ve bilişim etiği

Değişkenler		Bilgi Yönetimi	Bilgi Yapılandırma	Bilgi Kullanımı	Problem Çözme	Bilişsel Alan
Bilişim Etiği	r	.174	.307*	.158	.328*	.329*
	p	.228	.041	.275	.020	.020

Tablo 1'de görüldüğü gibi, öğrencilerin bilişim teknolojilerinin etik kullanımına yönelik tutumları ile bilgi yapılandırma, bilişsel alan becerileri ve problem çözme becerileri arasında pozitif anlamlı ilişkilerin olduğu belirlenmiştir. Bilişsel alan becerilerin bilgi yönetimi ve bilgi kullanımı alt boyutlarında anlamlı ilişkilere rastlanmamıştır.

Tablo 2. Duyuşsal alan ve bilişim etiği

Değişkenler		Öz Kimlik	Öz Değer	Kendi Kendini Yönetme	Öz Sorumluluk	Duyuşsal Alan
Bilişim Etiği	r	.169	.330*	.215	.094	.269
	p	.239	.019	.135	.517	.059

Tablo 2' incelendiğinde sadece öğrencilerin duyuşsal alan becerilerin öz değer alt boyutu ile bilişim teknolojilerinin etik kullanımına yönelik tutumları ile arasında anlamlı bir ilişki olduğu görülmektedir. Öz Kimlik, Kendi Kendini Yönetme ve Öz Sorumluluk Alan alt boyutlarında anlamlı ilişkiler gözlenmemiştir.

Tablo 3. Sosyokültürel alan ve bilişim etiği

Değişkenler		Sosyal Üyelik	Sosyal Hassasiyet	Sosyalleşme Yeteneği	Sosyal Yerine Getirme	Sosyokültürel Alan
Bilişim	r	.093	.136	.196	.232	238
Etiği	p	.519	.345	.173	.105	.096

Tablo 3' te görüldüğü gibi öğrencilerin bilişim teknolojilerinin etik kullanımına yönelik tutumları ile sosyokültürel alan becerileri (Sosyal Üyelik, Sosyal Hassasiyet, Sosyalleşme Yeteneği, Sosyal Yerine Getirme) arasında anlamlı bir ilişki olmadığı belirlenmiştir.

Sonuç

Bireylerin bilgi ve iletişim teknolojilerinin kullanımında etik olmayan şekilde davranmalarında farklı sebepler olabilmektedir. Bu nedenlerin neler olabileceği yapılan araştırmalarla belirlenmeye çalışılmaktadır. Literatür incelendiğinde yapılan çalışmalarda araştırmacıların, bilgi ve iletişim teknolojileri kullanımını çevreleyen etik konuları, okullardaki etik konulara ilişkin teknoloji politikaları, bilgi teknolojileri bağlamında etik karar verme süreçlerinde, kişisel ahlak felsefesinin ve ahlak yoğunluğunun rolünü inceledikleri belirlenmiştir (Dill & Anderson, 2003; Dorantes, Hewitt & Goles, 2006). Bilişim teknolojilerinin ortaya çıkardığı başlıca etik sorunlar; özel yaşamın gizliliği, bilgi doğruluğu, fikri mülkiyet, telif hakları, sayısal uçurum, sanal ortam, sanal ilişkiler, yetkisiz erişim, sahtecilik, dolandırıcılık, siberzorbalık, güvenlik ve kalite şeklinde sıralanabilir (Duymaz, 2013). Willcoks ve Whitley (2009)'e göre, bilişim ve bilgisayar teknolojilerinin insan faktörüne etkisi nedeniyle, bilgisayar ve internet kullanımı esnasında, etik bağlamında bireylerin yaptıkları seçimler ve nasıl davranacaklarına ilişkin profesyonel anlamda eğitim almaları önemlidir. Bu eğitim insanların bilgisayar teknolojilerini faydalı bir şekilde hayatı kolaylaştırmak amacıyla kullanmalarını sağlamada büyük önem taşımaktadır. Hur, Kim, Song ve Lee (2009) bilgi ve iletişim etiği eğitiminin gerekliliğini inceleyerek ilköğretim okullarından başlayarak bu tür eğitimlerin attırılması gerektiğine vurgu yapmaktadır. Etik dışı davranışlar "sosyokültürel ve ekonomik türler" ile "psikolojik türler" olmak üzere gruplandırılabilir. Bireyin etik dışı davranmasına, yetiştiği sosyal ve kültürel çevre ile birlikte yaşanılan çevrenin kalkınmışlık düzeyinin etkileri, kişisel özellikleri ve korku, kızgınlık, stres vb. gibi psikolojik durumları etkilidir (Gül, 2006). Başka bir ifadeyle kişinin bilişsel, duyuşsal ve sosyokültürel alanları etik dışı davranışlara bireyi yönlendirebilmektedir. Dolayısıyla söz konusu bu etmenler bireyin bilişim teknolojilerinin etik dışı kullanmasına neden olan faktörler olarak düşünülebilir. Bu görüşten hareketle çalışmada, ortaokul öğrencilerinin 21. yüzyıl becerilerine sahip olma düzeylerinin belirlenmesi ile bilişsel, duyuşsal ve sosyokültürel boyutlarda ölçülmesi ve bilişim teknolojilerinin etik kullanımlarına yönelik tutumlarını belirlemek amaçlanmıştır.

Araştırmada öğrencilerin bilişim teknolojilerinin etik kullanımına yönelik tutumları ile bilgi yapılandırma, bilişsel alan becerileri ve problem çözme becerileri arasında pozitif anlamlı ilişkilerin olduğu belirlenmiştir. Bilişsel alan becerilerin bilgi yönetimi ve bilgi kullanımı alt boyutlarında anlamlı ilişkilere rastlanmamıştır. Bu bulgu söz konusu alt boyutların öğrencilerin hangi becerilerini belirlemeye yönelik olduklarını açıklamayı gerektirmektedir. Bilgi yönetimi becerisi, araç ve kaynakların kullanımını ve sorgulama becerilerini kapsar. Bilgi yapılandırma yeteneği ise daha çok bilgiyi işleme, akıl yürütme becerileri ve eleştirel düşünme becerileriyle ilgilidir. Öğrencilerin sahip olduğu bilgi kullanımı yeteneği, analitik beceriler, yargılama ve değerlendirme ve çözüm üretme becerilerinden oluşur. Son olarak problem çözme yeteneği, üst biliş ve yaratıcı düşünme becerilerini kullanmayı gerektirir (Kang, Kim, Kim & You, 2012; Karakaş, 2015). Gün geçtikçe daha büyük bir ivme ile toplum bilgi toplumu haline dönüşürken, arama, analiz ve bilgi yapılandırma yeteneği öğrenciler için önemli bir beceri haline gelmektedir (Resnik, 2002). Bilgi yönetimi, bilgi yapılandırma ve gerçek yaşam problem çözme becerilerini geliştirmek yeni nesil öğrencileri için temel yetkinlikler haline gelirken, bilimsel ve teknolojik gelişmelerle birlikte nesillerin bilgi iletişim teknolojilerini kullanmaları da önemli hale gelmiştir. Çünkü bilgi iletişim teknolojileri kullanımı bilgiyi işleme ve kullanım becerilerini kolaylaştırır; öğrenciler üst düzey düşünmede daha fazla zaman harcayabilir, problem çözme, eleştirel, analiz ve yaratıcılık gibi alanlarda becerilerini geliştirebilir (Choi & Chun, 2002; Choi & Kim, 2003; Daud & Husin, 2004; Kang & Han, 2000; Macdonald, Heap & Mason, 2001; Wheeler, Waite & Bromfield, 2002).

Araştırmada öğrencilerin duyuşsal alan becerilerin öz değer alt boyutu ile bilişim teknolojilerinin etik kullanımına yönelik tutumları ile arasında anlamlı bir ilişki olduğu görülmektedir. Öz Kimlik, Kendi Kendini Yönetme ve Öz Sorumluluk Alan alt boyutlarında anlamlı ilişkiler gözlenmemiştir. Öz kimlik, kendini algılama, öz saygı ve benlik saygısıyla ilgi iken öz değer, farkındalık, güvenilirlik ve dürüstlük becerilerini gerektirir. Kendi kendini yönetme, öz yeterlik, hedef belirleme ve yükümlülük becerilerini kapsarken öz sorumluluk daha çok girişkenlik, direnme (ısrar) ve sorumluluk gibi becerilerden oluşur (Kang, Kim, Kim & You, 2012; Karakaş, 2015). Bilgi iletişim teknolojilerinin kullanımının öğrencilerin ihtiyaçlarına bağlı olarak farklı öğrenmeler için çeşitli fırsatlar sağlayabilmektedir. Böylece öğrenci merkezli ortamlar kurularak, öğrenme stillerini, hedeflerini ve stratejilerini öğrencinin belirlemesi ve kendi ilgi ve kararlarını kendilerinin vermesi sağlanabilir. Sonuç olarak, öğrenciler öğrenme ortamlarını bağımsız ve kendi tasarlar (Granger & Bowman, 2003). Duyuşsal alan günümüz bilgi toplumunda yaşam boyu öğrenme ve eğitim fırsatlarını arttırıcı olarak öğrenme başarısı için kritik faktörler olan öz kimlik, öz değer, kendi kendini yönetme, öz sorumluluk ve sosyal üyelik alanlarını içerir (Andone vd., 2006).

Çalışmada öğrencilerin bilişim teknolojilerinin etik kullanımına yönelik tutumları ile sosyokültürel alan becerileri (Sosyal Üyelik, Sosyal Hassasiyet, Sosyalleşme Yeteneği, Sosyal Yerine Getirme) arasında anlamlı bir ilişki olmadığı belirlenmiştir. Sosyal üyelik daha çok toplumsal değer sistemi, topluluk duygusu ve küresel vatandaşlıkla ilgilidir. Sosyal hassasiyet ise kültürler arası anlayış ve farklılıklara hoşgörü becerisini gerektirir. Sosyalleşme yeteneği, dil akıcılığı, kültürler arası iletişim ve iletişim becerilerinden oluşur. Sosyal ifa ile kastedilen liderlik, takım çalışması ve sosyal hizmetleri yerine getirme becerileridir (Kang, Kim, Kim & You, 2012; Karakaş, 2015). Bilgi iletişim teknolojileri ilerledikçe, yeniçağın öğrenenlerinde öncekilerden farklı olarak yeni deneyimler ortaya çıkmaktadır. Bu yeni oluşan boyutla, öğrencilerin başkalarıyla yakın ya da uzak ve farklı kültürlerden gelen kişilerle etkileşim halinde olacaktır (Kang vd., 2010). Öğrenciler zaman ve mekan sınırlarının ötesinde bilgi ve fikirlerini paylaşarak yeni bilgiler inşa edeceklerdir. Bu yüzden, bilgi iletişim teknolojileri odaklı toplumlarda başarılı olmak için iletişim yetenekleri (Kennewell & Morgan, 2006; Wild, 1996) ve farklı kültürlere saygı (Glimps & Ford, 2008) yetkinlikleri gerekli ve önemli hale gelmiştir. Başarılı bir şekilde öğrenmek için kişilerle güçlü bağlar kurmak ve açık fikirlilik kazanabilmeleri gerekir. Bu tarz sosyal ve işbirlikçi öğrenmeyi kolaylaştırmak için sosyal üyelik, sosyal hassasiyet, sosyalleşme yeteneği ve sosyal ifa yeniçağdaki bireyler için gerekli ve önemli ana becerilerdir. Ayrıca, öğrencilerin işbirliği ağları düzenlemek için daha fazla fırsat olacaktır (Karakaş, 2015).

Araştırmada, bilişim teknolojilerinin etik kullanımına yönelik tutumları belirleyebilmek için senaryo tabanlı ölçek kullanılmıştır. Araştırmada kullanılan Gerçek Yaşam Durum Senaryolarıyla Bilişim Etiği Ölçeği öğrencilerin gerçek hayatta yaptıkları etik olmayan davranışların farkına varmalarına, etik davranışlarda bulunmalarına ve olayları etik-etik olmayan şeklinde ayırt edebilmelerine yardımcı olmuştur. Bu da araştırmaya ayrı bir farkındalık katmıştır. Araştırmadan elde edilen bulguların ve başka araştırmacılar tarafından gerçekleştirilecek diğer çalışma bulgularıyla beraber gelecekte yapılacak olan bilişim etiği öğretim programlarının nasıl özellikler taşıması, hangi öğretim yöntem-tekniklerinin kullanılması, hangi konu başlıklarına ağırlık verilmesi gerektiğine yönelik öneriler getirmesini diliyoruz.

Kaynaklar

Al-Tai, M., (2010). *Work based learning and employers engagement*. 4. Uluslararası Bilgisayar ve Öğretim Teknolojileri Sempozyumu, Konya.

Andone, D., Dron J., Boyne, C. & Pemberton, L.(2006). *Are our students digital students?* Proceedings of 13th International Conference ALT-C 2006, 82-96.

Choi, W. & Chun, K. H. (2002). Effects of problem-based learning with Internet on information literacy and retention by achievement levels. *Korean Journal of Educational Technology*, 18(3), 109–131.

Choi, W. & Kim, M. S. (2003). Effects of an instructional model for academic controversies in problem-based learning utilizing Internet on balanced critical thinking skill. *Korean Journal of Educational Technology*, 19(3), 261–283.

Daud, M. & Husin, Z. (2004). Developing critical thinking skills in computer-aided extended reading classes. *British Journal of Educational Technology*, 35(4), 477–487.

Dill, B. J. & Anderson, R. E., (2003). Ethics-related technology policies in schools. *Social Science Computer Review*, 21(3):326-339.

orantes, C. A., Hewitt, B. & Goles, T., (2006). *Ethical decision-making in an IT context: the roles of personal moral philosophies and moral intensity*. Proceedings of the 39th Hawaii International Conference on System Sciences, Hawaii, USA.

Duymaz, S. H. (2013). *Ortaokul öğrencilerine yönelik "bilişim etiği öğretim programı" uygulaması*. Yüksek Lisans Tezi, Ege Üniversitesi Fen Bilimleri Enstitüsü, İzmir.

Glimps, B. J. & Ford, T. (2008). Using internet technology tools to teach about global diversity. *The Clearing House*, 82(2), 92-95.

Granger, D. & Bowman, M. (2003). *Constructing knowledge at a distance, the learner in context*. In M. G. Moore & W. G. Anderson (Eds.), The handbook of distance education, 169–180. Mahwah, NJ: Lawrence Erlbaum Associates.

Gül, H., (2006). Etik dışı davranışlar ve ussallaştırılması. *Selçuk Üniversitesi Karaman İ.İ.B.F. Dergisi*, 10:65-79.

Hur, J.-H., Kim, K.-Y., Song, J.-B. & Lee, T.-W., (2009). *The narrative approach to teach information and communication ethics education in elementary school*. Proceedings of the 17th International Conference on Computers in Education- ICCE, Asia-Pacific Society for Computers in Education, Hong Kong.

Johnson, D. G., (2000). *Computer ethics*. Englewood Cliffs, New Jersey, 216.

Kang, M. H., & Han, Y. S. (2000). The effects of inquiry training model on the inquiry skill and task performance in the resource-based learning environment. *Korean Journal of Educational Technology*, 16(2), 3–18.

Kang, M., Heo, H., Jo, I., Shin, J. & Seo, J. (2010). Developing an Educational Performance Indicator for New Millennium Students. *Journal of Research on Technology in Education*, 43(2): 157-170.

Kang, M., Kim, B., Kim, B., & You, H. (2012). Developing an Instrument to Measure 21st Century Skills for Elementary Students. *The Korean Journal of Eductional Methodolocy Studies*, 25(2).

Karataş, M. M. (2015). *Ortaokul sekizinci sınıf öğrencilerinin fen bilimlerine yönelik 21.yüzyıl beceri düzeylerinin ölçülmesi*. Yüksek Lisans Tezi, Eskişehir Osmangazi Üniversitesi Eğitim Bilimleri Enstitüsü, Eskişehir.

Kaya, K. & Tuna, M., 2010, Popüler kültürün ilköğretim çağindaki çocuklarin aile içi ilişkileri üzerindeki etkisi. *SDÜ Fen Edebiyat Fakültesi Sosyal Bilimler Dergisi*, 21:237-256.

Kim, T. & Yoon, H. (2008). *Study of developing core competencies of adolescent and promotion project* I. Seoul: National Youth Policy Institute.

Knnewell, S. & Morgan, A. (2006). Factors influencing learning through play in ICT. *Computers & Education*, 46(3), (s. 265-279).

Macdonald, J., Heap, N. & Mason, R. (2001). "Have I learnt it?" Evaluating skills for resources-based study using electronic resources. *British Journal of Educational Technology*, 32(4), 419–433.

Pieper, A., 1999, *Etiğe Giriş*, (Çev.V. Atayman ve S. Gönül), Ayrıntı Yayınları, İstanbul, 287s.

Resnik, M. (2002). Rethinking learning in digital age. Retrieved May 25, 2009, from
http://web.media.mit.edu/~mres/papers/wef.pdf

Shin, H.I. & Lee, S. H. (2008). *Analysis of new millennium learner's behavior*. Seoul: Keris.

Türkiye Bilişim Derneği, (2010). *Bilişim Etiği Nihai Rapor*. http://www.tbd.org.tr/usr_img/cd/kamubib14/raporlarPDF/RP2-2011.pdf (Erişim tarihi: 7 Temmuz 2012)

Wheeler, S., Waite, S. J. & Bromfield, C. (2002). Promoting creative thinking through the use of ICT. *Journal of Computer Assisted Learning*, 18, 367–378.

Wild, M. (1996). Investigating verbal interactions when primary children use computers. *Journal of Computer Assisted Learning*, 12(2), 66–67.

Willcocks, L. & Whitley, E. A., 2009, Developing the information and knowledge agenda in information systems: Insights from philosophy. *The Information Society: An International Journal*, 25 (3):190-197.

INTEGRATION OF INNOVATIVE TECHNOLOGIES TO ENGINEERING EDUCATION: 3D PRINTERS

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Abstract: The improvement of technology by time causes the diversity of human needs. It is very important to make these new technologies applicable in educational area. This results in improvement of education quality and rivalry in education sector which in turn result in again quality improvement. One of the recent emerging technologies is 3D printer. While 3D printers are becoming popular in many areas, they are very promising to fulfill the engineering education. Engineering education has a theoretically dense syllabus. Especially the design courses are taught at theoretical level and they cannot find the practical outcomes. That's why the studied subjects are not understood clearly and not reaching to a concrete result. By usage of 3D printers, the students will obtain the tangible outputs which will help them to understand the subject clearly. Besides, it will help the students to improve their motivation and vision. Furthermore, the topics taught by using 2-D drawings are not clearly understood. Using 3D models of these drawings will be much more helpful to the students. Consequently, integration of 3D printers to the engineering education has a great importance.

Keywords**:** 3D printer, education, innovation, engineering, technology

YENİLİKÇİ TEKNOLOJİLERİN MÜHENDİSLİK EĞİTİMİNE ENTEGRASYONU: 3B YAZICILAR

Özet: Zaman içerisinde teknolojinin ilerlemesi ile insanların ihtiyaçları da çeşitlilik arz etmektedir. Yeni teknolojilerin eğitim alanında kullanılabilir hale getirilmesi ise büyük öneme sahiptir. Buna bağlı olarak eğitimin kalitesi arttırılabilirken, eğitim sektöründe rekabet ortamı oluşturarak, eğitimde kalitenin artmasına ayrıca katkı sağlar. Son dönemde ortaya çıkan yeni teknolojilerden biri de 3B yazıcılardır. 3B yazıcılar bir çok alanda rağbet görürken , özellikle mühendislik eğitimi alanında ciddi bir boşluğu doldurabilir. Mühendislik eğitimi genellikle teorik olarak yoğun bir müfredata sahiptir. Özellikle tasarım derslerinde yapılan çalışmalar teoride kalmakta, pratik karşılığını bulamamaktadır. Bu nedenle yapılan bu çalışmalar tam anlamıyla anlaşılmamakta ve somut bir sonuca ulaşamamaktadır. 3B yazıcıların kullanımıyla yapılan tasarımların somut karşılığı öğrenci tarafından doğrudan elde edileceğinden, verilen eğitimin ayakları yere basacaktır. Ayrıca, bu sayede öğrencilerin motivasyonu ve ufku artacağından, eğitimin verimliliğine oldukça önemli bir katkı sağlayacaktır. Bunun yanında, yalnızca teknik resimle ifade edilmeye çalışılan konuların 3B yazıcı çıktılarıyla öğrenciye somut olarak sunulması konunun çok daha anlaşılır olmasını sağlayacaktır. Bunlardan dolayı 3B yazıcıların mühendislik eğitimlerinin içerisine entegrasyonunun sağlanması büyük önem arz etmektedir.

Anahtar Sözcükler**:** 3B yazıcı, eğitim, inovasyon, mühendislik, teknoloji.

Giriş

Dünyamızın içinde bulunduğu zaman artık "Dijital Çağ" olarak adalndırılırken bu çağın nesline de "Z" kuşağı denmektedir. Sanayi devriminden sonra artık Dijital devrim çağını yaşıyoruz. Öyle ki, bir gün önceki teknoloji artık eski bir teknolji olarak anılabiliyor. Baş döndüren bu hızdaki teknolojilere hayatımızın hiçbir kesitinde kayıtsız kalınamaz. Eğitim sistemleri ve müfredatları artık "Z" kuşağı gençliğinin ihtiyaçlarına göre belirlenmek zorundadır. Klasik eğitim modeli tüm cazibesin kaybetmiştir. Yakın gelecekte eğitim bilimciler mutlak suretle yeni eğitim modelleri ile karşımıza çıkacaklardır. Araştıran, geliştiren, sorgulayan ve analitik düşünebilen gençliğin yetiştirilmesi için yenilikçi eğitim modelleri içeren modern eğitim sistemlerine ihtiyaç olduğu kesindir. Zira günümüz eğitim sistemlerinin yeterliliği tartışılmaya başlanmıştır. Teknoloji ürünleri tüm hızıyla gündelik hayatımıza yerleşmişken bunları eğitim sistemlerinin içine dahil etmemek büyük bir hatadır demek yanlış olmayacaktır.

Geleceklerini gençliğine emanet edecek ülkeler, gençlerin ilgisini, ihtiyaçlarını, motivasyonlarını arttıracak yeni teknolojileri görmezden ve bilmezden gelemezler. Mutlak suretle bu gençliğin eğitimlerini planlarken bu temel

argümanları göz önüne almak zorundadırlar. Gençliğin teknolojilere olan aşırı ilgilerinden yararlanabilecek yeni eğitim modelleri geliştirilmelidir. Ancak bu sayade dijital çağın güçlü ve çağdaş ülkesi olabilir ve rekabet edebiliriz. Aksi halde yok olmak kaçınılmazdır. 3 boyutlu yazıcılar çağımızın son teknoloji ürünleri arasında yerini almış ve sürekli olarak gelişme kaydetmekte olan bir dijital çağ ürünleri olarak göze çarpmaktadırlar.
3B yazıcılar eskiden hayal gözüyle bakılan bir teknolojiyi hayata geçiriyor. 3B yazıcı teknolojisinin ilk kullanıma başladığı günden bu yana sürekli geliştiği vurgulanmaktadır. 3 boyutlu bilgisayar tasarımının özel yazıcılar sayesinde gerçek objelere dönüştürüldüğü sistem, sağlık, inşaat, havacılık, eğitim gibi sektörlerin yanında artık evlere de girmeye başladı. 3 boyutlu yazıcıların eğitimde kullanılması, eğitim müfredatının değiştirmeye yönelik değil, geliştirilmesine yönelik olacaktır. Öğretim üyelerinin ve öğrencilerin birlikte öğrendikleri ve geliştirdikleri bir öğrenme yönteminin kapılarını açacaktır. Problem çözme analitik düşünme yeteneğini artıracaktır. Teknolojiyi eğitimin içerisine entegre edecektir. Tüm mühendislik eğitimi veren öğretim üyelerinin bu teknoljiyi eğitimde kullanabilmesine olanak sağlayacaktır.
Bu bildiride mühendislik eğitiminde 3B yazıcıların önemi vurgulanarak, eğitimin nasıl geliştirilebileceği hakkında bilgiler sunulmuştur.

Mühendislik Eğitimi

21. yüzyıldaki bilim ve teknolojideki hızlı gelişim teknolojik uygulamalar ve üretimin ilkelerinin bütün dünyaya yayılması mühendislik ve mühendis kavramlarının değişmesine neden olmuştur. Mühendislik tanım olarak; eğitim, deneyim ve uygulama ile edinilen temel ve doğa bilimleri bilgisinin, sürdürebilirlilik ve mühendislik etiği ilkelerinin de gözetilerek insanlık yararına kullanılması için yöntemlerin geliştirildiği bir meslek grubudur (TMMOB ve Mühendislik Eğitimi, 2005). Mühendis ise; öğrenmeyi öğrenmiş, araştıran, bilgi üreten, yabancı dil bilen, teknolojiyi kullanabilen, sosyal bilimlere açık, çevresini sorgulayan, yaratıcı, üretken, toplumla bütünleşen, kalite bilincine sahip, yerel değerleri göz ardı etmeyen, zamanın değerini kavrayan, kendisiyle barışık, etik değerlere sahip, entellektüel özellikli, meslek örgütüne ve örgütlenmesine inanan, ülke ve meslek sorunlarına duyarlı biridir (EEBM 1.Ulusal Eğitim Sempozyumu, 2003).

Mühendislik eğitiminin öncelikli hedefi, matematik ve fizik gibi temel bilim derslerinden kazanılan bilgilerin, mühendislik problemlerinin çözümlenmesinde etkin bir şekilde kullanılması yeteneğinin kazandırılmasıdır. Mühendislerin öncelikli olarak tasarım, üretim ve test gibi konularda etkin görev üstlenebilecek formasyona kavuşturulacak bir eğitim almaları beklenmektedir. Klasik mühendislik eğitiminin aşamaları aşağıdaki şekilde özetlenebilmektedir:

- Temel bilimler (matematik ,fizik ,kimya, vs.)
- Temel mühendislik bilimleri (Termodinamik, akışkanlar mekniği, ısı transfr, vs.)
- Temel mesleki bilgiler (her mühendislik için kendine özgü)
- İleri mesleki bilgiler ve uygulamalar şeklinde özetlenebilir.

Temel mühendislik konuları aynı fakat mühendislik eğitimi konusunda her kurumun kendi sistemini oluşturması ve farklı yöntemler geliştirmesi artık bir gereksinimden öte bir zorunluluk olmuştur.Çünkü işveren ve sanayi kesimi bu kadar tek düze bir mühendislik kavramı yerine istediğini seçebilme özgürlüğü istemektedir. Tam bu noktada mühendislik eğitimleri hem nicelik hem de nitelik bakımından tartışılmaya başlanmıştır. Çünkü, Kritik düşünce, iletişim, özgüven, sorgulama, hayal gücü, sosyal beceriler, sanat, kültür, spor, yabancı dil, takım çalışması, inovasyon, girişimcilik, problem çözme ve diğer yaşam becerileri belirli bir olgunluk düzeyinde olmayan gençleri başarılı mühendislere dönüştürmek kesinlikle kolay değildir.

Modern dünyamız, yakın gelecekte teknolojiye sahip olanlar ve olmayanlar olarak ikiye ayrılacaktır, Bu anlamda genel mühendislik eğitimi çağı takip edebilmek açısından çok büyük bir önem taşımaktadır. Sonuç olarak mühendislik, bir bilim değil bir sanattır; bilimi uygulama sanatıdır. Bu sanatın üç temel ilkesi, güvenlik. ekonomi ve uygulanabilirliktir (Kasapoğlu, 1998).

Gelişmiş ülkelerde mühendislerden beklenen teknolojiye hakim olmaları ve bunları çağın ihtiyaçlarının karşılanmasında etkin bir biçimde kullanabiliyor olmalarıdır. Bu açıdan bakıldığında mühendis adaylarının eğitimlerinin de modernize edilmesi şarttır. 21. Yüzyıl dünyasının acımasız rekabet ortamları da göz önüne alındığında, mühendislik eğitimlerinin teknolojiden daha fazla yararlanılması, genç mühendislerin hayal güçlerinin teknoloji ile desteklenenerek tasarımların somut çıktılara ulaştırılması ve bu şekilde öğrencilerin heyecan ve motivasyonlarının artırılmasını sağlayacak yöntemlerin kullanılması bir zaruret olmaktadır.

Son yıllarda mühendilik eğitimlerinin geliştirlmesi için yapılan çalışmalardan bir tanesi de STEM modelidir. STEM (Science-Technology-Engineering-Mathematics), bilim, teknoloji, eğitim ve mühendisliğin harmanlanması ile oluşturulmuş bir mühendislik eğitimi modeli olup esasen öğrencilerin daha lise yıllarında iken bu disiplinlerde ezberci yöntemlerden kurtularak düşünme, sorgulama, problem çözebilme yeteneklerini kolayca geliştirebilmeleri hedeflenmiştir. Ayrıca üniversite yıllarında da bu model ileri teknoloji araçları ile de desteklenmesi beklenmektedir (Estapa1. and Kristina M. Tank, 2017).

3b Yazicilar

Teknoloji insanlığın bitmeyen ihtiyaçlarını çok daha hızlı, ekonomik ve de daha güvenli yollarla temin etmesi yolunu açmıştır. 3B yazıcılarda çağımızın son teknoloji ürünlerinden yalnızca biridir. Bu teknolojisyi hayallerin somut nesnelere dönüştürülebildiği teknloji olarak ta tanımlayabiliriz. 3B yazıcıların tarihi serüveni 1971 yılında, Pierre Ciraud isimli Fransız bilim adamı, ışın yardımıyla metal tozlarının birleştirilmesiyle gerçekleştirilen bir üretim yöntemine ilişkin bir patent başvurusu yapması ile başladı. Aynı yıl, Wyn Kelly Swainson SLA teknolojisine benzeyen ve üç boyutlu cisimlerin lazer ışınlarının kesiştirilmesiyle üretildiği bir yöntemi anlattığı başka bir patent başvurunda bulundu. 1979 yılında ise Ross Housholder SLS teknolojisini hatırlatan ve hammaddenin lazer ışınlarıyla katman katman katılaştırılarak üç boyutlu cisimlerin üretildiği bir üretim işlemi için patent başvurusu yaptı (Şimşek, 2017). 1984 yılında Charles Hull, SLA (stereolithograghy) teknolojisini kullanarak 3D yazıcıları geliştiren ilk bilim adamıydı. İki yıl sonra bu teknolojiyi üretecek olan ilk şirket 3D systems adıyla kuruldu. 1988 yılında ise SLS (Selective Laser Systems) ve FDM (Fused Deposition Model) teknolojileri keşfedildi. 1995 yılında ilk 3B yazıcı satışını Z Corporation şirketi yaptı. 2007 yılı itibariyle "Reprop" adıyla açık kaynak kodlu 3D yazıcılar ortaya çıktı. 2008 Object Geometries şirketi, Connex500 isimli yazıcıyı geliştirdi. Bu ürün aynı anda farklı malzemeler kullanarak 3 boyutlu ürünler oluşturuyordu. Ev tipi yazıcılardaki artış 2009 yılında Makerbot ve 3D systems şirketlerinin geliştirdiği "Cubify" isimli yazıcı ile gerçekleşti.

Mühendislik Eğitiminde 3b Yazıcılar

Araştırmalar 3B Yazıcıların eğitimde ağırlıklı olarak kullanılmasının STEM öğretimini zenginleştirdiğini ortaya koymuştur. 3D yazıcıların katkısı ile oluşturulacak farklı eğitim yöntemlerinin daha komplex yapılardaki bilimsel ve matematiksel verilerin anlaşılmasında kolaylaştırıcı etkisi olduğu anlaşılmıştır. 3B yazıcılar günümüzde özellikle prototipleme alanında endüstrinin hemen her alanında kullanılmaya başlanmıştır. Bunun yanısıra gündelik hayatımıza da hızla girmektedir.

3B yazıcılar kullanılan malzemeye göre bilgisayarda çizilen modelleri somut nesnelere dönüştürmektedirler. Öğrencilerin öğrenmeye ve keşfetmeye yönelik motivasyonlarını artırmakta ve eğlenerek öğrenmelerini sağlamaktadır. Öğrencilerin hayal ettikleri fikirlerini ortaya koyabilecekleri fikri, hepsi üzerinde inavasyona yönelik araştırmalarının artmasına sebep olmaktadır. Öğrenciler hayal ettiklerini yapabilecekleri fikirleri ile birlikte, bir proje içerisinde 3B yazıcıların yapabildiklerini gördüklerinde o projenin içerisine daha rahatlıkla girebilmekte ve projede yer alarak geliştirilmesinde rol oynayabilmektedir.

3 boyutlu nesnelerin çizimleri, uzay, boşluk gibi kavramların anlaşılmasına ve dolayısı ile geometrinin gelişmesine yardımcı olmaktadır. 2B nesnelerden 3B nesnelerin ortaya çıkartılması nesneleri anlama kabiliyetini artırmaktadır. Ayrıca planlama, tasarım yapma ve geliştirme aşamalarından oluşan üretim süresi kısaldığı için, planlama ve tasarım üzerinde daha fazla zaman ayrılarak çok daha iyi ürünler ve inovasyonlar ortaya konulabilmektedir. Öğrenciler kendi çizimlerini ortaya koyabildikleri gibi, açık kaynak kodları internette paylaşılan çok farklı ürünleri de basabileceklerdir. Bu ürünler arasında gerek ölçü gerekse fonksiyonerlik açısından geliştirmeler yapabileceklerdir. Öğrenciler 3B yazıcılar kullanarak bir mühendislik prosesini hem deneyimleyerek hme de oyunlaştırarak öğrenme durumunda olacaklardır.

3B yazıcıların mühendislik eğitimlerinde kullanılmasının iki yolu vardır. Birincisi yol özellikle tasarım ağrlıklı derslerde öğrencilerin hayal güçlerini arttırmaya yönelik olarak tercih edilebilir. Bu yöntemde eğitimciye büyük iş düşmektedir. Öğrenciye konu temelleri verildikten sonra, tasarım ödevleri somut çıktılarla istenebilir. Bu sayede öğrenci yaptığı tasarımın somut çıktısını elde ettiğinde başarmış olma hissi ile çok büyük bir öz güvene sahip olacaktır. Ayrıca üretebilme, hayal ederek tasarım yapabilme ve bir sorun olduğunda çözebilme kabiliyetleri de gelişebilecektir. İkinci bir yol ise 3B yazıcılar ile eğitim materyalleri geliştirmektedir. Farklı disiplinlerdeki mühendislik eğitimlerinin elbette farklı tip eğitim materyallerine ihtiyacı olacaktır. Örneğin denizci mühendislerin eğitiminde çok sayıda farklı tip makine ve donaımlarının öğrencilere öğretilmesinde birebir bu ekipmanları almak çok yüksek maliyet gerektirir. Ancak 3B yazıcılar ile bu donanımların hem öğrencilere tasarlattırılması hem de çıktılarının alınarak eğitimde tanıtım maksatltı maket modellerinin oluşturulması eğitimde daha az maliyetli çözümler sunmaktadır.

Sonuç

Dijital çağın mühendis adaylarını yetiştirirken klasik yöntemlerin bir zaman sonra tamamen etkisini kaybedeceğini söylemek abartı olmayacaktır. Mutlaka eğitim müfredatları içerisinde güncel teknolojilerin nimetlerinden yararlnamak lüks olmaktan çok bir zorunluluktur. Geleceğin mühendislerinden düşünen, sorgulayan, sentezleyen, merak eden ve tasarım kabiliyetleri gelişmiş ve aynı zamanda yeni teknolojilere hakim olmaları beklenmektedir. Bu bilgi ve beceri düzeylerine erişim ilk olarak bu teknolojileri daha eğitimleri sırasında iken görebilme ve kullanabilmeleri ile başlar, profesyonle iş hayatında devam eder. 3B yazıcılar hayal gücünü tasarıma dönüştüren veya somutlaştırma imkanı sağlayan bir teknoloji olarak genç mühendis adaylarındak merak duygularını kamçılayan, yenilikçi fikirlere yelken açtıran, üstüne üstlük tüm bu hayalleri daha az maliyetle gerçekleştirme imkanı sağlayan teknolojilerdir. Kesinlikle mühendislik eğitimlerinin vaz geçilmez bir parçası olarak kabul edilmelidirler. Bu maksatla 3B yazıcıların mühendislik eğitiminde iki farklı uygulama türünden söz etmek mümkündür. Birincisi, tasarım maksatlı ödev veya projelerin yalnızca sayfalarca hesap kitap yaparak ve teknik resim çizerek değil, direkt somut çıktılarla yaptırılması; bununla birlikte ikinci yöntem olarak verilen eğitimin amacına uygun olacak maket model tasarımların geliştirlmesi maksatlı uygulamalar için tercih edilebilirler. Netice itibariyle 3B yazıcıların mühendislik eğitimlerine enetagrasyonu sayesinde vizyonu geniş, ufku açık, öz güveni sağlam, üretebilen, sorun çözebilen ve herşeyden önce mühendis olabilme duygusunu çok iyi kavramış yetenekli mühendisler yetiştimek daha da kolay olacaktır.

Kaynaklar

Türk Mühendis ve Mimar Odaları Birliği (2005). TMMOB ve Mühendislik Eğitimi. *TMMOB Mühendislik Eğitimi Sempozyumu,19, 18-19 Kasım 2005.*

TMMOB Elektrik Mühendisleri Odası (2003). *EEBM 1.Ulusal Eğitim Sempozyumu Sonuç Bildirgesi, 2003.*

K. Ercin KASAPOĞLU (1998). Mühendislik eğitiminde kalite sorunu ve çözümü: Profesyonel Mühendislik, *Jeoloji Mühendisliğ Dergisi, 52, Mayıs 1998.*

Estapa1. and Kristina M. Tank (2017). Supporting integrated STEM in the elementary classroom: a professional development approach centered on an engineering design challenge k. *International Journal of STEM Education 4:6 DOI 10.1186/s40594-017-0058-3*

Emrehan ŞİMŞEK (2017). 3B yazıcı teknolojisi. *www.minifab.com.tr*

DESIGNATION AND IMPLEMANTATION OF AN EFFICIENT BOTANIC GARDEN VISIT IN ORDER TO IMPROVE PLANT AWARENESS AND ATTITUDE TOWARDS PLANTS

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Abstract: Plants are basis of the nature. Plant blindness is defined as that people do not notice plants around their own environment, comprehend the importance of the plants for environment and humans, appreciate aesthetic and unique features of the plants and they incline to downgrade the plants below animals according to their criterion of importance. People's attitude towards the plants comprises the compound of their considerations about plants, their sensations and behaviour related to the plants. How the plants are taught is very crucial in alleviating plant blindness and supporting positive attitude towards plants. Teaching in out-of-school environment has recently become one of the most focused educational programs about plants. In this study, a botanic garden visit for sixth grade students was designed and implemented in order to raise their awareness about plants and to support their positive attitudes towards plants. This instructional programme comprises of three stages: pre-visit, during the visit, post-visit. Pre-visit activities were designed to give information about place that will be visited, ensure that students are familiar with school curriculum, prepare students for visit and specify rules and schedule of the visit. In designing during the visit activities, student-oriented instruction strategies were used. During the visit, first, study pages were completed. After that, art activities of poster, collage and mask were implemented. In post-visit stage, three activities, namely my feelings and considerations, cloverleaf and acrostic were performed. Designed instructional programme was presented to a group of three experts in order to get their opinion. In 2014-2015 academic year, a pilot implementation of the programme was completed in a secondary school, in Yatağan, Muğla. A total of 32 students were attended to the pilot implementation. Main implementation of the programme was completed in 2015-2016 academic year, in Germencik, Aydın with the attendance of 28 students. In this study, this instruction was introduced and observations during instruction process were shared. It was observed in every stages of the programme that students talked about aesthetic and unique features of the plants, they tried to learn the scientific and local names of plants. Students told that they enjoyed the visit and met plants which astonished them during the visit. When students shared their experience with students who did not attend to visit, it was observed that other students wanted to attend to the visit. Designing and applying the instructions including before visit and after visit activities, worksheet and visual art activities are suggested to improve the student's attitudes and awareness towards to plants.

***Keywords*:** Plant awareness, attitude towards plant, plant blindness, out-of-school learning environment, botanic garden.

BİTKİ FARKINDALIĞI VE BİTKİLERE YÖNELİK TUTUMU GELİŞTİRMEK İÇİN ETKİLİ BİR BOTANİK BAHÇESİ GEZİSİNİN TASARLANMASI VE UYGULANMASI

Özet: Bitkiler, tabiatın temelini oluşturmaktadır. Kişilerin çevresindeki bitkileri fark etmemesi, bitkilerin çevre ve insan için önemini kavramaması, bitkilerin estetik ve eşsiz özelliklerini takdir edememesi, önem kriterine göre bitkileri hayvanlardan daha aşağıya koyma eğilimi göstermesi bitki körlüğü olarak tanımlanmaktadır. İnsanların bitkiler hakkındaki düşünceleri, bitkilere yönelik duyguları ve bitkilere davranışlarının bileşimleri, bitkilere yönelik tutumu oluşturur. Bitki körlüğünün zayıflatılmasında ve bitkilere yönelik pozitif tutumun desteklenmesinde bitkilerin nasıl öğretildiği önemlidir. Bitkiler hakkında öğretimde son zamanlarda en çok üzerinde durulan öğretim okul dışı öğrenme ortamlarıdır. Bu çalışmada 6. sınıf öğrencilerinin bitki farkındalığını geliştirmek ve bitkilere yönelik pozitif tutumlarını desteklemek için bir botanik bahçesi gezisi tasarlanmış ve uygulanmıştır. Öğretim ziyaret öncesi, ziyaret sırası ve ziyaret sonrası olmak üzere üç aşamadan oluşmuştur. Ziyaret öncesi etkinlikler ziyaret edilecek yer hakkında bilgi verir, öğrencinin okul müfredatı ile ilişki kurmasını sağlar, öğrenciyi geziye hazırlar, gezi kurallarını ve gezi programını belirler nitelikte tasarlanmıştır. Ziyaret sırasındaki etkinlikler tasarlanırken öğrenci merkezli öğretim stratejileri kullanılmıştır. Ziyaret sırasında ilk olarak çalışma yaprakları tamamlanmıştır. Sonrasında poster, maske ve kolaj sanatı etkinlikleri yapılmıştır.

Ziyaret sonrasında Hissettiklerim ve Düşündüklerim, Yonca Yaprağı ve Akrostiş olmak üzere üç etkinlik yapılmıştır. Tasarlanan öğretim üç kişiden oluşan uzman grubun görüşüne sunulmuştur. 2014 -2015 Eğitim Öğretim Yılında Muğla ili Yatağan ilçesindeki bir ortaokulda pilot uygulama yapılmıştır. Pilot uygulamaya 32 öğrenci katılmıştır. Asıl uygulama 2015 -2016 Eğitim Öğretim Yılında Aydın ili Germencik ilçesindeki bir ortaokulda 28 öğrenci ile gerçekleştirilmiştir. Bu çalışmada bu öğretim tanıtılmış ve öğretim sürecindeki gözlemler paylaşılmıştır. Öğrencilerin öğretimin her aşamasında bitkilerin estetik ve eşsiz özellikleri hakkında konuştukları, bitkilerin halk arasında kullanılan ismini ve bilimsel ismini öğrenmeye çalıştıkları gözlemlenmiştir. Öğrenciler gezi sırasında çok eğlendiklerini ve onları şaşırtan bitkilerle karşılaştıklarını ifade etmişlerdir. Geziye katılan öğrenciler geziye katılmayan öğrencilerle deneyimlerini paylaştıklarında geziye katılmayan öğrencilerinde geziye katılmak istedikleri gözlemlenmiştir. Öğrencilerin bitkilere yönelik tutumlarını ve bitki farkındalığını geliştirmek için ziyaret öncesi, sırası ve sonrası etkinliklerden oluşan, çalışma yaprakları ve görsel sanat etkinlikleri içeren öğretimlerin tasarlanması ve uygulanması önerilmiştir.

Anahtar Sözcükler: Bitki farkındalığı, bitkilere yönelik tutum, bitki körlüğü, okul dışı öğrenme ortamları, botanik bahçesi.

Giriş

Bitkiler, tabiatın temelini oluşturmaktadır (Allen, 2003). Bitkiler, insanoğlunun pek çok ihtiyacını karşılamaya yardımcı olan eşsiz ve verimli canlılardır. İnsanoğlu var olduğu andan bu zamana kadar bitkilerle ilişki içerisinde olmuştur (Çil, 2016). Biyosferin ve ekosistemlerin en önemli öğelerinden biri olan bitkiler, canlıların çoğunun temel besin maddelerinin kaynağını oluşturmalarının yanı sıra pek çok sektörde (gıda, kozmetik, ilaç, tekstil, kâğıt vb.) kullanılmaktadır (Çil, 2016; Pekel, Sevinç ve Kahraman, 2012).

Doğadaki tüm canlılar bir denge halindedir (Allen, 2003; Çil, 2016; Pekel ve diğerleri, 2012). Bu dengenin bozulması biyoçeşitlilik için bir tehdittir. Bir bütün olarak incelenen türlerden 16.118 tanesinin nesli tükenme tehlikesi altındadır. Bunlardan 8.390 tanesi bitkiler alemidir (International Union for Conservation of Nature and Natural Resources [IUCN, 2006]. Bitki türlerinin tehdit altında olması birçok nedenden kaynaklanmaktadır. Bunlardan en önemlileri nüfus artışı (Allen, 2003; Özel, Sürücü ve Bilen, 2013), sera gazı emisyonunun artışı (Fancovicova ve Prokop, 2010), tarım alanlarında kullanılan suni gübre ve kimyasal maddelerin suyun ve toprağın kirlenmesine neden olmasıdır (Allen, 2003).

Bitki türlerinin neslinin devamı için insanların bitkileri fark etmesi ve koruması gerekmektedir (Özel ve diğerleri, 2013). İnsanoğlu etrafında bulunan bitkileri genellikle fark etmez (Hoekstra, 2000). Wandersee ve Schussler (1999) bitkilerin ihmal edilmesini bitki körlüğü olarak tanımlamışlardır. Wandersee ve Suchussler (1999) bitki körlüğünün belirtilerini; kişilerin çevresindeki bitkileri fark etmemesi, çevre ve insan hayatında bitkilerin önemini kavramaması, bitkilerin estetik ve eşsiz özelliklerini takdir edememesi, bitkileri önem kriterine göre hayvanlardan daha aşağıya koyma eğilimi göstermesi şeklinde ifade etmiştir. Literatürde çocukların (Pany, 2014; Patrick ve Tunnicliffe, 2011; Strgar, 2007; Tunnicliffe ve Reiss, 2000; Tunnicliffe, 2001; Wandersee ve Schussler, 1999) ve yetişkinlerin (Allen, 2003; Hoekstra, 2000; Schussler ve Olzak, 2008) çoğunun bitki körü olduğu rapor edilmektedir.

Ulusal ve uluslararası kurumlara, örgütlere, kuruluşlara bitkilerin neslinin korunması için görevler düşmektedir. Ancak temeldeki görev bireylerindir. Bu bağlamda bireyin çevrenin en önemli öğesi olan bitkilere yönelik tutumları da çok önemlidir (Pekel ve diğerleri, 2012). Bitkilere yönelik tutum; insanların bitkiler hakkında hissettikleri, düşündükleri ve bitkilere yönelik davranış biçimlerinin bileşimidir. Bitkilere yönelik tutumun değişmesi bitkiler hakkındaki düşüncelerimizin, duygularımızın ve davranışlarımızın gelişmesine ve değişmesine bağlıdır. Çünkü tutumlar yalnızca duygusal bileşenlerden değil aynı zamanda bilişsel bileşenlerden oluşmaktadır (Verplanken, Hofstee ve Janssen, 1998). Öğrenciler bitkileri gözlemlediğinde, onları yakından izlediğinde, onları sevdiğinde ve onlardan korkmadığında, öğrenme hem bilişsel hem duyuşsal hem de psiko-motor düzeyde olmaktadır. Bitkilere yönelik tutum insanların çoğu için nötrdür (Çil, 2016; Fancovicova ve Prokop, 2010).

Okul dışı öğrenme okul dışında değişik kanallar vasıtasıyla yapılan eğitimdir. Fen eğitiminde en çok kullanılan okul dışı öğrenme ortamları müzeler, bilim merkezleri, hayvanat bahçeleri, botanik bahçeleri, doğal yaşam parkları, doğa merkezleri, akvaryumlar, fabrikalar, sanayi kuruluşları ve okul bahçeleridir (Laçin Şimşek, 2011). Okul dışındaki öğrenmeler, sınıftaki eğitime ve öğrencilerin yaşam boyu öğrenmelerine de katkı sağlar. Bitki körlüğünü yenmek ve bitkilere yönelik pozitif tutumu desteklemek için bitkilerin nasıl öğretildiği önemlidir. Bitkiler hakkında öğretimde son zamanlarda en çok üzerinde durulan öğretim okul dışı öğrenme ortamlarıdır. Açık alan eğitim programları canlı organizmalar konusunda geleneksel ortamlara göre daha iyi bilgi sağlayan ve olumlu tutum geliştiren bütünleyici ortamlardır. Yaşayan organizmayla çalışmak bitki öğretimi için önemli bir yoldur (Fancovicova ve Prokop, 2011; Hoese ve Nowicki, 2001). Yaşayan organizmaya direk temas, okuyarak, resmini inceleyerek veya modelini inceleyerek kazanılamayacak tecrübeyi elde etmeyi sağlamaktadır (Strgar, 2007). Bitki öğretimi yapılırken okul bahçesinin, okula yakın bir parkın, botanik bahçelerinin sıkça kullanıldığı görülmektedir (Franks ve Vore, 2010; Kavak, Tufan ve Demirelli, 2006). Açık alanda gerçekleştirilen öğretimler öğrencilerin sahip oldukları bitki bilgisini ve bitkilere yönelik tutumu değiştirebilmektedir. Açık alan öğretimlerinin bireylerin bitkilere yönelik tutumlarını ve bilgilerini geliştirmede alışılagelmiş fen ortamlarına uygun bir alternatif olduğu literatürde ifade edilmektedir (Fancovicova ve Prokop, 2011). Fakat öğrencilerin sosyo-ekonomik durumlarının planlanan her gezi için uygun olmaması, zaman sınırlılığı, öğretim programlarının yoğunluğu, ailelerden ve idari bölümlerden izin alınma konusunda yaşanan zorluklar gibi nedenler okul dışı öğrenme ortamlarını öğretimin bir parçası olarak kullanmayı zorlaştırmaktadır (Behrendt ve Franklin, 2014). Literatür incelendiğinde öğretmenlerin okul dışı öğrenme ortamlarına düzenlenecek gezileri planlarken güçlük yaşadıkları bu nedenle de öğretmenlerin okul dışı öğrenme ortamlarını tercih etmedikleri ifade edilmektedir (Laçin Şimşek, 2014).

Bu çalışmanın amacı 6. sınıf öğrencilerinin bitki farkındalığını ve bitkilere yönelik tutumu geliştirmek için etkili bir botanik bahçesi gezisinin tasarlanması ve uygulanmasıdır. Bu çalışma öğretmenlere etkili bir botanik bahçesi gezisi planlama ve yürütüme konusunda rehberlik etme potansiyeline sahip olduğundan önemlidir. Öğretmenler bu çalışma kapsamında tanıtılan öğretim etkinliklerini doğrudan alıp uygulayabilirler veya benzer etkinlikleri kendileri tasarlayabilirler.

Yöntem

Çalışma Grubu

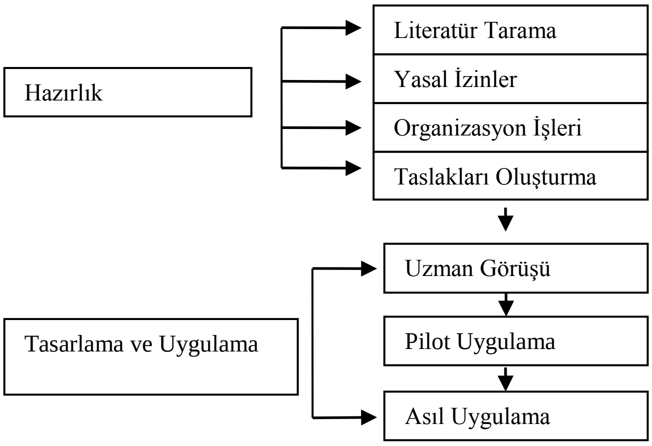
Bu çalışma 6. sınıf (11-13 yaş) öğrencileri ile gerçekleştirilmiştir. Literatür incelendiğinde bitki öğretimi ve bitkilere yönelik tutumun geliştirilmesi için 11-13 yaş aralığı oldukça uygundur (Fancovicova ve Prokop, 2011; Strgar, 2007; Tunnicliffe ve Reiss, 2000; Tunnicliffe, 2001). Çalışma 2015-2016 eğitim öğretim yılında Aydın ili Germencik ilçe merkezinde bir devlet okulunda öğrenim gören 28 öğrenci ile gerçekleştirilmiştir.

Ziyaret Edilen Botanik Bahçesinin Tanıtılması

Bu çalışmada Palmiye Merkezi ziyaret edilmiştir. Palmiye Merkezi, palmiye sevgisinin yerleştirilmesi ve yetiştirilen palmiye çeşidinin arttırılması amacıyla, 1993 yılında Muğla ili Köyceğiz ilçesinde Dr. Ragıp Esener tarafından kurulmuştur. Merkezin kapsadığı alan, 80.000m² dir. Palmiye Merkezi palmetum, tropik sera, kaktüs evi, rüya bahçesi, zakkum koleksiyonu olmak üzere beş bölümden oluşmaktadır. Palmetum çevresinde Washingtonia Palmiyeleri, Datça Hurmaları, Kraliçe Palmiyeleri, Afrika ağaçları, altuni mazılar bulunmaktadır. Buradaki 300m² süs havuzunda, Japon Koi balıkları, ortasındaki ufak adada ise Senegal Hurması bulunmaktadır. Palmetuma dikilen palmiye türü sayısı 40'ı aşmıştır. Palmiye dışında, bu alanda çok sayıda tür, yıllık, çok yıllık, çalı ve ağaç formunda bitki de yer almaktadır. Tropik sera koleksiyonu palmiyeler, sikaslar, tropik meyveler, starliçe-muzlar, çeşitli tropik çalı ve ağaçlardan oluşmaktadır. Kaktüs evi yaklaşık olarak 300 tür, alt tür ve kültivardan oluşmaktadır. Bunların yaklaşık 100 türü dış mekanda, geri kalanı ise daha hassas olmaları nedeniyle iç mekanda sergilenmektedir. Rüya Bahçesinde 16 tür nilüfere ilaveten çeşitli su ve bataklık bitkileri ve ot bahçesi bulunmaktadır. Zakkum Evi'nde 30'un üzerinde zakkum türü bulunmaktadır (www.palmiyemerkezi.com).

Öğretimin Tasarlanması ve Uygulanması

Öğretimin tasarlanma süreci Şekil 1. de sunulmuştur. İlk olarak okul dışı öğrenme ortamlarında fen öğretimi ile ilgili literatür incelenmiştir. Okul dışı öğrenme ortamlarında gerçekleştirilen öğretimlerin ilgi çekici, eğlenceli, öğrenci merkezli, olabildiğince çok duyuya hitap eden, birincil elden deneyimler kazandıran özelliklere sahip olması gerekmektedir (Laçin Şimşek, 2011). Okul dışı öğrenme ortamlarına gerçekleştirilen ziyaretlerin etkili olması için planlı programlı öğretime ihtiyaç vardır (Laçin Şimşek, 2011). Etkili bir ziyaret öğretmenler tarafından tamamen yapılandırılmış ya da hiç yapılandırılmayarak tamamen öğrencilerin seçimine bırakılmış öğretimlerden kaçınmalıdır (Bamberger ve Tal, 2008). Okul dışı öğrenme ortamlarına gerçekleştirilen ziyaretlerin; ziyaret öncesi, ziyaret esnasında ve ziyaret sonrasında gerçekleştirilen etkinlikler şeklinde düzenlenmesi gerekmektedir (Dewitt ve Storksdieck, 2008). Bu çalışmada öğretim tasarlanırken literatürde yer alan bütün bu öneriler göz önünde bulundurulmuştur.



Sekil 1. Öğretimin tasarlanması ve uygulanması süreci

Öğretimlerin uygulanabilmesi için Milli Eğitim Müdürlüğünden yasal izinler alınmıştır. Ziyaret edilecek botanik bahçesi ile iletişime geçilip randevu alınmış ve gezi günü ile ilgili planlama yapılmıştır. Otobüs tur şirketiyle gerekli görüşmeler ve planlamalar yapılmıştır. Öğretimlerin tasarlanması aşamasında öncelikle etkinliklerin ilk taslakları geliştirilmiş, üç kişiden oluşan uzman grubun görüşüne sunulmuştur. Uzman grup bir akademisyen ve iki Fen Bilimleri öğretmeninden oluşmaktadır. Uzman grubun önerileri ışığında gerekli değişiklikler ve düzenlemeler yapılmıştır. Örneğin ziyaret öncesi etkinliği olarak gezi alanı araştırması planlanmıştır. Araştırma görevinde botanik bahçesinin bulunduğu yer ve çalışanları hakkındaki sorular, danışılan uzman grubunun tavsiyesi üzerine çıkarılmıştır. Ziyaret sırasında kullanılması planlanan görsel sanat etkinliklerinde bazı değişiklikler yapılmıştır. Kolaj sanatı etkinliği için hazırlanan bitki görsellerinin arkalarına bitki isimlerinin yazılması önerilmiştir. Maske etkinliğinde botanik bahçesinde bulunan ilginç özelliklere sahip bitkilerin kullanılması önerilmiştir. Akrostiş çalışmasında kısa isimli bitkiler ile çalışmanın yapılması önerilmiştir. Uzmanların bütün bu önerileri yerine getirilmiştir. Öğretimin pilot uygulaması 2014-2015 Eğitim Öğretim Yılı Nisan ve Mayıs aylarında Muğla ili Yatağan ilçesinde bir devlet okulunda yapılmıştır. Pilot uygulamaya 32 öğrenci katılmıştır. Pilot uygulama sonrasında gereken değişikler ve düzenlemeler yapılarak öğretim uygulanabilir hale getirilmiştir. Örneğin ziyaret sırası etkinliklerinden biri olan çalışma yaprağındaki sorular yeniden düzenlenmiştir. Çalışma yaprağının son halinde 24 tane soru bulunmaktadır. Kolaj sanatı etkinliği pilot uygulama esnasında iki kişilik gruplar halinde 50x70 cm boyutlarında mukavva ile 20 dakikada yapılırken asıl uygulamanın bireysel ve 35x50 cm boyutlarında mukavva kullanılarak 40 dakikada yapılmasına karar verilmiştir. Bir diğer sanat etkinliği olarak maske yapılmıştır. Pilot uygulamada maske yapılırken kullanılan maske kalıbı tüm yüzü kaplamıştır ve öğrencileri rahatsız etmiştir. Bu nedenle asıl uygulama için yalnızca göz kısmını kaplayan bir maske kalıbının kullanılması ve etkinliğin 40 dakikada yapılması planlanmıştır. Diğer bir sanat etkinliği olan poster çalışması zamanın sınırlı olması ve öğrencilerin bu etkinliği yaparken sıkıldıkları gözlemlendiği için öğretimden çıkarılmıştır. Gezi sonrası etkinliklerinden biri olan Akrostiş çalışması için pilot uygulama esnasında 20 dakika verilirken asıl uygulama yapılırken bu sürenin 40 dakika olması planlanmıştır**.** Pilot uygulamada öğretimin tamamlanması için gereken süre 10 ders saati olarak planlanmasına rağmen, bu sürenin yeterli olmadığı gözlemlenmiştir. Asıl uygulamada öğretimin 12 ders saatinde tamamlanmasına karar verilmiştir. Asıl uygulama 2015-2016 Eğitim Öğretim Yılı Kasım ve Aralık aylarında Aydın ili Germencik ilçe merkezinde gerçekleştirilmiştir. Öğretimin son hali aşağıda tanıtılmıştır.

Ziyaret Öncesi Etkinlikler

Ziyaret öncesi etkinlikler; ziyaret edilecek yer hakkında bilgi verir, öğrencinin okul müfredatı ile ilişki kurmasını sağlar, öğrenciyi geziye hazırlar, gezi kuralları ve gezi programı hakkında bilgi verir (Krombaβ ve Harms, 2008). Ziyaret öncesi etkinlikler ziyaretten iki hafta önce uygulanmaya başlanmış ve iki hafta sürmüştür.

Tablo 1. Ziyaret öncesi etkinliklerin tanıtılması

Etkinliğin adı	Etkinliğin amacı	Etkinliğin tanıtılması
Botanik Bahçesi Tanıtımı	Dünyadaki ve ülkemizdeki botanik bahçelerini tanıtmak	Araştırmacılar tarafından ziyaret edilecek botanik bahçesinin tanımını, amacını, özelliklerini, nasıl kurulup düzenlendiğini içeren bir power point sunusu hazırlanmıştır. Öğrenciler botanik bahçeleri ve botanik bahçelerinde bulunan canlılar ile ilgili fikir yürütmüş, tahmin ve çıkarım yapmıştır. Bu etkinlik 40 dk. sürmüştür.

Gezi Alanı Araştırması	Öğrencilerin ziyaret edilecek yer ile ilgili bilgi sahibi olmalarını sağlamak	Bu etkinlikte çocuklara bir araştırma görevi verilmiştir. Araştırma görevi 18 açık uçlu sorudan oluşmaktadır. Sorular botanik bahçesinin bölümleri, botanik bahçesinin tarihi ve kuruluşu, botanik bahçesinde bulunan bitkiler ile ilgili bilgileri kapsamıştır. Öğrenciler bilişim teknolojileri sınıfında internet ortamında sorulara cevap aramıştır. Bu etkinlik 80 dk. sürmüştür.
Gezi Planının Tanıtımı	Gezi günü planı hakkında bilgi vermek	Ziyaret günü planı; hareket saati, mola yerleri, etkinlik süreleri, dönüş saati şeklinde planlanarak öğrencilerle paylaşılmak için çıktı şeklinde hazırlanmış ve paylaşılmıştır. Etkinlik 20 dk. tamamlanmıştır.
Gezi Kurallarının Belirlenmesi	Botanik bahçesinde uyulacak kuralları öğrencilerle birlikte belirlemek	Ziyaret sırasında uyulacak kurallar öğrencilerle birlikte belirlenmiştir ve öğrencilerle paylaşılmak için A4 çıktısı şeklinde hazırlanmıştır. Bu etkinlik 20 dk. sürmüştür.

Ziyaret Sırası Etkinlikleri

Okul dışı öğrenme ortamlarındaki öğretimin bel kemiğini ikinci aşama diğer bir ifadeyle ziyaret esnasındaki etkinlikler oluşturmaktadır (Tal ve Morag, 2007). Ziyaret esnasındaki etkinlikler öğrenciyi merkeze alan öğretimlerden oluştuğunda etkili bir öğretim sağlar. Ziyaret esnasında öğretmenlerin öğrencilere ziyaret edilen alanı keşfetmeleri için yeterli zamanı vermeleri ve müfredatı destekleyen etkinliklere yer vermeleri önerilmektedir (Çil, Maccario ve Yanmaz, 2015). Literatürde bu aşamada en sık kullanılan öğrenci merkezli strateji müze çalışma yapraklarıdır. Çalışma yaprakları öğretmenler veya müze personeli tarafından hazırlanmakta ve öğrenciye yapması gereken görevi işlem basamakları şeklinde sunmaktadır (Nyamupangedengu ve Oyoo, 2010). Çalışma yapraklarının birçok avantajı ve bazı dezavantajları vardır. Okul dışı öğrenme ortamlarında çalışma yapraklarının kullanılması ve eksiklerinin ortadan kaldırılması için bazı ek uygulamaların yapılması önerilmektedir (Krombaβ ve Harms, 2008). Çil ve diğerleri (2015) ek çalışmaların görsel sanatlar etkinlikleri olabileceğini belirtmektedir. Ziyaret edilen mekanda çalışma yapraklarıyla odaklanılan kavramlar görsel sanatlar etkinlikleri ile desteklendiğinde, öğrenme bilişsel, duyuşsal ve psikomotor düzeyde gerçekleşir. Fen eğitiminde görsel sanatlar etkinlikleri öğrencilerin hem fen kavramlarını keşfetmesini hem de sanatsal çalışmalar üretmesini sağlamaktadır (Çil ve diğerleri, 2015). Bu nedenle bu çalışmada botanik bahçesi ziyaretinde çalışma yaprağı, kolaj ve maske görsel sanat etkinlikleri ile desteklenmiştir.

Tablo 2. Ziyaret sırasındaki etkinliklerin tanıtılması

Etkinlik adı	**Etkinliğin amacı**	**Etkinliğin tanıtılması**
Botanik Bahçesinin Tanıtımı	Ziyaret edilen botanik bahçesi ve bölümleri hakkında bilgi vermek	Botanik bahçesi görevlileri tarafından botanik bahçesini ve bölümlerini tanıtan power point sunum izletilmiştir ve merkez hakkında kısa bir bilgilendirme yapılmıştır. Sunum ve bilgilendirme sırasında öğrencilerin iki gruba ayrılmıştır. Öğrenciler power point sunusu izlemiştir. Sunu hakkında ve botanik bahçesi hakkında sorular sormuştur. Bu etkinlik 40 dk. sürmüştür.
Çalışma Yaprağı	Ziyaret edilen yerde bulunan bitkileri ve özelliklerini keşfetmek	Çalışma yaprağı 23 tane açık uçlu soru ve bir tane seçme soru içermiştir. Ziyaret edilecek botanik bahçesi beş bölümden oluşmaktadır. Bu bölümler: palmetum, tropik sera, kaktüs evi, rüya bahçesi, zakkum koleksiyonudur. Çalışma yaprağında Palmetum ile ilgili altı açık uçlu soru, tropik sera ile ilgili üç açık uçlu soru, kaktüs evi ile ilgili üç açık uçlu soru, rüya evi ile ilgili bir açık uçlu soru, zakkum koleksiyonu ile ilgili iki açık uçlu soru yer almıştır. Diğer sorular da ise öğrencilerin daha önce ziyaret ettikleri botanik bahçeleri ile ilgili sahip oldukları tecrübelere ve ziyaret edilen botanik bahçesi hakkındaki duygu, düşünce ve gözlemleri üzerine odaklanılmıştır. Sorulardan bir tanesi sözel diğerleri yazılı olarak cevaplandırılmıştır. Öğrenciler kendi seçtiği bir arkadaşı ile ikişerli grup olmuştur. Botanik bahçesini gezerken çalışma yaprağını doldurmuştur. Bu etkinlik 80 dk. da tamamlanmıştır.
Kolaj Sanatı	Bir bitkiyi bütün organlarıyla oluşturmak	Kolaj sanatı için araştırmacılar tarafından bir yönerge, bitki resimleri ve örnek bir kolaj sanatı hazırlanmıştır. İlk olarak öğrenciler kolaj sanatı hakkında bilgilendirilmiştir. Sonrasında araştırmacılar tarafından hazırlanan kolaj sanatı eserlerini incelemişlerdir. Öğrenciler İkişerli gruplar halinde yönerge basamaklarını takip ederek kolaj sanatı çalışmasını

		yapmıştır. Bu etkinlik 40 dk. sürmüştür.
Maske Çalışması	Öğrencilerin bitkilerin estetik ve eşsiz özelliklerini fark etmesini sağlamak	Maske çalışması için araştırmacı tarafından bir yönerge, bitki resimleri ve maske kalıpları hazırlanmıştır. Araştırmacı her öğrenci için botanik bahçesinde bulunan bir bitkiyi seçmiştir. Bu bitkinin farklı açılardan renkli resimlerini temin etmiştir. Her öğrenci için birkaç çeşit yüz maskesi kalıbı hazırlamıştır. Yönergede maske hakkında bilgilendirmeye, örnek bir maske resmine, kullanılan malzemelerin listesine, maskenin yapılış basamaklarına yer verilmiştir. Öğrenci maske yönergesindeki basamakları takip ederek bir maske yapmıştır. Maskesini yüzüne takmış ve o bitki hakkında üç özelliği yüksek sesle arkadaşlarına söylemiştir. Bu etkinlik 40 dk. sürmüştür.

Ziyaret Sonrası Etkinlikler

Ziyaret sonrasında gerçekleştirilen etkinlikler öğrenmenin yapılanmasını sağlar nitelikte olduğunda kalıcı öğrenmeyi sağlar. Ziyaret sonrası etkinliklerin öğrencilere tartışma ortamı sunması, öğrencilerin deneyimlerini diğer arkadaşları ile paylaşarak öğrenmeyi pekiştirmesi oldukça önemlidir (Çil ve diğerleri, 2015). Ziyaret sonrası etkinlikler Hissettiklerim ve Düşündüklerim, Yonca Yaprağı ve Akrostiş olmak üzere üç etkinlik şeklinde planlanmıştır. Ziyaret sonrası etkinlikleri ziyaretten bir hafta sonra uygulanmaya başlanmıştır.

Tablo 3. Ziyaret sonrası etkinliklerin tanıtılması

Etkinlik adı	**Etkinliğin amacı**	**Etkinliğin tanıtılması**
Hissettiklerim Düşündüklerim	Öğrencilerin bitkiler ve gezi hakkında duygu ve düşüncelerini ifade etmesini sağlamak	Bu etkinlik öğrencilerin ziyaret sırasında ne öğrendiğini, nereden öğrendiğini ve ne hissettiğini ve duygunun sebebini ifade etmesini sağlayan dört tane açık uçlu sorudan oluşmaktadır. Öğrenciler etkinlik yaprağını doldurmuştur. Ne öğrendiğini ve bilginin kaynağını yazmıştır. Bu etkinlik 40 dk. sürmüştür.
Yonca Yaprağı	Öğrencilerin ziyaret esnasındaki deneyimlerini kullanmalarını, öğrendiklerini değerlendirmelerini ve pekiştirmelerini sağlamak	Yonca Yaprağı etkinliği botanik bahçesinin bölümlerini, bu bölümlerin ortak özelliklerini ve bu bölümlerde yaşayan bitkilerin isimlerini ve resimlerini içermiştir. Öğrenciler botanik bahçesinin bölümleri ile bu bölümlerde bulunan bitkileri eşleştirmiştir. Nilüferleri rüya bahçesi ile, palmiyeleri palmetum ile eşleştirip bu bölümlere yapıştırmıştır. Bu etkinlik 40 dk. sürmüştür.
Akrostiş Çalışması	Ziyaret boyunca meydana gelen öğrenmenin yapılanmasını ve öğrencilerin yaratıcılıklarını kullanmasını sağlamak.	Her öğrenci ona verilen bitkinin özelliklerini yansıtan bir akrostiş çalışması yapmıştır. Sikas, kaktüs gibi kısa isimli bitkilerle ilgili akrostiş çalışması yapmıştır. Bu etkinlik 40 dk. sürmüştür.

Sonuç ve Öneriler

Öğrenciler ziyaret öncesi etkinliklerinden biri olan araştırma görevini bilişim sınıfında yaptıkları için çok eğlendiklerini ifade etmiştir. Öğrencilerin araştırma görevini yaparken bu bitkileri ziyaret esnasında görüp göremeyeceklerini sorguladıkları ve zaman zaman bunu ilginç ve büyüleyici buldukları gözlemlenmiştir. Öğrencilerin, araştırmacılar tarafından izletilen tanıtım slaydında yer alan dünyadaki ve Türkiye'de ki botanik bahçeleri hakkında araştırma yaptıkları ve bu botanik bahçeleri içinde bulunan bitkiler hakkında sorular sordukları gözlemlenmiştir. Botanik bahçesi gezisinin öğrencilere bitkileri birden fazla duyu organını kullanarak öğrenme imkanı sağladığı gözlemlenmiştir. Gezi esnasında öğrenciler bitkileri gözlemlemiş, koklamış, onlara dokunmuştur. Öğrencilerin bitkilerin kokuları, dokuları ve görünüşleri ile ilgili duygu ve düşüncelerini paylaştıkları gözlemlenmiştir. Öğrencilerin çalışma yapraklarını doldururken birbirleriyle iletişim içinde oldukları, sorular hakkında konuştukları, fikir yürüttükleri ve iş birliği yaptıkları gözlemlenmiştir. Bitki bilimi ile ilgilenen kişilerle karşılaşmanın öğrencilerin kendilerini özel ve önemli hissettirdiği gözlemlenmiştir. Öğrencilerin botanik bahçesi çalışanlarına merak ettikleri soruları sorarken bitkilerin estetik ve eşsiz özelliklerine, zehirli olup olmadıklarına, kullanım alanlarına, maddi değerinin olup olmadığına ve endemik özelliğine odaklandıkları gözlemlenmiştir. Öğrencilerin çoğu rüya bahçesinde bulanan su nilüferlerini satın almaya çalışmıştır. Su nilüferlerinin yetişme koşulları hakkında sorular sordukları gözlemlenmiştir. Öğrencilerin maymun tırmanmaz ağacına dokunmak için izin istedikleri gözlemlenmiştir. Öğrenciler gezi sırasında yaptıkları görsel sanat ekinliklerinin çok eğlenceli, hatırlatıcı ve akılda kalıcı olduğunu ifade etmiştir. Öğrencilerin gezi sonrası etkinliklerinden biri olan akrostiş çalışmasını yaparken bitkilerin ilginç özelliklerine odaklandıkları gözlemlenmiştir. Öğrencilerin Yonca Yaprağı etkinliğini yaparken bitkileri özelliklerine göre gruplayabildikleri ve ilgili bölüme yerleştirdikleri gözlemlenIştir. Öğrencilerin öğretimin her aşamasında bitkilerin estetik ve eşsiz özellikleri hakkında konuştukları, bitkilerin halk arasında kullanılan ismini ve bilimsel ismini öğrenmeye çalıştıkları gözlemlenmiştir. Öğrenciler gezi sırasında çok eğlendiklerini ve onları şaşırtan bitkilerle karşılaştıklarını ifade etmişlerdir. Geziye katılan öğrenciler geziye katılmayan öğrencilerle deneyimlerini paylaştıklarında geziye katılmayan öğrencilerinde geziye katılmak istedikleri gözlemlenmiştir. Öğrencilerin bitkilere yönelik tutumlarını ve bitki farkındalığını geliştirmek için ziyaret öncesi, sırası ve sonrası etkinliklerden oluşan, çalışma yaprakları ve görsel sanat etkinlikleri içeren öğretimlerin tasarlanması ve uygulanması önerilmiştir.

Teşekkür

Bu çalışmada tanıtılan öğretim Funda Gül İRİ KARADENİZ'in yüksek lisans tezi kapsamında tasarlanmış ve uygulanmıştır. Tez Muğla Sıtkı Koçman Üniversitesi Bilimsel Araştırma Projeleri tarafından desteklenmiştir (Proje No: BAP 15/102).

Kaynaklar

Allen, W. (2003). Plant blindness. *BioScience, 53*(10), 926-926.

Bamberger, Y. & Tal, T. (2008). Multiple outcomes of class visits to natural history museums: The students' view. *Journal of Science Education and Technology*, *17*(3), 274-284.

Behrendt, M. & Franklin, T. (2014). A review of research on school field trips and their value in education. *International Journal of Environmental and Science Education*, *9*(3), 235-245.

Çil, E., Maccario, N. & Yanmaz, D. (2015, August-September). *Promoting students'acquisition of science concepts from museums via worksheets and visual arts activities.* Paper presented at the International Conference for the European Science Education Research Association, Helsinki, Finland.

Çil, E. (2016). Instructional ıntegration of disciplines for promoting children's positive attitudes towards plants. *Journal of Biological Education*, *50*(4), 366-383.

DeWitt, J. & Storksdieck, M. (2008). A short review of school field trips: key findings from the past and ımplications for the future. *Visitor Studies*, *11*(2), 181-197.

Fančovičová, J. & Prokop, P. (2010). Development and initial psychometric, assessment of the plant attitude questionnaire. *Journal of Science Education and Technology*, *19*(5), 415-421.

Fančovičová, J. & Prokop, P. (2011). Plants have a chance: outdoor educational programmes alter students'knowledge and attitudes towards plants. *Environmental Education Research*, *17*(4), 537-551.

Franks, M. & Vore, R. (2010). How to make a plant field guide. *Science and Children*, *47*(5), 21-25.

Hoekstra, B. (2000). Plant blindness-the ultimate challenge to botanists. *The American Biology Teacher*, *62*(2), 82-83.

Hoese, W. J. & Nowicki, S. (2001). Using "the organism" as a conceptual focus in an ıntroductory biology course. *The American Biology Teacher*, *63*(3), 176-183.

Kavak, N., Tufan, Y. & Demirelli, H. (2006). Fen teknoloji okuryazarlığı ve informal fen eğitimi gazetelerin potansiyel rolü. *Gazi Üniversitesi Gazi Eğitim Fakültesi Dergisi*, *26*(3), 17-28.

Krombaβ, A. & Harms, U. (2008). Acquiring knowledge about biodiversity in a museum are worksheets effective?. *Journal of Biological Education*, *42*(4), 157-163.

Laçin Şimşek, C. (2011). *Fen Öğretiminde Okul Dışı Öğrenme Ortamları*, Pegem Akademi Yayıncılık, Ankara.

Nyamupangedengu, E. & Oyoo, S. O. (2010). Moving beyond the controversy towards an ımprovement of worksheets that are used by learners during museum visits. *International Journal of Learning*, *17*(7), 501-511.

Özel, M., Sürücü, A. & Bilen, K. (2013). İlköğretim öğrencilerinin bitkilere yönelik tutumları. *Pamukkale Üniversitesi Eğitim Fakültesi Dergisi*, *34*(34), 119-132.

Pany, P. (2014). Students'ınterest in useful plants: A potential key to counteract plant blindness. *Plant Science Bulletin*, *60*(1), 18-27.

Patrick, P. & Tunnicliffe, S. D. (2011). What plants and animals do early childhood and primary students'name? Where do they see them?. *Journal of Science Education and Technology*, *20*(5), 630-642.

Pekel, F. O., Sevinç, Ö. S., Tan, Ş. & Kahraman, N. (2012, Haziran). *Öğretmen adaylarının bitkilere karşı tutumlarını ölçmeye yönelik ölçek geliştirme çalışması.* Bu çalışma X. Ulusal Fen Bilimleri ve Matematik Eğitimi Kongresi'nde sunulmuştur, Niğde, Türkiye.

Schussler, E. E. & Olzak, L. A. (2008). It's not easy being green: Student recall of plant and animal images. *Journal of Biological Education*, *42*(3), 112-119.

Strgar, J. (2007). Increasing the interest of students in plants. *Journal of Biological Education*, *42*(1), 19-23.

Tal, T. & Morag, O. (2007). School visits to natural history museums: Teaching or enriching?. *Journal of Research in Science Teaching*, *44*(5), 747-769.

Tunnicliffe, S. D. & Reiss, M. J. (2000). Building a model of the environment: How do children see plants?. *Journel of Biological Education, 34*(4), 172-177.

Tunnicliffe, S. D. (2001). Talking About Plants-comments of primary school groups looking at plant exhibits in a botanical garden. *Journal of Biological Education*, *36*(1), 27-34.

Verplanken, B., Hofstee, G. & Janssen, H. J. (1998). Accessibility of affective versus cognitive components of attitudes. *European Journal of Social Psychology*, *28*(1), 23-35.

Wandersee, J. H. & Schussler, E. E. (1999). Preventing plant blindness. *The American Biology Teacher*, *61*(2), 82-86.

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TEACHING HONEYBEE TO PRE SCHOOL CHILDREN THROUGH MUSEUM VISIT AND MULTIPLE INTELLIGENCES TEACHING

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Abstract: Bees have an essential role in our ecological system, because of their contribution to health and reproduction of fruits and cultivated plants, through the pollination of flowers. It is very important for children to be aware, since early years of school, of bees lifestyle, learning their anatomy, organization, hierarchy, and, being familiar with them, to be able to win their instinctive fear. For this aim, a learning program, that included theoretical and visual approach, with the help of exhibits and living beehives, was organized in collaboration with Muğla Beekeeping Museum for pre-school children class. The program included preliminary activities as to taste honey, complete some bees puzzle, watching animations and documentaries in classroom and, after that, the attendants were brought to visit Muğla Beekeeping Museum ,where direct observations were possible, and some more explanation had been given “on the field”. Again in classroom, under the teacher supervision, the children made role- plays about honey production and pollination and prepared draft showing their knowledges. Pre-test and post- test conducted with voice- recorded questionnaires, and analysis of the children draft have showed that bees- life, as anatomy, functions, hierarchy, ect. was far more familiar after this experience, as well as fear was now reduced. As an outdoor learning environment, supported by activities that stimulate multiple intelligences, it can be said that the experience in the museum have contributed to children's formation, even though the participants were in their early age of life.

Keywords: Early childhood education, outdoor learning, non-formal learning, honeybee, museum education multiple intelligences

MÜZE ZİYARETİ VE ÇOKLU ZEKA ETKİNLİKLERİ YOLUYLA OKUL ÖNCESİ DÖNEM ÇOCUKLARINA BAL ARILARININ ÖĞRETİLMESİ

Özet: Ürettikleri besinlerin insan yaşamı için önemi, bazı hastalıkların tedavisinde destek ürün olmaları yanında kültür bitkileri için tozlaşmaya katkıları nedeni ile bal arıları doğanın anahtar canlılarından biridir. Öğrencilerin küçük yaşlardan itibaren bal arılarının bütün canlılar için önemini fark etmeleri önemlidir. Bu nedenle okul öncesindeki çocukların bal arılarının anatomisini öğrenmeleri, yaşam için önemini kavramaları, arı ile ilgili korkularını yenebilmeleri amacı ile Muğla’da bulunan Arıcılık Müzesinde bir öğretim tasarlanmış ve uygulanmıştır. Bu çalışmanın amacı; Okul öncesinde Arıcılık Müzesi gezisi ve sınıfta çoklu zekayı destekleyecek öğretim etkinliklerinin çocukların bal arılarının anatomisini, ürettiği ürünleri ve ekolojiye katkılarını anlamaları üzerine etkilerini incelemektir. Çalışmada ön test-son test tek gruplu desen kullanılmıştır. Çalışma Muğla İlindeki iki ana sınıfta uygulanmıştır. Öğretim sürecinde müze gezisi için hazırlık etkinliklerinde çocuklar sınıfta ballı süt içip, arı yap boz maketini tamamlayıp - animasyon ve belgesel izlemişlerdir. Daha sonra Muğla Arıcılık Müzesi ziyaret edilmiştir. Geziden sonra sınıfta tozlaşmayı ve bal yapımını konu alan canlandırmalar yapılmıştır. Çalışmanın verileri çizimler ve mülakatlar ile elde edilmiştir. Çocukların çizimleri ve cümleleri doğru, kısmen doğru ve yanlış olarak kategorize edilmiştir. Frekans ve yüzde hesaplanmıştır. Çizimler ve mülakatlardan elde edilen veriler ayrı ayrı analiz edilmiş, birbiri ile kıyaslanmıştır. Öğretim sonrasında çocukların arı korkularında azalma olduğu tespit edilmiştir. Ayrıca arıların vücut özellikleri, organlarının işlevleri, aralarındaki işbölümü, kovan içi ve dışındaki görevleri, ürettiği ürünler, kovan içi arı çeşitliliği hakkındaki bilgilerinde artış olduğu, öğretim sonunda yeni bilgiler edindikleri tespit edilmiştir. Mülakat ve çizimlerden elde edilen bulguların birbiri ile benzer olduğu ortaya çıkmıştır. Çalışmamızda gezi öncesi hazırlık çocukların güdülenmesini ve merak etmelerini sağlarken müze ortamında canlı arıları gözlemek sanat eserlerini görmek ilgilerini çekmiş bilgilerinin pekişmesini sağlamıştır. Gezi sonrasında yaptıkları canlandırmada öğrendiklerini canlandırmaya aktarabilmişlerdir. Yaşları küçük olsa da çoklu zekayı uyaran etkinliklerle desteklenmiş bir okul dışı öğrenme ortamı olarak müzedeki yaşantılarının çocukların öğrenmelerine katkı getirdiği söylenebilir.

Anahtar Sözcükler: Erken çocukluk eğitimi, okul dışı öğrenme ortamları, non-formal öğrenme, bal arıları, müze eğitimi, çoklu zeka

Giriş

Bal arıları ortak yaşam sürdüren sosyal böceklerdir. Bal arıları insanların da besin kaynağı olarak tükettiği balı üretmektedirler. Bal dışında arının ürettiği polen –propolis-arı sütü gibi ürünler insan yaşamına katkılar sağlamakta, bazı hastalıkların tedavisinde destek ürünler olarak kullanılabilmektedir. Tozlaşmaya gereksinim duyan kültür bitkilerinde arıların katkısı ile tozlaşmayı gerçekleştirmektedir. Bütün bu sebeplerden dolayı ekolojiye de çok önemli katkıları bulunan bal arıları doğanın anahtar canlılarıdır.

Türkiye'de «Arı ve Arıcılığı» konu alan az sayıda müze vardır. Bu müzelerden birisi de Muğla Arıcılık Müzesidir. Müzede gerçek arıların yer aldığı akvaryum kovan içinde canlı arıların davranışlarını ve bal yapımını gözlemek mümkündür. Müzede ayrıca arıyı konu alan farklı sanat eserleri-arıcıların tarihsel süreçte bal üretiminde kullandıkları nesneler ve arı kovanlarını yerleştirildiği coğrafi alanlar temsil edilmektedir.

Müzeler informal öğrenme çevreleri olarak kabul edilmektedir. Ev ve okul dışında zengin ve çeşitli öğrenme ortamları sunan müzelerde, öğrenmenin en iyi biçimde rahat informal bir atmosferde eğitim ile eğlencenin birbiri ile kaynaştığı bir ortamda gerçekleştiği keşfedici öğrenme yaklaşımında kabul edilmektedir. Bu yaklaşımda öğrenme rol oynamayı içeren etkinlik temelli doğrudan katılımlı bir araştırma süreci olarak görülür. Öğrenciler pasif izleyiciler olmaktan çok aktif katılımcılar olarak kabul edilir. Nesne –Temelli Bilgi Kuramında da ele alındığı gibi müzede gezerken nesnelerin doğal ve kültürel tarihini gözlemek ve değerlendirmenin yarattığı fırsatla nesnelerden öğrenme gerçekleşmektedir (Onur,2012).Öğrenmenin ve öğretmenin kişilerin Sözel / Dilsel-Mantıksal/Matematiksel-Müzikal-Uzamsal/Görsel-Bedensel/Knestetik-Sosyal-İçsel-Doğasal zekalarına dayanması gerektiği anlayışını getiren Çoklu zeka kuramının kurucusu Howard Gardner de çocuk müzeleri gibi informal çevrelerin çocukların çoklu yollarla kolayca öğrenebildikleri bir ortam sağladığına inanmaktadır. Gardner'e göre müzeler çocukları bağlar ve kendi öğrenmelerinin sorumluluğunu almalarını sağlar. Bazı müzeler Çoklu Zeka Kuramını hem eğitim programlarında hem de nesne sergilerinde ve yorumlarında kullanmaktadırlar (Onur, 2012)

Okul öncesi dönemde çocukların dikkatini soyut olaylardan çok somut nesneler çekmektedir. Çevresini araştırma yolu ile keşfetme merakı olan çocukların özellikle fen eğitiminde bol materyalli oyunlar- canlandırma ve dramatizasyonlar- bulmacalar- şarkılar sunularak daha çekici bir ortamda eğitilmeleri önerilmektedir (Şimşek, 2008).

Farklı zeka alanlarını destekleyecek -sınıf içi etkinliklerinin de katkısı ile bal arılarının çevre-tarım –sağlık vb. pek çok alanda insan yaşamına getirdikleri katkıyı ve diğer bütün canlılar için önemini öğrencilerin küçük yaşlardan itibaren fark etmeleri önemlidir. Müzede yapılacak öğretimi destekleyecek gezi öncesi hazırlık etkinlikleri akabinde müze gezisi ve gezi sonrası tamamlayıcı etkinliklerle eğitim ortamının olanakları zenginleştirilebilmektedir. Muğla Arıcılık Müzesi de okul dışında öğretim için uygun bir ortam oluşturmaktadır. Müzeyi gezenler müze ortamında arıların vücut özelliklerini, ürettikleri ürünler, tarıma katkılarını gözlemektedirler. 2015 yılında Arıcılık Müzesinde çoklu zekayı uyaracak etkinliklerle zenginleştirilerek yapılmış başka bir çalışmada da Eğitim Fakültesi öğrencilerinin yapılan öğretime dayalı görüşleri ele alınmış ve olumlu sonuçlara ulaşılmıştır (Maccario, 2016) .

Bu çalışmada ana sınıfında bulunan çocuklara bal arılarının vücut özellikleri, çeşitleri, ürünlerini ve arıların ekolojiye katkılarını anlamaları için bir öğretim tasarlanmıştır. Çalışmada yer alan öğretimin temelini sınıf içi etkinliklerle desteklenmiş öğrenme ortamlarından biri olan Arıcılık Müzesi oluşturmaktadır. Sınıf içinde yapılan etkinlikler çocukların duyularını uyaracak nitelikte olup görsel materyallerle desteklenmiş, şarkı ve canlandırmaları da içermektedir. Bu çalışmanın temel amacı söz konusu öğretimin çeşitli değişkenler üzerine etkilerini incelemektir. Bu çalışmanın alt problemleri ise bu çalışma kapsamında tasarlanan ve uygulanan öğretimin ana sınıfı çocuklarının;

- Bal arılarının vücut özelliklerini ve işlevleri ile çeşitlerini,
- Bal arılarının ürettiği ürünleri ,
- Bal arılarının Ekolojiye katkılarını anlamaları üzerine etkileri nelerdir?
- Bu öğretim ana sınıfı çocuklarının arı korkusunun üstesinden gelinmesine katkı sağlar mı?

Araştirmanin Yöntemi

Bu çalışmada araştırmacı tarafından tasarlanan bir öğretimin çocuklar üzerindeki etkileri incelenmiştir. Bu nedenle çalışmada deneysel yöntem kullanılmıştır. Çalışmanın deseni ön test son test tek gruplu yarı deneysel desendir.

Çalışma Grubu: Çalışma Muğla İlinde 2016 yılının Nisan ayında toplam 23 anasınıfı öğrencisi ile gerçekleştirilmiş çalışma için gerekli bütün veriler 16 çocuktan elde edilmiştir.

Öğretim süreci: Müze gezisi öncesi ana sınıfında yapılan hazırlık etkinlikleri , müze gezisi ve müze gezisi sonrasında sınıfta yapılan etkinliklerle tamamlanmıştır.

Müze Ziyareti Öncesi Etkinlikleri: Çocuklarla tanışma ve ön testlerin uygulanması (çizim testi ve mülakat) tamamlandıktan sonra müze gezisine hazırlık amacı ile çocuklarla hazırlık etkinlikleri yapılmıştır. Bu etkinlikler farklı duyuları uyarmak ve bilgilendirmek amacı ile yapılmıştır. Bu etkinlikler aşağıda resimlerde de görüleceği gibi: Süte bal ekleyerek içme (Resim :1)- Çocukları arıların vücutlarının özellikleri çeşitleri ürünleri ile ilgili görsel sunumla bilgilendirme ve arı ile ilgili soru sorma (Resim:2)- Arı ile ilgili belgesel ve animasyon izleme(Resim:3)-Arının vücudu ile ilgili yap boz maketi birleştirme (Resim:4) ile tamamlanmıştır. Daha sonraki hafta da Muğla Arıcılık Müzesi ziyaret edilmiştir.




Resim1 Resim2 Resim3 Resim4

Arıcılık Müzesindeki Etkinlikler : Arıcılık Müzesinde Eğitim Fakültesi öğrencileri eşleştikleri çocuklarla etkinlik sürecinde bire bir ilgilenmişlerdir. Müzeyi gezerken sergilenen nesneleri tanıtıp ve ellerindeki çalışma yaprağındaki soruları çocuklara sormuşlardır. (Resim 10) Gezi sürecinde oluşabilecek kargaşayı engellemek için müze daha önceden belirlenen temalar çerçevesinde istasyon tekniği ile gezilmiştir. (Resim11) Daha sonra da çocukların ellerine ve yüzlerine arı figürü çizildikten sonra çocuklar hep birlikte arı ile ilgili şarkı söyleyip oynamışlar ve etkinlik sona ermiştir.


(Resim10) (Resim11)

Müze Gezisi Sonrası Ana Sınıfında Yapılan Etkinlikler: Müzede sergilenen nesnelerle ilgili temaları içerecek şekilde ana sınıfında sınıf çocuklar bal arılarının doğadaki tozlaşmaya katkısı ve bal yapımını_konu alan canlandırmaları yapmışlardır. Canlandırma bitiminde çocuklara canlandırmada geçen bilgilerle ilgili sözlü sorular sorulmuş ve çocuklar soruların cevaplarını hatırlayabilmişlerdir. Etkinlikler bitince çocuklara son test soruları sorulmuş verdikleri cevaplar ses kaydı yapılmış ve arıyı konu alan bir çizim yapmışlardır.

Veri Toplama Araçları

Yapılan öğretimin etkilerini değerlendirmek üzere iki veri toplama aracı uygulanmıştır. Veri toplama araçları araştırmacı tarafından geliştirilmiştir. Veri toplama araçlarının kapsam geçerliği için uzman görüşleri alınmıştır. Uzman grup iki fen eğitimcisi, bir görsel sanatlar ve müze eğitimcisi, iki okul öncesi öğretmeninden oluşmaktadır. Veri toplama araçlarından biri Yarı yapılandırılmış mülakatlardır. Mülakat sırasında çocuklar okuma yazma bilmediği için ses kaydı yapılmıştır. Ana sınıflarında 16 çocukla ön test ve son testle ilgili mülakatlar yapılıp veriler elde edilmiştir. Yarı yapılandırılmış mülakatlar dört ana tema (Bal arılarına yönelik tutum, bal arısının anatomisi, kovandaki bal arılarının çeşitleri ve ekolojiye katkıları, bal arılarının ürettikleri ürünler) ile ilgili soruları içermektedir. Bu temalar Arıcılık Müzesindeki sergilemede yer alan temalara uygundur. Diğer veri toplama aracı «Arı» konulu çizim testidir. Çizim testinde çocuklardan «Arı» konulu bir resim çizmeleri istenmiştir. Çocukların 19 u ön test ve son test olarak arı ile ilgili çizim yapmışlardır. Bu çizimlerde ön test son test karşılaştırılması ile incelenmiş temalar göre ortaya çıkan durum analiz edilmiştir

Kız ve Erkek Çocukların Ön test ve son Test Olarak Yaptığı Arı Konulu Çizimler:

K
1.
Ön

test: K 1 . Son test: Kovan içi E1: Ön test
E1.: Son test: Kovan dışı yaşam
Arı çizimi yaşam ve kovan çevresi Arı çizimi arıların birlikte uçması bal özü polen toplama

Verilerin Analizi

Mülakat ve çizimle elde edilen nitel veriler içerik analizine tabi tutulmuştur. Ortaya çıkan kategorilerin frekans ve yüzdesi hesaplanmıştır.

Bulgular

Bu bölümde ilk olarak mülakatların analizinden elde edilen bulgular sunulmuştur. Çizimlerin analizinden elde edilen bulgulara daha sonra yer verilmiştir.

Mülakatların Analizi: Mülakatların analizi ile ön test ve son testin karşılaştırılması ilgili ortaya çıkan durum aşağıda yer almaktadır.

Çocukların Arı ile ilgili Tutumlarına Yönelik tutumları ile ilgili bulgular Tablo1 de sunulmuştur

Tablo 1. Çocukların arı ile ilgili tutumları

TESTLER / TUTUMLAR	ÖN TEST		SON TEST		GEREKÇELER
	f	%	f	%	
KORKUYOR	8	50	4	25	Korkma nedenleri arının sokması. / Sokunca canımızın yanar . İnsanların ölebilir
KORKMUYOR	10	62.5	11	68,7	Arılar çok küçük / Dokunmayınca sokmazlar. Kıpırdamayınca sokmazlar
SEVİYOR	16	100	16	100	İnsanlar a bal yapıyorlar

Tablo 1 de görüldüğü gibi çocukların arı ile ilgili korkularında azalma, korkmayanların sayısında da artış olmuştur. Arıları sevmeleri ile ilgili olarak ön test ve son testte de değişiklik olmamıştır.

Mülakatta arıların anatomisi ile hakkında sorulan soruların analizi Tablo 2 de sunulmuştu**r.**

Tablo 2. Arıların anatomisi

Büyük gözlerin sayısı				Anten sayısı				Kanat sayısı				Bacak sayısı			
ÖN TEST		SON TEST		ÖN TEST		SON TEST		ÖN TEST		SON TEST		ÖN TEST		SON TEST	
f	%	F	%	f	%	f	%	f	%	f	%	f	%	f	%
16	100	14	87,5	15	93,7	15	93,7	0	0	13	81	0	0	12	75

İğnenin oluşu				Başındaki organlar				Küçük gözlerin sayısı			
ÖN TEST		SON TEST		ÖN TEST		SON TEST		ÖN TEST		SON TEST	
f	%	f	%	f	%	f	%	f	%	f	%
14	87,5	8	50	9	56,2	1	6,2	0	0	12	75

Arıların Anatomisi ile ilgili Tablo 2 de arının başında bulunan organlarla ilgili olarak kanat sayısı, bacak sayısı ve küçük gözlerin sayısında belirgin bir artış olmuştur. Arının vücudunda farklı işlevleri olan üç çift bacak bulunduğu için ayrı bir tabloda ele alınmıştır.

Tablo 3. Arının bacaklarının işlevi ile ilgili tablo

10.Soru: Arıların bacakları ne işe yarar? Bacakları ile ne yapar ? Cevap veren:	ÖN TEST	f	%	SON TEST : Bazı çocuklar iki ya da üç cevabı bir ara da vermişledir.	f	%
	Tutunur-konar-durur:	6	37,5	Arka ayaklarında polen taşır:	12	75
	Yürür :	8	50	Tutunur- konar- durur:	4	25
				Yürür:	2	12,5
				Ön bacakları ile polen temizler:	1	6,7
Cevap vermeyen		2	12,5		2	12,5

Bacakların görünen ve belirgin iki işlevi dışında arıların arka ayakları ile polen taşıması ile ilgili ön testte hiç doğru yokken son testte belirgin bir artış olmuştur. Arının ön bacakları ile polen temizlemeleri ile ilgili ön testte doğru cevap yokken son testte artış olmuştur.

Mülakatta bal arılarının çeşitleri ve bu arı çeşitlerinin kovandaki görevleri hakkındaki sorulan soruların analizi Tablo 4 de sunulmuştu**r.**

Tablo 4. balarılarının çeşitleri nelerdir? kovandaki arılar ne iş yapar?

Balarılarının kaç çeşidi var?				Kraliçe arı ne iş (neler) yapar				Erkek arı ne iş yapar?				Arılar nerede yaşar ?			
ÖN TEST		SON TEST		ÖN TEST		SON TEST		ÖN TEST		SON TEST		ÖN TEST		SON TEST	
f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%
0	0	7	43,7	1	6,2	11	68,7	0	0	6	37,5	11	63,7	16	100

Balarılarının çeşitleri ile ilgili olarak Tablo 4 de ön testte doğru cevap yokken son testte bütün arı çeşitlerini bilenlerde artış olmuştur. Arıların kovanda yaşadıkları ile ilgili olarak Tablo 4 de son testte bütün çocuklar doğru cevabı vermiş ve artış olmuştur. Kovanda yaşayan farklı arılardan Kraliçe arının görevleri ile ilgili olarak son testte artış olmuştur. Erkek arının görevi ile ilgili olarak ön testte doğru cevap yokken son testte artış olmuştur.

Mülakatta arı çeşitlerinin görevleri ile ilgili olarak, işçi arılarının kovan içi ve kovan dışında pek çok görevi olması neden ile kovan içindeki görevleri hakkındaki sorulan soruların analizi Tablo 5 de sunulmuştu**r.**

Tablo 5. İşçi arıların kovan içinde yaptığı işler

KOVAN İÇİNDEKİ GÖREVLER	ÖN TEST		SON TEST	
	f	%	f	%
Kovanda yavru besleme	1	6.2	7	43.7
Kovanda bal yapma	11	68.7	4	25
Kraliçe arıya yardım etme	0	0	4	25
Kovan içi ısıyı kanat çırparak ayarlama	0	0	3	18.7
Kraliçe arıyı koruma	0	0	3	18.7
Kraliçe arıyı besleme	0	0	2	12.5
Kovanı koruma	0	0	1	6.2
Kraliçe arının doğmasına yardım etme	0	0	1	6.2

İşçi arıların kovan içinde yaptığı işlerle ilgili olarak: İşçi arının görevlerinden bazılarını için ön testte doğru cevap yokken son testte artış olmuştur. Bu cevaplar :İşçi arılar kovanda kraliçeye yardım eder -İşçi arılar kovan içinde kanatlarını çırpıp yavru arılar için kovanın ısısını artırırlar-İşçi arılar kraliçeyi korur-İşçi arılar kraliçeyi besler-İşçi arılar kovanı korurlar-İşçi arılar kovan içinde kraliçe arının doğmasına yardım ederler-Kovandaki yavruları besler şeklinde ortaya çıkmıştır -Kovanda bal yaparlar cevabı son testte azalmıştır. Kovan içi görevlerinde çocuklar son testte yeni öğrendikleri bilgileri daha kolay ifade etmişlerdir.

Tablo 6. İşçi arıların kovan dışında yaptığı işler

İşçi arıların kovan dışında çiçeklerden bal özü toplar				İşçi arılar kovan dışında çiçeklerden polen toplar			
ÖN TEST		SON TEST		ÖN TEST		SON TEST	
f	%	f	%	f	%	f	%
9	56,2	10	62,5	0	0	8	50

Tablo 7. Arının ürünleri

TEST / ÜRÜNLER	ÖN TEST		SON TEST	
	f	%	f	%
BAL	16	100	15	93,7
POLEN	8	50	9	56
ARI SÜTÜ	6	37,5	6	37,5

İşçi arıların kovan dışında yaptığı işlerle ilgili olarak Tablo 6 de İşçi arılar kovan dışında çiçeklerden bal özü toplar cevabı son testte artmıştır. İşçi arılar kovan dışında çiçeklerden polen toplar cevabı ön testte doğru cevap yokken son testte artmıştır. Tablo 7 de arının ürünleri ile ilgili olarak Polen ise son testte artmıştır. Arı sütü ise ön test ve son testte aynı kalmıştır. Çocukları arıların polen toplamaları ile ilgili izlediği videolardaki görüntüler kalıcı olmuştur.

Çizim Testinin Analizi : Çizim testinin analizi ile ön test ve son testin karşılaştırılması ilgili ortaya çıkan durum aşağıda yer almaktadır**.**

Tablo 8: Müze gezisi öncesinde ve sonrasında yapılan çizimlerde ortaya çıkan durum

KATEGORİLER	ÖN TEST		SON TEST	
	f	%	f	%
Arılardaki büyük göz sayısı:	19	100	19	100
Arılardaki küçük göz sayısı	0	0	6	31
Anten sayısı	16	84	18	94,7
Kanat sayısı	2	16,5	16	84
Bacak sayısı	1	5	11	57,8
İğne olup olmadığı:	14	73,6	15	93,7

Tablo 9 incelendiğinde çocukların çizimlerinde küçük gözlerin sayısında kanat sayısında bacakların sayısında ki artış belirgin olarak ortaya çıkmış ve organlar doğru şekilde çizilmiştir. Çocuklardan birisi arının kanadının sayısını doğru doğru çizerken son çizimde kanat çizmemiştir. Başka bir çocuk ise son testte arı figürünü yandan çizdiği için tek kanat olarak çizebilmiştir. Son testinde kanat çizmeyen bir çocuk olmuştur. Bazı çocuklar arıyı uçarken çizdikleri için yandan çizilmiş ya da arıları uçarken üstten çizdikleri için bacaklarını gösterememişler. İki çocuk sesli yapılan son testte bacak sayısını doğru bildikleri halde resim çizerken arıyı uçarken çizdikleri için arının bacaklarını resimde gösterememişlerdir. Son testte arının iğnesini gösterenlerin sayısı artmıştır. Çocuklar son resimlerinde tek arı yerine birden fazla arıyı birlikte uçarken ve küçük çizdikleri için iğnesini gösterememişlerdir.
Araştırma problemi olmamasına rağmen çocukların çizimlerinde son testte ortaya çıkan bazı noktalar dikkati çekmiştir. Buna yönelik bulgular Tablo 9 da görülmektedir.

Tablo 9: Müze gezisindeki temalara göre çocukların öğrendikleri bilgilerin resimlerine yansıması

	f	%
Kraliçe arı / Kraliçe arının yumurtlaması ve yavru arılar / Kraliçe arının yumurtlama anı -yavru arıların petek içinde büyümesi süreci ve yavru arıların görünüşü ile ilgili durumlar :	9	47
Müzedeki gördükleri ağaçta asılı kovan ile ilgili çizilmiş figürler.	9	47
Kovan ve kovan içinde bulunan petek gözlerinin görünüşü:	4	21
Arıların kovan içi yaşamı : Kovanda yaşayan ve çalışan arılar	4	21
Arıların kovan dışı yaşamı: Arılar gökyüzünde birlikte uçarken gösterilmiş.	2	16
Resimde bulunan çiçek figürleri:	6	31,5
Resimlerde kağıdın üst kısmına yerleştirilmiş ışınları çıkan güneş figüre (Ezber biçimler) Güneşle birlikte bulutlar var	9	47
Ağaç figürlerinin beş tanesi lolipop şeklinde ağaç figürü (Ezber biçimler)	7	36,8
Gök yüzünde M şeklinde kuş figürleri var. (Ezber biçimler)	3	15,7
Resminde Arı Maya çizgi filmindeki karakterlerin etkisi var: Bir çocuk çizgi film Kahramanlarından Arı Maya ve Arı Bee yi de çizdiğini söyledi.	1	5
62 rakamından tavşan resmi	1	5

Müze gezisi öncesi sınıfta yapılan etkinlikler, müze gezisi ve gezi sonrasında sınıfta yapılan canlandırma etkinliklerinden sonra çocukların yaptıkları son arı resimlerinde ön resimlere göre farklılıklar ortaya çıkmıştır. Çocuklar öğrendikleri bilgileri son çizimlerine yansıtabilmişlerdir. Gezi öncesi yaptıkları resimlerde sınıftaki çok yetenekli bir çocuk hariç genel olarak arıyı tek başına resimlemişlerdir. Ancak yapılan öğretim sonrasında çocuklar arıları tek çizmek yerine arının kovan içi ve kovan dışındaki yaşantısı içinde çizmişlerdir. Kovan içinde işçi arılar dışında, kraliçe arı ve yavru arılar, kovan dışında ise birlikte uçarken polen ve bal özü toplamaya yönelik durumları göstermişlerdir. Birlikte uçarken çizdikleri arı figürlerini küçük çizdikleri için arının organlarından çok yaşantısı ile ilgili detaylar resimlerde ortaya çıkmıştır. Örneğin kovanın içinde peteklerin, petek içinde yavru arıların gösterilmesi, kovan dışında çiçek, ağaç, güneş, dağ gibi doğa ile ilgili figürlerde resimleri tamamlayan unsurlar olmuştur. Ayrıca çizgi film kahramanlarının etkisi az da olsa resimlerde yer almıştır.

Son resimlerde özellikle kovan içinde kraliçe arı yavru arılar petek, arıların kovan içi ve kovan dışındaki yaşamlarında yaptıkları işler ve birlikte hareket etmeleri, müzedeki sergilemede gördükleri ağaca asılı doğal kovanı gibi detaylar belirgin oranında ortaya çıkmıştır. Bu da çocukların öğrendikleri bilgileri hatırlayabildiklerini göstermektedir. Araştırmanın problemlerinden olmasa da çizgisel gelişim basamaklarında görülen ezber biçimler (Sterotype resimler) çocukların resimlerinde de yer almıştır. Özellikle çiçek –ışınları görünen güneş –lolipop görünüşlü ağaç figürleri belirgin bir şekilde yer alırken, gökyüzünde uçan V görünüşlü kuş figürleri -62 den tavşan ve çizgi film kahramanları çok daha az miktarda görülmüştür. Sesli olarak sorulan soruya cevap verseler bile çocuklar yaşları gereği son resimlerde arı figürlerinin çizerken kanat ve bacakları doğru şekilde gösterememişlerdir. Üsten görünüşlü ve uçarken çizdikleri arı figürlerinde bu durum ortaya çıkmıştır.

Sonuç ve Öneriler

Okul öncesinde bilgiyi anlatarak aktarmak yanında arıları müze ortamında kovan içinde çalışırken gözleme, gerçek yaşamlarından yakın plan çekilmiş videoları, çizgi film ve animasyonları izleme, arının organlarının ve vücut bölümlerinin yerleştirilebildiği yap bozu tamamlama dışında arının tozlaşmaya katkısı ile tozlaşma ve bal özü ve polen toplamasının konu edildiği canlandırmada rol alma ,balın tadına bakma, arının sesini dinleme gibi duyularını uyaran etkinlikler yaşları küçük ve ilgilerinin sınırlı olmasına rağmen çocukların öğrendikleri bilgileri hatırlayabilmelerinde etkili olduğu söylenebilir.

Okul dışı öğrenmede müzeler katılımcıların dahil ve aktif olduğu ortamlar olduğu için daha çok ilgi çekmektedir. Bu çalışmada müze gezisi öncesi çocukların duyularının uyarılması animasyon ve belgesellerin izlenmesi çocukların zihinsel olarak hazırlanmasını ve merak etmelerini sağlamıştır. Müze ortamında canlı arıları gözlemek ve arıcılarla ilgili eşyaları ve sanat eserlerini görmek dikkatlerini çekip öğrendikleri bilgilerinin pekişmesini sağlamış olabilir. Eğitim Fakültesi öğrencileri de bu durumu fark etmişler yaptıkları yazılı ve sözlü değerlendirmede çocukların müzeye bilgili gelmelerinin sonuçlarının olumlu olarak değerlendirmişlerdir. Müze gezisi sonrasında sınıfta yapılan canlandırmada yaşları gereği rol ezberlemek yerine öğrendiklerini rahatlıkla rol oynarken canlandırmaya aktarabilmişlerdir.

Çalışmada seçilen temalarla ilgili bulgular incelendiğinde hem sesli yapılan kayıtlarda hem de yaptıkları resimlerde çocukların öğrenmeleri ile ilgili artış görüldüğü söylenebilir. Yapılan öğretimin etkisini araştırırken sadece resimlerini incelemek yeterli olmayacaktır. Çocuklar yaşları gereği bazen çizim zorluğu nedeni ile bildiklerini resimlerine aktarmakta zorluk çekebilmektedirler. O nedenle sesli kayıtla birlikte resim çizdirilmesi öğrenmenin ne kadar gerçekleşebildiği ile ilgili daha fazla fikir verebilecektir

Müze gezisi öncesi sınıf içi ve müze gezisi sonrasında da yapılan sınıf etkinliklerinin zaman alması gibi durumlar hiç kuşkusuz bu çalışmanın zorluklarını oluşturmuştur. Çocukların yaşlarının küçük olması tanımadıkları kişi ile (araştırmacı) hemen iletişim kurmanın zorluğu, ses kayıtlarının tek bir günde yapılamaması, ses kaydı için çocukların dikkati toplama ve kısa sürede bitirmeye çalışma, sınıfın kendi etkinlik programlarının aksamaması için görüşme sayısının az tutulmaya çalışılmasına rağmen ön ve son testler kayıtları için ikişer kere sınıfta kayıt yapılması gibi durumlar bu zorluklar için söylenebilir. Ayrıca müzede çocuklara eşlik edecek Eğitim Fakültesindeki öğrencilerinin de hem psikolojik hem de materyal üretme ile ilgili hazırlanmaları için yönlendirilmeleri gerekmiştir.

Eğitim Fakültelerimizin farklı bölümlerinin derslerinde de müzelerin eğitim ortamı olarak kullanılması ile ilgili konular olmasına rağmen öğretmenlerimizin meslek yaşamlarında ilköğretimde olduğu gibi okul öncesinde de müzelerden yararlanma olanakları oldukça sınırlıdır. Bu nedenle deneysel olarak yapılan çalışmaların sunulması yaşanabilecek sorunların tespiti ve katkılarını anlamaya fırsat verebilir.

Çevresindeki ve ülkesindeki doğal-sanatsal ve kültürel değerlerin küçük yaşta tanıma fırsatı olan çocuklarımız bu değerlerin korunması ile ilgili farkındalık geliştirebilecektir. Aynı şekilde etkinliğe katkıda bulunan Eğitim Fakültesi öğrencilerinin de okul dışı ortamlarda çocuklarla birlikte aktif eğitim olanaklarının yaratacağı fırsatları görmeleri meslek yaşamları açısından katkı getireceği söylenebilir.

Kaynakça

Maccario N.(2016) “Okul Öncesi Dönemde Arıcılık Müzesinin Öğretim Amaçlı Kullanımı” USOS 2016 .15 Mayıs 2016 Bodrum. Uluslararası Sınıf Öğretmenliği Eğitimi Sempozyumu Bildiri Kitabı,1696-1707.

Onur B. (2012) Çağdaş Müze Eğitim ve Gelişim Müze Psikolojisine Giriş. İmge Kitabevi Yayınları. Ankara.

Şimşek N. ,Çınar Y.(2008).Okul Öncesi Dönemde Fen ve Teknoloji Eğitimi. Anı Yayıncılık. Ankara.

INVESTIGATION OF HIGH SCHOOL STUDENTS' UNDERSTANDING ABOUT ELECTROCHEMISTRY CONCEPTS

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Abstract: Most of the high school students are required to study fundamental electrochemistry concepts in their classes. Research studies have shown that both high school students and pre-service chemistry teachers hold misconceptions in electrochemistry. On the other hand, electrochemistry has considerable importance in much application such as batteries, corrosion and electrolysis in daily life. For this reason, it is important for the students to learn the electrochemical concepts correctly. In this study, it was investigated 12th grade students' understanding of electrochemistry concepts. An 18-item multiple-choice test was administered to 267 12th grade students from four different high schools in Balıkesir. The electrochemistry test is relating to five conceptual categories such as reactions occurring during electrolysis, differences between electrolytic and voltaic cells, movement of ions in voltaic cells, poles in voltaic cells, voltaic cell reactions. It was concluded that several misconceptions previously reported in the literature were held by the study's students. The implications for teaching and learning were provided at the end of the study.

Keywords: High school students, misconceptions, electrochemistry

ORTA ÖĞRETİM ÖĞRENCİLERİNİN ELEKTROKİMYA KAVRAMLARINI ANLAMALARININ İNCELENMESİ

Özet: Temel elektrokimya ve onun temel kavramları orta öğretim programında yer alan önemli konulardır. Çalışmalar, hem orta öğretim öğrencilerinin hem de kimya öğretmen adaylarının elektrokimyada yanlış kavramaları olduğunu göstermiştir. Öte yandan elektrokimya, günlük hayatta piller, korozyon ve elektroliz gibi birçok uygulamada önemli bir yere sahiptir. Bu nedenle, öğrencilerin elektrokimyasal kavramları doğru bir şekilde öğrenmeleri önemlidir. Bu çalışmada, 12. sınıf öğrencilerinin elektrokimya kavramlarını anlamaları araştırılmıştır. 18 maddelik çoktan seçmeli bir test, Balıkesir'deki dört farklı orta öğretim kurumuna devam eden 267 12. sınıf öğrencisine uygulanmıştır. Elektrokimya testi, elektroliz sırasında meydana gelen reaksiyonlar, elektrolitik ve voltaik hücreler arasındaki farklar, volta hücrelerinde iyon hareketleri, voltaik hücrelerdeki kutuplar, voltaik hücre reaksiyonları gibi beş kavramsal kategoriyle ilgilidir. Daha önce literatürde bildirilen bazı kavram yanılgılarına çalışmadaki öğrencilerde de yer aldığı belirlenmiştir. Çalışmanın sonunda öğretim ve öğrenmeyle ilgili önerilerde bulunulmuştur.

Anahtar Sözcükler: Orta öğretim öğrencileri, yanlış kavramalar, elektrokimya

Giriş

Elektrokimya ile ilgili yapılan çalışmalar incelendiğinde, hem ortaöğretim seviyesinde hem de üniversite seviyesinde öğrencilerinin elektrokimya konu ve kavramlarını anlamada zorlandıkları ve ayrıca konu ile ilgili önemli yanlış kavramalara sahip oldukları görülür (Allsop & George, 1982; Brandriet & Bretz, 2014; Garnet & Treagust, 1992a ve 1992b; Ogude, & Bradley, 1994 ve 1996; Özkaya, 2002; Özkaya, Üce & Şahin, 2003; Rahayu, Treagust, Chandrasegaran, Kita, & Ibnu, 2011; Sanger & Greenbowe, 1997a ve 1997b; Schmidt, Marohn & Harrison, 2007). Lise ve üniversite düzeyinde anlatılan elektrokimya kavramlarının öğrenci tarafından tam anlaşılamaması, öğrenciyi bu konudan soğutmakta ve öğrenci bu alanda üst bilgi edinmekten ya da çalışmaktan korkmaktadır. Öğrencilerin elektrokimya ile ilgili anlama güçlükleri ve yanlış kavramalarının olduğu konu ve kavramları şu başlıklar altında toplanabilir; Elektrik devreleri, indirgenme-yükseltgenme reaksiyonları, elektrokimyasal hücreler, elektrolitik hücreler, derişim pilleri ve kimyasal ve elektrokimyasal denge.

Garnet ve Treagust (1992a ve 1992b), öğrencilerin özellikle tuz köprüsünün devrenin tamamlanması için elektron sağlayıcı bir role sahip olduğu düşündüklerini belirlemişlerdir. Konu ile ilgili olarak, öğrencilerin tuz köprüsü ile ilgili sorunlarını gruplandırmışlardır. Bunlar, elektronların elektrotlar ve tuz köprüsü boyunca hareket edip, katyonlar ve anyonlar vasıtasıyla taşınma veya transfer edilmesi; protonların elektrotlar ve tuz köprüsü boyunca hareket etmesi ve çözeltideki iyon hareketlerinin bir elektriksel akım oluşturmadığıdır. Elektroliz konusunun öğrenciler tarafından anlaşılmasındaki sorunlardan biri elektroliz ürünlerinin tahmin edilmesi ile ilgilidir. Schmidt, Marohn ve Harrison (2007), öğrencilerin elektroliz sırasında elektrik akımı ile iyonların oluştuğunu veya maddenin bozulduğunu düşündüklerini belirlemişlerdir. Garnett ve Treagust (1992b) ise öğrencilerin sulu çözeltilerin elektrolizi sırasında suyun tepkimeye girmediğini düşündükleri sonucuna ulaşmışlardır. Görüldüğü gibi yapılan çalışmalar elektrokimya konu ve kavramlarına yönelik öğrencilerin önemli sorunları olduğunu göstermiştir. Bu noktadan hareketle bu çalışmada 12. Sınıf öğrencilerinin elektrokimya konuları ile ilgili anlama düzeylerinin incelenmesi amaçlanmıştır.

Yöntem

Çalışmanın Modeli

Çalışmada ***genel tarama modeli*** kullanılarak ortaöğretim öğrencilerinin elektrokimya konularına yönelik anlama/yanlış kavrama durumları belirlenmeye çalışılmıştır.

Çalışmanın Örneklemi

Çalışmanın örneklemini, Balıkesir ilinde yer alan 4 farklı liseden toplam 365 12. sınıf lise öğrencisi oluşturmuştur.

Ölçe Aracının Geliştirilmesi

Çalışmada veri toplamak üzere Rahayu ve ark. (2011) tarafından geliştirilen ve kendilerinden izin alınarak Türkçe'ye çevrilen 18 maddelik çoktan seçmeli bir test kullanılmıştır. Testin 14 ve 17. sorularında 2 seçenek bulunurken diğer sorular 4 seçenek içermektedir. Ayrıca testteki sorular 5 kavram kategorisinden oluşmaktadır. Testin Türkçeye çevirme işlemi 2 farklı kişi tarafından yapıldıktan sonra, Elektrokimya alan uzmanı olan araştırmacılardan biri tarafından kontrol edilmiştir. Ayrıca elektrokimya konusunun 12. sınıf kimya öğretim programında yer alması nedeniyle, kapsam geçerliğini sağlamak için önce 12. sınıf kimya öğretim programı incelenmiş ve ayrıca 2 kimya öğretmeninin görüşü alınmıştır. Bu işlemler testin kapsam geçerliğini sağladığını göstermiştir. Testin kapsam geçerliliğinin sağlanmasından sonra güvenilirliği KR-20 formülü ile belirlenmiştir. 0.54 olarak belirlenen bu değer, orijinal test için 0.63'dür. Testin güçlüğü dikkate alındığında testin güvenilir olduğuna karar verilmiştir.

Veri Analizi

Veri analizi için SPSS 18.00 programı kullanmıştır. Analizler iki şekilde gerçekleştirilmiştir. Testin toplam başarısının belirlenmesi amacıyla doğru şıklar için "1", yanlış şıklar için "0" şeklinde veri girişi yapılarak betimsel istatistikler gerçekleştirilmiştir. Testten alınacak en yüksek puanın 18 olması nedeniyle ortalama değer buna göre belirlenmiştir. Her soru için % doğru değerleri hesaplanarak bir sütun grafiği oluşturulmuştur. Ayrıca testte yer alan her bir şıkka verilen yanıtların frekans ve yüzleri hesaplanmıştır.

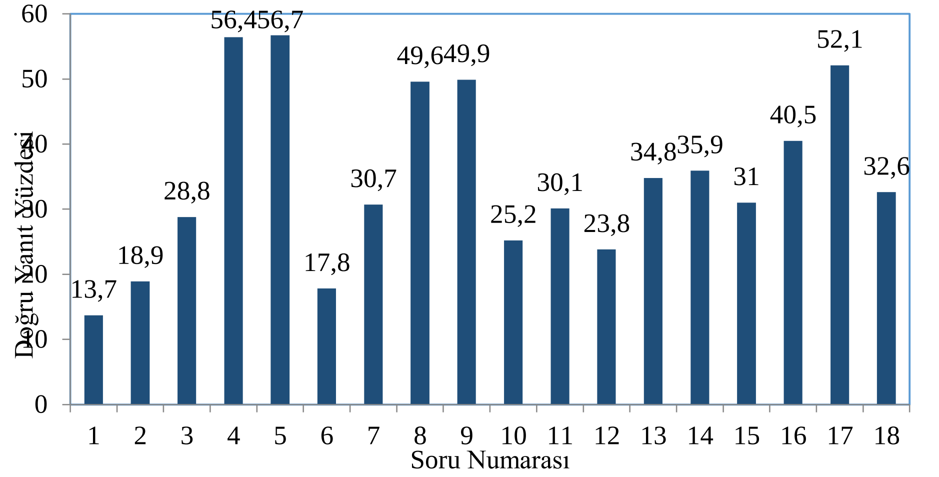
Bulgular

Öğrencilerin elektrokimya konu ve kavramlarını anlamalarına yönelik testin betimleyici istatistik bulguları Tablo 1'de verilmiştir.

Tablo 1. Elektrokimya testine ait betimleyici istatistik bulguları

Değişkenler	Değer
N	365
Ortalama	6.10
Standart sapma	2.788
Maximum	16
Minimum	1
Ortanca (medyan)	6.00

Tablo 1 incelendiğinde öğrencilerin 18 puan üzerinden ortalamalarının 6.10 olduğu görülmektedir. Bu durum testten genel olarak başarının düşük olduğunu göstermektedir. Bu genel başarı durumunun incelenmesinden sonra her soruya yönelik öğrenci başarı değerleri incelenmiş ve sonuçlar Şekil 1'de verilmiştir.



Şekil 1. Testteki her soruya verilen doğru cevap yüzdesi

Şekil 1 incelendiğinde sadece 5 soruda öğrencilerin başarılarının % 50 civarı veya biraz üzerinde olduğu görülür (4, 5, 8, 9 ve 17. Sorular). Öğrencilerin bu sorulardan 5 kategoriye göre başarı durumlarına bakıldığında, elektroliz sırasındaki tepkimelere ait üç soru olan 1, 2 ve 17. soruların hepsine doğru yanıt verme başarı ortalaması 3.8'dir. Elektrolitik ve voltaik hücrelerin farkı ile ilgili sorulan 3, 4, 9 ve 18. soruların başarı ortalaması, 5.2 iken; voltaik hücrelerdeki iyon hareketi ile ilgili soruların (5, 7, 8 ve 10) başarı ortalaması 3.0'dır. Voltaik hücrelerdeki kutuplara yönelik sorulan 11, 12, 13 ve 14. soruların başarı ortalaması 8.4 ve Voltaik hücre tepkimelerine yönelik 6, 15 ve 16. soruların ortalaması ise 2.4'dür.

Sonuç ve Öneriler

Elektrokimya konu ve kavramlarının öğrenciler tarafından anlaşılmasındaki önemli sorunlardan bir tanesi, kimyanın üçlü gösterimi adı verilen olayların makroskobik, mikroskobik altı ve sembolik seviyelerle ilgilidir. Bu çalışmada ede edilen bulgular doğrultusunda, öğrencilerin elektrokimya ile ilgili kavramları anlama düzeylerinin kimyanın üçlü gösterimi olan makroskopik, mikroskopik ve sembolik gösterimlerle ilgili olduğu görülmektedir. Öğrenciler özellikle makroskopik gösterimle ilgili sorulara daha yüksek oranda doğru yanıt vermişlerdir. Örneğin makroskopik gösterim ile ilgili olan kategorideki "Voltaik hücrelerde kutuplar" en fazla doğru cevap verilen kategori iken mikroskopik ve sembolik gösterimle ilgili olan kategorideki "Voltaik hücre tepkimeleri" en az doğru cevap verilen kategoridir. Diğer taraftan en fazla yanlış işaretlenen şık (%73) 1. sorudaki "HCl elektroliz yoluyla H^+ ve Cl^- iyonlarına ayrışır" şeklinde verilen c şıkkıdır. Öğrencilerin yanlış olduğu halde bu şıkkı işaretlemelerindeki temel nedenin çözelti kimyası, kuvvetli asit-baz kavramı bilgisinin tam oturmamış olmasından kaynaklandığı görülmektedir. Elektrokimyanın hem diğer kimya konularını, hem de fizik derslerinde kazanılması gereken çok fazla ön bilgi içermesi, elektrokimya öğretimindeki diğer önemli sorundur. Bu nedenlerle elektrokimya konularının öğretimi öncesinde, öğrencilerin hem ön-bilgileri hem de ön-koşul bilgileri gözden geçirilmeli ve varsa hatalar düzeltilmelidir. Bu konulardan önemli olanlar ana başlıklarla; maddenin tanecikli yapısı ve bağ kavramları, iyon oluşumu, yükseltgenme-indirgenme tepkimeleri, yükseltgenme basamağı, elektrik akımı ve elektrik devresi, potansiyel, enerji ve enerji birimleri, çözelti kimyası, derişim, aktiflik, iletkenlik, elektronötralite, termodinamik (özellikle iş ve serbest enerji değişimi), kimyasal denge şeklinde verilebilir. Ayrıca hemen hemen bütün kategorilerde mikroskobik seviyenin yer alması nedeniyle öğretimde görselliğin (simulasyon, animasyon ve çeşitli grafiksel materyaller) kullanılması da önemlidir.

Kategorilere göre tüm sorulara doğru yanıt verme yüzdelerine bakıldığında elektrokimyanın 12. sınıf öğrencileri için anlaşılması güç bir konu olduğu, literatürde verilen Endonezya ve Japonya'daki öğrencilerde de durumun hemen hemen aynı olduğu ve anlama düzeylerinin ülkenin gelişmişlik düzeyine göre değişmediği görülmektedir.

Kaynaklar

Allsop, R. T., & George, N. H. (1982). Redox in Nuffield advanced chemistry. *Education in Chemistry*, *19*, 57-59.

Brandriet, A. R., & Bretz, S.L. (2014). Measuring meta-ignorance through the lens of confidence: examining students' redox misconceptions about oxidation numbers, charge, and electron transfer. *Chemistry Education Research and Practice, 15*, 729-746.

Garnet, P.J., & Treagust, D.F. (1992a). Conceptual difficulties experienced by senior high school students of electrochemistry: Electric circuits and oxidation-reduction equations. *Journal of Research in Science Teaching, 29(2),* 121-142.

Garnet, P.J., & Treagust, D.F. (1992b). Conceptual difficulties experienced by senior high school students of electrochemistry: Electrochemical (Galvanic) and electrolytic cells. *Journal of Research in Science Teaching, 29(10),* 1079-1099.

Ogude, A.N., & Bradley, J. D. (1994). Ionic conduction and electrical neutrality in operating electrochemical cells: pre-college and college student interpretations, *Journal of Chemical Education*, 71(1), 29-34.

Ogude, A.N., & Bradley, J. D. (1996). Electrode processes and aspects relating to cell emf, current, and cell components in operating electrochemical cells: Precollege and college student interpretation. *Journal of Chemical Education*, *73 (12),* 1145-49.

Özkaya, A. R. (2002). Conceptual difficulties experienced by prospective teachers in electrochemistry: Half-cell potential, cell potential, and chemical and electrochemical equilibrium in galvanic cells. *Journal of Chemical Education, 79 (6),* 735-738.

Özkaya, A. R., Üce, M., Şahin, M. (2003). Prospective teachers' conceptual understanding of electrochemistry: Galvanic and electrolytic cells, *University Chemistry Education, 7,* 1- 12.

Rahayu, R. , Treagust, D. F., Chandrasegaran, A.L., Kita, M, & Ibnu, S. (2011). Assessment of electrochemical concepts: A comparative study involving senior high-school students in Indonesia and Japan. *Research in Science & Technological Education*, *29(2),* 169–188.

Sanger, M. J., & Greenbowe, T. J,. (1997a). Students' misconceptions in electrochemistry: Current flow in electrolyte solutions and the salt bridge. *Journal of Chemical Education, 74(7),* 819-823.

Sanger, M. J., &Greenbowe, I. J. (1997b). Common students' misconceptions in electrochemistry: Galvanic, electrolytic and concentartion cells. *Journal of Research in Science Teraching, 34 (4),* 377-398.

Schmidt, H-J., Marohn, A., & Harrison, A.G. (2007). Factors that prevent learning in electrochemistry. *Journal of Research in Science Teaching, 44(2),* 258–283.

THE EVALUATION OF THE MATERIALS DEVELOPED BY TEACHER CANDIDATES: WITH THE PERSPECTIVE OF RESEARCHER, PEER AND SELF-EVALUATION

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Abstract: Developing and changing dynamics of the world affect our lives in all fields. It is not possible not to be affected by this dynamism ranging from health sector to education sector. Teacher candidates play a vital role in raising the generation that will be a part of world dynamics. Teacher candidates need to achieve different perspectives by improving themselves both technologically and materially. Therefore, it is thought that the teacher candidates in faculties of universities have an adequate level of competency in terms of instructional technologies and material design. Based on this expectation, the aim of this study to enable the teacher candidates studying in 5th grade of biology teaching department to evaluate the biology related materials that were improved for the courses of instructional technologies and material design by having the perspective of researcher, peer and self-evaluation. This study has been conducted with 23 5th grade students studying in the department of biology in a university in Black Sea region of Turkey. Three forms have been distributed to the biology teacher candidates as data collection tools of the study. The data that have been collected from such forms were evaluated by comparing content analysis with the percentiles. Content analysis is implemented as a technique in which an information can be deeply examined through some codings and categories. By means of the results obtained from the study, interpretations have been made and suggestions were offered.

***Keywords*:** Science education, teacher candidate, instructional technologies, biology education, material development

ÖĞRETMEN ADAYLARI TARAFINDAN GELİŞTİRİLEN MATERYALLERİN DEĞERLENDİRİLMESİ: ARAŞTIRMACI, AKRAN VE ÖZ DEĞERLENDİRME BAKIŞ AÇISIYLA

Özet: Gelişen ve değişen dünya dinamiği yaşamımıza her alanda etki etmektedir. Sağlık sektöründen, eğitim sektörüne kadar bu dinamizmden etkilenmemek mümkün değildir. Dünya dinamizminin bir parçası olacak kuşağın yetiştirilmesinde ise öğretmen adaylarının payı oldukça büyüktür. Öğretmen adaylarının gerek teknoloji gerekse materyal olarak kendilerini geliştirerek farklı bakış açıları kazanmaları gerekmektedir. Bu nedenledir ki, fakültelerde öğretmen adaylarının öğretim teknolojileri ve materyal tasarım açısından iyi bir yetkinlikte olmasının önemli olduğu düşünülmektedir. Bu beklentiden yola çıkarak araştırmanın amacını; biyoloji öğretmenliği programı 5.sınıfında okumakta olan öğretmen adaylarının, öğretim teknolojileri ve materyal tasarım dersi için geliştirmiş oldukları biyoloji konularına yönelik materyallerin araştırmacı, akran ve öz değerlendirme bakış açısıyla değerlendirilmesi oluşturmaktadır. Bu çalışma Türkiye'nin Karadeniz bölgesindeki bir üniversitenin biyoloji öğretmenliği anabilim dalında öğrenim görmekte olan 23 5. Sınıf öğrencisi ile yürütülmüştür. Çalışmada veri elde etme aracı olarak üç adet form kullanılmıştır. Bu formlardan elde edilen veriler içerik analizi ve yüzdeler ile karşılaştırılarak değerlendirilmiştir. İçerik analizi, bazı kodlama ve kategorilerle bir bilginin derinlemesine incelenebildiği bir teknik olarak uygulanmaktadır. Çalışmadan elde edilen sonuçlar ile yorumlamalara gidilmiş ve öneriler sunulmuştur.

Anahtar Sözcükler: Fen eğitimi, öğretmen adayı, öğretim teknolojileri, biyoloji eğitimi, materyal geliştirme

Giriş

Günümüz inovasyon çağı gereğince, bilim ve teknoloji olarak gelişim sınır tanımamakta ve aktif bir şekilde süregelmektedir. Çağımızda yenilikleri takip etmemek toplumsal olarak geri kalmaya neden olabilmektedir. Her fikir, bir ürüne, bir teknolojiye dönüşebilme kapasitesine sahiptir. Ancak fikirler geliştirilirse başka ürünlere evrilebilmektedir. Geliştirilemeyen fikir zaman içerisinde yok olamaya mahkum olabilmektedir. Özellikle toplum olarak gelişimin en önemli niteliklerinden biri bilim ve teknolojiye verilen değer ile paralellik göstermektedir. Nitekim ülkemizde de Bilim ve Teknoloji Stratejileri Vizyon 2023 ile belirlenmiş ve bu nokta da çeşitli adımlar atılmıştır. Bu adımlardan biri de, bilim ve teknolojiyi üretebilen ve onu kullanabilen, bu noktadaki gelişmeleri toplumsal ve ekonomik faydaya dönüştürebilen bir "refah toplumu" oluşturma hedefidir (Tübitak, 2015).

Postmodernizm ile birlikte olayları farklı bakış açılarından görmek ve bu uğurda fikirler geliştirmek inovatif toplumun önemli temellerindendir. Bu noktada bireylerin küçük yaşlardan itibaren yetiştirilme düzeyleri oldukça önem arz etmektedir. Yaratıcı fikirler geliştirmek ve bu fikirleri bir şekilde bir ürüne dönüştürmek çocukların ilerleyen yaşlarında teknolojiyi, bilimi üretebilen bireyler olmalarında etkin olacaktır. Özellikle fen bilimlerini seven bu alanda çok çeşitli sorular sorup sorgulayan, araştıran bireyler bilim toplumunu yönlendirmede etkin olacaktır. Yaratıcılık becerisini geliştirme potansiyeline sahip olan bir çocuk ise, bilimi elinde tutan bir bilim insanı gibidir. Bu noktada öğretmenlerin donanımlı ve etkin olması bireylerin yaratıcılık becerilerinin gelişiminde oldukça önemlidir. Öğretmenlerin mesleklerini etkili ve verimli biçimde yerine getirebilmeleri için; bazı bilgi, beceri ve tutumlara sahip olmaları gerekmektedir (Cabı ve Ergün, 2016). İyi bir öğretmen iyi bir nesil demektir. İyi bir nesil ise, iyi bir toplumu oluşturmaktadır.

Bu noktada Milli Eğitim Bakanlığı (MEB, 2006) tarafından öğretmen yeterlikleri belirlenirken özellikle teknolojik yeterlilik bakımından özetle "teknoloji ile ilgili kavram ve uygulamaların bilgi ve becerisine sahip; mesleki gelişimini desteklemek için bilgi ve iletişim teknolojilerinden yararlanan; teknolojiyi, bilgiyi paylaşma amacıyla yararlanan; bilgi ve iletişim teknolojilerini de kullanarak, farklı deneyim ve özellikleri olan öğrencilere uygun öğrenme ortamları sunan; materyal geliştirmede bilgisayar gibi teknolojik araçlardan faydalanan; teknolojiyi etkili kullanarak rol model olan" öğretmen yeterlikleri beklenmiştir. Buradan anlaşılacağı üzere MEB aslında teknolojiyi günlük yaşamında ve mesleğinde rahatlıkla kullanabilen öğretmenler beklemektedir.

Söz konusu bu durum teknoloji kullanımını ile birlikte aslında her türlü materyal oluşturma, kullanma ve yapılandırma becerisinin oldukça önem arz ettiğini göstermektedir. Mevcut bir dersin öğrenim sürecinde sadece teknoloji kullanma yeterli olmamakta bazen öğretmenlerin ya da öğrencinin kendi materyalini oluşturması gerekmektedir. Gerek konunun daha görsel hale getirilmesi gerekse anlama kolaylığı yaratması bakımından materyal geliştirmeyi bilmek ve bu beceriyi öğrencilere aktarmak öğrencilerin daha farklı fikirler üreterek yaratıcı ürünler geliştirmelerine de imkan kılabilecektir.

Teknolojiyi, materyal geliştirmeyi içselleştirebilmiş öğretmenlerin yetişmesinde ise eğitim fakültelerine çok önemli görevler düşmektedir. Eğitim fakültelerinde yetiştirilen öğretmen adaylarının teknolojiyi iyi kullanabilen, teknolojik yeniliklere açık, bu araçlardan mesleğinin gelişiminde faydalanan ve gerektiğinde kendi öğretim materyalini rahatlıkla oluşturabilen ve kullanabilen bireyler olmaları oldukça önemlidir.

Yöntem

Araştırmanın amacını; biyoloji öğretmenliği programı 5.sınıfında okumakta olan öğretmen adaylarının, öğretim teknolojileri ve materyal tasarım dersi için geliştirmiş oldukları biyoloji konularına yönelik materyallerin araştırmacı, akran ve öz değerlendirme bakış açısıyla değerlendirilmesi oluşturmaktadır.
Bu çalışma Türkiye'nin Karadeniz bölgesindeki bir üniversitenin biyoloji öğretmenliği anabilim dalında öğrenim görmekte olan 23 5. Sınıf öğrencisi ile yürütülmüştür.

Araştırmanın desenini "durum çalışması" oluşturmaktadır. Durum çalışması bir ya da daha fazla olayın, ortamın, programın, sosyal grubun veya birbirine bağlı sistemlerin derinlemesine incelendiği sistem olarak tanımlanmaktadır (McMillan, 2000; Akt. Büyüköztürk, Kılıç Çakmak, Akgün, Karadeniz ve Demirel, 2008). Çalışmada veri elde etme aracı olarak üç adet form kullanılmıştır. Söz konusu bu formların oluşturulmasında, Yanpar Yelken'in (2011) örnek değerlendirme kontrol listelerinden yararlanılmıştır.
Araştırmada kullanılan değerlendirme formları araştırmacı, akran ve öz olmak üzere üç adettir. Akran ve öz değerlendirme formları öğretmen adayları tarafından, araştırmacı değerlendirme formu ise araştırmacılar tarafından doldurulmuştur. Bu formlar öğretmen adaylarının ders esnasında geliştirdikleri materyallerin değerlendirilmesi ile işlenmiştir. Bu formlardan elde edilen veriler içerik analizi ve yüzdelikler ile karşılaştırılarak değerlendirilmiştir. İçerik analizi, bazı kodlama ve kategorilerle bir bilginin derinlemesine incelenebildiği bir teknik olarak uygulanmaktadır.

Bulgular

Araştırmadan elde edilen veriler bir tabloda sunulmuştur. Söz konusu bu tabloda öz, akran ve araştırmacı değerlendirme formlarından elde edilen veriler yüksek, orta ve düşük kategoriler ile karşılaştırmalı olarak verilmiştir.

Tablo1. Öz, akran ve araştırmacı değerlendirme formlarından elde edilen veriler

Form maddeleri	**Yüksek (%)**			**Orta (%)**			**Düşük (%)**		
	Öz	**Akran**	**Araştırmacı**	**Öz**	**Akran**	**Araştırmacı**	**Öz**	**Akran**	**Araştırmacı**
Giriş yeterlikleri	95,65	78,26	65,22	4,35	13,04	13,04	0	8,70	26,07
Kazanıma uygunluk	100	100	82,61	0	0	13,04	0	0	4,35
Anlaşılabilirlik	100	95,65	78,26	0	4,35	8,70	0	0	13,04
Etkililik delilleri	21,74	0	21,74	21,74	4,35	73,91	56,52	95,65	4,35
Kullanım kolaylığı	91,3	86,96	60,87	8,70	13,04	30,44	0	0	8,70
Dayanıklılık	91,3	73,91	78,26	4,35	26,07	13,04	4,35	0	8,70
Gerçeği yansıtma	95,65	78,26	78,26	4,35	21,74	13,04	0	0	8,70
Önemlilik derecesi	78,26	69,57	60,87	21,74	30,44	30,44	0	0	8,70
Yönergenin olması	26,07	8,70	8,70	26,07	8,70	86,96	47,83	82,61	4,35
Geliştirilebilirlik	95,65	69,57	73,91	0	30,44	13,04	4,35	0	13,04
Yönerge yeterliği	26,07	4,35	8,70	17,39	8,70	86,96	56,52	86,96	4,35
Programa uygunluk	95,65	95,65	82,61	4,35	4,35	8,70	0	0	8,70
Doğru ve geçerli	100	95,65	78,26	0	4,35	13,04	0	0	8,70
Açık ve yalın bir dil	100	95,65	60,87	0	4,35	30,44	0	0	8,70
Motivasyon ve ilgiyi sağlama	86,96	65,22	78,26	8,70	34,78	13,04	4,35	0	8,70
Öğrenen katılımı	73,91	17,39	65,22	21,74	82,61	21,74	4,35	0	13,04
Teknik yeterlik	69,57	21,74	60,87	30,44	73,91	26,07	0	4,35	13,04
On yargıdan uzak olması	82,61	82,61	95,65	17,39	17,39	0	0	0	4,35
Okunabilirlik	100	100	65,22	0	0	26,07	0	0	8,70
Basitlik ve açıklık	95,65	100	86,96	4,35	0	4,35	0	0	8,70
Renk	100	95,65	43,48	0	4,35	34,78	0	0	21,74
Biçim	91,3	95,65	69,57	8,70	4,35	17,39	0	0	13,04
Vurgu	95,65	95,65	69,57	4,35	4,35	17,39	0	0	13,04
Fon	91,3	95,65	56,52	8,70	4,35	30,44	0	0	13,04

Tabloda da görüldüğü üzere, gerek öz gerek akran gerekse araştırmacı değerlendirmeleri karşılaştırıldığında genel olarak, yüksek düzeyin ortaya çıktığı belirlenmiştir. Ancak her üç değerlendirmeci tarafından etkililik, yönerge olması ve yeterliliği ise orta ve düşük kriterlerinde belirlenmiştir. Yine öğrenen katlımı ve teknik yeterlilik bakımından akran değerlendirmesi orta düzeyde olurken; renk bakımından ise araştırmacı değerlendirmesi hemen hemen eşit dağılım göstermiştir.

Sonuç

Teknoloji okuryazarlığı teknoloji, bilim, ekonomi ve eğitim gibi birçok alanı etkileyen bir kavram olarak hayatımızın içinde mevcut bulunmaktadır. Bu durum ile birlikte birçok alanda bazı standartlar geliştirilerek bunların gerçekleştirilmesi hedeflenmektedir. 2006-2007 öğretim yılından itibaren Eğitim Fakültelerinin bazı öğretim programlarında ortak standartların belirlenmesi amacıyla, değişikliğe gidilmiş ve yeni öğretim programlarının uygulanması sağlanmıştır (YÖK, 2007). Nitekim Ulusal Eğitim Teknolojileri Standartları da (ISTE, 2015), öğretmenler için teknoloji ile birlikte öğrenme ortamları tasarlama ve uygulama, teknoloji destekli farklı değerlendirme stratejilerini kullanma, mesleki gelişim için teknolojik yenilikleri takip etme ve kendini geliştirme gibi bazı kriterler ortaya koymuşlardır.

Tüm bu sebeplerden ötürü eğitim fakültelerinde zorunlu ortak ders olarak belirlenen Öğretim Teknolojileri ve Materyal Tasarımı dersi öğrencilerin yaratıcılık becerilerini olumlu yönde etkilemekte; olaylara farklı bakabilme becerisi kazandırmakta ve etkili materyaller tasarlamalarına olanak sağlamaktadır (Kolburan Geçer, 2010).

Taş ve Düz'ün (2016) yapmış doldukları çalışmaya göre; teknoloji ağırlıklı farklı öğretim yöntemlerinin kullanılması, farkındalık oluşturması ve akademik başarı anlamında olumlu yönde etki etmektedir. Bu çalışmaya benzer olarak literatürde materyal gelişimi ile ilgili çok sayıda çalışmanın olduğunu görmekteyiz (Taşçı, Yaman ve Soran, 2010; Kahyaoğlu 2011; Seferoğlu ve ark. 2008; Keskin, 2011; Durndell ve Haag, 2002; Jackson ve diğerleri, 2008). Tüm bu çalışmalarda materyallerin öğrenim süreci üzerindeki etkinliği görülebilmektedir.

Yapılan bir çalışmada Öğretmenlerin çoğunluğunun bilgisayar kullanabilmesine karşın bilgi iletişim teknolojilerinin öğrenme öğretme sürecine entegrasyonuyla ilgili herhangi bir etkinlikte bulunmadıkları görülmüştür (Demiraslan ve Usluel, 2005). Benzer olarak literatürde öğretmenlerin teknolojiyi kullanma durumlarının incelendiği çalışmalarda öğretmenlerin teknolojiyi kullanmayı bildiği fakat aynı oranda sınıf ortamında öğretim amaçlı kullanmadığı vurgulanmaktadır (Taşçı, Yaman ve Soran, 2010). Yine Taşçı ve diğerlerinin (2010) biyoloji öğretmenlerinin öğretimde yeni teknolojileri kullanım durumlarını inceledikleri çalışmalarında, bilgisayar kullanmayı bildiğini ifade eden biyoloji öğretmenlerinin oranının yüksek olmasına rağmen bilgisayarın öğretim amaçlı kullanılma sıklığının ise oldukça düşük olduğu vurgulanmaktadır. Kahyaoğlu'nun (2011) çalışmasında ise, fen ve teknoloji öğretmenlerinin akıllı tahtayı öğretim amacıyla hiç kullanmadıklarına işaret edilmektedir.

Bu noktadan hareketle geleceğin öğretmenleri olarak Eğitim Fakültesinde öğrenim gören öğrencilerin eğitimde teknoloji entegrasyonu konusunda önemli rollere sahip oldukları düşünülmelidir (Özmen, Usluel ve Çelen, 2014). Aslan Efe, Yücel, Efe (2016) yapmış oldukları çalışmada; Türk öğretmen adayları arasında akıllı tahta, LCD ve projeksiyon kullanım sıklığının düşük, İsviçreli öğretmen adayları arasında ise orta ve yüksek düzeyde olduğu; internet ve sosyal ağların Türk ve İsviçreli öğretmen adayları tarafından kullanımının ise oldukça yüksek olduğu belirlenmiştir. Devecioğlu'nun (2011) yapmış olduğu çalışmada; öğretmen adaylarının etkin olarak kullandıkları öğretim teknolojileri tahta, tebeşir, çalışma yaprağı, kavram haritası, saydam, tepegöz, hikâyeler, soru kartları, bilgisayar, internet ve laboratuvar araç-gereçleri olarak belirlenmiştir.

Ancak gerek materyallerin oluşturulması gerekse uygulanması aşamasında bazı kriterlere dikkat edilmesi gerektiği de önemlidir. Nitekim yapılan bu çalışmada geliştirilen materyallerin özellikle etkililik, yönerge olması ve yeterliği bakımından çok yeterli olmadıkları belirlenirken; kazanıma uygunluk, anlaşılabilirlik, okunabilirlik, biçim, vurgu ve fon… gibi unsurlarda üç değerlendirmeci bakımından yeterli oldukları belirlenmiştir.
Tüm bu durumların yanı sıra Erdemir ve Bakırcı'nın (2016) yapmış oldukları çalışmada; genel anlamda öğretmen adaylarının, öğretim elemanlarının teknolojiyi ve materyalleri kullanmalarını bekledikleri de saptanan noktalardan olmuştur.

Gelişen ve değişen dünya dinamiği yaşamımıza her alanda etki etmektedir. Sağlık sektöründen, eğitim sektörüne kadar bu dinamizmden etkilenmemek mümkün değildir. Dünya dinamizminin bir parçası olacak kuşağın yetiştirilmesinde ise öğretmen adaylarının payı oldukça büyüktür. Öğretmen adaylarının gerek teknoloji gerekse materyal olarak kendilerini geliştirerek farklı bakış açıları kazanmaları gerekmektedir. Bu nedenledir ki, fakültelerde öğretmen adaylarının öğretim teknolojileri ve materyal tasarım açısından iyi bir yetkinlikte olmasının önemli olduğu düşünülmektedir.

Öneriler

Tüm bu çalışmalardan yola çıkarak şu öneriler getirilebilir:
-Öğretim teknolojileri ve materyallerini içeren ders etkinliklerinin nicelik ve nitelik olarak gelişimi sağlanabilir.
-Özellikle eğitim fakültelerinde öğretim teknolojileri ve materyalleri ile ilgili sınıflar oluşturarak mevcut materyallerin korunması ve yenilerinin geliştirilmesi sağlanabilir.
-Geliştirilen materyallerin, biçimsel, niteliksel, kapsam ve uygulanabilirlik açısından yeterli duruma getirilmesi sağlanabilir.

Kaynaklar

Aslan Efe, H., Yücel, S. & Efe, R. (2016). Türkiyeli ve İsviçreli fen alanları öğretmen adaylarının öğretim teknolojilerini kullanma sıklığının karşılaştırılması. *YYÜ Eğitim Fakültesi Dergisi ,13*(1), 232-256.
Büyüköztürk, Ş., Kılıç Çakmak, E., Akgün, Ö. E., Karadeniz, Ş. & Demirel, F., (2008). Bilimsel araştırma yöntemleri. Ankara: Pegem Akademi.

Cabı, E. & Ergün, E. (2016). Öğretim teknolojileri ve materyal tasarımı dersinin öğretmen adaylarının eğitimde teknoloji kullanımına yönelik kaygılarına etkisi. *Başkent Unıversıty Journal of Educatıon, 3*(1), 37-43.

Demirarslan, Y. & Kocak Usluel, Y. (2005). Bilgi ve iletişim teknolojilerinin öğrenme öğretme sürecine entegrasyonunda öğretmenlerin durumu. *The Turkish Online Journal of Educational Technology, 4*(3), 109-113.

Devecioğlu, Y. (2011). Öğretmen adaylarının öğretmenlik uygulaması sürecinde öğretim teknolojilerini kullanma yeterlikleri. *Bayburt Üniversitesi Eğitim Fakültesi Dergisi 6*(I-II), 95-104.

Durndell, Z. & Haag, Z. (2002). Computer self efficacy, computer anxiety,attitudes towards the Internet and reported experience with the Internet, by gender, in an East European sample. *Computers in Human Behavior, 18*, 521–535.

Erdemir, N. & Bakırcı, H. (2016). Öğretmen adaylarının öğretim elemanlarından bilgi teknolojilerini kullanma konusunda beklentileri. *YYÜ Eğitim Fakültesi Dergisi (YYU Journal of Education Faculty), (XIII)*I, 275-300.

Jackson, L.A., Zhao, Y., Qui, W., Kolenic, A., Fitzgerald, H.E., Harold, R. & Eye, A.V. (2008). Culture, gender and information technology use: A comparison of Chinese and US children. *Computers in Human Behavior, 24*, 2817-2829

ISTE (2015). Standards for Teachers Resources. http://www.iste.org/standards/standards-for -teachers.

Keskin, Y. (2011). DKAB bölümleri öğrencilerinin bilgisayar ve internet kullanma durumları ve yeterlikleri. *Ondokuz Mayıs Üniversitesi İlahiyat Fakültesi Dergisi, (30)*, 211-233

Kolburan Geçer, A. (2010). Teknik öğretmen adaylarının öğretim teknolojisi ve materyal geliştirme dersine yönelik deneyimleri. *Yüzüncü Yıl Üniversitesi, Eğitim Fakültesi Dergisi, 7* (2), 1-25.

Kahyaoğlu, M. (2011). İlköğretim öğretmenlerinin fen ve teknoloji dersinde yeni teknolojileri kullanmaya yönelik görüşleri. *Eğitim Bilimleri Araştırmaları Dergisi, 1*(1), 79-96

MEB (2006). Milli Eğitim Bakanlığı, Öğretmenlik Mesleği Genel Yeterlikleri. http://otmg.meb.gov.tr/belgeler/otmg/Yeterlikler.pdf.

Özmen B., Usluel Y. K. & Çelen, F. K. (2014). Araştırmalarda bilgi ve iletişim teknolojilerinin öğrenme öğretme sürecine entegrasyonu konusunda var olan durum ve yönelimler. *Eğitimde Kuram ve Uygulama, 10*(5), 1224-1253.

Seferoğlu, S.S., Akbıyık, C. & Bulut, M.(2008). İlköğretim öğretmenlerinin ve öğretmen adaylarının bilgisayarın öğrenme/öğretme sürecinde kullanımı ile ilgili görüşleri. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi, (35),* 273-283.

Taşçı, G., Yaman, M., & Soran, H. (2010). Biyoloji öğretmenlerinin öğretimde yeni teknolojileri kullanma durumlarının incelenmesi. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi, (38),* 267-278.

Taş, M. & Düz, İ. (2016). Sosyal bilgiler öğretiminde teknoloji entegrasyonu. *Eğitim ve Öğretim Araştırmaları Dergisi, 5*(1), 180-188.

TÜBİTAK (2015). Vizyon 2023 teknoloji öngörü projesi, eğitim ve insan kaynakları sonuç raporu ve strateji belgesi. http://www.tubitak.gov.tr/tr/kurumsal/politikalar/icerik-vizyon-2023.

Yanpar Yelken, T. (2011). Öğretim teknolojileri ve materyal tasarımı. 10. Baskı. Ankara: Anı yayıncılık

YÖK (2007). Eğitim fakültesi öğretmen yetiştirme lisans programları. www.yok.gov.tr.

USE OF CONCEPT MAPS IN ELIMINATING MISCONCEPTIONS

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Abstract: In this study it was aimed to determine the levels of drawing a concept map in order to eliminate the misconceptions of prospective science teachers. In this research, answers to two sub-problems as well as to the main problem were sought in addition. The first sub-problem of this study is related to determining the current misconceptions of the prospective science teachers under the aforementioned titles. The second sub-problem of this study is about determining the prospective science teachers' levels of drawing an accurate concept map. The research was conducted with 3rd year prospective science students, who study at the science education department of a university in Istanbul province. In this study, 40 prospective science teachers studying at university were randomly chosen. The data retrieved from the study were analyzed through content analysis. In content analysis, existing case can be elaborately analyzed through themes and codings, thus the raw data obtained from the study can be examined in depth. Therefore, in this study main themes were created and the data obtained from the study were indicated in frequency based on the themes created. Moreover, in this study we tried to provide examples of the concept maps drawn by prospective science teachers. In the current literature, there are many studies related to the significance of both domains including misconceptions and concept maps. In addition to these studies, this current research was comparatively evaluated and interpreted. For that matter, we tried to present some recommendations, which, we believe, will contribute to the field of science education.

Keywords**:** Concept map, science education, misconception, prospective teacher

KAVRAM YANILGILARININ GİDERİLMESİNDE KAVRAM HARİTALARININ KULLANILMASI

Özet: Araştırma İstanbul ilindeki bir üniversitenin fen bilgisi eğitimi alanında eğitim görmekte olan 3. Sınıf fen eğitimi öğretmen adayları ile gerçekleştirilmiştir. Söz konusu bu çalışmada öğrenim görmekte olan mevcut öğretmen adaylarından rasgele 40 öğretmen adayı seçilmiştir. Eğitimde gerek planlama, gerek süreç ve gerekse değerlendirme gibi birçok alanda etkin olarak uygulanan önemli öğretim yöntemlerinden biri olan kavram haritalarının kavram yanılgılarının giderilmesinde de etkin olarak kullanılabileceği düşünülmektedir. Bu noktadan hareketle, çalışmada fen eğitimi öğretmen adaylarının kavram yanılgılarını giderebilmek adına kavram haritası oluşturabilmesi düzeyleri belirlenmeye çalışılmıştır. Çalışmanın bu ana problemi yanı sıra iki alt probleme de yanıt aranılmıştır. Bu çalışmanın birinci alt problemini fen öğretmen adaylarının bazı konu başlıklarındaki mevcut kavram yanılgılarının tespit edilmeye çalışılması; ikinci alt problemini ise, öğretmen adaylarının doğru bir kavram haritası oluşturma düzeylerini belirleme olmuştur. Çalışmadan elde edilen veriler içerik analizi ile değerlendirilmiştir. İçerik analizinde temalar ve kodlamalarla var olan durumun analizi detaylı olarak gerçekleştirilebilmekte, böylece elde edilen ham veriler daha derinlemesine incelenebilmektedir. Mevcut alanyazında kavram yanılgıları ve kavram haritaları ile yapılmış, her iki çalışma alanının önemine ilişkin birçok çalışma bulunmaktadır. Söz konusu bu çalışmalarla mevcut çalışmanın karşılaştırmalı yorumlaması gerçekleştirilmiştir. Bu noktada fen eğitimi alanına katkı sağlayabileceği düşünülen öneriler de getirilmeye çalışılmıştır.

Anahtar Sözcükler: Kavram haritası, fen eğitimi, kavram yanılgısı, öğretmen adayı.

Giriş

Kavramlar aslında günlük hayatta bazı ifadelerimizi tanımlamayı kolaylaştırmak adına kurduğumuz sözcük öbekleridir. Bu sözcük öbekleri gerek günlük yaşamda kendimizi ifade etmede, gerekse bilimsel olarak bazı tanımlamaları yapıp yeni bilgiler oluşturmada olmazsa olmaz terimlerdir. Kavramlarımız olmazsa bilgilerimizi etkili bir şekilde sınıflandıramayız ve bu bilgilerimizi başka kişilere aktaramayız (Kaptan, 1999).

Doğru kavram, doğru bilginin temelini oluşturmaktadır. Bir bilginin doğru olarak aktarılması ya da yeni bilgilerle transfer edilmesi, kullanılan kavramların doğruluğu ile ilişkilidir. Her kavram zihinde başka kavramlarla örüntü içine girerek anlamlı öğrenmeyi oluşturur. Mevcut olan kavram ilişkisine sürekli olarak ya da zaman zaman yeni kavramların eklenmesi ile bilgi farklı formlara evrilmektedir. Bu sebepledir ki, okuduğunu anlama ve doğru kavramları doğru bir şekilde öğrenerek kullanma, bilginin anlam bütünlüğü ve sürekliliği için oldukça önemlidir. Bireyin sahip olduğu fikirler bazen bilimsel gerçeklerden farklı olabilmektedir (Palmer, 1999). Söz konusu bu durumda zihinde yanlış kavramlar oluşmakta ya da tam olarak doğru bir kavram oluşmamaktadır. Bu noktada bu kavram ile ilgili başka kavramların zihinde ilişkilendirilmesi, ya yanlış ya eksik ya da hiç gerçekleşmemektedir.

Bireyin sahip olduğu yanlış ön bilgiler, yanlış kavramalarına sebep olmaktadır (Ecevit, Özdemir Şimşek, 2017). Bireyin zihin haritasında var olan yanlış kavramlar, yeni kavramları da bu yanlış örüntüye ekleyebilmektedir. Dolayısıyla yanlış bir bilgi örüntüsü oluşabilmektedir. Yanlış bir bilgi örüntüsünü zihinde tekrar doğruya dönüştürmek ise çok kolay gerçekleşmemektedir. Literatürde kavram yanılgısı olarak tanımlanan bu durum eğitim bilimlerinde en önemli konulardan biri olarak karşımıza çıkmaktadır. Kavram yanılgısının oluşumu çoğu zaman belki de farkında olmadan, gelişigüzel kullanılan ifadelerden ve yanlış, eksik yapılan öğretimden de gerçekleşebilmektedir.

Öğretilecek fen kavramlarının anlamlı ve kalıcı olması için, yeni öğrenilen kavramlar ile var olan kavramların anlamlı bir bütünlük oluşturması sağlanmalıdır (Yağbasan ve Gülçiçek, 2003). Nitekim Tennyson, Woolley ve Merrill (1972), kavram yanılgısı olan bir bireyin, kavram oluşturma sırasında genelleme ve ayırt etme gibi bazı bilişsel becerileri doğru olarak gerçekleştiremediğini ifade etmektedirler. Kavram yanılgısı, bilimsellikten uzak, bilimsel gerçekliği kanıtlanmış kavramların öğretilmesine engel olan bilgilerdir (Yürük, Çakır ve Geban, 2000). Kavram yanılgıları ile yapılan tanımlamaların ortak noktası, bireyin yanlış öğrenmesine neden olması gerçeğidir (Aydoğan ve Köksal, 2017).

Kavram yanılgıları, öğretim metotlarına karşı oldukça direnç göstermektedir (Çalık ve Ayas, 2003). Bu sebepledir ki, kavram yanılgılarını düzeltmek çok da kolay bir süreç getirmemektedir. Kavram yanılgılarını düzeltmek için yapılan çalışmalarda kavramsal değişim metinleri, kavram karikatürleri, metinler, kavram haritaları gibi yöntemler kullanılmaktadır (Duit ve Treagust, 2003; Köse, 2007; Tekkaya, 2003; Ünal, 2008). Bu noktada kavram yanılgılarını düzeltmek adına kullanılabilecek yöntemlerden biri de kavram haritaları olarak karşımıza çıkmaktadır.

Kavram haritaları bir konudaki kavramlar arasındaki ilişkinin daha açık ve anlamlı öğrenilmesini sağlamaya yardımcı olabilecek eğitim araçlarındandır (Çetin, Güler ve Sarıca, 2016). Bir başka ifadeyle kavram haritaları kavramları belli bir düzen ve ilişkiler içerisinde düzenleyen görsel çizimlerdir. Kavram haritaları, genel kavramlar, özel kavramlar, merkez kavram, bağlantı, bağlantı kelimeleri, önerme, örnekler gibi öğelerden oluşmaktadır (Kaya, 2003). İki veya daha fazla kavramın bazı oklarla birleştirilmesi sonucu oluşan kavram bağları ise, birbiri ile ilişkili kavramları ve aralarındaki ilişkileri göstermek için kullanılmaktadır (Hsu, 2004).

Kavram yanılgıları özellikle küçük yaşlarda öğrenilen yanlış ve eksik bilgiler sonucu gerçekleşebildiği ve ilerleyen zaman içerisinde bu yanılgıların giderilmesi daha da zorlaştığı için, özellikle ilköğretim çağında bu yanılgıların giderilmesi oldukça önem taşımaktadır. Bu noktada öğretmenlerin kavram yanılgıları hakkında oldukça dikkatli olmaları gerekmektedir. Özellikle yeni yetişen öğretmen adaylarının kavram yanılgılarının tespiti ve bu yanılgıların giderilmeye çalışılması ileride yetiştirilecek olan çocukların yanılgılar ile temas kurmasını engelleyebilecektir. Bu sebepledir ki öğretmen adayı eğitiminin oldukça önemli olduğu düşünülmektedir.

Yöntem

Araştırma İstanbul ilindeki bir üniversitenin fen bilgisi eğitimi alanında öğrenim görmekte olan 3. Sınıf fen eğitimi öğretmen adayları ile gerçekleştirilmiştir. Söz konusu bu çalışmada öğrenim görmekte olan mevcut öğretmen adaylarından rasgele 40 öğretmen adayı seçilmiştir.

Eğitimde gerek planlama, gerek süreç ve gerekse değerlendirme gibi bir çok alanda etkin olarak uygulanan önemli öğretim yöntemlerinden biri olan kavram haritalarının kavram yanılgılarının giderilmesinde de etkin olarak kullanılabileceği düşünülmektedir.
Bu noktadan hareketle, çalışmada fen eğitimi öğretmen adaylarının kavram yanılgılarını giderebilmek adına kavram haritası oluşturabilme düzeyleri belirlenmeye çalışılmıştır. Çalışmanın bu ana probleminin yanı sıra iki alt probleme de yanıt aranılmıştır. Bu çalışmanın birinci alt problemini fen öğretmen adaylarının bazı konu

başlıklarındaki mevcut kavram yanılgılarının tespit edilmeye çalışılması; ikinci alt problemini ise, öğretmen adaylarının doğru bir kavram haritası oluşturma düzeylerini belirleme olmuştur.

Araştırmanın desenini "durum çalışması" oluşturmaktadır. Durum çalışması bir ya da daha fazla olayın, ortamın, grubun veya birbirine bağlı sistemlerin derinlemesine incelendiği sistem olarak tanımlanabilmektedir (McMillan, 2000; Akt. Büyüköztürk, Kılıç Çakmak, Akgün, Karadeniz ve Demirel, 2009). Çalışmadan elde edilen veriler içerik analizi ile değerlendirilmiştir. İçerik analizinde temalar ve kodlamalarla var olan durumun analizi detaylı olarak gerçekleştirilebilmekte, böylece elde edilen ham veriler daha derinlemesine incelenebilmektedir.

Bulgular

Çalışmadan elde edilen veriler **"***Öğretmen adaylarının mevcut kavramlar ile ilgili yanılgıları", "Seçilen kavramların sayısal dağılımı", Öğretmen adaylarından elde edilen verilerin içerik analizi* "olmak üzere 3 tablo halinde sunulmuştur.

Tablo1. Öğretmen adaylarının mevcut kavramlar ile ilgili yanılgıları

	Var (f)	Yok (f)	Kısmen (f)
Toplam kavram yanılgısı	10	18	11
Isı-sıcaklık	3	34	3
Canlı-cansız	1	37	2
Aşı-serum	4	34	2
Kütle-ağırlık	2	34	4

Tablo1'de de görüldüğü üzere, öğretmen adaylarının genel olarak mevcut kavramlar ile ilgili yanılgıları bulunmamış; ancak kısmen oranın yüksekliği de dikkat çekmiştir. Kavramsal olarak bakıldığında ise, canlı-cansız kavramlarındaki yanılgının diğer kavramlara göre daha az olduğu da görülmüştür..

Tablo2. Seçilen kavramların sayısal dağılımı

Isı-sıcaklık (f)	Canlı-cansız (f)	Aşı-serum (f)	Kütle-ağırlık (f)
10	10	10	10

Tablo2'de de görüldüğü üzere seçilen kavramlara göre öğretmen adayları aynı sayıda seçilmeye çalışılmıştır.

tablo3. öğretmen adaylarından elde edilen verilerin içerik analizi

	Yeterli (f)	Yetersiz (f)	K.yeterli (f)
Kavram h. doğruluğu	6	14	20
Doğru çapraz bağlantı varlığı	8	22	10
Yönergelerin bilimsel doğruluğu	16	10	14
Kullanılan kavramların bilimsel doğruluğu	12	5	23
Kavram haritasının yanılgıyı düzeltme yetisi	7	16	17

Tablo3'de de görüldüğü üzere, öğretmen adaylarının kavram haritaları kısmen yeterli, doğru çapraz bağlantıların sayısı yetersiz, yönergelerin bilimsel doğruluğu genel olarak yeterli, kullanılan kavramların bilimsel doğruluğu kısmen yeterli bulunurken; kavram haritalarının yanılgıyı düzeltme yetisi ise kısmen yeterli ve yetersiz kategorilerinde kalmıştır.

Sonuç

Kavram yanılgıları eğitim bilimlerinde belki de çok karşılaşılan problemlerin başında gelmektedir. Kavram yanılgılarının oluşturulmaması oldukça önemlidir. Oluşan kavram yanılgılarının giderilmesinde ise oldukça iyi düşünülmüş ve planlanmış bir öğretim süreci oluşturulması gerekmektedir. Zira bu kavram yanılgısı küçük yaşlarda oluşmuş ise, giderilmesi oldukça emek isteyen bir süreci kapsamaktadır.

Özellikle de fen bilimlerinde çok yaygın olan kavram yanılgıları ne yazık ki öğrenimi oldukça etkileyebilmektedir. Nitekim Ecevit ve Özdemir Şimşek (2017) yapmış oldukları çalışmada fen ve sınıf öğretmenlerinin özellikle ısı-sıcaklık, kütle-ağırlık, kuvvet-hareket, elektrik, ışık-ses, madde, hücre, solunum-fotosentez, kalıtım konuları ile ilgili kavram yanılgılarına rastladıklarını belirtmişlerdir. Benzer olarak bu çalışmada da araştırmacılar tarafından ısı-sıcaklık, kütle-ağırlık, aşı-serum ve canlı-cansız kavramları seçilerek öğretmen adaylarına sunulmuştur. Çalışmada bu kavramalarla ilgili mevcut bir yanılgı saptanmamış; ancak aşı-serum, ısı-sıcaklık ve kütle-ağırlık kavramlarında daha çok kavram yanılgısının olduğu da tespit edilmiştir.

Kavram yanılgıları ile ilgili olarak alanyazında çok sayıda literatür bulunmaktadır (Akbulut Taş, 2017; Bingül ve Çavaş, 2016; Arı, Peşman ve Baykara, 2017). Aydoğan ve Köksal (2017) yapmış oldukları çalışmada; 2000-2014 yılları arasında yapılan çok sayıda bilimsel makaleyi, kavram yanılgısını gidermede kullanılan yöntem ve teknik bakımından irdelemişler ve bu yanılgıyı gidermede en çok kavram karikatüründen faydalanıldığını tespit etmişlerdir. Görsel yöntemlerin kullanılmasının kavram yanılgılarının giderilmesinde oldukça önemli olduğu düşünülmektedir. Kavram yanılgılarını gidermede pek çok yöntem kullanıldığı literatürde görülebilmektedir. Kavram yanılgılarını gidermek adına kullanılabilecek yöntemlerden biri de kavram haritalarıdır. Nitekim Yavuz ve Büyükekşi'nin (2015) yapmış olduğu çalışmada öğrencilerden tepkime hızı ile ilgili kavram haritası çizmeleri istenerek; orta ve alt düzey kavrayan öğrencilerde, sıcaklığın tepkime hızına etkisi üzerinde kavram yanılgıları olduğu tespit edilmiştir. Yapılan bu çalışmada da kavram haritalarının doğruluğu, doğru çapraz bağlantıların varlığı ve yanılgıyı düzeltme yetisinin yeterli-yetersiz düzeylerinde orta seviyede kaldıkları görülürken; kullanılan kavramların ve yönergelerin bilimsel doğruluğu yeterli olarak tespit edilmiştir. Söz konusu bu durumda kavram haritasının doğru yapılandırılmasındaki eksikliğin yanılgıları gidermede de etkili olmuş olabileceği söylenebilmektedir.

Kavram haritaları eğitim ve fen bilimleri alanyazınında oldukça çalışılan başarılı bir yöntem olarak karşımıza çıkmaktadır (Turan Oluk, Kan ve Ekmekçi, 2016; Çetin, Güler ve Sarıca, 2016; Çakmak, Oral, Özaltaş, Kaplan, 2016; Çömek, Akınoğlu, Elmacı, Gündoğdu, 2016). Özellikle kavram yanılgılarının giderilmesinde tam olarak yanılgının nerede olduğunu saptayabilme bakımından kavram haritaları çalışmalarının önemli olduğu düşünülmektedir. Bu sebepledir ki, gerek kavram yanılgılarının tespiti, gerek giderilmesi adına görsel yöntemlerden bir olan kavram haritaları gibi yöntemler ile ilgili daha fazla sayıda çalışma yapılmasının önemli olduğu düşünülmektedir.

Kaynaklar

Akbulut Taş, M. (2017). Türkiye'deki kavram yanılgıları ile ilgili araştırmaların kavramın içerik ögeleri açısından incelenmesi. *Eğitimde Kuram ve Uygulama Journal of Theory and Practice in Education, 13(1), 111-143*

Arı, Ü., Peşman, H. & Baykara, O. (2017). Sorgulamaya dayalı öğretimde rehberlik düzeyinin fen bilimleri öğretmen adaylarının kavram yanılgılarını iyileştirmedeki etkisinin bilimsel süreç becerileriyle etkileşimi. *Bartın Üniversitesi Eğitim Fakültesi Dergisi, 6*(1), 304-321.

Aydoğan, Ş. & Köksal, E. A. (2017). İlköğretim fen eğitiminde kavram yanılgıları konusunda yapılan çalışmaların içerik analizi. *Eğitimde Kuram ve Uygulama Journal of Theory and Practice in Education,13(2), 232-260.*

Bingül, D. & Çavaş, B. (2016). Fen bilgisi öğretmen adaylarının deprem konusundaki kavram yanılgıları üzerine bir araştırma. *Internatıonal Congress On New Trends In Hıgher Educatıon: Keepıng Up Wıth The Change,* 12-13 Nisan, İstanbul.

Büyüköztürk, Ş., Kılıç Çakmak, E., Akgün, Ö. E., Karadeniz, Ş. & Demirel, F. (2008). Bilimsel araştırma yöntemleri. Ankara: Pegem Akademi.

Çakmak, M., Oral, B., Özaltaş, G. & Kaplan, H. (2016). Fen ve teknoloji öğretiminde kavram haritaları ile not tutmanın öğrencilerin akademik başarısına etkisi. *Elektronik Eğitim Bilimleri Dergisi, 1*(1), 87-98.

Çalık, M. & Ayas, A. (2003). Çözeltilerde kavram başarı testi hazırlama ve uygulama. *Pamukkale Üniversitesi Eğitim Fakültesi Dergisi, (2)*14, 1-17.

Çetin, B., Güler, N. & Sarıca, R. (2016). Using generalizability theory to examine different concept map scoring methods. *Eurasian Journal of Educational Research,* 66, 211-228.

Çömek, A., Akınoğlu, O., Elmacı, E. & Gündoğdu, T. (2016) Fen eğitiminde kavram haritaları kullanımının akademik başarı ve tutuma etkisi. *International Journal of Human Sciences, 13*(1), 348-363.

Duit, R., & Treagust, D. F.(2003). Conceptual change: A powerful framework for improving science teaching and learning. *International Journal of Science Education, 25*(6), 671–688.

Ecevit, T. & Özdemir Şimşek, P.(2017). Öğretmenlerin fen kavram öğretimleri, kavram yanılgılarını saptama ve giderme çalışmalarının değerlendirilmesi. *Elementary Education Online, 16*(1), 129-150.

Hsu, L. (2004). Developing concept maps from problem-based learning scenario discussions. *Journal of Advanced Nursing,* 48(5), 510-518.

Köse, S. (2007). The effects of concept mapping instruction on overcoming 9 th grade students' misconceptions about diffusion and osmosis. *Journal of Baltic Science Education, 6(*2), 16-25.

Kaptan, F. (1999). Fen Bilgisi Öğretimi. İstanbul: Milli Eğitim Bakanlığı Yayınları.

Kaya, O. N. (2003). Fen eğitiminde Kavram haritaları. *Pamukkale Üniversitesi Eğitim Fakültesi Dergisi*, 1(13), 70-79.

Palmer, D.H. (1999). Exploring the between students' scientific and nonscientific conceptions. *Science Education*, *83*,639-653.

Tekkaya, C. (2003). Remediating high school students' misconceptions concerning diffusion and osmosis through concept mapping and conceptual change text. *Research in Science & Technological Education, 21*(1), 5-16.

Tennyson, R. D., Woolley, F.R., & Merrill, M. D. (1972). Exemplar and non-exemplar variables which produce correct concept classification behavior and specified classification errors. *Journal of Educational Psychology, 63*, 144-152.

Turan Oluk, N. Kan, A. & Ekmekçi, G. (2016). Kavram haritası yöntemine yönelik tutum ölçeğinin geliştirilmesi: Geçerlik ve güvenirlik çalışması. *Ahi Evran Üniversitesi Kırşehir Eğitim Fakültesi Dergisi (KEFAD), (17)*1, 95-110

Ünal, S. (2008). Changing students' misconceptions of floating and sinking using hands-on activities**.** *Journal of Baltic Science Education, 7*(3),I34-146.

Yağbasan, R. & Gülçiçek, Ç. (2003). Fen öğretiminde kavram yanılgılarının karakteristiklerinin tanımlanması. *Pamukkale Üniversitesi Eğitim Fakültesi Dergisi*, *13*, 102-120.

Yavuz, S. & Büyükekşi, C. (2015). Tepkime hızı konusundaki öğrenci kavram haritalarının değerlendirilmesi. *Karaelmas Journal of Educational Sciences, (3),*126-132.

Yürük, N., Çakır, O.S. & Geban, O. (2000). *Kavramsal değişim yaklaşımının hücresel solunum konusunda lise öğrencilerinin biyoloji dersine karsı tutumlarına etkisi*. 4. Fen Bilimleri Eğitimi Kongresi, Ankara.

A STUDY ON THE RELATIONSHIP BETWEEN VOCATIONAL HIGH SCHOOL STUDENTS' PROBLEM-SOLVING SKILLS AND THEIR ATTITUDES TOWARDS COMPUTER PROGRAMMING

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Abstract: A problem is generally a mental imbalance that is created by a conflict situation in which an individual encounters a barrier while they are trying to reach a goal. People meet numerous problematic situations in their daily lives and to be able to overcome these problems, they normally seek solutions in a simple way by implementing the rules which they learned through their past experiences. However, problem solving involves not only mental skills but also certain attitudes and values. Therefore, the problem solving process is one that requires extensive learning and development of some information and skills. Computer programming skills, too, involve at the bottom line the problem solving processes. The purpose of this study is to investigate the relationship between the problem solving skills of the 10^{th}, 11^{th} and 12^{th} grade students attending vocational high schools and their attitudes towards computer programming. The relational survey model was used as the research method. The working group of the study was determined on a voluntary basis from among students attending 3 different vocational high schools located in a province in central Turkey. "The Problem Solving Inventory", which was composed of 24 items and 3 factors, and "The Scale for Attitude towards Computer Programming", which consisted of 38 items and 4 factors, were used to collect the research data. The research data have now been collected and the students' problem solving skills and their attitudes towards computer programming will be compared and contrasted in terms of various demographic variables and the relationship between their problem solving skills and attitudes towards computer programming was investigated. Suggestions was made on the basis of the findings obtained from the study.

Keywords: Problem solving skills, attitude towards computer programming, relational survey

MESLEK LİSESİ ÖĞRENCİLERİNİN PROBLEM ÇÖZME BECERİLERİ İLE BİLGİSAYAR PROGRAMLAMAYA KARŞI TUTUMLARI ARASINDAKİ İLİŞKİNİN İNCELENMESİ

Özet: Problem genel olarak, bireyin bir hedefe ulaşmada engelleme ile karşılaştığı bir çatışma durumunun oluşturduğu zihinsel dengesizliktir. İnsanlar günlük yaşamlarında birçok problem durumuyla karşılaşmakta ve bu problemlerin üstesinden gelebilmek için genellikle önceki yaşantıları sayesinde öğrenmiş oldukları kuralları basit biçimde uygulayarak çözüm yolları aramaktadırlar. Ancak, problem çözme sadece zihinsel becerileri değil, aynı zamanda belli tutum ve değerleri de içermektedir. Bu yüzden, problem çözme süreci bir takım bilgi ve becerilerin kapsamlı bir şekilde öğrenilmesini ve geliştirilmesini gerektiren bir süreçtir. Bilgisayar programlama becerilerinin temelinde de problem çözme süreçleri yatmaktadır. Bu çalışmanın amacı; meslek lisesinde öğrenim gören 10, 11, ve 12. sınıf öğrencilerinin problem çözme becerileri ile programlamaya karşı tutumları arasındaki ilişkinin incelenmesidir. Araştırma yöntemi olarak ilişkisel tarama modeli kullanılmıştır. Araştırmanın çalışma grubu, Türkiye'nin orta kesimlerinde bulunan bir ildeki 3 farklı meslek lisesinde öğrenim gören öğrencilerden gönüllülük esasına göre belirlenmiştir. Araştırmanın verilerini toplamak için 24 madde ve 3 faktörden oluşan "Problem Çözme Envanteri" ile 38 madde ve 4 faktörden oluşan "Bilgisayar Programlamaya Karşı Tutum Ölçeği" kullanılmıştır. Araştırmaya yönelik veriler toplanmış olup öğrencilerin problem çözme becerileri ve bilgisayar programlamaya karşı tutumları çeşitli demografik değişkenler açısından karşılaştırılarak problem çözme becerileri ile programlamaya karşı tutumları arasındaki ilişkiler araştırılmıştır. Araştırma sonucundan elde edilen bulgulardan yola çıkılarak önerilerde bulunulmuştur.

Anahtar Kelimeler: Problem çözme becerisi, bilgisayar programlamaya karşı tutum, ilişkisel tarama

Giriş

Problem çözme, belirlenen hedefe varabilmek amacıyla etkili ve faydalı olan araç ve davranışları seçebilme ve kullanabilme yolu şeklinde açıklanabilir (Otacıoğlu, 2008). Problem çözme; bireyin ihtiyaçları, hedefleri, değer yargıları, becerileri ve tutumları ile ilgilidir ve bununla birlikte yaratıcı düşüncesini, zekâsını, duygularını, iradesini bütünleştirmesinin bir sonucu olması nedeniyle de çok yönlü bir kavramdır (Kaptan ve Korkmaz, 2002).

Başka bir deyişle problem çözme becerisi, günlük hayatta bireyin karşılaştığı karmaşık problemlerin çözümünde kullandığı becerileri ifade etmekte olup (Zadnik ve Loss, 1995), bireyin önceki yaşantılarından bugüne değin günlük hayatta karşılaştığı problemlerle baş edebilmek amacıyla kullandığı çözüme dönük eylemlerinin birikiminden ve bu yaşantıları algılama biçiminden oluşmaktadır (Ittenbach ve Harrison, 1990). Problem çözme süreci ise; algılanan ve betimlenen problem hakkında bilgi toplama, çözüme dönük isteklilik ve engellerin ne olduğunun saptanması gibi davranışların birleşiminden oluşmaktadır (Davidson, Deuser ve Sternberg, 1994). Problem çözme sürecinde birey, en akılcı çözümün ne olduğu ve nasıl uygulanması gerektiği hakkında seçim yapmak zorundadır.

Problem Çözme Tekniği (Descartes'e göre):
"

- Doğruluğu kesin olarak kanıtlanmadıkça, hiçbir şeyi doğru olarak kabul etmeyin; tahmin ve ön yargılardan kaçının.
- Karşılaştığınız her güçlüğü mümkün olduğu kadar çok parçaya bölün.
- Düzenli bir biçimde düşünün; anlaşılması en kolay olan şeylerle başlayıp yavaş yavaş daha zor ve karmaşık olanlara doğru ilerleyin.
- Olaya bakışınız çok genel, hazırladığınız ayrıntılı liste ise hiçbir şeyi dışarıda bırakmayacak kadar kusursuz ve eksiksiz olsun."

Problem çözme sırası ise;
"

1. Problemi anlama (Understanding, Analyzing),
2. Bir çözüm yolu geliştirme (Designing)
3. Algoritma ve program yazma (Writing),
4. Tekrar tekrar test etme (Reviewing)" şeklinde ifade edilmektedir (Arslan, 2013).

Farklı bir perspektifle problem çözme aşamalarını ortaya koyan J. Dewey'e göre ise, düşünmenin temelinde engel, karmaşıklık ve şüphe bulunmakta, bunlar bireyi düşünmeye sevk etmektedir. "Dewey'in problem çözme yaklaşımına dayalı olarak Bingham tarafından belirlenmiş olan problem çözme aşamaları şunlardır:

1. Problemin farkında olmak ve onunla uğraşma isteği duymak.
2. Problemi açıklamak, ilgili olduğu alanı tanımak ve ilgili olduğu problemler grubunu anlamaya çalışmak.
3. Problemle ilgili bilgiler toplamak, problemin çözümüne uygun düşecek bilgiler seçmek ve düzenlemek.
4. Toplanan bilgiler ışığında muhtemel çözüm yolları belirlemek.
5. Çözüm yollarını değerlendirerek en iyisini seçmek.
6. Seçilen çözüm yolunu uygulamak.
7. Kullanılan çözüm yolunu değerlendirmek. " (Fidan, 1985).

Günümüzde problem çözme işlemlerinin birçoğu, programlar aracılığıyla bilgisayarlara yaptırılmaktadır. Özellikle kayıt tutma, arama, değişiklik yapma, raporlama ve istatistik oluşturma (İraz, 1999), otomasyona girilen bilgilere göre soruları otomatik cevaplama ve yönlendirme işlemleri, uzman bilgisayar sistemleri, bu uygulamaları gerçekleştirebilmek için özel tasarlanmış bilgisayar programları ile yapılmaktadır (Elibol, 2005). Gelişmiş bilgisayar programlarına olan ihtiyaçlar da bu çerçevede gün geçtikçe artmaktadır (MEB, 2011). Mobil teknolojilerin kullanımının hızla yaygınlaşması da mobil cihazlar üzerinde çalışabilecek programların ve uygulamaların geliştirilmesini hızlandırmıştır.

Öte yandan, bilgisayar programlama becerilerinin kazandırılmasına yönelik eğitim-öğretim tasarımı çalışmaları da, öğrenicileri merkeze alan bir yapı üzerinde yoğunlaşmaktadır. Klasik öğretim yöntemleri yerini modüler ve öğrenci merkezli yapılandırmacı yaklaşımlara bırakmıştır (MEB, 2011; MEB, 2016).

Gelişmiş ve beklentilere cevap verebilen bilgisayar programlarının yazılabilmesi, programlama becerilerine sahip, problem çözme ve bilgisayar kullanabilme kabiliyetleri yüksek, nitelikli programcılarla mümkün olacaktır. Programlama becerisi özellikle bilgisayar alanları eğitimi için mühimdir. Ne var ki son yıllarda bilgisayar alanında eğitim alan öğrenci sayısında düşüş gözlenmektedir (Başer, 2013a; Heersink ve Moskal, 2010).

Yapılan bazı çalışmalarda çeşitli araştırmacılar, üniversite öğrencilerinin programlamaya karşı tutumlarının genellikle olumlu olduğu sonucuna (Anastasiadou ve Karakos, 2011) ve öğrencilerin programlamayı öğrenmenin gerekliliğine yüksek düzeyde inandıkları ancak öğrenmeye orta seviyede istekli oldukları sonucuna ulaşmışlardır (Korkmaz ve Altun, 2013). Türkiye'de meslek liselerinde Bilişim Teknolojileri Alanı bulunan okullarda programlama dersleri verilmektedir (MEB, 2011). Bu çalışmada problem çözme becerileri ile bilgisayar programlamaya karşı tutum arasındaki ilişki hakkında genel çerçevede bir sonuca ulaşabilmek için, meslek lisesi bilişim teknolojileri alanı 10, 11, 12. sınıf öğrencileri üzerinde anket uygulaması yapılmıştır. Araştırma sonuçlarının öğrencilerin problem çözme becerileri ile bilgisayar programlamaya karşı tutumları arasındaki ilişki hakkında katkı vereceği düşünülmektedir.

Araştırmanın Amacı

Bu araştırmanın genel amacı, meslek lisesi bilişim teknolojileri alanı 10, 11, 12. sınıf öğrencilerinin problem çözme becerileri ile bilgisayar programlamaya karşı tutumları arasındaki ilişkiyi incelemektir. Bu çerçevede aşağıdaki soruların yanıtları aranmıştır.

1. Öğrencilerin problem çözme becerileri ile bilgisayar programlamaya karşı tutumları arasında bir ilişki var mıdır?
2. Öğrencilerin problem çözme becerileri ile bilgisayar programlamaya karşı tutumları
    a. Cinsiyet
    b. Bilgisayar sahipliği
    c. Akademik başarı
    d. Günlük bilgisayar kullanım süresi

    değişkenlerine göre farklılık göstermekte midir?

Yöntem

Araştırma Modeli

Bu araştırmada "ilişkisel tarama modeli" kullanılmıştır. Genel tarama modelleri, 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 düzenlemeleridir. İlişkisel tarama ise iki ve daha çok sayıda değişken arasında birlikte değişim varlığını ve/veya derecesini belirlemeyi amaçlayan araştırma modelleridir. İlişkisel çözümleme, korelasyon türü ilişkiler veya karşılaştırma yolu ile elde edilen ilişkilerdir (Karasar, 2006).

Çalışma Grubu

Araştırma, 2016-2017 Eğitim Öğretim Yılında Konya ili Ereğli ilçesi merkezinde bulunan ve bünyesinde Bilişim Teknolojileri Alanı olan 3 tane meslek lisesinde yürütülmüştür. Araştırmaya Bilişim Teknolojileri Alanında öğrenim gören toplam 209 öğrenci katılmıştır. Çalışma grubu istatistikî bilgileri Tablo 1'de verilmiştir.

Tablo 1. Çalışma grubundaki öğrencilerin demografik özellikleri

Öğrenci Özellikleri	Seçenek	f	%
Cinsiyet	Kız	82	39,2
	Erkek	127	60,8
Bilgisayar Sahipliği	Var	148	70,8
	Yok	61	29,2
Akademik Başarı	Düşük (0-60)	72	34,4
	Orta (60-70)	95	45,5
	Yüksek (70-100)	42	20,1
Günlük Bilgisayar Kullanım Süresi	0-2 saat arası	85	40,7
	2-4 saat arası	64	30,6
	4-6 saat arası	41	19,6
	6-10 saat arası	19	9,1

Tablo 1'de görüleceği üzere, çalışmaya katılan öğrencilerden %39,2'sinin (82 öğrenci) kız, %60,8'inin (127 öğrenci) erkek olduğu tespit edilmiştir. Öğrencilerin 148'i (%70,8) bilgisayara sahipken, 61'inin (%29,2) bilgisayarının olmadığı görülmüştür. Akademik başarı dağılımında ise; 72 öğrenci düşük (0-60 arası), 95 öğrenci orta (60-70 arası), 42 öğrenci yüksek 70-100 arası) ortalamaya sahip olduğu görülmektedir. Öğrencilerin günlük bilgisayar kullanım sürelerine bakıldığında ise, %40,7'sinin (85 kişi) 0-2 saat arası, %30,6'sının (64 kişi) 2-4 saat arası, %19,6'sının (41 kişi) 4-6 saat arası ve %9,1'inin de (19 kişi) 6-10 saat arası bilgisayar kullandığı görülmektedir.

Veri Toplama Araçları

Kişisel Bilgi Formu

Araştırma kapsamında öğrencilerin cinsiyet, bilgisayar sahipliği, akademik başarı ve günlük bilgisayar kullanım süresi gibi demografik özelliklerini belirlemek için araştırmacılar tarafından geliştirilen kişisel bilgi formu kullanılmıştır. Kişisel bilgi formunda demografik değişkenlerle ilgili kapalı uçlu sorular sorulmuş ve araştırmaya katılan öğrencilerden kendilerine uygun seçeneği işaretlemeleri istenmiştir.

Çocuklar için Problem Çözme Envanteri

Öğrencilerin problem çözme ile ilgili tutumlarını belirlemek için; Serin, Bulut Serin ve Saygılı (2010) tarafından geliştirilen "Çocuklar için Problem Çözme Envanteri" (PÇE) kullanılmıştır. Ölçek; "Problem Çözme Becerisine Güven" (12 madde), "Öz Denetim" (7 madde) ve "Kaçınma" (5 madde) olmak üzere toplam 3 faktör ve 24 maddeden oluşmaktadır. Ölçeğin seçenekleri ise "hiçbir zaman böyle davranmam" (1) ve "her zaman böyle davranırım" (5) aralığında verilmiştir. Alınabilecek en düşük toplam puan 24, en yüksek toplam puan 120'dir. Serin, Bulut Serin ve Saygılı (2010) tarafından bulunan ölçek alt faktörlerinin Cronbach alfa değerleri Tablo 2'deki şekilde verilmiştir. Ölçeğin tamamının Cronbach-alfa güvenirlilik katsayısı 0,80 olarak bulunmuştur.

Tablo 2. Çocuklar için problem çözme envanteri ölçek alt faktörlerinin ve ölçeğin toplamının cronbach alfa değerleri

	Problem Çözme Becerisine Güven	**Öz Denetim**	**Kaçınma**	**Toplam**
Cronbach Alfa	0,85	0,78	0,66	0,80

Bilgisayar Programlamaya Karşı Tutum Ölçeği

Öğrencilerin bilgisayar programlamaya karşı tutumlarını belirlemek için Başer (2013b) tarafından geliştirilen "Bilgisayar Programlamaya Karşı Tutum Ölçeği" (PTO) kullanılmıştır. Ölçek; 38 maddeden ve (1) Tamamen Katılmıyorum, (2) Katılmıyorum, (3) Kararsızım, (4) Katılıyorum, (5) Tamamen Katılıyorum şeklinde seçeneklerden oluşan 5'li Likert tipinde bir ölçektir. Ölçeğin; "Programlamada kendine güven ve güdülenme" (17 madde), "Programlamanın faydası" (10 madde), "Programlamada başarıya karşı tutum" (8 madde) ve "Programlamada başarının sosyal algısı" (3 madde) olmak üzere 4 alt kategorisi bulunmaktadır. Ölçekten alınabilecek minimum puan 38, maksimum puan ise 190'dır. Başer (2013b) tarafından bulunan ölçek alt faktörlerinin Cronbach alfa değerleri Tablo 3'teki şekilde verilmiştir. Ölçeğin tamamının Cronbach-alfa güvenirlilik katsayısı 0,95 olarak bulunmuştur.

Tablo 3. Bilgisayar programlamaya karşı tutum ölçeği alt faktörlerinin ve ölçeğin toplamının cronbach alfa değerleri

	Programlamada kendine güven ve güdülenme	**Programlamanın faydası**	**Programlamada başarıya karşı tutum**	**Programlamada başarının sosyal algısı**	**Toplam**
Cronbach Alfa	0,94	0,92	0,93	0,62	0,95

Verilerin Analizi

Toplanan veriler SPSS 21.00 paket programı ile analiz edilmiştir. Sonuçlar yorumlanırken 0,05 anlamlılık düzeyi ölçütü dikkate alınmıştır. Araştırma kapsamında toplanan verilerin analizinde betimsel istatistikler, korelasyon analizi, ikili gruplar arasındaki farkları belirlemek için bağımsız örneklem T-testi, ikiden fazla gruplar arasındaki farkları belirlemek için de ANOVA analizi kullanılmıştır.

Bulgular

Problem Çözme Becerileri ile Bilgisayar Programlamaya Karşı Tutumları Arasındaki İlişki

Öğrencilerin problem çözme becerileri ile bilgisayar programlamaya karşı tutumları arasındaki ilişkiyi analiz edebilmek amacıyla Pearson Momentler Çarpım Korelâsyonu kullanılmış olup analiz sonucu elde edilen değerler Tablo 4'te gösterilmiştir.

Tablo 4. Problem çözme becerileri ile bilgisayar programlamaya karşı tutumları arasındaki ilişki

Ölçek	1-PÇE problem çözme becerisine güven	2-PÇE öz denetim	3-PÇE kaçınma	4-PTO programlamada kendine güven ve güdülenme	5-PTO programlamanın faydası	6-PTO programlamada başarıya karşı tutum	7-PTO programlamada başarının sosyal algısı
1	-						
2	-0,126	-					
3	0,051	,513**	-				
4	,201**	-0,07	0,075	-			
5	0,124	0,115	,152*	,382**	-		
6	,233**	-0,048	,142*	,469**	,275**	-	
7	-,201**	0,087	0,085	0,097	,218**	0,051	-

**. Korelasyon 0.01 düzeyinde anlamlıdır (2-tailed)
*. Korelasyon 0.05 düzeyinde anlamlıdır (2-tailed)

Programlamaya karşı tutum ölçeğinin "Programlamada kendine güven ve güdülenme" alt boyutunun çocuklar için problem çözme envanterindeki "Problem Çözme Becerisine Güven" (r=,201; p<0,01) alt boyutu ile, PTO "Programlamanın faydası" alt boyutunun PÇE "Kaçınma" (r=,152; p<0,05) alt boyutu ile, PTO "Programlamada başarıya karşı tutum" alt boyutunun PÇE "Problem Çözme Becerisine Güven" (r=,233; p<0,01) ve PÇE "Kaçınma" (r=,142; p<0,05) alt boyutları ile pozitif yönde anlamlı bir ilişki gösterdiği bulunmuştur. Bu sonuçlar bize PTO "programlamada başarıya karşı tutum" ve PÇE "problem çözme becerisine güven" arasında doğru orantılı bir bağ olduğunu göstermiştir. Öte yandan PTO "programlamada başarının sosyal algısı" alt boyutu ile PÇE "problem çözme becerisine güven" (r=-,201; p<0,01) alt boyutu arasında negatif yönde anlamlı bir ilişki görülmüş olup, PTO "programlamada başarının sosyal algısı" ve PÇE "problem çözme becerisine güven" arasında da ters orantılı bir bağ olduğu ortaya çıkarılmıştır.

Cinsiyet Açısından Problem Çözme Becerileri ile Bilgisayar Programlamaya Karşı Tutumlar

Öğrencilerin problem çözme becerileri ve bilgisayar programlamaya karşı tutumlarının cinsiyet açısından farklılaşma durumları bağımsız örneklem t-testi ile analiz edilmiştir. Analiz sonuçları Tablo 5'te verilmiştir.

Tablo 5. Cinsiyet açısından problem çözme becerileri ile bilgisayar programlamaya karşı tutumlar

Ölçek	Alt Boyut	Cinsiyet	f	$\bar{X}$	SS	t	p
Problem Çözme Envanteri	PÇE problem çözme becerisine güven	Kız	82	3,55	,911	,201	,841
		Erkek	127	3,53	,756		
	PÇE öz denetim	Kız	82	2,75	1,050	-1,091	,276
		Erkek	127	2,90	,962		
	PÇE kaçınma	Kız	82	3,56	1,133	,534	,594
		Erkek	127	3,48	1,020		
Programlamaya Karşı Tutum Ölçeği	PTO programlamada kendine güven ve güdülenme	Kız	82	3,03	,517	,010	,992
		Erkek	127	3,03	,447		
	PTO programlamanın faydası	Kız	82	3,07	,530	,545	,586
		Erkek	127	3,03	,584		
	PTO programlamada başarıya karşı tutum	Kız	82	3,59	,679	,661	,510
		Erkek	127	3,53	,702		
	PTO programlamada başarının sosyal algısı	Kız	82	2,29	1,181	-,949	,344
		Erkek	127	2,44	1,101		

Tablodaki değerler incelendiğinde, kız ve erkek öğrencilerin Problem Çözme Becerileri ile Bilgisayar Programlamaya Karşı Tutumlarında cinsiyet açısından anlamlı bir farklılığın olmadığı (p>0,05) görülmüştür.

Bilgisayar Sahipliği Açısından Problem Çözme Becerileri ile Bilgisayar Programlamaya Karşı Tutumlar

Öğrencilerin problem çözme becerileri ve bilgisayar programlamaya karşı tutumlarının bilgisayar sahipliği açısından farklılaşma durumları bağımsız örneklem t-testi ile analiz edilmiştir. Analiz sonuçları Tablo 6'da verilmiştir.

Tablo 6. Bilgisayar sahipliğine göre problem çözme becerileri ile bilgisayar programlamaya karşı tutumlar

Ölçek	Alt Boyut	Bilgisayar	f	$\bar{X}$	SS	t	p
Problem Çözme Envanteri	PÇE problem çözme becerisine güven	Var	148	3,68	,786	**3,987**	**<,000**
		Yok	61	3,20	,801		
	PÇE öz denetim	Var	148	2,86	,987	,400	,689
		Yok	61	2,80	1,033		
	PÇE kaçınma	Var	148	3,57	1,092	1,236	,218
		Yok	61	3,37	,985		
Programlamaya Karşı Tutum Ölçeği	PTO programlamada kendine güven ve güdülenme	Var	148	3,02	,473	-,384	,701
		Yok	61	3,05	,482		
	PTO programlamanın faydası	Var	148	3,07	,534	1,117	,265
		Yok	61	2,98	,625		
	PTO programlamada başarıya karşı tutum	Var	148	3,57	,674	,587	,558
		Yok	61	3,51	,739		
	PTO programlamada başarının sosyal algısı	Var	148	2,41	1,119	,525	,600
		Yok	61	2,32	1,171		

Tablodaki değerlerden de görüldüğü gibi, problem çözme envanterinin "problem çözme becerisine güven" alt boyutundan alınan puanlarda bilgisayar sahipliği açısından anlamlı bir farklılık vardır ($t=3,987$; $p<0,05$). Bu değer bilgisayarı olan öğrencilerin ($\bar{X}=3,68$) bilgisayarı olmayan öğrencilere ($\bar{X}=3,20$) göre problem çözme becerisine güvenlerinin daha fazla olduğunu göstermektedir. Diğer taraftan, problem çözme envanterinin "problem çözme becerisine güven" alt boyutu dışındaki hiçbir boyutunda ve programlamaya karşı tutum ölçeğinin hiçbir alt boyutunda bilgisayar sahipliği açısından anlamlı bir fark olmadığı ($p>0,05$) görülmüştür.

Akademik Başarı Açısından Problem Çözme Becerileri ile Bilgisayar Programlamaya Karşı Tutumlar

Öğrencilerin problem çözme becerileri ve bilgisayar programlamaya karşı tutumlarının akademik başarı açısından farklılaşma durumları varyans analizi (F-testi) ile analiz edilmiştir. Analiz sonuçları Tablo 7'de verilmiştir.

Tablo 7. Akademik başarı açısından problem çözme becerileri ile bilgisayar programlamaya karşı tutumlar

Ölçek	Alt Boyut	Akademik Başarı	f	$\bar{X}$	SS	F	P	Fark (Scheffe)
Problem Çözme Envanteri	PÇE problem çözme becerisine güven	Düşük	72	3,40	,775	1,735	,179	
		Orta	95	3,63	,795			
		Yüksek	42	3,57	,923			
	PÇE öz denetim	Düşük	72	2,92	1,038	1,371	,256	
		Orta	95	2,72	1,012			
		Yüksek	42	2,97	,88			
	PÇE kaçınma	Düşük	72	3,27	1,004	2,840	,061	
		Orta	95	3,64	1,051			
		Yüksek	42	3,64	1,144			

Tablo 7.'nin devamı

Ölçek	Alt Boyut	Akademik Başarı	f	$\bar{X}$	SS	F	P	Fark (Scheffe)
Programlamaya Karşı Tutum Ölçeği	PTO programlamada kendine güven ve güdülenme	Düşük	72	3,00	,509	,459	,632	
		Orta	95	3,02	,432			
		Yüksek	42	3,09	,509			
	PTO programlamanın faydası	Düşük	72	3,01	,584	,296	,744	
		Orta	95	3,07	,543			
		Yüksek	42	3,03	,578			

	PTO programlamada başarıya karşı tutum	Düşük	72	3,43	,686	1,868	,157
		Orta	95	3,64	,729		
		Yüksek	42	3,57	,596		
	PTO programlamada başarının sosyal algısı	Düşük	72	2,46	1,062	,287	,751
		Orta	95	2,33	1,173		
		Yüksek	42	2,35	1,176		

Tablodaki sonuçlara göre akademik başarıları açısından öğrencilerin problem çözme becerileri ile bilgisayar programlamaya karşı tutumları arasında anlamlı bir fark olmadığı görülmektedir.

Günlük Bilgisayar Kullanım Süresi Açısından Problem Çözme Becerileri ile Bilgisayar Programlamaya Karşı Tutumlar

Öğrencilerin problem çözme becerileri ve bilgisayar programlamaya karşı tutumlarının günlük bilgisayar kullanım süresi açısından farklılaşma durumları varyans analizi (F-testi) ile analiz edilmiştir. Analiz sonuçları Tablo 8'de verilmiştir.

Tablo 8. Bilgisayar kullanım süresi açısından problem çözme becerileri ile bilgisayar programlamaya karşı tutumlar

Ölçek	Alt Boyut	Bilgisayar Kullanım Süresi (Günlük-Saat)	f	$\bar{X}$	SS	F	P	Fark (Scheffe)
Problem Çözme Envanteri	PÇE problem çözme becerisine güven	0-2 (A)	85	3,40	,761	**5,139**	**,002**	**B>A B>C**
		2-4 (B)	64	3,85	,796			
		4-6 (C)	41	3,50	,809			
		6-10 (D)	19	3,21	,906			
	PÇE öz denetim	0-2 (A)	85	2,83	,900	1,114	,345	
		2-4 (B)	64	2,98	1,092			
		4-6 (C)	41	2,79	1,038			
		6-10 (D)	19	2,52	,990			
	PÇE kaçınma	0-2 (A)	85	3,63	,929	**4,848**	**,003**	**A>D B>D**
		2-4 (B)	64	3,70	,978			
		4-6 (C)	41	3,34	1,194			
		6-10 (D)	19	2,75	1,287			
Programlamaya Karşı Tutum Ölçeği	PTO programlamada kendine güven ve güdülenme	0-2 (A)	85	2,96	,498	**3,246**	**,023**	**C>A**
		2-4 (B)	64	3,01	,461			
		4-6 (C)	41	3,23	,400			
		6-10 (D)	19	2,95	,477			
	PTO programlamanın faydası	0-2 (A)	85	3,07	,590	,264	,851	
		2-4 (B)	64	3,00	,553			
		4-6 (C)	41	3,03	,522			
		6-10 (D)	19	3,11	,582			
	PTO programlamada başarıya karşı tutum	0-2 (A)	85	3,44	,651	2,360	,073	
		2-4 (B)	64	3,69	,768			
		4-6 (C)	41	3,66	,630			
		6-10 (D)	19	3,38	,657			
	PTO programlamada başarının sosyal algısı	0-2 (A)	85	2,53	1,093	1,463	,226	
		2-4 (B)	64	2,36	1,151			
		4-6 (C)	41	2,08	1,247			
		6-10 (D)	19	2,46	,924			

Tabloda problem çözme envanterinin "Problem Çözme Becerisine Güven" alt boyutundan alınan puanlara [$F_{(3,205)}$=5,139; p<0,05] bakıldığında bilgisayar kullanım süreleri açısından anlamlı bir farklılık görülmektedir. Fark çıkmasına sebep olan değişkeni saptamak için Scheffe testi uygulanmıştır. Scheffe testi sonuçlarına göre, Problem çözme envanterinin "problem çözme becerisine güven" alt boyutunda ortaya çıkan farkın günlük bilgisayar kullanım süresi "2-4" saat olan öğrenciler ile "0-2" ve "4-6" saat olan öğrencilerin puanlarından kaynaklandığı görülmüştür.

Programlamaya karşı tutum ölçeğinin "programlamada kendine güven ve güdülenme" alt boyutundan alınan puanlara [$F_{(3,205)}$=3,246; p<0,05] bakıldığında da bilgisayar kullanım süreleri açısından istatistiksel olarak anlamlı bir fark olduğu görülmektedir. Farkı oluşturan temel etkinin hangi değişkenden geldiğini belirlemek için Scheffe testi uygulanmıştır. Scheffe testi sonuçlarına göre, programlamaya karşı tutum ölçeğinin "programlamada kendine güven ve güdülenme" alt boyutunda çıkan farkın günlük bilgisayar kullanım süresi "0-2" saat olan öğrenciler ile "4-6" saat olan öğrencilerin puanlarından kaynaklandığı görülmüştür.

Bu sonuçlara göre günlük bilgisayar kullanım süreleri "4-6" saat olan öğrencilerin diğer öğrencilere göre programlamada kendilerine güven ve güdülenme duygularının daha fazla olduğu; günlük bilgisayar kullanım süreleri "2-4" saat olan öğrencilerin problem çözme becerisine güvenlerinin diğer öğrencilere göre daha fazla olduğu, günlük bilgisayar kullanım süreleri "0-2" saat ve "2-4" saat olan öğrencilerin ise problem çözmede kaçınma davranışlarının günlük bilgisayar kullanım süreleri "6-10" saat olan öğrencilere göre daha fazla olduğu söylenebilir.

Sonuç ve Tartışma

Bu araştırmada meslek lisesi bilişim teknolojileri alanı 10, 11, 12. sınıf öğrencilerinin problem çözme becerileri ile bilgisayar programlamaya karşı tutumları arasındaki ilişkiyi inceleyerek, öğrencilerin problem çözme becerileri ile bilgisayar programlamaya karşı tutumlarında cinsiyet, bilgisayara sahip olma, akademik başarı ve bilgisayar kullanım süreleri açısından farklılık olup olmadığı tespit edilmeye çalışılmıştır.

Araştırma sonucundan elde edilen bulgular, öğrencilerin programlamaya karşı tutumlarının problem çözme becerileri ile bazı noktalarda ilişkili olduğunu ortaya koymaktadır. Örneğin PÇE "problem çözme becerisine güven" alt boyutunun, PTO "programlamada başarıya karşı tutum" ve PTO "programlamada kendine güven ve güdülenme" alt boyutları arasında elde edilen doğru orantılı ilişki, öğrencilerin bilgisayar programlama konusunda kendilerine olan güvenin artmasıyla problem çözmeye karşı daha olumlu bir tutum sergilediklerini göstermektedir. Benzer biçimde programlamaya karşı tutum açısından, başka bir çalışmada araştırmacılar, bilgisayar teknolojileri bölümü, bilgisayar programcılığı öğrencilerinin programlamaya karşı tutumlarının genel manada olumlu olduğu sonucuna ulaşmışlardır (Özyurt ve Özyurt, 2015). Alan yazın taramasında bu sonucun farklı çalışmaların sonuçlarıyla örtüştüğü görülmüştür (Başer, 2013b). Başer (2013b) çalışmasında bilgisayar mühendisliği öğrencilerinin programlamaya karşı olumlu tutuma sahip olduklarını belirtmiştir. PÇE "problem çözme becerisine güven" alt boyutunun, PTO "programlamada başarının sosyal algısı" alt boyutu ile negatif yönlü ilişkisi olduğu görülmüştür. Bu sonuç; problem çözme konusunda kendisine güveni olmayan öğrencilerin programlamada gösterecekleri bir başarı veya başarısızlık durumunda, çevreden etkilendikleri, başarılarının sosyal çevrede kabul görebilmek için gerekli olduğunu düşündükleri şeklinde yorumlanabilir.

Cinsiyet açısından genel algının, kadınların bilgisayar programlamaya karşı tutumlarının erkeklere göre daha olumsuz olduğu yönündedir (Başer, 2013b; Korkmaz ve Altun, 2013; Özyurt ve Özyurt, 2015). Bununla birlikte öğrencilerin problem çözme becerilerinde ve bilgisayar programlamaya karşı tutumlarında cinsiyetleri açısından anlamlı bir farklılığın olmadığı görülmüştür. Yapılan farklı çalışmalarda öğrencilerin cinsiyetleri bakımından programlamaya karşı tutumları karşılaştırıldığında erkeklerin lehine anlamlı bir fark bulunmuştur (Başer, 2013b; Korkmaz ve Altun, 2013). Başer (2013b)'in bilgisayar programlamaya karşı tutum ölçeği geliştirme çalışmasında bulduğu programlamaya karşı tutumlar açısından erkeklerin lehine anlamlı fark, Korkmaz ve Altun (2013) tarafından yapılan çalışmanın sonucu ile benzerlik taşısa da bazı çalışmalarda da cinsiyetler arasında fark bulunmadığı tespit edilmiştir (Yıldırım ve Kaban, 2010; Erol ve Kurt, 2017). Örneğin, Erol ve Kurt (2017), Bilgisayar ve Öğretim Teknolojileri Eğitimi (BÖTE) bölümünde öğrenim gören öğrencilerin programlamaya karşı tutumlarının incelenmesi üzerine yaptıkları çalışmalarında öğrencilerin programlamaya karşı tutumlarının cinsiyete göre farklılık göstermediğini, kadın katılımcıların ve erkek katılımcıların programlamaya karşı tutumlarının benzer olduğunu ifade etmişlerdir.

Kendi bilgisayarı olan öğrencilerin, bilgisayarı olmayan öğrencilere göre problem çözme becerilerine daha çok güvendikleri ortaya çıkmıştır. Bu sonuç, bilgisayarı olan öğrencilerin bilgisayar kullanımı esnasında karşılaştıkları problemleri çözme tecrübesi edinmeleri veya bilgisayarda karşılaştıkları problemleri çözmek için elde ettikleri bilgilerin olumlu sonuçlarını görerek problem çözme konusunda kendilerine olan güvenlerinin artması şeklinde yorumlanabilir. Diğer taraftan, ölçeklerin problem çözme becerisine güven boyutu dışındaki hiçbir boyutunda öğrencilerin bilgisayar sahipliği açısından anlamlı bir fark olmaması, bilgisayar sahipliği ile programlama becerileri ve tutumlarının doğrudan bağlantılı olmadığını göstermiştir. Araştırmaya katılan öğrencilerin yaklaşık %70'inin kendi bilgisayarının olması ve öğrencilerin yaklaşık %60'ının günde 2 saatten daha fazla bilgisayar kullandıklarını belirtmesine karşın, programlamaya karşı olumlu tutumlarının bu oranların çok altında kaldığının görülmesiyle de bilgisayar sahipliğinin programlamaya karşı bakış açılarını çok da etkilemediği söylenebilir. Bu sonucun çıkmasında, araştırma grubundaki öğrencilerin tamamının bilişim teknolojileri alanı öğrencisi olmalarından dolayı gün içerisinde derslerde sürekli bilgisayar ile iç içe oldukları, dolayısıyla bilgisayarı olmayan öğrencilerin de bilgisayarı olanlar kadar bilgisayara erişim imkanlarının olmasının etkili olduğu düşünülmektedir.

Akademik başarıları açısından öğrencilerin problem çözme becerileri ile bilgisayar programlamaya karşı tutumları arasında anlamlı bir fark olmadığı görülmektedir. Araştırmaya katılan öğrencilerin meslek lisesi öğrencisi olması dolayısıyla akademik başarılarının genel olarak düşük olduğu bilinmektedir. Bu durumdan ötürü öğrencilerin akademik başarı düzeylerine göre problem çözme becerileri ile bilgisayar programlamaya karşı tutumları arasında herhangi bir farklılık ortaya çıkmadığı düşünülmektedir. Başka bir çalışmada da öğrencilerin problem çözme becerileri ile akademik başarıları arasındaki ilişki araştırılmış ve istatistiksel olarak anlamlı bir farklılaşmanın olmadığı saptanmıştır (Saracaloğlu, Serin ve Bozkurt, 2001).

Öğrencilerin günlük bilgisayar kullanım saatleri açısından ortaya çıkan sonuçlara bakıldığında ise günlük bilgisayar kullanım süreleri "4-6" saat olan öğrencilerin diğer öğrencilere göre programlamada kendilerine güven ve güdülenme duygularının daha fazla olduğu, günlük bilgisayar kullanım süreleri "2-4" saat olan öğrencilerin problem çözme becerisine güvenlerinin diğer öğrencilere göre daha fazla olduğu, günlük bilgisayar kullanım süreleri "0-2" saat ve "2-4" saat olan öğrencilerin ise problem çözmede kaçınma davranışlarının günlük bilgisayar kullanım süreleri "6-10" saat olan öğrencilere göre daha fazla olduğu ortaya çıkmıştır. Sonuçlara göre öğrencilerin problem çözme becerileri ve programlamaya karşı tutumları, bilgisayar kullanım sürelerine göre hem olumlu hem de olumsuz yönde değişkenlik göstermektedir. Bu itibarla daha fazla veya daha az bilgisayar kullanmanın ötesinde, öğrencilerin bilgisayarda hangi işleri yaparak vakit geçirdiğinin, yani öğrencinin bilgisayarı hangi amaçlı kullandığının önemli olduğu söylenebilir.

Öneriler

Araştırma sonucunda elde edilen bulguların değerlendirilmesinden sonra şu öneriler getirilmiştir:

- Programlama öğretimi daha eğlenceli ve basit biçime getirilebilir.
- Programlama dillerini öğretmek yerine programlamanın temel mantığı ve programlamanın günlük hayat ile bağı öğretilebilir.
- Temel programlama mantığı öğretilirken, öğrencilere yönelik uygulamalar ve görsellikler artırılabilir.
- Programlama öğretimi sonuçlarının ölçülmesi ve değerlendirilmesi, uygulama ve proje tabanlı yapılabilir.

Son olarak, bu çalışmanın çalışma grubunun sınırlı olması nedeniyle sonuçlarının genele yayılamayacağını da belirtmek gerekir. Bundan dolayı araştırmanın daha geniş ve farklı gruplar üzerinde yinelenmesi doğru olacaktır.

Kaynakça

Anastasiadou, S. D. ve Karakos, A. S. (2011). The beliefs of electrical and computer engineering students' regarding computer programming. *The International Journal of Technology, Knowledge and Society*, *7* (1), 37-51.

Arslan, E. (2013). *Problem çözme ve algoritmalar*. 18 Haziran 2017 tarihinde https://www.google.com.tr/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0ahUKEwi40OS9-s7UAhXra5oKHZweDZ0QFgglMAA&url=http%3A%2F%2Faves.istanbul.edu.tr%2FImageOfByte.aspx%3FResim%3D8%26SSNO%3D3%26USER%3D40412&usg=AFQjCNFBG8xhXBQxaqD2RRa0B-88gqttvQ adresinden alınmıştır.

Başer, M. (2013a). Attitude, gender and achievement in computer programming. *Middle-East Journal of Scientific Research*, *14* (2), 248-255.

Başer, M. (2013b). Bilgisayar programlamaya karşı tutum ölçeği geliştirme çalışması. *The Journal of Academic Social Science Studies*, *6* (6), 199-215.

Davidson, J. E., Deuser, R., ve Sternberg, R. J. (1994). The role of metacognition in problem solving. In Metcalfe, J. & Shimamura, A.P. (Eds.), *Metacognition: Knowing about knowing* (pp. 207-226). Cambridge, MA: MIT Press.

Elibol, H. (2005). Bilişim teknolojileri kullanımının işletmelerin organizasyon yapıları üzerindeki etkileri, *Selçuk Üniversitesi Sosyal Bilimler Dergisi*, *13*, 155-162.

Erol, O. ve Kurt, A. A. (2017). BÖTE bölümü öğrencilerinin programlamaya karşı tutumlarının incelenmesi. *Mehmet Akif Ersoy Üniversitesi Eğitim Fakültesi Dergisi, 41,* 314-325.

Fidan, N. (1985). *Okulda öğrenme ve öğretme*. Ankara: Pegem Yayınları No:17.

Heersink, D. ve Moskal, B. M. (2010). Measuring high school students' attitudes toward computing. *Proceedings of the 41st ACM Technical Symposium on Computer Science Education*, 446-450.

Ittenbach, R. F. ve Harrison, P. L. (1990). Predicting ego-strength from problem-solving ability of college student. *Measurement & Evaluation in Counseling & Development*, *23* (3), 128-137.

İraz, R. (1999). Bilişim teknolojisi ve örgütsel değişim, bankacılık sektöründe bir uygulama. Yayınlanmamış Doktora Tezi. Konya: Selçuk Üniversitesi, Sosyal Bilimler Enstitüsü.

Kaptan, F. ve Korkmaz, H. (2002). Türkiye'de hizmet öncesi öğretmenlerin problem çözme becerilerine yönelik algıları üzerine bir inceleme. *Qafqaz Üniversitesi Dergisi*, *9* (3)

Karasar, N. (2006). *Bilimsel araştırma yöntemleri* (5. Baskı). Ankara: Nobel Yayın Dağıtım.

Korkmaz, Ö. ve Altun, H. (2013). Engineering and ceit student's attitude towards learning computer programming. *The Journal of Academic Social Science Studies International Journal of Social Science*, *6* (2), 1169-1185.

MEB. (2011). *Milli Eğitim Bakanlığı, bilişim teknolojileri alanı çerçeve öğretim programı*. 15 Haziran 2017 tarihinde http://mtegm.meb.gov.tr/program/dokuman/egitimogretim/cop/B%C4%B0L%C4%B0%C5%9E%C4%B0M%20TEKNOLOJ%C4%B0LER%C4%B0.pdf adresinden alınmıştır.

MEB. (2016). *Milli Eğitim Bakanlığı, Ortaöğretim Genel Müdürlüğü, Bilgisayar Bilimi Dersi Öğretim Programı*. 15 Haziran 2017 tarihinde http://ttkb.meb.gov.tr/program2.aspx/program2.aspx?islem=2&kno=262 adresinden alınmıştır.

Otacıoğlu, S. G. (2008). Prospective teachers' problem solving skills and self-confidence levels, *Educational Sciences: Theory & Practice, 8* (3), 915-923.

Özyurt, Ö. ve Özyurt, H. (2015). Bilgisayar programcılığı öğrencilerinin programlamaya karşı tutum ve programlama öz-yeterliklerinin belirlenmesine yönelik bir çalışma. *Eğitimde Kuram ve Uygulama*, *11*(1), 51-67.

Saracaloğlu, A. S., Serin, O. ve Bozkurt, N. (2001). Dokuz Eylül Üniversitesi Eğitim Bilimleri Enstitüsü öğrencilerinin problem çözme becerileri ile başarıları arasındaki ilişki. *M.Ü. Atatürk Eğitim Fakültesi Eğitim Bilimleri Dergisi*, *14*, 121-134.

Serin O., Bulut Serin, N. ve Saygılı G., (2010). Developing Problem Solving Inventory for children at the level of primary education (PSIC). *Elementary Education Online*, *9* (2), 446-458.

Yıldırım, S. ve Kaban, A. (2010). Attitudes of pre-service teachers about computer supported education. *International Journal of Human Sciences*, *7* (2), 158-168.

Zadnik, M. G. ve Loss, R. D. (1995). Developing numerical problem-solving skills through estimations of quantities in familiar contexts. *Australian Science Teachers Journal*, *41* (1), 15-19.

PERCEPTIONS OF TEACHING STAFF RELATED TO TECHNOLOGICAL HARDWARE ADEQUACY OF UNIVERSITIES IN TURKEY

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Abstract: Universities aim to cultivate highly qualified individuals with creative thinking, discipline, and broad qualification are centers where multidimensional work is being pursued and science and technology are being developed. These institutions are dynamic, they are institutions that constantly renew themselves because of their scientific origins. It will increase the quality of the workforce in terms of graduates who have the qualification of using technological information for the field which facilitates adaptation to the conditions of the day. In this study, it was aimed to determine the perceptions of the teaching staff about the technological hardware sufficiency of the universities in Turkey. The study was a qualitative study and the data obtained were analyzed based on the content analysis.

Keywords: University, technology, hardware, teaching staff

TÜRKİYE'DE ÜNİVERSİTELERİN TEKNOLOJİK DONANIM YETERLİLİĞİNE İLİŞKİN ÖĞRETİM ELEMANLARININ ALGILARI

Özet: Yaratıcı düşünceye sahip, disiplinli, ufku geniş niteliksel açıdan yüksek niteliğe sahip olan bireyler yetiştirmeyi hedef alan Üniversiteler, çok boyutlu işleve sahip olmakla birlikte bilim ve tekniğin geliştirilmeye çalışıldığı merkezlerdir. Bu kurumlar dinamik bir yapıyı, bilimsel açıdan içerisinde barındırdığından dolayı sürekli kendisini yenileyen kurumlardır. Bu kurumlardan mezun olan öğrenciler alanlarına yönelik yeterliliklere sahip olarak mezun olup meslek hayatına başlangıç yapmış olurlar. Meslek hayatına başlayan öğrencilerin günün şartlarına uyumu kolaylaştıran alanına yönelik teknolojik bilgi kullanım yeterliliğine sahip olarak mezun olması işgücü anlamında niteliği arttıracaktır. Bu çalışmada da Türkiye'de üniversitelerin Teknolojik donanım yeterliliğine ilişkin öğretim elemanlarının algılarını belirlenmesi amaçlanmıştır. Yapılan çalışma nitel bir çalışma olup elde edilen veriler içerik analizine dayalı olarak analiz edilmiştir.

Anahtar Kelimeler: Üniversite, teknoloji, donanım, öğretim elemanı

Giriş

Teknoloji, birkaç asırdır insanoğlunun yaşamını etkileyen olguların başında gelmektedir. Bu etki, özellikle son yıllarda yaşamın her alanını belirleyen bir noktaya ulaşmıştır (Baltacı ve Akpınar, 2011). Nitekim günümüzün önde gelen teknolojilerinden birisi olan internet, yaşamının vazgeçilmez bir gereği olarak birçok alanda yerini almıştır. İnternet teknolojisinden etkilenen alanlardan birisi de eğitimdir. Bugün internetin, topyekûn eğitim sistemi ve özellikle eğitimin uygulama boyutu üzerinde belirleyici bir etkiye sahip olduğu tartışmasızdır. Bunun nedenleri arasında, toplumda eğitim isteğinin artması, öğrenci sayısı ve bilgi miktarının çoğalması, öğretilecek içeriğin karmaşıklaşması ve bireysel eğitimin önem kazanması sayılabilir (Odabaşı, 2008; Akpınar ve Baltacı, 2011).

Türkiye'de birçok alanda teknolojik anlamda yapılan değişikliklerin temeli cumhuriyetin ilanına kadar dayandırabiliriz (Aydın ve Aydın, 2010). Ülkemizde son yıllarda gelişen teknoloji, askeriyeden sanayiye, sağlıktan eğitime her alanda büyük kolaylıkları da beraberinde getirmiştir. Özellikle bilgisayar teknolojisinin geliştirilmesi, yaygınlaştırılması ve çok amaçlı olarak kullanılabilmesi, gerek hız ve ekonomi, gerek görsellik ve ses imkânlarını sağlaması bilgisayar teknolojisini artık evlerde bile büyük bir ihtiyaç haline getirmiştir(Demirci, 2006; Güven ve Sülün, 2012).Bu teknolojik gelişmeler ve beraberinde getirdiği yeni teknolojik ürünler eğitimde de yansımalarını bularak, etkili iletişim ve bireysel öğretim aracı olarak bilgisayarları eğitim- öğretim sürecine katmıştır. Bilgisayarın bu süreçte yer almasıyla birlikte, "Bilgisayar Destekli Öğretim" deyimi ortaya çıkmıştır. Uşun (2000), bilgisayar destekli öğretimi, öğretim sürecini ve öğrenci motivasyonunu güçlendiren, öğrencinin kendi öğrenme hızına göre yararlanabileceği, kendi kendine öğrenme ilkelerinin bilgisayar teknolojisi ile birleşmesinden oluşmuş bir öğretim yöntemi olarak açıklamaktadır. Hannafin ve Peck (1988) ise, bilgisayar destekli öğretimi, öğretimsel içerik veya etkinliklerin bilgisayar yoluyla öğrenciye aktarılması olarak tanımlamaktadır. Burada bilgisayar, öğretme sürecine, öğretmenin yerine geçecek bir seçenek olarak değil, sistemi tamamlayıcı ve güçlendirici bir araç olarak girmektedir (Güven ve Sülün, 2012). Türkiye'de eğitim-öğretim sürecinde teknolojik donanıma dayalı materyal kullanımı bilgisayar ve internet tabanlı eğitime dayandığından dolayı örgün eğitimin hemen hemen her kademesinde kullanıldığını söyleyebiliriz. Ancak bu kullanım öğrencinin gelişim özelliklerine ve ihtiyaçlarına göre farklılıklar göstermektedir. Mesleki ve alan eğitiminin kazandırılmasında önemli bir işleve sahip olan üniversitelerde de verilen teknoloji destekli eğitim öğrencilerin toplumsal uyum ve algılama sürecini kolaylaştıracağını söyleyebiliriz. Ancak ülkemizdeki üniversiteler arası gelişmişlik farkı bu alanda da baş göstermektedir. Üniversite eğitiminde mevcut alan yazını bize Web teknolojileri ile ilgili olarak genel içerikli çalışmalar (DeAndrea, Ellison, Meyer, 2010; Rodrigues, Sabino, & Zhou, 2010; Top, Yukselturk, ve Cakır, 2011; Usluel & Mazman, 2009; Baran ve Ata, 2013) ya da her bir teknolojiyle ilgili bireysel çalışmalar yapıldığı göstermektedir (Baran, 2010; Griffiths & Wall, 2011; Kuzu, 2007; McGarr, 2009; Fernandez, Simoa, & Sallana, 2009; Baran ve Ata, 2013). Ancak yapılan bu çalışmaların ulusal düzeyde değerlendirilmesi üniversitelerimizin teknolojik yetersizlik düzeylerini çarpıcı bir şekilde ortaya çıkarmıştır. Bu eksikliği gidermeye yönelik yollarda gerek donanım gerekse nitelikli eleman ihtiyacını giderme konusunda önemli adımlar atılmaktadır. Bu çalışmada da "Türkiye'de Üniversitelerin Teknolojik Donanım Yeterliliğine İlişkin Öğretim Elemanlarının Algıları" belirlenip çözüm önerilerinin getirilmesi amaçlanmıştır.

Araştırmanın Amacı

Araştırmanın amacı, Türkiye'de Üniversitelerin Teknolojik Donanım Yeterliliğine İlişkin Öğretim Elemanlarının Algılarını belirleyip genel amaç çerçevesinde çeşitli öneriler sunmaktır. Bu genel amaç çerçevesinde şu sorulara cevap aranmıştır:

- ✓ Teknoloji temelli öğrenme ortamı deyince ne anlıyorsunuz?
- ✓ Türkiye'de üniversitelerin teknolojik anlamda yeterli donanıma sahip olduğunu düşünüyor musunuz, niçin?
- ✓ Türkiye'de teknolojik donanım olarak gelişmiş olan üniversitelerin gelişmemiş olan üniversitelerden sizce ne gibi farklılıkları bulunmaktadır?
- ✓ Türkiye'de teknoloji temelli öğrenme ortamlarının üniversite öğrencilerinin öğrenme süreci üzerindeki etkileri nelerdir?

Yöntem

Araştırmanın Modeli

Türkiye'de Türkiye'de Üniversitelerin Teknolojik Donanım Yeterliliğine İlişkin Öğretim Elemanlarının 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, İnönü, Cumhuriyet ve Fırat Üniversitelerine bağlı çeşitli fakültelerde görev yapan 50 öğretim elemanı oluşturmaktadır. Araştırmacının, öğretim elemanlarına aha rahat ulaşmak, araştırmacıya araştırmanın güvenirliği açısından kolaylık sağladığından dolayı çalışma grubu üyeleri bu üniversitelerden seçilmiştir.

Veri Toplama Aracı

Araştırmanın kuramsal boyutu oluşturulduktan sonra Türkiye'de Üniversitelerin Teknolojik Donanım Yeterliliğine İlişkin Öğretim Elemanlarının Algılarını belirlemeye yönelik 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, Türkiye'de Üniversitelerin Teknolojik Donanım Yeterliliğine İlişkin Öğretim Elemanlarının Algılarından 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, İnönü, Cumhuriyet ve Fırat Üniversitelerinde görev yapan öğretim elemanlarının Türkiye'de Üniversitelerin Teknolojik Donanım Yeterliliğine İlişkin görüşleri belirlenip ve bu görüşleri uygun temalara dönüştürüldükten sonra tablolar halinde sunulmuştur.

Teknolojik Öğrenme Ortamının Tanımına ilişkin Bulgular

Araştırmada çalışma grubunu oluşturan öğretim elemanları "Teknoloji temelli öğrenme ortamı deyince ne anlıyorsunuz?" 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 teknolojik öğrenme ortamına ilişkin algıları

1.TEMA: *Teknolojik Öğrenme Ortamının Tanımları*	
Alt Temalar	***f***
G.1. *Teknolojik materyale dayalı öğrenme ortamı*	*22*
G.2. *Zamansal ihtiyaçları gideren araç gereçlere dayalı öğrenme ortamı*	*8*
G.3. *Öğrenciyi güdülemeye, sorgulamaya ve araştırmaya teşvik edici öğrenme ortamı*	*16*
G.4. *Öğrencinin etkin katılımını temele alan öğrenme ortamı*	*4*

Tablo 1'de çalışma grubunu oluşturan öğretim elemanlarının verdiği cevaplar alt temalar şeklinde gruplandırılarak verilmiştir. Bu alt temaları oluşturan öğretmen görüşleri aşağıda örneklendirilmiştir.

> *"Teknolojik öğrenme ortamı günümüz Türkiye'sinde çok önemli bir kavramdır. Çünkü küreselleşen dünyada bireyin hızlı bilgi edinme ve karar alma becerisi bu öğrenme ortamlarını zaruri hale getirmiştir. Ben bu kavramı tanımlarken zaman kavramından ayrı düşünemem. Çünkü zamana göre bu öğrenme ortamlarındaki teknolojik araç ve gereçler de değişkenlik göstermektedir"***(G.2)**

Türkiye'de Üniversitelerin Teknolojik Donanıma Sahip Olma Yeterliliği Durumu

"Türkiye'de üniversitelerin teknolojik anlamda yeterli donanıma sahip olduğunu düşünüyor musunuz, niçin?" biçimindeki soruya öğretim elemanlarının birbirinden farklı yanıtlar verdiği tablo 2'de görülmektedir.

Tablo 2. Çalışma grubu üyelerinin üniversitelerin teknolojik boyutuna ilişkin algıları

2.TEMA: *Türkiye'de Üniversitelerin Teknolojik Donanım Yeterliliği*		
Alt Temalar		***f***
Evet	*G.1.Proje teşvik uygulamaları*	*30*
	G.2. İlgili alanda Ana bilim dallarının açılması	*4*
	G.3.Devlet destekli kalkınma planlarının düzenlenmesi	*2*

	G.4.Teknoloji destekli uygulama laboratuvarlarının açılması	*4*
Hayır	*G.5. Nitelikli eleman eksikliği*	*6*
	G.6.Genele yaymada sıkıntıların yaşanması	*4*

Çalışma grubu üyelerinin "Türkiye'de üniversitelerin teknolojik anlamda yeterli donanıma sahip olduğunu düşünüyor musunuz, niçin?" şeklindeki soruya araştırmada verdikleri yanıtların içerik ve betimsel analize tabi tutularak tablo 2'de verilmesine bağlı olarak çalışma grubunun görüşleri de şu şekilde örneklendirilmiştir:

> *"Ben 20 yıllık bir öğretim üyesi olarak şunu söyleyebilirim. Üniversitelerimiz her anlamda insan dolu, ancak bu doluluğu oluşturan kitlenin niteliksiz olması hangi teknolojiyi getirirseniz getirin hiç bir anlam ifade etmeyecektir. Onun için teknolojik donanım ne kadar önemliyse onu kullanmasını bilen nitelikli elemanların olması bir o kadar önemlidir."* **(G.5).**

Teknolojik Donanım Olarak Gelişen Üniversitelerin Diğerlerinden Farklı Kılan Nitelik Durumu

Araştırmada elde edilen bulguların oluşmasında belirleyici role sahip olan ve çalışma grubunu oluşturan üyelerin, yarı yapılandırılmış görüşme formunda yer alan "Türkiye'de teknolojik donanım olarak gelişmiş olan üniversitelerin gelişmemiş olan üniversitelerden sizce ne gibi farklılıkları bulunmaktadır?" şeklindeki soruya birbirinden farklı yanıtlar vermişlerdir. Çalışma grubu üyelerinin verdiği yanıtlar tablo 3'de içerik ve betimsel analize tabi tutulara alt temalara ayrılmıştır.

Tablo 3. Çalışma grubu üyelerinin teknolojik donanım ölçütüne ilişkin üniversiteleri farklı kılan özelliklere ilişkin algıları

3.TEMA: *Teknolojik Donanım Bakımından Gelişen Üniversitelerin Gelişmeyenlerden Farklıları*	
Alt Temalar	***f***
G.1. *Nitelikli işgücü yetiştirme*	*35*
G.2. *öğrencinin kavrama ve anlama seviyesinin artması*	*7*
G.3*. Öğrencinin birinci elden somut kaynaklara ulaşması*	*6*
G.4. *Global dünyaya hızlı uyum sağlayan öğrenciler yetiştirme*	*2*

"Türkiye'de teknolojik donanım olarak gelişmiş olan üniversitelerin gelişmemiş olan üniversitelerden sizce ne gibi farklılıkları bulunmaktadır? Şeklindeki soruya çalışma grubunu oluşturan üyelerin, 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.

"Teknolojik anlamda donanımlı gelişmiş olan üniversitelerde eğitim görüp eğitimini tamamlayan öğrenciler, her anlamda kendilerini daha güvenli bir iş bulma süreci içerinde hissedeceklerdir. Çünkü yetiştiği ana bilim dalında ya da bilim dalında gerekli temel ilk elden somut numunelere ulaşma fırsatını yakalayıp ve değerlendirmiştir. Bu da öğrencinin iş hayatında ki başarısını şüphesiz arttıracaktır." **(G.3)**

Türkiye'de Teknoloji Temelli Öğrenme Ortamlarının Üniversite Öğrencilerinin Öğrenme Süreci Üzerindeki Etkilerine İlişkin Durum

Yarı yapılandırılmış görüşme formunda yer alan "Türkiye'de teknoloji temelli öğrenme ortamlarının üniversite öğrencilerinin öğrenme süreci üzerindeki etkileri nelerdir?" şeklindeki soruya çalışma grubunu oluşturan üyelerin birbirinden yanıtlar vermesi farklı temalarında ortaya çıkmasını beraberinde getirmiştir.

Tablo 4: Çalışma grubu üyelerinin fatih projesinin uygulama sürecinde karşılaşılan olumsuzluklara ilişkin algıları

4.TEMA: *Teknolojik Temelli Öğrenme Ortamlarının Öğrenme Üzerindeki Etkileri*	
Alt Temalar	***f***
G.1. *Somut öğrenme olanağı sağlama*	*20*
G.2. *Teorik öğrenmeleri pratiğe dökme imkanı sağlama*	*11*
G.3*. Bilgiye ulaşma süresini kısaltma*	*4*
G.4. *Küresel anlamda ihtiyaç duyulan bilgiye ulaşma*	*15*

Yarı yapılandırılmış görüşme formunda yer alan "Türkiye'de teknoloji temelli öğrenme ortamlarının üniversite öğrencilerinin öğrenme süreci üzerindeki etkileri nelerdir?" şeklindeki soruya çalışma grubunu oluşturan üyelerin birbirinden yanıtlar içerik ve betimsel analize tabi tutularak tablo 4'de verilmesine bağlı olarak öğretim elemanlarının görüşleri de şu şekilde örneklendirilmiştir:

"Teknolojik donanıma sahip öğrenme ortamlarının öğrencinin öğrenme sürecini her anlamda etkilediğini söyleyebilirim. Ancak en dikkat çekici yararının küresel anlamda var olan bilgiye ulaşma kolaylığı sağlaması olduğunu söyleyebilirim." **(G.4)**

Sonuç ve Öneriler

Cumhuriyet, İnönü ve Fırat Üniversitelerinde görev yapan çalışma grubu üyelerinin görüşlerine bağlı içerik ve betimsel analize dayalı olarak elde edilen sonuçlardan hareketle "Türkiye'de Üniversitelerin Teknolojik Donanım Yeterliliğine İlişkin" yapılan çalışmada bir çok dikkat çekici sonuç elde edilmiştir. Elde edilen bu sonuçlar değerlendirildiğinde ülkemizde teknolojik donanım bakımından üniversitelerin birbirinden farklılıklar gösterdiği, bu farklılıklarında öğrenim gören öğrencilerin öğrenme süreci üzerinde etkili olduğunu öğretim elemanlarının görüşlerinden çıkarabiliriz. Üniversitelerdeki teknolojik donanıma bağlı eksikliklerin giderilmesi sürecinde kamu kurum ve kuruluşları üzerine düşen sorumlulukları son yıllarda yerine getirirken bu teknolojik materyallerin kullanımı sürecinde ortaya çıkabilecek eksiklikleri de göz önünde bulundurarak gerekli niteliğe sahip bireylerin yetişmesi için eğitimler vermeyi ihmal etmemelidir. Çalışmanın ortaya çıkardığı en önemli sonuçların başında teknolojik öğrenme ortamlarının öneminin anlaşılması ve bu öğrenme alanlarının öğrenme sürecine kazandırdıklarının farkındalığına sahip olmadır. Elde edilen bu sonuçlardan hareketle;

- ✓ Teknolojik donanıma sahip öğrenme ortamları son teknolojik materyallerle yenilenmelidir
- ✓ Üniversitelerimizdeki teknolojik donanıma sahip öğrenme ortamları her bilim dalına uygun bir şekilde hazırlanmalıdır
- ✓ Teknolojik donanıma sahip öğrenme alanlarındaki materyalin kullanımı konusunda nitelikli bireyler yetiştirilmelidir
- ✓ Teorik bilginin aktarımında bu bilginin kullanılmasına yönelik teknolojik donanımın kullanıldığı uygulamalar yapılmalıdır.

Kaynakça

Aydın, M. ve Aydın, K.(2010). Türk Inkılâbı Tarihi, Ankara: Cantekin Matbaacılık.

Baltacı, M. ve Akpınar, B.(2011). Web Tabanlı Öğretimin Öğrencilerin Akademik Başarısına Etkisi, Fırat Üniversitesi Sosyal Bilimler Dergisi *Fırat University Journal of Social Science* Cilt: 21, Sayı: 1, Sayfa: 77-88.

Baran, B. (2010). Facebook as a formal instructional environment. *British Journal of Educational Technology, 41*(6), 146-149. doi: 10.1111/j.1467-8535.2010.01115.x-

Baran, B. ve Ata, F.(2013). Üniversite Öğrencilerinin Web 2.0 Teknolojileri Kullanma Durumları, Beceri Düzeyleri ve Eğitsel Olarak Faydalanma Durumları, Eğitim ve Bilim Dergisi, 38(169), 195-196.

DeAndrea, D. C., Ellison, N. B., LaRose, R., Steinfield, C. & Fiore, A. (in pres). Serious social media: On the use of social media for improving students' adjustment to college, *The Internet and Higher Education.*

Demirci, H. G. (2006). Ticaret Meslek ve Anadolu Ticaret Meslek Liseleri Bilgisayar Programcılığı Bölümü öğrencilerinin İnternete Yönelik Tutumları İle İnternet Ağ Sistemleri Dersindeki Akademik Başarıları Arasındaki İlişki, *Yayımlanmamış Yüksek Lisans Tezi,* Çukurova Üniversitesi, Bilgisayar ve Öğretim Teknolojileri ABD.

Fernandez, V., Simoa, P. & Sallana, J. M. (2009). Podcasting: A new technological tool to facilitate good practice in higher education. *Computers & Education, 53* (2), 385-392.

Griffiths P. & Wall A. (2011). Social media use by Enrollment management. In Laura A. Wankel and Charles Wankel (Eds.), *Higher Education Administration with Social Media: Including Applications in Student Affairs, Enrollment Management, Alumni Relations, and Career*. Emerald Group Publishing

Güven, G. ve Sülün, Y.(2012). Bilgisayar Destekli Öğretimin 8.Sınıf Fen Ve Teknoloji Dersindeki Akademik Başarıya Ve Öğrencilerin Derse Karşı Tutumlarına Etkisi, *Türk Fen Eğitim Dergisi,* 9(1), 69-70.

Hannafin, M.S. and Peck, K.L. (1988). The Design, Development and Evaluation of Instructional Software. MacMillan, Londra.

Kuzu, A. (2007). Views of pre-service teachers on blog use for instruction and social interaction. *The Turkish Online Journal of Distance Education, 8*(3), 34-51.

McGarr, O. (2009). A review of podcasting in higher education: Its influence on the traditional lecture. *Australasian Journal of Educational Technology, 25*(3), 309-321.

Merriam, S. (1998). *QualitativeResearchand Case Study Applications in Education.* San Francisco: Jossey-Bass.

Meyer, K.A. (2010). A comparison of Web 2.0 tools in a doctoral course. *The Internet and Higher Education, 13*, 226-232.

Miles, M., Huberman, A. (1994). *QualitativeData Analysis: An Expanded Source Book.* 2nd. Ed.Thousand

Oakes: Sage Publications.

Odabaşı, F. (2008). Bilgisayar destekli eğitim. http://www.aof.anadolu.edu.tr adresinden 22/05/2008 tarihinde indirildi.

Rodrigues, J.J.P.C. , Sabino, F.M.R. & Zhou L. (2010). Enhancing e-learning experience with online social Networks. *IET Communications, 5*(8), 1147-1154. Retrieved from http://ieeexplore. ieee.org/stamp/stamp.jsp?tp=&arnumber=5893894.

Top, E., Yükseltürk, E. ve Çakır, R. (2011). Gender and Web 2.0 technology awareness among ICT teachers. *British Journal of Educational Technology, 42*(5), E106-E109.

Usluel, Y.K. ve Mazman, S.G. (2009). Adoption process of Web 2.0 tools in distance education, (p. 818-823). Procedia - Social and Behavioral Sciences, 1(1).

Uşun, S. (2000). Dünyada ve Türkiye'de Bilgisayar Destekli Öğretim. Pegem A Yayıncılık. Ankara.

Yıldırm, A. ve Şimşek, H. (2008). *Sosyal Bilimlerde Nitel Araştırma Yöntemleri*. Ankara: Seçkin Yayıncılık

Yin, R. K. (1994). Evaluation: A Singular Craft. (Ed.):Charles Reichardtand Sharon Rallis. *New Directions in Program Evaluation*, 1994, 71-84.

ON MULTIPLE INTELLIGENCE APPLICATIONS IN TURKEY EVALUATION OF TECHNOLOGY USAGE

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Abstract: We can say that, in institutions where formal and informal education is provided in Turkey for multiple intelligence applications, the learning environments and activities aimed at the development of more than one intelligence dimension of the student at the same time are being tried to be increased by the related institutions especially within the framework of constructivist learning theory. The increase in these practices has brought some reforms in terms of teacher competence, learning environment and material in educational institutions. We can say that these regulations are mostly technology-centered regulations. We can say that the ability of the teachers to use the technology, the technological tools in the learning environments or the hardware and the materials used in the lessons meet the daily needs of the technologically influential students on the development process of multiple intelligence dimensions. In this study, it was aimed to evaluate the use of technology in education on multiple intelligence applications in the context of the views of secondary school teachers working in public schools in different regions in Turkey. The study was based on qualitative methodology and NVivo 11 program was used for analysis of data and creation of models.

Keywords: Multiple intelligence, middle school, teacher, technology

TÜRKİYE'DE ÇOKLU ZEKÂ UYGULAMALARI ÜZERİNDE TEKNOLOJİ KULLANIMININ DEĞERLENDİRİLMESİ

Özet: Çoklu zeka uygulamalarına yönelik olarak Türkiye'de, formal ve informal eğitimin verildiği kurumlarda, öğrencinin aynı anda birden çok zeka boyutunu geliştirmeye yönelik, öğrenme ortamları ve etkinliklerinin özellikle yapılandırmacı öğrenme kuramı çerçevesinde ilgili kurumlar tarafından arttırılmaya çalışıldığını söyleyebiliriz. Bu uygulamaların artması eğitim kurumlarında öğretmen yeterliliği, öğrenme ortamı ve materyal açısından bir takım yenilikler ya da düzenlemeler getirmiştir. Yapılan bu düzenlemeler daha çok teknoloji merkezli düzenlemeler olduğunu söyleyebiliriz. Öğretmenlerin teknolojiyi kullanma yeterliliği, öğrenme ortamlarında yer alan teknolojik araçlar ya da donanım ve derslerde kullanılan materyallerin teknolojik açıdan günün ihtiyaçlarını karşılama düzeyi öğrencilerin çoklu zekâ boyutlarını geliştirme süreci üzerinde etkili olduğunu söyleyebiliriz. Yapılan bu çalışmada Türkiye'de farklı bölgelerde devlet okullarında görev yapan ortaokul öğretmenlerinin görüşleri çerçevesinde çoklu zekâ uygulamaları üzerinde eğitimde teknoloji kullanımının değerlendirilmesi amaçlanmıştır. Çalışma nitel yönteme dayalı bir çalışma olup verilerin analizinde ve modellerin oluşturulmasında NVivo 11 programından yararlanılmıştır.

***Anahtar Kelimeler*:** Çoklu zekâ ortaokul, öğretmen, teknoloji

Giriş

İnsanlığın ihtiyaçlarına cevap verebilmek amacıyla sürekli olarak değişen dünyamızda, bu ihtiyaçların karşılanması için birbirinden farklı fikirlere dayalı olarak projeler üretilmektedir. Üretilen bu projelerin her biri tasarlama sürecinde birbirinden farklı zekâ türlerinin katkılarını barındırmakla birlikte, bilgi, teknoloji ve uygulamayla birlikte geliştirilebilir. İhtiyaçlara bağlı olarak dünya değiştikçe zekâ kavramı da değişmektedir. Çalışmanın ana değişkenlerinden birini oluşturan çoklu zekâ kuramı da bu değişimin bir ürünüdür.

Çoklu zekâ kuramının temsilcisi olan Gardner (1993) zekayı; "problem çözme kapasitesi ya da bir veya daha fazla kültürel bağlamda değer atfedilen ürünler ortaya koyabilme yetisi" olarak tanımlamıştır. Gardner zekânın tek bir faktörle açıklanamayacak kadar çok sayıda yetenekten ileri geldiğini; çoklu öğrenme ortamlarında bireylerin problem çözme becerisi ve üretkenliğinin daha fazla olabileceğini belirtmiştir (Demirel, 2000; Öngören ve Şahin, 2008). Yeni anlayışa göre zeka; genetik olduğu kadar çevresel etmenlere de bağlı, geliştirilebilir, çoğul, sayısal olarak hesaplanamayan ancak gerçek yaşam koşullarında gözlenen, ve bireylerin başarılı olabilecekleri farklı yolları anlamak için başvurulan bir kavram olarak algılanır (Saban, 2002; Selçuk vd., 2004; Öngören ve Şahin, 2008). Görüldüğü üzere yeni anlayış bireyi etiketlemek ve sınıflandırmak yerine, onu anlama ve ona fırsatlar sunma gayretine ağırlık vermektedir. Gardner'e (1985, 1993) göre zekâ alanları çoğuldur ve yaşam boyunca yapılan hiçbir etkinlik tek bir zekâ alanını içermez. Dolayısıyla insanlardaki farklı zekâ alanları birbirleriyle etkileşerek uyum içinde çalışırlar. Herkes çeşitli düzeylerde zekâ alanlarına sahip olarak doğarlar, ancak bu zeka alanları insanın yaşamı boyunca edinilen olumlu deneyim ve beslenme gibi faktörlerle geliştirilebilir. O zaman, bu yaklaşımda "kaderci" anlayışa da yer yoktur. Gardner'in önerdiği sekiz farklı zekâ alanı (1) Sözel-Dilsel Zekâ, (2) Mantıksal- Matematiksel Zekâ (3) Görsel-Uzamsal Zekâ, (4) Müziksel-Ritmik Zekâ, (5) Bedensel-Kinestetik Zekâ (6) Sosyal-Kişiler Arası Zekâ (7) İçsel-Özedönük Zekâ ve (8) Doğacı Zekâ olarak ifade edilmiştir. Gardner'a (1993) göre her insanın bir ya da bir kaç zekâ alanı, diğerlerinden daha gelişmiş olabilir(Öngören ve Şahin, 2008). Eğer kişilere zekâ alanlarını geliştirme şansı verilirse, zayıf olan zekâ alanı baskın zekâ alanı haline gelebilir. Bu nedenle, Gardner'in ileri sürdü ğü anlayışta öğrencileri " düşük zekâlılar" veya "üstün zekâlılar" olarak tanımlamak yanlış ve sakıncalıdır. 1739 sayılı Milli Eğitim Temel Kanunu'nda da bireylerin ilgi, istidat ve kabiliyetleri doğrultusunda eğitilmesi gerektiği vurgulanmıştır. O zaman öğrencilerin yetersizliklerine değil, onların güçlü oldukları zekâ alanlarına ve hangi yollarla en iyi öğrendiklerine vurgu yapılmalı; onlara bu alanlarda başarılı olmaları için fırsatlar sunmalıdır (Saban, 2002; Öngören ve Şahin, 2008).

Teknoloji insanlık tarihiyle başlamış ve bilgi akışının hızlı olduğu bu çağda da her alanda olduğu gibi eğitim alanında da kullanılması vazgeçilmezdir (Altıntaş, Kahraman ve Altıntaş, 2013). Ülkemizde de eğitim için vazgeçilmez olan teknolojinin yaygın bir şekilde kullanılmaya başladığı yıllar cumhuriyetin ilanına kadar dayandırabiliriz (Aydın ve Aydın, 2010). Teknolojik gelişmeler eğitim ortamlarını etkilemekte ve eğitim programlarını, öğretmenleri, öğrencilerin eğitim ortamlarının bir parçası olmuştur. Özellikle bilgisayarın eğitim ortamına girmesiyle teori ve uygulamada değişmeler meydana getirmiştir. Alkan (1997)'e göre eğitim teknolojisi; öğrenme-öğretme süreçlerinin tasarımlanması, uygulanması ve geliştirilmesi sürecidir. Eğitim teknolojisi öğretim, öğrenim, gelişimve yönetim teknolojilerini kapsadığından, öğretim teknolojisi, eğitim teknolojisinin bir alt kümesi olarak tanımlanır (Karademirci, 2010; Altıntaş, Kahraman ve Altıntaş, 2013). Araç gereç kullanımı çoklu öğrenme ortamı sağladığı gibi, öğrencilerin bireysel ihtiyaçlarının karşılanmasına yardımcı olur, dikkat çeker, hatırlamayı kolaylaştırır; soyut karmaşık kavramları, anlaması güç olgu ve olayları basitleştirir (Akçay, Feyzioğlu, Tüysüz, 2003; Altıntaş, Kahraman ve Altıntaş, 2013). Çoklu zekâ kuramı içerisinde yer alan hangi zekâ türü olursa olsun neredeyse bütün zekâ türlerinin ürünleri somutlaştırma ihtiyacı öğrenme sürecinde hissetmektedir. Bundan dolayı bu kurama dayalı bütün aktarımlarda teknolojik temelli araç ve gereçlerin kullanılması önemlidir.

Araştırmanın Amacı

"Nitel araştırma yöntemlerinin kullanılarak yapılan bu çalışmada, Türkiye'de devlet okullarında görev yapan ortaokul öğretmenlerinin görüşleri çerçevesinde çoklu zekâ uygulamaları üzerinde eğitimde teknoloji kullanımının değerlendirilmesi amaçlanmıştır. Bu genel amaç çerçevesinde çalışma grubu üyelerine şu sorular yöneltilmiştir:

- ✓ Somutlaştırma kavramı deyince ne anlıyorsunuz?
- ✓ Zekâ ile somutlaştırma arasında bir etkileşim olduğunu düşünüyor musunuz, niçin?
- ✓ Çoklu Zekâ kuramına dayalı hazırlanıp kullanılan etkinliklerde teknoloji destekli materyaller kullanıyor musunuz, niçin?
- ✓ Soyut olan konuların aktarımında materyal kullanıyorsanız, bu materyallerde aradığınız en önemli özellik nedir?

Yöntem

Araştırmanın Modeli

"Türkiye'de devlet okullarında görev yapan ortaokul öğretmenlerinin görüşleri çerçevesinde çoklu zekâ uygulamaları üzerinde eğitimde teknoloji kullanımının değerlendirilmesi" temelli bu araştırma, nitel bir çalışma olup, yarı yapılandırılmış görüşme yöntemiyle gerçekleştirilmiştir. Creswell (1998) nitel araştırmayı, sosyal yaşamı ve insanla ilgili problemleri kendine özgü metodlarla sorgulayarak, anlamlandırma süreci olarak ifade etmektedir. Nitel araştırma sürecinde araştırmacı bütüncül bir araştırma tablosu ortaya koyarak; kelime analizleri, detaylı katılımcı görüşme raporları kullanır ve araştırmayı doğal ortamda düzenler. Nitel araştırmada genel olarak takip edilen araştırma süreci parçadan bütünedir [tüme-varım]. Genel itibariyle nitel araştırmacı gözlem, görüşme ve dokümanlardan yola çıkarak kav ramları, anlamları ve ilişkileri açıklayarak süreci sürdürür (Merriam, 1998; Yıldırım ve Şimşek, 2008).Yarı yapılandırılmış görüşmelerde ise, görüşme soruları önceden belirlenmiş görüşme durumlarını kapsamaktadır (Balcı, 2004). 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 etmektedir (Yin, 1994, s.13; Merriam, 1998, s. 27).

Çalışma Grubu

Araştırmada çalışma grubunu, Konya, Malatya ve Gaziantep de Milli eğitim bakanlığına bağlı çeşitli okullarda görev yapan 60 sosyal bilgiler öğretmeni oluşturmaktadır. Araştırmanın bu illerde yapılması araştırmacının uygulama sürecinde araştırmanın güvenirliği açısından yaşadığı kolaylıktan dolayı çalışma grubu üyeleri bu illerden seçilmiştir.

Veri Toplama Aracı

Araştırmanın kuramsal boyutu oluşturulduktan sonra "Türkiye'de devlet okullarında görev yapan ortaokul öğretmenlerinin görüşleri çerçevesinde çoklu zekâ uygulamaları üzerinde eğitimde teknoloji kullanımının değerlendirilmesi" için 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, İnönü Üniversitesi Eğitim Fakültesinde 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

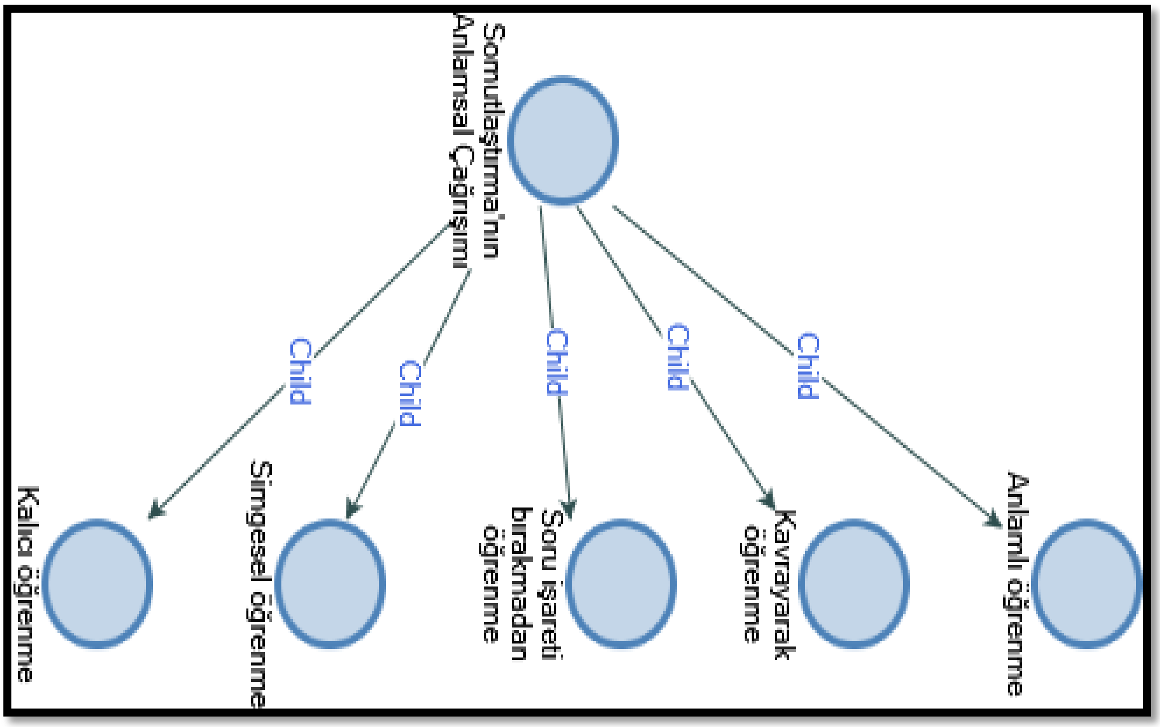
Araştırmada yarı yapılandırılmış görüşme formu ile ilgili çözümlemeler, nitel boyutta gerçekleştirilmiştir. Bilgisayar destekli nitel veri analizi yapılmıştır. Verilerin analizinde ve modellerin oluşturulmasında NVivo 11 programından yararlanılmıştır. Kodlamalar araştırmacıların ortak görüşleri doğrultusunda oluşturulmuştur. Bu çerçevede, "Türkiye'de devlet okullarında görev yapan ortaokul öğretmenlerinin görüşleri çerçevesinde çoklu zekâ uygulamaları üzerinde eğitimde teknoloji kullanımının değerlendirilmesine" yönelik görüşleri betimsel ve içerik analizi teknikleriyle belli temalar altında bu görüşler gruplanarak çözümlenmeye çalışılmıştır. Araştırmanın güvenirliğini sağlamak için, araştırmada ulaşılan uzman görüşüne başvurulmuştur. Araştırmacılar ve uzmanlar tarafından öncelikle ana temalar ardından bunlara bağlı 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

"Türkiye'de devlet okullarında görev yapan ortaokul öğretmenlerinin görüşleri çerçevesinde çoklu zekâ uygulamaları üzerinde eğitimde teknoloji kullanımının değerlendirilmesi" temelli bu çalışmada yarı yapılandırılmış görüşme formu aracılığıyla sosyal bilgiler öğretmenlerinden alınan görüşler analiz edilerek aşağıda verilen bulgular elde edilmiştir.

Somutlaştırma Kavramının Çalışma Grubunda Oluşturduğu Çağrışımlar Durumu

Yarı yapılandırılmış görüşme formunda yer alan *"Somutlaştırma kavramı deyince ne anlıyorsunuz?"* şeklindeki soruya çalışma grubunu oluşturan sosyal bilgiler öğretmenlerinin birbirinden farklı yanıtlar vererek çeşitli temalar oluşturdukları şekil 1 de gözlemlenmektedir.



Şekil 1: *Çalışma grubu üyelerinin somutlaştırma kavramına ilişkin algıları*

Yarı yapılandırılmış görüşme formunda yer alan "*Somutlaştırma kavramı deyince ne anlıyorsunuz?*" şeklindeki soruya çalışma grubu üyesi olan sosyal bilgiler öğretmenlerinin 5 farklı tema altında farklılaştıkları şekil 1'de gözlemlenmektedir. Sosyal bilgiler öğretmenleri bu soruya, kalıcı öğrenme (f-9), simgesel öğrenme (f-8), soru işareti bırakmadan öğrenme (f-13), kavrayarak öğrenme (f-18) ve anlamlı öğrenme (f-12) şeklinde temalar altında grupsal bir dağılım göstermektedirler (Şekil 1).

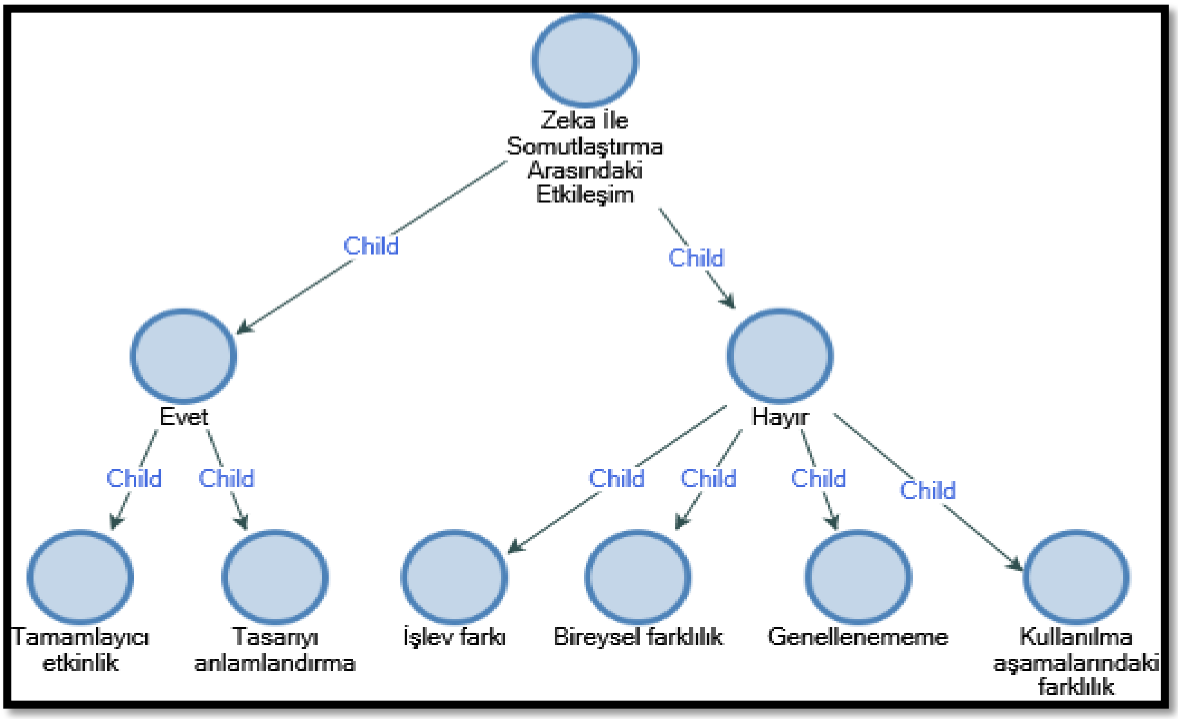
Çalışma grubunu oluşturan sosyal bilgiler öğretmenlerinin somutlaştırma kavramına yönelik sorulan bu soruya vermiş oldukları cevaplar şu şekilde örneklendirilebilir:

"Sosyal bilgiler dersine yaklaşık 8 yıldır giren bir bıranş öğretmeni olarak somutlaştırma kavramının bende oluşturduğu izlenim öğrencilerin ders işleme sürecinde dersi dinlerken, bir daha dinledikleri konuyu çalışacak zamanları olmayacakmış gibi kalıcı öğrenmelerini sağlayan bütün her şeydir." ***(Sosyal Bilgiler Öğretmeni, 7)***

"Somutlaştırma kavramı her ne kadar Piaget'e göre belli bir yaş aralığında (7-11) kritik bir öneme sahip olsa da ben insanın hayatı boyunca bu kavramın kritik özelliğini devam ettirdiğini düşünenlerdenim. Çünkü birey bu kavram sayesinde soyut olan zihinsel algılamalarını bazı nesne, eşya ya da simgelerle anlamlandırmaktadır." ***(Sosyal Bilgiler Öğretmeni, 41)***

Zekâ İle Somutlaştırma Arasında Bir Etkileşim Olduğunu Düşünme Durumu

Çalışma grubunu oluşturan sosyal bilgiler öğretmenlerine yöneltilen *"Zekâ ile somutlaştırma arasında bir etkileşim olduğunu düşünüyor musunuz, niçin?"* şeklindeki soruya çalışma grubu üyelerinin 2 farklı ana tema ve bunlara bağlı alt temalarla farklılaştıklarını şekil 2 de görülmektedir. Sosyal bilgiler öğretmenleri bu soruya, ana tema olarak "EVET" (f-15) ve "HAYIR" (f-35) şeklinde farklılaştıklarını söyleyebiliriz. Evet diyen çalışma grubu üyeleri, tamamlayıcı etkinlik (f-10) ve tasarıyı anlamlandırma (f-5) temalarını ortaya çıkarırken; Hayır diyen öğretmenler ise, işlev farkı (f-23), bireysel farklılık (f-12), genellememe (f-5) ve kullanılma aşamalarındaki farklılık (f-5) temalarını oluşturmuşlardır (Şekil 2).



Şekil 2: *Çalışma grubu üyelerinin zekâ ile somutlaştırma arasındaki etkileşime ilişkin algıları*

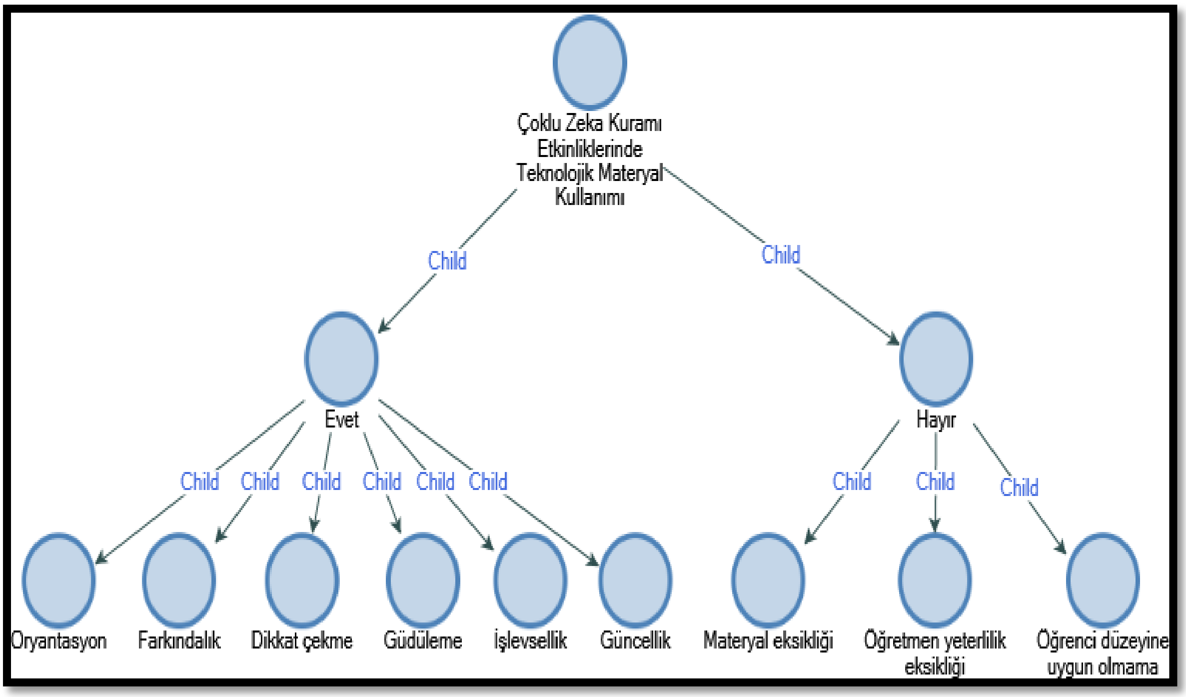
"Zekâ ile somutlaştırma arasında bir etkileşim olduğunu düşünüyor musunuz, niçin?" şeklindeki soruya çalışma grubu üyelerinin verdiği yanıtlar aşağıda örneklendirilmiştir.

"Zekâ ile somutlaştırma arasında bir etkileşimin olması bana göre söz konusu bile değildir. Çünkü zekâ her insanda var olan doğal bir yetenektir. Ancak somutlaştırma, bireyin zihinsel aktivitesi sonucu uzun süreli belleğe alınan ayırt edici uyarıcının kalıcı hale gelmesi için kullanılan her şey olabilir. ***(Sosyal Bilgiler Öğretmeni, 53)***

*"Somutlaştırma ile bireyin algılama kapasitesini ifade eden zekâ arasında bir etkileşim kesinlikle bulunmaktadır. Çünkü bireyin öğrenme süreci içerisinde nesne, simge veya herhangi bir araç gereç aracılığıyla öğrendiği durumu kavrama hızı yüksek iken; unutkanlık düzeyi ise düşüktür.****" (Sosyal Bilgiler Öğretmeni, 16)***

Çoklu Zekâ Kuramına Dayalı Hazırlanıp Kullanılan Etkinliklerde Teknoloji Destekli Materyallerin Kullanılma Durumu

Çalışma grubunu oluşturan sosyal bilgiler öğretmenlerine yarı yapılandırılmış görüşme formu aracılığıyla yöneltilen *"Çoklu Zekâ kuramına dayalı hazırlanıp kullanılan etkinliklerde teknoloji destekli materyaller kullanıyor musunuz, niçin?"* şeklindeki soruya, çalışma grubunu oluşturan öğretmenlerin birbirinden farklı yanıtlar verdiği şekil 3 de görülmektedir. Sosyal bilgiler öğretmenleri 2 ana tema ve bunlara bağlı alt temalarla birbirinden farklı düşündükleri ortaya çıkmıştır.



Şekil 3: *Çalışma grubu üyelerinin çoklu zekâ kuramı etkinliklerinde materyal kullanımına ilişkin algıları*

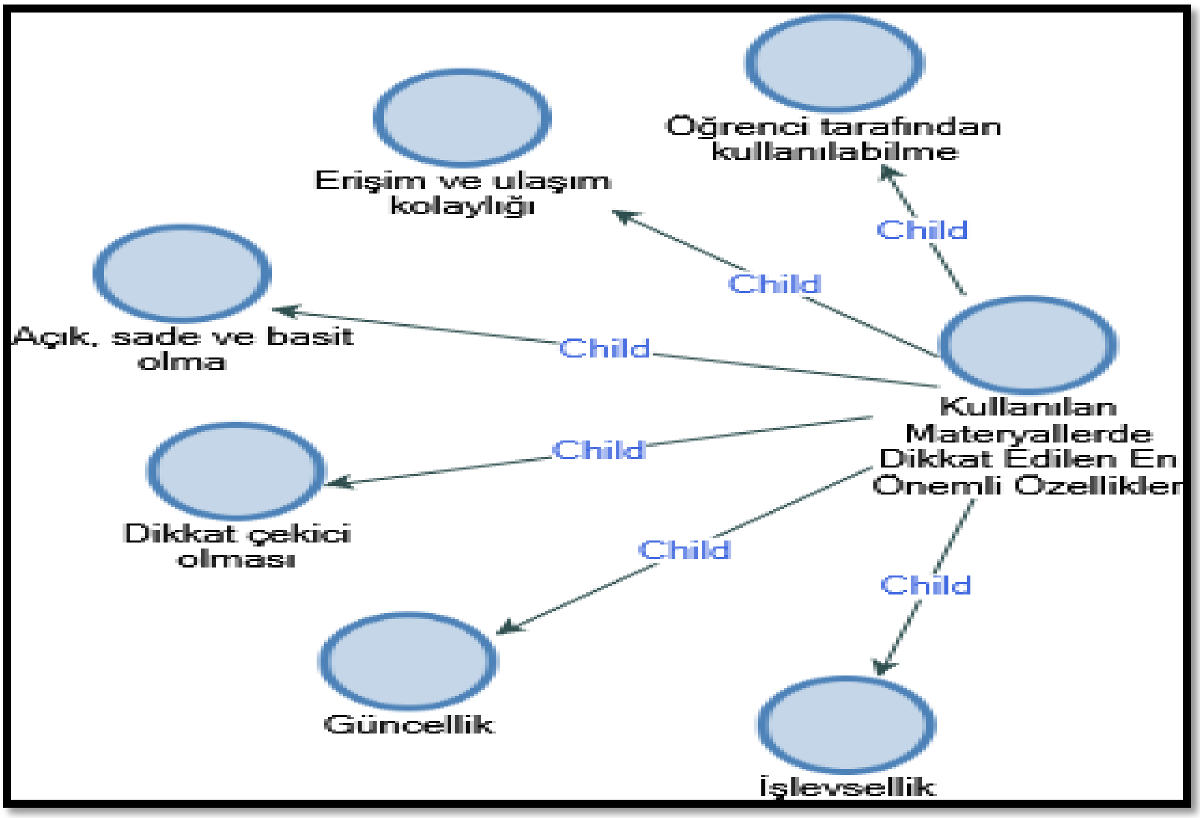
Yarı yapılandırılmış görüşme formunda yer alan *"Çoklu Zekâ kuramına dayalı hazırlanıp kullanılan etkinliklerde teknoloji destekli materyaller kullanıyor musunuz, niçin?"* şeklindeki soruya çalışma grubu üyesi olan sosyal bilgiler öğretmenlerinin 2 ana tema altında farklılaştıkları şekil 3'de gözlemlenmektedir Sosyal bilgiler öğretmenleri bu soruya, ana tema olarak "EVET" (f-45) ve "HAYIR" (f-15) şeklinde farklılaştıklarını söyleyebiliriz. Evet diyen çalışma grubu üyeleri, oryantasyon (f-10), farkındalık (f-5), dikkat çekme(f-10), güdülenme (f-7), işlevsellik (f-5) ve güncellik (f-8) temalarını ortaya çıkarırken; Hayır diyen öğretmenler ise, materyal eksikliği (f-6), öğretmen yeterlilik eksikliği (f-10) ve öğrenci düzeyine uygun olmama (f-4) temalarını oluşturmuşlardır (Şekil 3). Yukarıda 2 ana tema altında bir araya gelen ve farklılaşan sosyal bilgiler öğretmenlerinin görüşleri aşağıda örneklendirilmiştir.

"Çoklu zekâ kuramının temelinde birey yaratılış gereği birçok zekâ türüne sahip olarak dünyaya gelip yaşadığı çevre ve geçirmiş olduğu yaşantı sayesinde bunları geliştirdiği ilkesinden dolayı, bu kurama yönelik etkinliklerin hazırlanıp sunulmasında teknoloji destekli materyal kullanıyorum. Ayrıca kullandığım bu materyaller sayesinde öğrencinin derse olan istek düzeyi de artmış oluyor" ***(Sosyal Bilgiler Öğretmeni, 60)***

"Bu kuram kesinlikle bireyde var olan yetenekleri ortaya en ideal şekilde ortaya çıkaran kuram olduğunu düşünüyorum. Dolayısıyla bu kurama dayalı aktarımlarda materyal kullanımının genele hitap etmeyeceği kanısındayım. Her bireyin zekâ düzeyi farklı olduğu için kendi seviyesine uygun materyal de farklı olacaktır." ***(Sosyal Bilgiler Öğretmeni, 27)***

Soyut Olan Konuların Aktarımında Materyal Kullanma ve Bu Materyallerde Aranan En Dikkat Çekici Özellik Durumu

Yarı yapılandırılmış görüşme formunda yer alan *"Soyut olan konuların aktarımında materyal kullanıyorsanız, bu materyallerde aradığınız en önemli özellik nedir?"* şeklinde ki soruya, çalışma grubunu oluşturan sosyal bilgiler öğretmenlerinin 6 farklı tema altında bir araya geldiğini ve farklı düşündüklerini tablo 4 de gözlemlemekteyiz. Yarı yapılandırılmış görüşme formunda yer alan "Soyut olan konuların aktarımında materyal kullanıyorsanız, bu materyallerde aradığınız en önemli özellik nedir?" şeklindeki soruya çalışma grubu üyesi olan sosyal bilgiler öğretmenlerinin 6 farklı tema altında farklılaştıkları şekil 4'de gözlemlenmektedir. Sosyal bilgiler öğretmenleri bu soruya, öğrenci tarafından kullanılabilme (f-13), erişim ve ulaşım kolaylığı (f-8), açık, sade ve basit olma (f-9), dikkat çekici olma (f-15), güncellik (f-10) ve işlevsellik (f-5) şeklinde temalar altında grupsal bir dağılım göstermektedirler (Şekil 4).



Şekil 4: *Çalışma grubu üyelerinin soyut olan konuların aktarımında kullanılan materyallerde aranan özelliklere ilişkin algıları*

"Soyut olan konuların aktarımında materyal kullanıyorsanız, bu materyallerde aradığınız en önemli özellik nedir?" şeklindeki soruya çalışma grubu üyelerinin verdiği yanıtlar aşağıda örneklendirilmiştir.

"Soyut konuların aktarımında sürekli olarak materyal kullanan biri olarak şu cevabı vermek bana göre en doğru özellik olacaktır. Kullandığım bir materyalde aradığım birçok özellik olmakla birlikte dikkat ettiğim en önemli kısmı, materyalin açık, sade ve anlaşılır olmasıdır." ***(Sosyal Bilgiler Öğretmeni, 3)***

"Öğrenme öğretme sürecinde öğrencinin derse katılım düzeyinin artmasında en önemli adımın materyal kullanmak olduğuna inanan biri olarak, işlediğim derslerde soyut olan konuların öğrenciler tarafından daha iyi anlaşılması için sürekli olarak materyal kullanmaktayım. Bu materyalin en önemli özelliği bence dinleyiciler açısından dikkat çekici olması gerekir." ***(Sosyal Bilgiler Öğretmeni, 22)***

Sonuç ve Öneriler

"Türkiye'de devlet okullarında görev yapan ortaokul öğretmenlerinin görüşleri çerçevesinde çoklu zekâ uygulamaları üzerinde eğitimde teknoloji kullanımının değerlendirilmesi" temelli bu çalışmada yarı yapılandırılmış görüşme formu aracılığıyla sosyal bilgiler öğretmenlerinden alınan görüşler analiz edilerek elde edilen bulgular ışığından birbirinden farklı, dikkat çekici sonuçlar elde edilmiştir. Çalışma grubunu oluşturan sosyal bilgilerinin çoklu zekâ kuramına yaklaşımına dayalı derslerde kullanılan etkinliklere materyal ölçütü açısından yaklaşımlarının farklı olması, çalışmanın en önemli sonuçlarından birini oluşturmaktadır. Sosyal bilgiler öğretmenlerinden bir kısmının zekâ kavramını sadece doğal yetenek olarak ifade etmeleri ve materyal kullanımının bireyin zekâ gelişimine ve algılama düzeyine katkı sağlamayacağı şeklinde elde edilen sonuç, çalışmanın dikkat çekici diğer bir yönünü göstermektedir. Çalışma grubunu oluşturan sosyal bilgiler öğretmenlerinin, soyut konuların aktarımında materyal kullanımı konusunda hem fikir olmaları, derslerde kullandıkları materyallerde birbirinden farklı altı özelliği ön plana çıkarmaları, bireyin zekâ gelişimi ile somutlaştırma düzeyi arasında ilişkin çoğu üye için olmaması bu çalışmanın sonuçlarını önemli kılan diğer bir kısımdır. Çalışmada elde edilen bu sonuçlardan hareketle;

- ✓ İlkokul ve ortaokul düzeyinde derslere giren öğretmenler materyal kullanımına daha çok dikkat etmeleri,
- ✓ Soyut konuların aktarımında konuya uygun materyaller kullanmaları,

- ✓ Zekâ ile bireyin kalıcı ve somut algılama kapasitesi arasındaki etkileşim uzmanlar tarafından öğretmenlere anlatılmalı,
- ✓ Çoklu zekâ kuramına yönelik etkinliklere derslerinde yer veren öğretmenlerin bu etkinlikleri materyallerle desteklemeleri,
- ✓ Öğrencilerin anlama kapasitelerini arttırmayı temele alan zekâ kavramına yönelik derslerde kullanılan teknoloji destekli materyallerin kullanılmasında, bu materyallerin öğrenciler tarafından rahatlıkla kullanılacak şekilde tasarlanmaları gerekir, şeklinde önerilerde bulunulabilir.

Kaynakça

Akçay, H., Tüysüz, C., & Feyzioğlu, B. (2003). Bilgisayar destekli fen bilgisi öğretiminin öğrenci başarısına ve tutumuna etkisine bir örnek: mol kavramı ve avogadro sayısı. The Turkish Online Journal of Educational Technology, 2(2), 57-66.

Alkan, C. (1997). Eğitim teknolojisi (5. Baskı). Ankara: Anı Yayıncılık.

Altıntaş, G., Kahraman, E. ve Altıntaş, S.U.(2013). Teknoloji Entegrasyonunda Öğrencilerin Çoklu Zeka Alanları, Fen Tutumları, Akademik Başarıları ve Hatırlama Düzeyleri, *Eğitim ve Öğretim Araştırmaları Dergisi*, 4(3), 84-91.

Aydın, M. ve Aydın, K.(2010). Türk Inkılâbı Tarihi, Ankara: Cantekin Matbaacılık.

Balcı, A. (2004). *Sosyal Bilimlerde Araştırma, Yöntem, Teknik ve İlkleler,* Ankara: Pegem Akademi Yayınları.

Demirel, Ö. (2000). *Kuramdan uygulamaya eğitimde program geliştirme*. Ankara: PegemA Yayıncılık.

Gardner, H. (1985a). *Frames of mind: The theory of mulitple intelligences*. New York, NY: BasicBooks.

Gardner, H. (1993b). *Multiple intelligences: The theory in practice.* New York, NY: BasicBooks.

Karademirci, A. H. (2010). Öğretim Teknolojileri: Tanımı ve Tarihsel Gelişimine Yeniden Bakmak. XII.Akademik Bilişim Konferansı Bildirileri’10, 496.

Merriam, S. (1998). Qualitative Research and Case Study Applications in Education. San Francisco: Jossey-Bass.

Miles, M. ve Huberman, A. (1994). Qualitative Data Analysis: An Expanded Source Book. Thousand Oakes: Sage Publications.

Öngören, H., Şahin, A.(2008). Çoklu Zeka Kuramı Tabanlı Öğretimin Öğrencilerin Fen Bilgisi Başarılarına Etkileri

Saban, A. (2002). *Çoklu zeka teorisi ve eğitim*. Ankara: Nobel Yayın Dağıtım.

Selçuk, Z., Kayılı H., ve Okut, L. (2004). *Çoklu zeka uygulamaları*. Ankara: Nobel Yayın Dağıtım.

Yıldırım, A. ve Şimşek, H. (2008). Sosyal Bilimlerde Nitel Araştırma Yöntemleri. Ankara: Seçkin Yayıncılık.

Yin, R. K. (1994). “Evaluation: A Singular Craft”. Eds.: C. Reichardt and S. Rallis. New Directions in Program Evaluation, 1994, 71-84.

INVESTIGATION OF INTERNET ADDICTION LEVELS OF FINAL CLASS OF PRIMARY SCHOOL STUDENTS

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Abstract: In this study, the stuation of the addiction to the last grade students who continue their education in secondary school which linked to the Ministry of Education has been examined by several variables. The last grade students who continue their education year of 2016-2017, 4456 students in 79 elementary schools in the 4th grade in Malatya/Yeşilyurt are universe of the study. The sample of the study consists of 500 randomly selected 22 schools in the 4th class. The model of research is relational screening model. In order to determine the levels of addiction to the internet of the student, the Internet Addiction Scale which is developed by Günüç (2009) was used in the research. This scale is come into existence from sub-dimension 'deprivation', 'control difficulty', 'deterioration in functionality' and 'social isolation'. Results of researh will be reported later. T-test, k-Mean clustering analysis, one way ANOVA were used in the analysis of the data. LSD test which is technique of post-hoc were used to find the sources of differences when determined any significant difference as a result of ANOVA test. These analysis took place with the Statistical Package Program SPSS for Windows 22.0. The following findings were reached extractly in the study: From 500 students, 62 students (%12,4) are in the "internet addictive group", 200 students (%40) are in the "risk group" and 238 (47,6) students are in the "non-internet addicted group". According to the results; majority of the students forming the sample are in the "non-addictive group". There is no significant differences were determined among the the scores of internet addiction and sex of students and family's monthly economic status.

Keywords: Internet, internet addiction, addiction

İLKOKUL SON SINIF ÖĞRENCİLERİNİN İNTERNET BAĞIMLILIK DÜZEYLERİNİN İNCELENMESİ

Özet: Bu araştırmada M.E.B.'e bağlı ilkokullarda öğrenimini sürdüren son sınıf öğrencilerin internet bağımlılığı durumları çeşitli değişkenlere göre incelenmiştir. Araştırmanın evrenini 2016-2017 eğitim öğretim yılında Malatya ili Yeşilyurt ilçesinde öğrenimini sürdüren ilkokul son sınıf öğrencileri oluşturmaktadır. Araştırmanın evrenini Araştırmanın evrenini, 2016-2017 eğitim-öğretim yılında Malatya ili Yeşilyurt ilçesinde bulunan 79 ilkokulda 4. sınıfta öğrenim gören 4456 öğrenciden oluşturmaktadır. Araştırmanın örneklemini de tesadüfi olarak seçilmiş 22 okulda 4. sınıfta öğrenim gören 500 öğrenci oluşturmaktadır. Araştırmanın modeli ilişkisel tarama modelidir. Araştırmada öğrencilerin internet bağımlılık düzeylerini tespit etmek amacıyla Günüç (2009) tarafından geliştirilen 'İnternet Bağımlılık Ölçeği' kullanılmıştır. Bu ölçek; yoksunluk, kontrol güçlüğü, işlevsellikte bozulma ve sosyal izolasyon alt boyutlarından oluşmaktadır. Elde edilen verilerin analizinde t-testi, k-ortalama küme metodu, tek yönlü varyans analizi (One Way Anova) testi kullanılmıştır. "ANOVA" testi sonucunda anlamlı farklılaşmanın olduğu durumlarda farklılaşmanın hangi grup ya da gruplardan kaynaklandığını tespit etmek için "post-hoc" tekniklerinden "LSD" uygulanmıştır. Bu analizler "SPSS for Windows 22.00" istatistik paket programıyla bilgisayarda gerçekleştirilmiştir. Araştırmada özetle şu bulgulara ulaşılmıştır: 500 öğrenciden 62'si (%12,4) bağımlı grupta, 200'ü (%40) risk grubunda ve 238'i (%47,6) de bağımlı olmayan grupta yer almışlardır. Öğrencilerin internet bağımlılık puan ortalamaları ile cinsiyet ve aile aylık gelir durumları arasında anlamlı bir farklılaşma tespit edilmemiştir.

Anahtar Kelimeler: İnternet, internet bağımlılığı, bağımlılık

Giriş

Genel olarak bağımlılık ve madde kullanımının bireye günlük yaşamdaki zorlukların üstesinden gelmesi için yardım etme fonksiyonunu yerine getirdiği düşünülmektedir (Flores, 2004, s. 1). Çoğu zaman kimyasal madde elde etmek amacıyla bazen de amacı olmaksızın tekrarlanan davranış rutinlerini ifade eden bağımlılık, kişinin yinelenen takıntılar veya zorunluluk hissine dayalı davranışlar gösterdiği psikiyatrik bir bozukluktur (Marks, 1990, s. 1389). Geleneksel olarak sadece alkol ya da kokain gibi insan davranışlarına etki eden uyarıcı maddelerden kaynaklanan bir fenomen olarak görülmesine karşın, son 30 yılda yapılan araştırmalar bireylerin bağımlılık belirtileri gösteren davranış ve alışkanlıklarından dolayı da zarar görebileceklerini göstermiştir. Aşırı yeme, kumar, alışveriş, seks ve internet kullanımı da uyarıcı maddelerle benzer problemleri yaratabilmektedir (Padwa & Cunningham, 2010, s. 1). Bundan dolayı bağımlılık kavramı artarak birçok insan davranışını açıklamak amacıyla da kullanılmaya başlanmıştır (Netherland, 2012, s. 11).

Bilgisayarların yoğun olarak kullanılmaya başladığı zamanlarda insan ile makine iletişimini içeren kimyasal olmayan bir bağımlılık türü olarak tanımlanan teknoloji bağımlılığı ilk olarak Griffiths (1995, s. 14,15) tarafından dile getirilmiştir. İnternetin 90'ların ortalarından itibaren dünya çapında yayılmaya başlamasıyla birlikte internet bağımlılığı bireylerin bilişsel, duygusal ve sosyal gelişimini etkileyen önemli yasal bir psikolojik bozukluk olarak tanımlanmıştır (Price, 2011, s. 7). Henüz 1998 yılında Amerika'da çevrimiçi kullanıcıların 6%'sının bu sorunla yüzleştiği tespit edilmiştir (Brenner, 2000, s. 452). Ancak kimyasal bağımlılığın aksine aşırı internet kullanımı bağlayıcı olarak eleştirilmektense topluma sağladığı bazı teknolojik faydalarla ön plana çıkmıştır (Young, 2009, s. 217). İlk belirtileri ortaya çıktığında klinisyenler ve akademisyenler arasında tartışmalara yol açmıştır. Aşırı internet kullanımı bazıları tarafından patolojik, bağımlılık yapan ve teknolojik bağımlılığın bir türü olarak kabul edilmiştir (Widyanto & Griffiths, 2006, s. 31).

Bilgi çağının gerçeklerinden birisi olan internet kullanımı, yaşamın hemen her sahasını etkilediği gibi, eğitim ve okul sistemi ile öğretimde eğitim programlarının yapı ve sunumunu da önemli ölçüde etkilemiştir. Internet, bilgiye ulaşmayı ucuzlatıp, kolaylaştırmakla kalmamış, aynı zamanda bilgiyi zaman ve mekandan bağımsız hale getirmiştir. Bunun doğal sonucu olarak bilgiye ulaşmak, sorun olmaktan çıkmış gibi görünmektedir (Aydemir vd., 2013).

İnternet bağımlılığı kavramının uygun biçimde tanımlanması bakış açılarına göre değişkenlik göstermiştir. Genellikle kontrol edilemeyen meşguliyetin yanı sıra bozulmaya, sıkıntıya yol açan bilgisayar ve internet kullanımına ilişkin dürtü ya da davranışlarla nitelendirilmiştir (Shaw & Black, 2008, s. 353). Bazı araştırmacılar alkol ve madde kullanımını içeren bağımlılıklarla (Griffiths M. D., 1999, s. 246) diğer bazıları ise kişinin yinelenen takıntılar veya kompulsif (dürtüsel) kontrol bozukluklarıyla (Belsare, Gaffney, & Black, 1997) ilişkilendirmiştir. Patolojik internet kullanımı (Davis, 2001, s. 187), problemli internet kullanımı (Caplan, 2003, s. 625) ifadeleri de bu sorunu tanımlamada kullanılmıştır. Teknoloji bağımlığının son halkası olan internet bağımlılığı kavramı ilk olarak Ivan Goldberg tarafından dile getirilmiştir (Suler, 1996). Kontrol edilemeyen, önemli derecede zaman alan, sorunlu; ya da sosyal, mesleki zorluklarla sonuçlanan bir süreçtir (Shapira, Goldsmith, Keck, Khosla, & McElroy, 2000, s. 268). Young'a göre ise hızla büyüyen bir fenomen olarak internet bağımlılığı kumar bağımlılığıyla ilişkili geniş davranış çeşitliliği ve dürtü kontrol problemi içeren bir kavramdır (2004, s. 402). Griffiths (1999) ise aşırı kullanıcıların çoğu için internetin bağımlılık olmayabileceğini ayrıca diğer bağımlılıkları tatmin etmenin bir vasıtası olabileceğini belirtmiştir.

2000 yılında dünya genelinde 360 milyon olan internet kullanıcı sayısı 2017 yılında 3 milyar 700 milyon kişiyi aşmıştır (InternetWorldStats, 2014). 2016 yılı verilerine göre Türkiye'de internet kullanan bireylerin oranı %61,2'dir (TÜİK, 2014). Kullanıcı sayısı ise yaklaşık 41 milyon kişi olarak kayıtlara geçmiştir(IWS, 2017). Bu yaklaşık iki kişiden birinin aktif kullanıcı olduğu anlamına gelmektedir. İnternetin günlük yaşamdaki yerinin bu şekilde artmasıyla birlikte psikolojik etkenler başta olmak üzere bir çok değişken ile internet bağımlılığı arasındaki ilişki araştırılmıştır. Bu araştırmalarda problemli internet kullanımı ile dikkat eksikliği ve hiperaktivite bozukluğu (Yen vd, 2007; Ko, 2009; Dalbudak ve Evren, 2013; Öztürk vd, 2013), depresyon (Koronczai vd, 2013; Şahin vd, 2013; Şenormancı vd, 2014; Yang vd, 2014; Choi vd, 2014), yalnızlık (Yao & Zhong, 2014), nevrotik kişilik (Tsai, et al., 2009; Wang, Ho, Chan, & Tse, 2015), düşük özsaygı (Armstrong, Phillips, & Saling, 2000; Aydın & Sarı, 2011; Sariyska, et al., 2014), düşük özdenetim (Özdemir, Kuzucu, & Ak, 2014), akademik başarısızlık (Stavropoulos, Alexandraki, & Stefanidi, 2013), düşmanlık hissi (Koç, 2011), uyku problemi (Anderson, 2001; Lam, 2014) gibi psikolojik bozukluklar arasında ilişki olduğu görülmüştür.

Yöntem

Bu araştırmada var olan durumu olduğu gibi betimlemeyi amaçlayan tarama modeli kullanılmıştır. Tarama modelleri, 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 taramadır (Karasar, 2011, s. 110).

Evren ve Örneklem

Örnekleme yapılırken, öncelikle araştırmanın amaçları doğrultusunda sonuçların genelleme yapılmak istendiği evrenin sınırlandırılıp çalışma evreninin tanımlanması gerekir. Araştırmaların amaçlarına göre en uygun bir çalışma evreni vardır (Karasar, 2011, s. 111). Çalışmanın evrenini 2016-2017 eğitim- öğretim yılında Malatya ili Yeşilyurt ilçesinde öğrenim gören ilkokul son sınıf öğrencileri oluşturmaktadır.

Örneklem, belli kurallara göre, belli bir evrenden seçilmiş ve seçildiği evreni temsil yeterliği kabul edilen küçük kümedir. Araştırmalar çoğunlukla örneklem kümeler üzerinde yapılır ve elde edilen sonuçlar ilgili evrenlere genellenir (Karasar, 2011). Çalışmamızda örneklem alınmaya gidilmemiş örneklemin tamamı örneklem olarak alınmış ve evrenin tümüne ulaşılmaya çalışılmıştır. Ulaşılan 500 öğrenicinin tamamı değerlendirmeye alınmıştır.

Veri Toplama Aracı

Araştırmada, öğrencilerin internet bağımlılık düzeylerini tespit etmek amacıyla; Günüç (2009) tarafından geliştirilen "İnternet Bağımlılığı Ölçeği" kullanılmıştır. Ölçek, "yoksunluk", "kontrol güçlüğü", "işlevsellikte bozulma" ve "sosyal izolasyon" alt faktörleriyle birlikte 35 maddeden oluşmaktadır.

Verilerin Toplanması ve Analizi

Araştırmada, katılımcılara ilişkin veriler SPSS (The Statistical Packet for Social Sciences) 22.0 paket programı kullanılarak çözümlenmiştir. Ölçeklerle elde edilen veriler bilgisayar ortamına yüklendikten sonra normal dağılıma uygun olup olmadığının belirlenmesinde normallik testi (Test of Normality) yapılmıştır. İstatistiksel bir çalışmada, birçok testin yapılabilmesi için dağılımın normal veya normale yakın olması gerekmektedir (Kalaycı, 2006). Pek çok özellik evrende normal bir dağılım göstermesine karşılık, ilgilenilen bir özelliğe ilişkin ölçümlerin küçük bir gruptan ($n<30$) elde edilmesi durumunda normal dağılımdan sapmalar olacaktır. Grubun büyüklüğü arttıkça dağılım normale yaklaşacaktır (Ravid, 1994, akt. Büyüköztürk 2014; s. 63). Tabachnick ve Fidell, çarpıklık (skewness) ve basıklık (kurtosis) değerlerinin +1,500 ve -1,500 değerleri arasında olduğu durumlarda dağılımın normal olarak gerçekleştiğini kabul etmektedirler (s. 81). Uygulanan normallik testi sonucunda ölçek ifadelerinin çarpıklık (,762) ve basıklık (,074) değerleri +1,500 ve -1,500 değerleri arasında olduğu için araştırmada dağılımın normal olduğu söylenebilir. Bundan dolayı araştırmada verilerin analizinde parametrik testler kullanılmıştır. Araştırmanın alt problemlerine yanıt aramak için frekans dağılımları, k-ortalama küme metodu, t-testi ve tek yönlü varyans analizi kullanılmıştır. Tek yönlü varyans analizi sonucunda anlamlı bir farklılık çıkması durumunda farklılığın hangi gruplardan kaynaklandığını belirlemek için varyansların eşit olması halinde LSD testi kullanılmıştır. Verilerin analizinde anlamlılık değeri ($p<,05$) olarak alınmıştır.

Bulgular

Öğrencilerin demografik özelliklerine göre dağılımlarına ilişkin bilgiler Tablo 1'de frekans ve yüzde olarak verilmiştir.

Tablo 1. Öğrencilerin demografik özellikleri

Değişken	**Seçenekler**	**Frekans**	**Yüzde (%)**
	Kadın	250	50
Cinsiyet	Erkek	250	50
	Toplam	**500**	**100**
	0-1500 TL	125	25
	1501-3000 TL	213	42,6
Aile Gelir Durumu	3001-4500 TL	101	20,2
	4501 TL ve üzeri	61	12,2
	Toplam	**500**	**100**

Tablo 1'de görüldüğü üzere örneklem grubunu oluşturan öğrencilerin yüzde 50'si (%50,0) kadın, yüzde 50'si (%50,0) erkek öğrencilerden oluşmaktadır. Öğrencilerin ailelerinin aylık gelirine bakıldığında ise sırası ile öğrencilerin %42'sinin (%42,6) aylık aile geliri 1501-3000 TL aralığında, %25'inin (%25,0) aylık aile geliri 0-1500 TL aralığında, %20'sinin (%20,2) aylık aile geliri 3001-4500 TL aralığında ve %12'sinin de (%12,2) aylık aile geliri 4501 TL ve üzeri olduğu bulunmuştur.
Öğrencilerin ölçeğe verdikleri cevaplardan aldıkları puan dağılımı incelenmiş olup analiz sonuçları tablo 2'de verilmiştir.

Tablo 2. Öğrencilerin internet bağımlılık ölçeğinden aldıkları ortalama puanların dağılımı

	Kişi Sayısı (N)	**En Düşük Puan**	**En Yüksek Puan**	$\bar{X}$	**Standart Sapma**
Puan Değeri	500	1,03	4,97	2,18	0,80

Tablo 2'de görüldüğü gibi araştırmaya katılan öğrencilerin "İnternet Bağımlılık Ölçeği"ne vermiş oldukları en düşük puan ortalaması 1,03, en yüksek puan ortalaması ise 4,97'dir. Ölçekten elde edilen aritmetik ortalama ($\bar{X}$= 2,18) ve standart sapma ise (ss= 0,80) olarak bulunmuştur.

İnternet bağımlılığı olan ya da olmayan grubu belirlemek ve bireylerin bağımlılık durumları hakkında daha detaylı sonuçlar elde edebilmek için örnekleme sınıflama tekniklerinden "kümeleme analizi" tekniği uygulanmıştır. Kümeleme analizinin genel amacı, belirli özelliklerine göre birimlerin benzerliklerini ortaya koymak ve bu benzerlikleri esas alarak birimleri doğru kategorilere sınıflandırmaktır (Çokluk ve Ark., 2014; s. 139). Bu yöntem, örneklem içerisinde örtük bulunan bazı uç değerlerin de açığa çıkmasına olanak sağlamıştır. Bu kümeleme yöntemi ile bireylerin bağımlılık düzeyleri daha sağlıklı bir şekilde sınıflanabilmiştir (Günüç ve Kayri, 2009; s. 171).

Bireylerin bağımlılık durumlarının belirlenmesi konusunda daha detaylı bir sonuç elde edebilmek için kümeleme analizi uygulanmış ve üç alt kümeden oluştuğu gözlemlenmiştir. Buna göre Tablo 3'de de görüldüğü üzere; birinci kümede "bağımlı grup", ikinci kümede "bağımlılık riski taşıyan grup", üçüncü kümede ise "bağımlı olmayan grup" yer almaktadır. Kümelerin isimlendirilmesinde Günüç (2009)'ün tezi örnek alınmıştır.

Bu kısımda öğrencilerin internet bağımlılığının ne seviyede olduğuna dair, ölçeğin toplamında elde edilen puanlar dikkate alınarak, öğrencilerin internet bağımlılık puanlarının frekans ve yüzdelik dağılımları tablo 3'de verilmiştir.

Tablo 3. Öğrencilerin internet bağımlılık durumları için frekans ve yüzde değerleri

Kümeleme (k-ortalama)	**f**	**Toplam (%)**
1 (Bağımlı Grup)	62	12,4
2 (Risk Grubu)	200	40
3 (Bağımlı Olmayan Grup)	238	47,6
Toplam	**500**	**100**

Tablo 3 incelendiğinde bu çalışmada 500 öğrenciden; 62'si (%12,4) bağımlı grupta, 200'ü (%40,0) risk grubunda ve 238'i (%47,6) bağımlı olmayan grupta yer almaktadır. Bu sonuçlar dikkate alındığında örneklemi oluşturan öğrencilerin çoğunluğunun "bağımlı olmayan grup "da olduğu görülmektedir.

Bu verilerden yola çıkılarak yapılan literatür taramasında; İşleyen (2013)'in çalışmasında bağımlı grubun örneklemin %7'sini, Günüç (2009)'ün çalışmasında % 10,1'ini, İnan (2010)'ın çalışmasında %0,4'ünü, Çalışgan (2013)'ın araştırmasında %0,2'sini, Döner (2011)'in araştırmasında ise %0'ını oluşturduğu tespit edilmiştir. Diğer bazı çalışmalarda ise bu oranlar %4 (Wang ve Ark.2001), %1,1 (Bayraktar, 2001), %3,1 (Kaltiala-Heino, Lintonen ve Rimpela, 2004), %2 (Johansson ve Götestam, 2004), %20,7 (Yen ve Ark., 2007), %2,4 (Cao ve Su, 2007), % 8 (Elizabeth ve Tee, 2007), %4,3 (Jang, Hwang ve Choi, 2008) olarak bulunmuştur (akt., Günüç, 2009; s. 89).

Ayrıca literatür taramasında; İnan (2010)'ın çalışmasında internet bağımlılığı semptomu gösteren grup: örneklemin %9'unu, Döner (2011)'in araştırmasında sınırlı semptom gösterenler %9'unu, İşleyen (2013)'in çalışmasında risk grubu örneklemin %23'nü, Şahin (2011)'in araştırmasında sınırlı semptom gösterenler örneklemin %14'ünü, Günüç (2009)'ün çalışmasında risk grubu örneklemin %29'unu oluşturmuştur.

Öğrencilerin cinsiyetlerine göre internet bağımlılık puanları arasında anlamlı bir farklılaşma olup olmadığını belirlemek için " t testi" yapılmış ve sonuçlar Tablo 4'de gösterilmiştir.

Tablo 4. Öğrencilerin cinsiyetlerine göre internet bağımlılığı ile ilgili bulgular

Boyutlar	Cinsiyet	n	$\bar{X}$	s	t	p
Yoksunluk	Kız	250	2,55	0,91	-0,70	,077
	Erkek	250	2,70	1,02		
Kontrol Güçlüğü	Kız	250	1,98	0,84	-1,02	,547
	Erkek	250	2,06	0,90		
İşlevsellikte Bozulma	Kız	250	1,93	0,93	-0,37	,848
	Erkek	250	1,96	0,96		
Sosyal İzolasyon	Kız	250	1,92	0,94	0,32	,508
	Erkek	250	1,90	0,93		
İnternet Bağımlılık Ölçeği (Genel)	Kız	250	2,14	0,76	-1,01	,345
	Erkek	250	2,21	0,84		

N=500

Tablo 4 İncelendiğinde, öğrencilerin cinsiyetlere göre internet bağımlılığı ölçeğinin genelinde ($p<0.05$), yoksunluk ($p<0.05$), işlevsellikte bozulma ($p<0.05$), sosyal izolasyon ($p<0.05$) ve kontrol güçlüğü ($p<0.05$) alt boyutlarında anlamlı bir farklılaşma görülmemektedir.
Bu veriler dikkate alındığında öğrencilerin cinsiyetleri ile internet bağımlılık ortalamaları arasında anlamlı bir farklılaşmanın olmadığı söylenebilir. Bu bağlamda yapılan literatür taramasında araştırma bulgusunu destekleyen çok sayıda çalışmalara rastlanmıştır. Brenner (2000), Lee ve arkadaşları (2007), Batıgün (2011), Ceylan (2011), Kaya (2011), Jelenhick ve arkadaşları (2012), Hawii (2012), Çalışgan (2013), Andreou ve Svoli (2013), Dikme (2014) de cinsiyetin internet bağımlılığı üzerinde etkisinin olmadığını tespit etmişleridir.

Literatürde, internet bağımlılığı ile cinsiyet arasında anlamlı farklılaşma olduğunu ortaya koyan çalışmalara rastlamak da mümkündür. Ayaroğlu'nun 2002'de yapmış olduğu araştırmasında, üniversite öğrencilerinin internet kullanımları ile yalnızlık düzeyleri arasındaki ilişkiyi incelemiş; erkeklerin webde gezinme ve dosya transferi yapma alanlarında kadınlara kıyasla daha fazla zaman harcadıkları sonucuna varmıştır. Scherer ve Bost 1997'de internet kullanımı açısından 531 öğrenciyi incelemişlerdir. İnternet bağımlısı olarak tespit edilen öğrencilerin büyük çoğunluğunun (%71) erkek öğrenciler olduğu bulgusuna ulaşmışlardır. Döner (2011) yapmış olduğu araştırmada, 282 kız, 342 erkek olmak üzere toplamda 624 öğrenciye ulaşmıştır. Araştırma bulgularına göre erkek öğrencilerin kadın öğrencilere göre internet bağımlılıkları anlamlı bir şekilde farklılaşmış ve erkeklerin lehine çıkmıştır. Benzer şekilde Morahan-Martin ve Schumacher (2000), Chou ve Hsiao (2000), Bayraktar (2001), Koch ve Pratarelli (2004), Aktaş (2005), Yang ve Tung (2007), Balta ve Horzum (2008), Ögel (2012), Günüç (2009), Kelleci ve arkadaşları (2009), Tsai ve arkadaşları (2009), Esen (2010), Gürcan (2010), Yıldız (2010), Döner (2011), Gençer (2011), Liberatore ve arkadaşları (2011), Carli ve arkadaşları (2012), Gökçearslan ve Günbatar (2012), Yılmaz (2013) da cinsiyet değişkeni bakımından erkek öğrencilerin, kadın öğrencilere göre internet bağımlılık düzeylerinin daha yüksek olduğunu belirtmişlerdir. Az sayıda çalışma da ise internet bağımlılığının kadın öğrenciler lehine olduğu görülmüştür (Griffiths, 1995; Griffiths, 1996).

Cinsiyet değişkeni ile internet bağımlılığı arasında farklılaşma çıkmamasının sebebi; internetin, cinsiyet farklılığı gözetmeksizin çocukların erişebileceği bir durumda olması ve bu erişiminde günümüzde çok kolay olmasından kaynaklanabilir.

Öğrencilerin öğrenim gördükleri sınıflara göre internet bağımlılık puanları arasında anlamlı bir farklılaşma olup olmadığını belirlemek için "tek yönlü varyans analizi" yapılmış ve sonuçları Tablo 5'de gösterilmiştir.

Tablo 5.Öğrencilerin aile aylık gelir durumları ile internet bağımlılığı puanlarının varyans analizi sonuçları

Boyutlar	Sınıf	Kareler Toplamı	Sd	Kareler Ortalaması	F	p
Yoksunluk	Gruplar arası	32,91	3	3,65	3,65	0,06
	Grup içi	2601,21	2606	1,00		
	Toplam	**2634,13**	**2609**			
Kontrol Güçlüğü	Gruplar arası	15,66	3	1,74	2,03	0,48
	Grup içi	2228,27	2607	0,85		
	Toplam	**2243,93**	**2610**			
İşlevsellikte Bozulma	Gruplar	7,79	3	0,86	2,85	0,50

	arası					
	Grup içi	2445,02	2605	0,94		
	Toplam	**2452,82**	**2608**			
Sosyal İzolasyon	Gruplar arası	23,72	3	2,63	2,85	0,08
	Grup içi	2400,54	2607	0,92		
	Toplam	**2424,27**	**2610**			
İnternet Bağımlılığı Ölçeği (Genel)	Gruplar arası	17,09	3	1,89	2,69	0,22
	Grup içi	1832,47	2604	0,70		
	Toplam	**1849,56**	**2607**			

Tablo 5 İncelendiğinde, öğrencilerin internet bağımlılıklarına ilişkin durumları öğrencilerin ailelerinin gelir düzeyine göre, internet bağımlılık ölçeği geneli için $p<0,05$ düzeyinde ($p=0,22$) $p>0,05$ olduğu için anlamlı bir farklılaşma görülmemiştir ve yine alt boyutlar incelendiğinde de alt boyutlarda $p<0,05$ düzeyinde anlamlı bir farklılaşma görülmemiştir. Öğrencilerin ailelerinin aylık gelir düzeyi ile internet bağımlılığı arasında anlamlı bir farklılaşma tespit edilmemiştir.

İnternet bağımlılığı ile ailelerin gelir düzeyleri arasında anlamlı bir farklılaşma olmamasının sebebi olarak internetin her sosyo-ekonomik düzeyde bulunan bireyler için erişiminin ucuz ve rahat olması gösterilebilir. Elde edilen bu bulgu ailelerin gelir düzeyi değişkeni açısından literatürde yapılan çalışma verilerini destekler niteliktedir. Song (2003) ve Balta ve arkadaşları (2008)'nın yapmış oldukları araştırmaya göre internet bağımlılığı ile sosyoekonomik düzey arasında bir ilişkinin olmadığını ortaya koymuşlardır. Bakken ve arkadaşları (2009) da gelir düzeyi ile internet bağımlılığı arasında anlamlı bir farklılaşma bulmamışlardır. Esen (2010), İnan (2010), Gençer (2011) de benzer şekilde bulgulara ulaşmışlardır. Literatürde elde edilen bulguların aksine çalışmalara da rastlamak mümkündür. Yılmaz (2013) yapmış olduğu araştırmada yüksek ekonomik düzeyde bulunan öğrencilerin, orta ekonomik düzeyde bulunan öğrencilere göre daha çok internet bağımlısı olduğunu bulmuştur. Şahin (2011), aile gelir düzeyi arttıkça öğrencilerin internet bağımlılığına yatkınlığının da arttığını belirtmiştir. Benzer şekilde Bayraktar (2001), Batıgün ve Kılıç (2011), Sevindik (2011) de ekonomik düzey ile internet bağımlılığı arasında, aile gelir düzeyi arttıkça öğrencilerin internet bağımlılık düzeylerinin de arttığı yönünde anlamlı bir farklılaşma tespit etmişlerdir.

Sonuç

Bu bölümde araştırmadan elde edilen bulgulara dayalı olarak ulaşılan sonuçlara yer verilmiştir.

- İlkokul son sınıf öğrencilerinin internet bağımlılık düzeylerini incelemek için yapılan kümeleme analizi sonucunda öğrencilerin % 12'si bağımlı grupta yer alırken, %40'ı bağımlılık riski taşıyan grupta ve %48'si de bağımlı olmayan grupta yer almıştır.
- Öğrencilerin internet bağımlılık ölçeğinden aldıkları puanların ortalamalarının cinsiyet değişkenine göre farklılaşmadığı tespit edilmiştir.
- Öğrencilerin aile gelir düzeylerinin ağırlıklı olarak 1501-3000 TL aralığında olduğu görülmüş ve internet bağımlılık ölçeği puan ortalamaları arasında anlamlı bir ilişki bulunmamıştır.

Öneriler

Bu araştırmadan elde edilen bulgular doğrultusunda aşağıdaki öneriler sunulabilir:

- Öğrencilerin %40'ının risk grubunda yer alması göz önüne alındığında; ilkokul öğrencileri, gerek bilişim derslerinde gerekse diğer ilgili derslerde internet bağımlılığı hakkında bilgilendirilmeli ve bu derslere internet bağımlılığı ile ilgili gerekli içerikler eklenmelidir.
- İnternet bağımlılığının diğer madde bağımlılığı gibi önemli bir yere sahip olduğu konusunda, gelişen teknolojik imkânlar da göz önüne alınarak aileler ve çocuklar, çeşitli kanallar aracılığı ile bu durumdan haberdar etmek gerekir.
- 9-12 yaş grubundaki öğrenciler ailelerine bağımlı olmakla birlikte, daha fazla bağımsızlık ve güven duygusuna gereksinim duyarlar. Buna bağlı olarak, interneti ödev, araştırma ve iletişim aracı olarak kullanabilirler (Odabaşı, 2007). Örneklemde yer alan çocukların büyük çoğunluğu bu yaş grubunda yer aldığından grubun özelliklerine uygun olarak anne-babalar, çocukların güven duygularını zedelemeden internet kullanımı konusunda yönlendirici ve denetleyici olmalıdırlar.

- Bu araştırma Malatya ili Yeşilyurt ilçesinde öğrenim görmekte olan ilkokul son sınıf öğrencileri ile gerçekleştirilmiş olup daha geniş bir evren ve örneklem ile başka bölgelerde benzer karşılaştırmalı araştırmalar yapılabilir.

Kaynaklar

Anderson, K. J. (2001). Internet Use Among College Students: An Exploratory Study. *JOURNAL OF AMERICAN COLLEGE HEALTH* , 21-26.

Armstrong, L., Phillips, J. G., & Saling, L. L. (2000). Potential determinants of heavier internet usage. *International Journal of Human -Computer Studies* , 537-550.

Ayaroğlu, N. S. (2002). The Relationship Between Internet Use and Loneliness of University Students. Ankara: Orta Doğu Teknik Üniversitesi Eğitim Bilimleri Bölümü, Yayımlanmamış Yüksek Lisans Tezi.

Aydemir, H., Benzer, A. İ., Karahan, O., & Akmençe, E. (2013). Üniversite Öğrencilerinin İnternet Kaynaklarına Yönelik Görüşlerinin Değerlendirilmesi. *Procedia-Social and Behavioral Sciences* .

Aydın, B., & Sarı, S. V. (2011). Internet addiction among adolescents: the role of self-esteem. *Procedia So*

Bağımlılık ve Tedavisi Bilgi Merkezi. (2015). 1 10, 2015 tarihinde www.bagimlilik.info.tr: http://www.bagimlilik.info.tr/internet_bagimliligi.html adresinden alındı

Bayraktar, F. (2001). *İnternet Kullanımının Ergen Gelişimindeki Rolü.* İzmir: Ege Üniversitesi Sosyal Bilimler Enstitüsü.

Belsare, T. J., Gaffney, G. R., & Black, D. W. (1997). Compulsive computer use. *The American Journal Of Psychiatry* , 289.

Brenner, V. (2000). *İnceleme.* Milwaukee, Wisconsin: Wisconsin School of Professional Psychology.

Cao, F., & Su, L. (2007). Internet addiction among Chinese adolescent: Prelavence and psychological features. *Child: Care, Health and Developmant*, *33*(3), 275-281.

Caplan, E. C. (2003). Preference for Online Social Interaction A Theory of Problematic Internet Use and Psychosocial Well-Being. *Communication Research* , 625-648.

Choi, J.-S., Park, S. M., Roh, M.-S., Lee, J.-Y., Park, C.-B., Hwang, J. Y., et al. (2014). Dysfunctional inhibitory control and impulsivity in Internet addiction. *Psychiatry Research* , 424-428.

Çalışgan, H. (2013). *İlköğretim Öğrencilerinde İnternet Bağımlılığı Ve Siber Zorbalık.* İstanbul: Yeditepe Üniversitesi Sosyal Bilimler Enstitüsü.

Çokluk, Ö., Şekercioğlu, G., & Büyüköztürk, Ş. (2014). *Sosyal Bilimler İçin Çok Değişkenli İstatistik SPSS ve Lisrel Uygulamaları.* Ankara: Pegem Akademi.

Dalbudak, E., & Evren, C. (2013). The relationship of Internet addiction severity with Attention Deficit Hyperactivity Disorder symptoms in Turkish University students; impact of personality traits, depression and anxiety. *Comprehensive Psychiatry* , 497-503.

Davis, R. A. (2001). A cognitive-behavioral model of pathological Internet use. *Computers in Human Behavior* , 187-195.

Döner, C. (2011). *İlköğretim Öğrencilerinde İnternet Bağımlılığının Farklı Değişkenlere Göre İncelenmesi.* Ankara: Ankara Üniversitesi Eğitim Bilimleri Enstitüsü.

Elizabeth, H., & Tee, M. Y. (2007). Excessive internet use: The role of personality, linoliness and social support networks in internet addiction. *Australian Journal of Emerging Technologies and Society*, *5*(1), 34-47.

Esen, E. (2010). *Ergenlerde İnternet Bağımlılığını Yordayan Psiko-Sosyal Değişkenlerin İncelenmesi.* İzmir: Dokuz Eylül Üniversitesi Eğitim Bilimleri Enstitüsü.

Flores, P. J. (2004). *Addiction as an Attachment Disorder.* Northvhale/New Jersey: Jason Aronson Press;.

Griffiths, M. D. (1999). Internet addiction: Fact or fiction? *The Psychologist: Bulletin of the British Psychological Society* , 246-250.

Griffiths, M. (1995). Technological addictions. *Clinical Psychology Forum* , 14-19.

Günüç, S. (2009). *İnternet Bağımlılık Ölçeğinin geliştirilmesi ve bazı demografik değişkenler ile internet bağımlılığı arasındaki ilişkilerin incelenmesi.* Van: Yüzüncü Yıl Üniversitesi Sosyal Bilimler Enstitüsü.

Günüç, S., & Kayri, M. (2009). The Adapdation of Internet Addiction Scale into Turkish: The Study of Validitiy and Reliability. *Ankara University Journal of Faculty of Educational Sciences*, 157-175.

İnan, A. (2010). *İlköğretim II. Kademe Ve Ortaöğretim Öğrencilerinde İnternet Bağımlılığı.* Erzurum: Atatürk Üniversitesi Sosyal Bilimler Enstitüsü.

İşleyen, F. (2013). *Lise Öğrencilerinin İnternet Bağımlılığı Düzeylerinin Kişisel ve Ailesel Faktörlerle İlişkisinin İncelenmesi.* İzmir: Ege Üniversitesi Sosyal Bilimler Enstitüsü.

Jang, K. S., Hwang, S. Y., & Choi, J. Y. (2008). Internet Addiction and Psychiatric Symptoms among Korean Adolescents. The Journal of School Health, 78(3).

Johansson, A., & Götestam, G. K. (2004). Internet addiction: Characteristics of a questoinnaire an prevalence in Norwegian Youth (12-18 years). *Scandinavian Journal of Psycholog*, *45*, 223-229.

Kaltiala-Heino, R., Lintonen, T., & Rimpela, A. (2004). Internetaddiction? Potentially problematic use of the internet in a population of 12-18 year-old adolescents. *Addiction Research and Theory*, *12*(1), 89-96.

Karasar, N. (2011). *Bilimsel Araştırma Yöntemi.* İstanbul: Nobel Yayın Dağıtım.

Koronczai, B., Kökönyei, G., Urban, R., Kun, B., Papay, O., Nagygyörgy, K., et al. (2013). The mediating effect of self-esteem, depression and anxiety between satisfaction with body appearance and problematic internet use. *American Journal of Drug and Alcohol Abuse* , 259-265.

Lam, L. T. (2014). Internet Gaming Addiction, Problematic Use of the Internet, and Sleep Problems A Systematic Review. *CHILD AND ADOLESCENT DISORDERS* .

Marks, I. (1990). Behavioural (non-chemical) addictions. *British Journal of Addiction* , 1389-1394.

Netherland, J. (2012). *Critical Perspectives on Addiction.* HowardHouse, WagonLane, Bingley BD16 1WA, UK: Emerald Group Publishing Limited.

Ögel, K. (2012). *internet bağımlılığı nasıl gelişiyor?* 2 6, 2015 tarihinde http://www.internetbagimliligi.info: http://www.internetbagimliligi.info/gelisim_internet_bagimliligi.asp adresinden alındı

Ögel, K. (2012). *Neden İnternet ve Bilgisayar Bağımlılığı*. 2 6, 2015 tarihinde www.internetbagimliligi.info: http://www.internetbagimliligi.info/neden_internet_bagimliligi.asp adresinden alındı

Özdemir, Y., Kuzucu, Y., & Ak, Ş. (2014). Depression, loneliness and Internet addiction: How important is low self-control? *Computers in Human Behavior* , 284-290.

Özturk, F. Ö., Ekinci, M., Öztürk, Ö., & Canan, F. (2013). The Relationship of Affective Temperament and Emotional-Behavioral Difficulties to Internet Addiction in Turkish Teenagers. *Hindawi Publishing Corporation ISRN Psychiatry* , 1-6.

Padwa, H., & Cunningham, J. (2010). *Addiction A Reference Encyclopedia.* Santa Barbara,California: BC-CLIO,LLC.

Pratarelli, M. E., Browne, L., & Johnson, K. (1999). The bits and bytes of computer/Internet addiction: A factor analytic approach. *Behavior Research Methods. Instruments, & Computers* , 305-314.

Price, H. (2011). *Psychology of Emotions, Motivations and Actions İnternet Addiction.* New York: Nova Science Publishers, Inc.

Sariyska, R., Reuter, M., Bey, K., Sha, P., Li, M., Chen, Y.-F., et al. (2014). Self-esteem, personality and Internet Addiction: A cross-cultural comparison study. *Personality and Individual Differences* , 28-33.

Shaw, M., & Black, D. W. (2008). Internet Addiction Definition, Assessment, Epidemiology and Clinical Management. *CNS Drug* , 353-365.

Stavropoulos, V., Alexandraki, K., & Stefanidi, F. M. (2013). Recognizing internet addiction: Prevalence and relationship to academic achievement in adolescents enrolled in urban and rural Greek high schools. *Journal of Adolescence* , 65-576.

Suler, J. (1996). *Internet Addiction Support Group.* 2 15, 2015 tarihinde The Psychology of Cyberspace: http://users.rider.edu/~suler/psycyber/supportgp.html adresinden alındı

Şahin, M. (2011). *İlköğretim Okulu Öğrencilerindeki İnternet Bağımlılığı.* İstanbul: Yeditepe Üniversitesi Sosyal Bilimler Enstitüsü.

Şahin, S., Özdemir, K., & Ünsal, A. (2013). Evaluatıon Of The Relatıonshıp Between Internet Addiction and Deppression in University Students. *Medicinski Glasnik* , 14-27.

Şenormancı, Ö., Saraçlı, Ö., Atasoy, N., Şenormancı, G., Koktürk, F., & Atik, L. (2014). Relationship of Internet addiction with cognitive style, personality, and depression in university students. *Comprehensive Psychiatry* , 1385-1390.

TÜİK. (2014, 8 22). *Hanehalkı Bilişim Teknolojileri Kullanım Araştırması, 2014.* 2 12, 2015 tarihinde Türkiye İstatistik Kurumu: http://www.tuik.gov.tr/PreHaberBultenleri.do?id=16198 adresinden alındı

Wang, H., Zhou, X., Lu, C., Wu, J., Deng, X., & Hong, L. (2011). Problematic internet use in high school students in Guangdong Province, China. *Open-Acces, 6*(5), 1-8.

Widyanto, L., & Griffiths, M. (2006). 'Internet Addiction': A Critical Review. *International Journal of Mental Health and Addiction* , 31-51.

Yang, L., Sun, L., Zhang, Z., Sun, Y., Wu, H., & Ye, D. (2014). Internet addiction, adolescent depression, and the mediating role of life events: Finding from a sample of Chinese adolescents. *International Journal of Psychology* , 342-347.

Yen, J.-Y., Ko, C.-H., Yen, C.-F., Wu, H.-Y., & Yang, M.-J. (2007). The Comorbid Psychiatric Symptoms of Internet Addiction: Attention Deficit and Hyperactivity Disorder (ADHD), Depression, Social Phobia, and Hostility. *Journal of Adolescent Health* , 93-98.

Yıldız, İ. (2010). *Lise Öğrencilerinde Problemli İnternet Kullanımı İle Sağlıklı Yaşam Biçimi Davranışları Arasındaki İlişki.* Sivas: Cumhuriyet Üniversitesi Sağlık Bilimleri Enstitüsü.

Young, K. (2009). Internet Addiction: Diagnosis and Treatment Considerations. *J Contemp Psychother* , 241–246.

Young, K. S. (2004). Internet Addiction A New Clinical Phenomenon and Its Consequences. *AMERICAN BEHAVIORAL SCIENTIST,* , 402-415.

Young, K. S. (1996). Internet addiction: The emergence of a new clinical disorder. *CyberPsychology and Behavior* , 237-244.

Young, K. S. (2015). *Parenting in the Digital Age: Strategies and Prevention.* 1 11, 2015 tarihinde Net Addiction: http://netaddiction.com/childrenonline/ adresinden alındı

Young, K., & de Abreu, C. N. (2011). *Internet addiction: A handbook and guide to evaluation and treatment.* (K. Young, & C. Nabuco de Abreu, Dü) New Jersey: John Wiley & Sons, Incorporation.

TEACHER COMPETENCIES RELATED TO THE USE OF TECHNOLOGY IN HISTORY TEACHING

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Abstract: Concrete based activities and materials have an important role in meaningful and lasting learning of the students, which is the main component of the learning environment in the learning teaching process in education. The most important principle that determines the quality of these activities and materials in the learning environment is the ability of the teacher to organize activities and use materials. Especially the use of these activities and materials is becoming more important on the permanent learning of the learners, such as the history prepared on the basis of abstract acquisition and content. Nowadays, materials used in educational environments are based on technological equipment, and teachers have problems with using these materials. Based on these problems, the main purpose of this study is to determine the perceptions of history teachers working in state schools on the use of technology in the process of learning teaching. The study was a qualitative study and Nvivo11 program was used in data analysis.

Keywords: History, technology, teacher, concretization

TARİH ÖĞRETİMİNDE TEKNOLOJİ MATERYALİ KULLANIMINA İLİŞKİN ÖĞRETMEN ALGILARI

Özet: Eğitimde öğrenme - öğretme sürecinde öğrenme ortamının temel bileşeni olan öğrencilerin anlamlı ve kalıcı öğrenmesi için somutlaştırmaya dayalı etkinlikler ve materyaller önemli bir işleve sahiptir. Bu etkinliklerin ve materyallerin öğrenme ortamındaki niteliğini belirleyen en önemli ilke ise öğretmenin etkinlikleri düzenleyebilme ve materyalleri kullanabilme yeterliliğidir. Özellikle soyut kazanım ve içeriğe dayalı olarak hazırlanan tarih gibi derlerde öğrencinin kalıcı öğrenmesi üzerinde bu etkinliklerin ve materyallerin kullanımı daha da önem kazanmaktadır. Günümüzde eğitim ortamlarında kullanılan materyaller ise teknolojik donanıma dayalı olduğundan öğretmenlerin bu materyalleri kullanımına ilişkin bir takım problemlerle ortaya çıkmaktadır. Ortaya çıkan bu problemlerden hareketle yapılan bu çalışmanın temel amacı, devlet okullarında çalışan tarih öğretmenlerinin öğrenme öğretme sürecinde teknoloji kullanımına ilişkin algılarını belirlemektir. Çalışma nitel bir çalışma olup veri analizinde Nvivo11 programından yararlanılmıştır.

Anahtar Kelimeler: Tarih, teknoloji, öğretmen, somutlaştırma

Giriş

Tarih eğitimi, tarih nedir, tarihi niçin öğretiyoruz, tarih öğretiminde kullanılan strateji, yöntem ve teknikler nelerdir ve tarih öğretiminde öğrenme hangi düzeyde gerçekleşmiştir? Sorularına cevap arayan bir disiplindir. Bu eğitiminde alan bilgisi yeterliliği kadar, branş öğretmenlerinden meslek bilgisi yeterliliği de önemli görülmektedir. Çünkü meslek bilgisi yeterliliği, belirlenmiş ölçüt düzeyinde olmayan öğretmenlerin tarih programlarında yer alan, niçin (hedef), ne (içerik), nasıl (eğitim durumları) ve Ne kadar (Ölçme ve değerlendirme) sorularına cevap verme olasılığının minimum düzeyde olduğu söylenebilir.

Tarih derslerinin geleneksel yöntemlerle işlenmesinden dolayı öğrencilere sıkıcı ve itici geldiği bilinmektedir. Bu derslerin insanlara sıkıcı ve itici gelmesinin sebepleri arasında; dersin soyut olarak işlenmesi, öğretmenlerin derslerde genelde sözlü ifadeler kullanarak ders işlemeleri ve bunun akabinde de tarihin sürekli olarak ezberleneceği mantığının oluşması yer almaktadır (Şimşek, 2003; Aslan ve Turan, 2016). Bu anlayışı yok etmek için, Tarih eğitimine yönelik olarak işlenen derslerin öğrenme- öğretme sürecinde, geleneksel yöntemlerin kullanılmasından dolayı oluşan bu sıkıcılığı ortadan kaldırmak amacıyla öğrencilerin gelişim özelliklerine uygun olarak materyal kullanılması öğrencilerin algılama ve dikkat düzeyini arttırabileceğini söyleyebiliriz. Aksi takdirde Tarih derslerinde ezberci anlayıştan dolayı özellikle küçük yaştaki öğrenciler geçmiş dönemlerde meydana gelen olayları anlamlandırmada ve yorumlamada bir takım problemler yaşayacaklardır (Demircioğlu, 2012). Bu problemlerin yaşanmasında öğretmen merkezli derslerin işlenmesi, öğrencilerin dinleyici konumunda olmaları ve öğretimin ezbere dayalı yürütülmesinin etkili olduğu söylenebilir (Balkaya, 2002; Aslan ve Turan, 2016). Tarih dersi gibi sözlü anlatımın yüksek oranda olduğu derslerde öğrencileri derse güdülemek, dersi canlı tutmak ve anlatılanların daha kolay anlaşılmasını sağlamak için derslerde birden çok duyu organına hitap eden eğitim araçlarını kullanmanın gerekliliği gün geçtikçe artmaktadır (Demircioğlu, 2007).

Teknolojik gelişmeler doğrultusunda ileri düzeyde kullanılmaya başlanan teknolojik materyaller, tarih eğitimi alanında da öğrencilerin ilgilerini çekmek için kullanılmalıdır (Bal ve Yiğittir, 2012). Kullanılan materyallere bakıldığında kazanıma dayalı materyallerin kullanımının ilgili kurumlar tarafından teşvik edildiğini eğitim programlarında görmekteyiz. Tarih derslerine yönelik olarak genellikle haritaların ve akıllı tahtalarda yer alan tarihi figürleri sergileyen simgesel şekiller yaygın bir şekilde kullanılırken bu materyallere ilaveten bilgisayar oyunları, belgeseller, animasyonlar, filmler, resimler ve hikayelerde kullanılabilir.

Araştırmanın Amacı

"Nitel araştırma yöntemlerinin kullanılarak yapılan bu çalışmada, Türkiye'de farklı iki ilde devlet okullarında görev yapan lise öğretmenlerinin görüşleri çerçevesinde, Tarih öğretiminde teknoloji materyalinin kullanılmasının değerlendirilmesi amaçlanmıştır. Bu genel amaç çerçevesinde çalışma grubu üyelerine şu sorular yöneltilmiştir:

- ✓ Bir Tarih öğretmeni olarak teknolojik materyal deyince ne anlıyorsunuz?
- ✓ Tarih derslerinde öğrenme-öğretme sürecinde teknolojik materyaller kullanıyor musunuz, niçin?
- ✓ Tarih derslerinde, öğrenme-öğretme sürecinde bir tarih öğretmeni olarak en çok kullandığınız teknolojik materyaller nelerdir?

Yöntem

Araştırmanın Modeli

"Türkiye'de farklı iki ilde devlet okullarında görev yapan lise öğretmenlerinin görüşleri çerçevesinde, Tarih öğretiminde teknoloji materyalinin kullanılması" temelli bu araştırma, nitel bir çalışma olup, yarı yapılandırılmış görüşme yöntemiyle gerçekleştirilmiştir. Creswell (1998) nitel araştırmayı, sosyal yaşamı ve insanla ilgili problemleri kendine özgü metodlarla sorgulayarak, anlamlandırma süreci olarak ifade etmektedir. Nitel araştırma sürecinde araştırmacı bütüncül bir araştırma tablosu ortaya koyarak; kelime analizleri, detaylı katılımcı görüşme raporları kullanır ve araştırmayı doğal ortamda düzenler. Nitel araştırmada genel olarak takip edilen araştırma süreci parçadan bütünedir [tüme-varım]. Genel itibariyle nitel araştırmacı gözlem, görüşme ve dokümanlardan yola çıkarak kav ramları, anlamları ve ilişkileri açıklayarak süreci sürdürür (Merriam, 1998; Yıldırım ve Şimşek, 2008).Yarı yapılandırılmış görüşmelerde ise, görüşme soruları önceden belirlenmiş görüşme durumlarını kapsamaktadır (Balcı, 2004). 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 etmektedir (Yin, 1994, s.13; Merriam, 1998, s. 27).

Çalışma Grubu

Araştırmada çalışma grubunu, Malatya ve Elazığ il merkezlerinde Milli eğitim bakanlığına bağlı çeşitli okullarda görev yapan 25 tarih öğretmeni oluşturmaktadır. Araştırmanın bu illerde yapılması araştırmacının uygulama sürecinde araştırmanın güvenirliği açısından yaşadığı kolaylıktan dolayı çalışma grubu üyeleri bu illerden seçilmiştir.

Veri Toplama Aracı

Araştırmanın kuramsal boyutu oluşturulduktan sonra "Türkiye'de farklı iki ilde devlet okullarında görev yapan lise öğretmenlerinin görüşleri çerçevesinde, Tarih öğretiminde teknoloji materyalinin kullanılmasına yönelik çalışma grubu üyelerinin görüşleri değerlendirilmesi" için 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, İnönü Üniversitesi Eğitim Fakültesinde 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

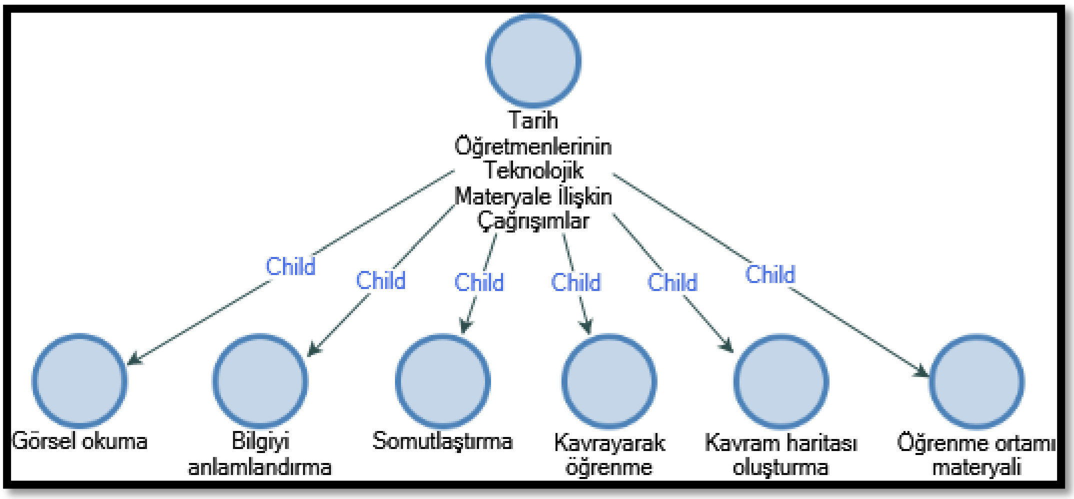
Araştırmada yarı yapılandırılmış görüşme formu ile ilgili çözümlemeler, nitel boyutta gerçekleştirilmiştir. Bilgisayar destekli nitel veri analizi yapılmıştır. Verilerin analizinde ve modellerin oluşturulmasında NVivo 11 programından yararlanılmıştır. Kodlamalar araştırmacıların ortak görüşleri doğrultusunda oluşturulmuştur. Bu çerçevede, "Türkiye'de farklı iki ilde devlet okullarında görev yapan lise öğretmenlerinin görüşleri çerçevesinde, Tarih öğretiminde teknoloji materyalinin kullanılmasına" yönelik görüşleri betimsel ve içerik analizi teknikleriyle belli temalar altında bu görüşler gruplanarak çözümlenmeye çalışılmıştır. Araştırmanın güvenirliğini sağlamak için, araştırmada ulaşılan uzman görüşüne başvurulmuştur. Araştırmacılar ve uzmanlar tarafından öncelikle ana temalar ardından bunlara bağlı 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

Tarih öğretiminde teknolojik materyallerin kullanımına ilişkin yapılan bu nitel çalışmada, çalışma grubu üyelerinin görüşleri doğrultusunda aşağıda verilen bulgular elde edilmiştir.

Teknolojik Materyallere İlişkin Tarih Öğretmenlerinde Çağrışım Uyandıran Kavramlar Durumu

Yarı yapılandırılmış görüşme formunda yer alan "Bir Tarih öğretmeni olarak teknolojik materyal deyince ne anlıyorsunuz?" şeklindeki soruya çalışma grubu üyesi olan tarih öğretmenlerinin 6 farklı tema altında farklılaştıkları şekil 1'de gözlemlenmektedir. Tarih öğretmenleri bu soruya, görsel okuma (f-3), bilgiyi anlamlandırma (f-2), somutlaştırma (f-13), kavrayarak öğrenme (f-3), kavram haritası oluşturma (f-2) ve öğrenme ortamı materyali (f-2) şeklinde temalar altında grupsal bir dağılım göstermektedirler (Şekil 1).



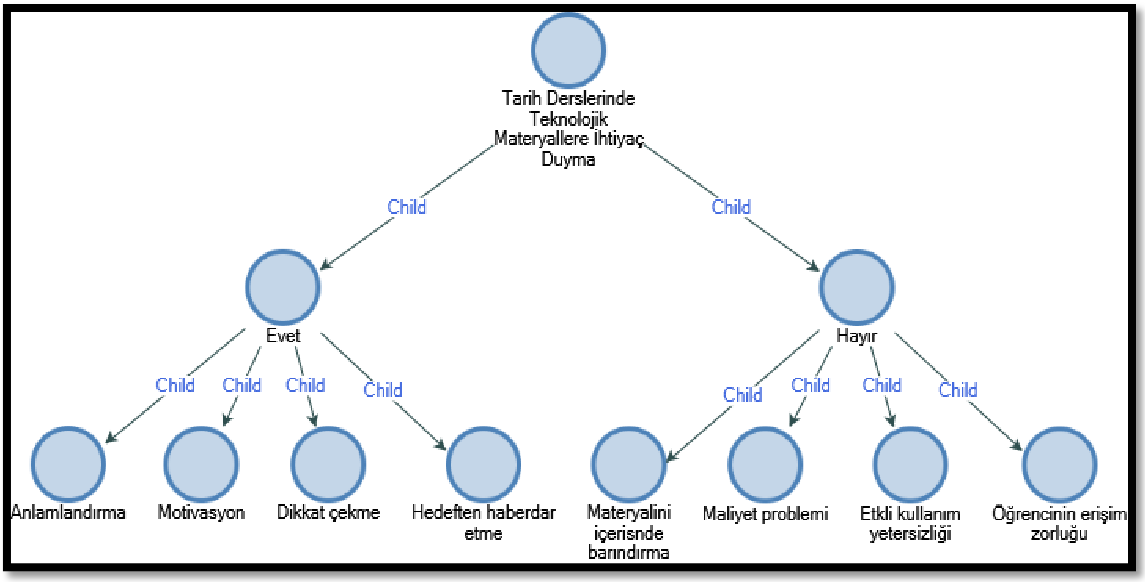
Şekil1. Tarih öğretmenlerinin teknolojik materyale ilişkin algıları

Çalışma grubu üyelerinin vermiş oldukları görüşler çerçevesinde oluşan şekil 1 deki görünümü örneklendiren öğretmen görüşü aşağıda örneklendirilmiştir.

> *"Ben 10 yıllık bir tarih öğretmeni bu soruya şöyle cevap verebilirim. Tarih dersi soyut bir ders gibi gözükse de materyal olmadan da hikâyeci anlatımla somutlaştırılarak anlamlı öğrenme sağlanabileceği kanısındayım. Dolayısıyla materyalin olduğu bir öğrenme ortamında benim aklıma ilk gelen kavram bilgiyi anlamlandırmadır."*

Tarih Derslerinde Öğrenme-Öğretme Sürecinde Teknolojik Materyaller Kullanma Durumu

Çalışmaya katılan lise düzeyinde eğitim veren tarih öğretmenleri kendilerine yöneltilen "Tarih derslerinde öğrenme-öğretme sürecinde teknolojik materyaller kullanıyor musunuz, niçin?" şeklindeki soruya birbirinden farklı cevapları oluşturan 2 farklı tema altında bir araya geldiğini şekil 2'de görmekteyiz. Tarih öğretmenleri bu soruya, ana tema olarak "EVET" (f-15) ve "HAYIR" (f-10) şeklinde farklılaştıklarını söyleyebiliriz. Evet diyen çalışma grubu üyeleri, anlamlandırma (f-2), motivasyon (f-3), dikkat çekme (f-7) ve hedeften haberdar etme (f-3) temalarını ortaya çıkarırken; Hayır diyen öğretmenler ise, materyali içerinde barındırma (f-3), maliyet problemi (f-2), etkili kullanım yetersizliği (f-2) ve öğrencinin erişim zorluğu (f-3) temalarını oluşturmuşlardır (Şekil 2).



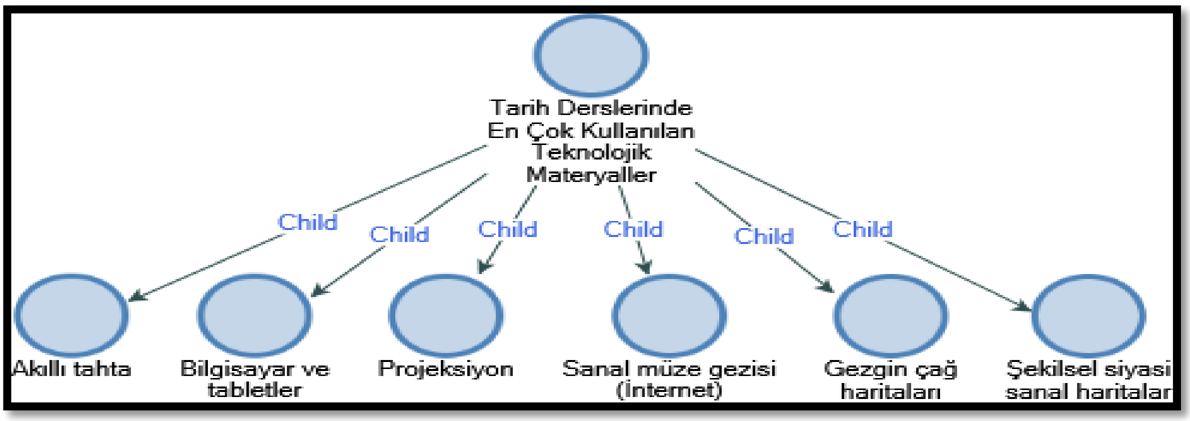
Şekil2. Tarih öğretmenlerinin teknolojik materyallere derslerde ihtiyaç duyma durumu

Şekil 2 de çalışma grubu üyelerini oluşturan tarih öğretmenlerinin oluşturduğu ana ve alt temalar aşağıda örneklendirilmiştir.

> *"Soyut temelli her derste teknolojik destekli materyalin kullanılması gerektiğine inanan biri olarak, Tarih derslerinde de bu materyallerin kullanılması gerektiğini söylemekle birlikte kendimde her derste kullanmaya özen gösteriyorum. Çünkü öğrencilerimiz mu materyaller sayesinde öğrenme sürecinde dikkat düzeyleri sürekli canlı kalmaktadır."*

Tarih Derslerinde Kullanılan Teknolojik Materyallere İlişkin Durum

Yarı yapılandırılmış görüşme formunda yer alan "Tarih derslerinde, öğrenme-öğretme sürecinde bir tarih öğretmeni olarak en çok kullandığınız teknolojik materyaller nelerdir?" şeklindeki soruya çalışma grubu üyesi olan tarih öğretmenlerinin 6 farklı tema altında farklılaştıkları şekil 3 de gözlemlenmektedir. Tarih öğretmenleri bu soruya, akıllı tahta (f-3), bilgisayar ve tablet (f-2), projeksiyon (f-13), sanal müze gezisi (internet) (f-3), gezgin çağ haritaları (f-2) ve şekilsel sanla siyasi haritalar (f-2) şeklinde temalar altında grupsal bir dağılım göstermektedirler (Şekil 3).



Şekil 3. Tarih öğretmenlerinin kullandıkları teknolojik materyallere ilişkin durum

Çalışma grubunu oluşturan tarih öğretmenlerinin "Tarih derslerinde, öğrenme-öğretme sürecinde bir tarih öğretmeni olarak en çok kullandığınız teknolojik materyaller nelerdir?" şeklindeki soruya vermiş oldukları yanıtlar şu şekilde örneklendirilmiştir.

> *"Fatih projesi çerçevesinde okullarımızda kullanılmaya başlanan akıllı tahta uygulaması Tarih gibi soyut derslerin somutlaştırılması sürecinde çok yarar sağladığını öğrencilerden aldığımız tepkilere bakarak söyleyebilirim. Bende bundan dolayı akıllı tahta kullanımına derslerimde daha çok yer vermekteyim."*

Sonuç ve Öneriler

Türkiye'de farklı iki ilde devlet okullarında görev yapan lise öğretmenlerinin görüşleri çerçevesinde, Tarih öğretiminde teknoloji materyalinin kullanılması" temelli bu araştırmada elde edilen sonuçlara bakıldığında, çalışma grubunu oluşturan öğretmenlerin çoğunun (f-15) derslerinde materyal kullanımına önem verdiklerini, bu durumu da materyal kullanımının öğrenciye kazanımlarıyla açıkladıklarını söyleyebiliriz. Bu kazanımları, dikkat çekme, güdüleme, hedeften haberdar etme, anlamlı öğrenme, kavrayarak öğrenme ve bilgiyi anlamlandırma şeklimde sıralayabiliriz. Çalışma grubunu oluşturan tarih öğretmenlerinin tarih dersini soyut bir ders olarak görmeleri ve bu derste materyal kullanılmasa da hikâyeci bir anlatımla bu dersin somutlaştırılıp anlamlı öğrenmenin oluşturulabileceğini ifade etmeleri de dikkat çekici bir diğer sonucu oluşturmaktadır. Çalışmada elde edilen bu sonuçlardan hareketle;

- ✓ Tarih derslerinde materyal kullanımı önemi tarih öğretmenlerine anlatılıp materyallerin kullanımı teşvik edilmelidir,
- ✓ Tarih dersi gibi soyut içeriğe sahip olan derslerin somutlaştırılmasına yardımcı olan materyallere öğretmenlerin ulaşımı ilgililer tarafından kolaylaştırılmalıdır,
- ✓ Tarih dersine uygun güncel teknolojik materyaller hazırlanmalıdır,
- ✓ Tarih dersine yönelik hazırlanan teknolojik materyallerin kullanımı kolay, materyal açık, sade ve anlaşılır olmalıdır, şeklinde öneriler sunulabilir.

Kaynakça

Aslan, H. ve Turan, İ.(2016).Tarih Öğretmenlerinin Görsel Materyal Kullanım Düzeyleri, Kafkas Üniversitesi Sosyal Bilimler Enstitüsü Dergisi Kafkas University Journal of the Institute of Social Sciences Sonbahar Autumn 2016, Sayı Number 18, 347-361 DOI:10.9775/kausbed.2016.018.

Bal, M. ve Yiğittir, S. (2012). "Okul Duvarlarındaki Görsellerin Tarih Öğretimi Açısından İncelenmesi", Kastamonu Eğitim Dergisi, 20 (3), s. 999- 1016.

Balcı, A. (2004). *Sosyal Bilimlerde Araştırma, Yöntem, Teknik ve İlkleler,* Ankara: Pegem Akademi Yayınları.

Balkaya, A. (2002). İlköğretim Sosyal Bilgiler Dersi Tarih Konularının Öğretiminde Tarihsel Kanıtların Etkililiği. Yayımlanmamış Yüksek Lisans Tezi, Marmara Üniversitesi Eğitim Bilimleri Enstitüsü, İstanbul.

Demircioğlu, İ. (2012). Tarih Öğretimi, Öğretim Teknolojileri ve Materyal Tasarımı. Tarih Öğretiminde Öğretim Teknolojileri ve Materyal Tasarımı (birinci baskı) içinde (s. 1-12). Ankara: Pegem Akademi.

Merriam, S. (1998). Qualitative Research and Case Study Applications in Education. San Francisco: Jossey-Bass.

Miles, M. ve Huberman, A. (1994). Qualitative Data Analysis: An Expanded Source Book. Thousand Oakes: Sage Publications

Şimşek, A. (2003). "Tarih Öğretiminde Görsel Materyal Kullanımı". G.Ü. Kırşehir Eğitim Fakültesi Dergisi, Cilt 4, Sayı 1, 143- 157.

Yıldırım, A. ve Şimşek, H. (2008). Sosyal Bilimlerde Nitel Araştırma Yöntemleri. Ankara: Seçkin Yayıncılık.

Yin, R. K. (1994). "Evaluation: A Singular Craft". Eds.: C. Reichardt and S. Rallis. New Directions in Program Evaluation, 1994, 71-84.

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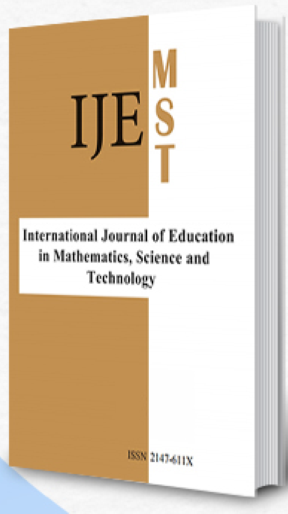

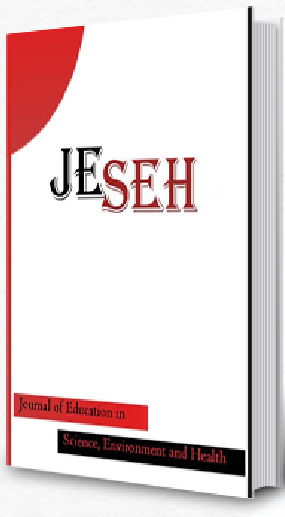

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