

A Research on Postgraduate Dissertations Related with Educational Games: An Evaluation in the Context of Mathematics Education

Eğitsel Oyunlarla İlgili Lisansüstü Çalışmaların İncelenmesi: Matematik Eğitimi Bağlamında Bir Değerlendirme

Selçuk ALKAN¹

Ebru KORKMAZ²

Abstract

In this study, postgraduate dissertations about digital and non-digital educational games are examined. The data were obtained from 108 dissertations from the national thesis center. The theses have been searched with keywords educational games and digital game. The theses were classified with regard to the course, thesis type, the university, the year, the audience and game type. Then, related to mathematics education dissertations were classified in regard to the type of educational games, audience and the methods used considering the expertise of the advisors. The theses were carried out between 1990 and 2020 on 16 different courses, 89 of them are masters and 19 are doctoral studies. Mostly related theses were prepared in (14.8%) Gazi, (7.4%) Atatürk and (7.4%) Marmara Universities. The theses were carried out from pre-school to university in terms of implementation and 40 of them are digital and 68 are non-digital educational games. 9 of the theses were about mathematics education, 6 of them are related to digital educational games and 3 of them are related to non-digital educational games. The rate of digital game used theses in mathematics education is higher than the other course areas. All theses were prepared for the secondary school level. In addition, 5 of the advisors were mathematics educators and 4 of them were in different fields. According to the findings, almost all of the theses results have positive effects on academic achievement, but there is no statistically significant difference in academic study and attitude only in one study.

Keywords: Digital games, educational games, mathematics education.

Öz

Bu çalışmada dijital ve dijital olmayan eğitsel oyunlar ile farklı dersler üzerine eğitimi gerçekleştirilmiş lisansüstü tez çalışmaları incelenmiştir. Çalışma verileri ulusal tez merkezi sisteminden eğitsel oyun ve dijital oyun başlıklarıyla elde edilen yayımlanmış toplam 108 lisansüstü tezin incelenmesiyle elde edilmiştir. İncelenen tezler; uygulandığı derse, tezin türüne, yürütülen üniversiteye, yayımlandığı yıla, hedef kitesine, kullanılan oyunların türüne göre sınıflandırılarak genel bir değerlendirmeye tabi tutulmuştur. Daha sonra incelenen tüm tezler arasından matematik eğitimiyle ilişkili olan tezlerde eğitsel oyunların türü, hedef kitlesi ve tezi yürüten danışmanların uzmanlık alanlarına göre kullanılan yöntemlere göre sınıflandırılarak incelenmiştir. Yayımlanan tezler 1990 ile 2020 yılları arasında, 16 farklı ders üzerine gerçekleştirilmiş olup 89'u yüksek lisans, 19'u doktora çalışmasıdır. Tez çalışmalarına ev sahipliği yapan ilk üç üniversite (%14,8) Gazi, (%7,4) Atatürk (%7,4) ve Marmara Üniversitesi olarak belirlenmiştir. Tezler okul öncesinden üniversiteye kadar tüm düzeylerde gerçekleştirilmiş olup 40'ı dijital, 68' i de dijital olmayan eğitsel oyun içeriklidir. İncelenen tezlerin 9 tanesi matematik eğitimi üzerine gerçekleştirilmiş olup 6 tanesi dijital olan eğitsel oyunları 3 tanesi de dijital olmayan eğitsel oyunları kapsamaktadır. Matematik eğitiminde dijital oyun kullanım oranının diğer ders alanlarına göre daha yüksek olduğu,

¹ Arş. Gör. Dr., Hatay Mustafa Kemal Üniversitesi, Eğitim Fakültesi, Antakya-Hatay, selcukal4401@hotmail.com, orcid.org/0000-0001-8717-4983

² Dr. Öğr. Üyesi, Muş Alparslan Üniversitesi, Eğitim Fakültesi, Muş, eb.korkmaz@alparslan.edu.tr, orcid.org/0000-0001-6250-3293

çalışmaların ortaokul düzeyinde olduğu ancak ilkököl ve üniversite düzeyinde hiçbir çalışma bulunmadığı belirlenmiştir. Ayrıca matematik eğitimi üzerine yapılan tezleri yürüten danışmanların 5'inin matematik eğitimcisi, 4'ünün de farklı alanlarda uzman oldukları tespit edilmiştir. Elde edilen bulgular ışığında incelenen lisansüstü tezlerin hemen hepsinde eğitsel oyunların akademik başarıya olumlu etkilerinin olduğu ancak bir çalışmada akademik başarıya ve bir başka çalışmada da tutuma yönelik istatistiksel olarak anlamlı bir farklılığın oluşmadığı gözlemlenmiştir.

Anahtar Kelimeler: Dijital oyunlar, eğitsel oyunlar, matematik eğitimi.

INTRODUCTION

While the importance of mathematics increases day by day in line with the increasing needs due to the rapid changes in human life with the development of technology in this age, it is an undeniable situation that it is an indispensable tool for other sciences with interdisciplinary interaction. As Ülger (2003) states, mathematics, which is defined as "something to be learned" terms, was used for the first time in the school established by Pythagoras and it is one of the first branches of science that was passed to written sources by the famous thinker Plato. Mathematics born in Mesopotamia has emerged in daily work and in line with needs and has continued to develop from past to present. Unlike other disciplines, its development is related to its previous and subsequent development (Özcan, 2014). The fact that scientists from different cultures and ethnic origins benefit each other and support each other with their studies shows that mathematics has an international language. With all these principles, it can be said that mathematics still continues to develop and the development levels of countries depend on this (Soydan, 2019).

Due to the deficiencies in the education system and infrastructure problems, students see mathematics as the aim of passing the exams instead of using it as a tool that they can use in daily life (Baki, 2006). The disconnection between mathematics teaching in schools and real life; It is insufficient to use the learned information in real life or for solving problems encountered (Altun & Bozkurt, 2017). In this direction, it has been observed that students quickly concentrate on result-oriented operations rather than thinking about existing problems or developing solution strategies (Verschaffel, et al., 1999).

Mathematics consists of abstract procedures and some rules due to its mathematical structure. Students, on the other hand, memorize these formulas and rules in order to pass the exams instead of integrating them into real life and forget them after the exam. In educational institutions, the teaching of the lessons mostly with traditional methods makes it difficult to learn because of the abstract structure of mathematics. A lesson that is achieved by memorizing and failed when the rules are forgotten becomes difficult for students. It is generally not possible for a lesson to be liked by students that has no place in real life and is based on memorization. As a matter of fact, the student may have a negative attitude towards the lesson because he has difficulty in understanding mathematics that he does not use in his life and that he thinks it is not useful for him, even it can become a fear of students (Özçelik, 2015). The reflection of this fear is seen in various exams. Studies in which mathematics lessons and achievements are evaluated both nationally and internationally reveal the current situation of the students. PISA, PIRLS and TIMSS are examples of international studies. At national level, KPSS, YKS, LGS exams can be given as examples. Although there have been positive developments as a result of the improvements made in the field of education as of the beginning of the 21st century, the low scores of the students in the domestic general exams coincide with the international exam results and the level we are in as a country shows a partial improvement (Korkmaz, 2017).

In today's life, which is accepted as the information age, individuals are expected to have skills such as questioning the problems in their daily lives, researching, coming up with various solutions and making inferences by reasoning. In order to acquire these skills and to reach the determined educational targets, primary education in 2004 and secondary education level in 2005 mathematics course curriculum were renewed (Tutak & Güder, 2014). It is known that the

mathematics curriculum was renewed again in 2015. Reasoning, predicting and finding different solutions take the place of skills such as transactional and calculation skills, which were emphasized in previous curriculums with renewed insights. The main purpose of the renewed mathematics curriculum is for the individual to use mathematics in his own life, to discuss the cause and solution of the problems he / she solves, to work in cooperation and to develop a positive attitude towards the mathematics lesson (MEB, 2018). Until recently, it was thought that knowing mathematics was to remember mathematical rules and concepts correctly, to use them, to learn as defined by the teacher and to answer the questions correctly; in short, mathematics was aimed at finding the exact and correct answer (De Hoyos et al., 2002). Today, it is perceived as abilities that center on modeling of reality, that occur through problem solving and interpretation processes, and that also develop in the process in question (Santos-Trigo, 1996). At this point, the main problem is not what to teach in mathematics, but how to teach mathematics (Freudenthal, 1968). Reports prepared as a result of researches should be able to shed light on reforms in education. Permanent and long-term projects should be included in the implementation instead of the solution offers to save the day in the temporary and short term. Reform studies should be carried out effectively towards the identified problems (Korkmaz & řahin, 2013).

Methods and techniques used differently from traditional mathematics teaching will also enable students to learn meaningfully (Fırat, 2011). There are educational games among these different methods and techniques. The word "game" is used in TDK (2019) as "spending time, having fun, etc. dealing with something with goals ". Game; it is a tool that helps children to develop emotionally, to reflect on and discover the difficulties encountered, to understand the roles in social life, and to develop their communication skills (Fırat, 2011). In addition, as Malta (2010) stated, games are important activities that provide personal development at different ages and in different ways. Game and teaching technique can appeal to students at all levels. It can make the topics covered in the competition and racing environment more enjoyable. The games can be applied in groups or individually, depending on the purpose, time and topic. During the game, mathematical information should be used at an adequate level and compliance with the subject to be transferred should be ensured in line with the made plans (Uğurel, 2003). Since the problems encountered by students while playing games enable them to produce various solutions, it also improves their thinking skills. In addition, the games that provide these improvements determine the reactions of the person to the problems that they will encounter in the future (řahin, 2016). Thanks to the social cooperation established with friends, learning takes place. Thanks to game learning, the individual is rewarded with pleasure and happiness instead of external feedback such as getting high marks (Sönmez, 2012).

In order for mathematics to be adopted and understood by getting rid of its abstract structure, the individual needs concrete experiences and vital facts. In order to develop students' imaginations and independently develop exploratory thinking skills, mathematical expressions should be freed from the abstract structure by using concrete teaching materials and visualizing them (Tutak, 2008).The importance and functionality of mathematics in daily life is based on solid foundations in its teaching.

This study, which examines the postgraduate thesis published within the scope of Higher Education Council (YÖK), includes the evaluation of digital and non-digital educational games used in the field of education according to different criteria. After the general examination, digital and non-digital educational games used for mathematics education were evaluated. In this way, the theses related to mathematics education were compared with other theses and scientifically different comparisons were made.

Examination of educational games within the scope of the thesis is important in terms of giving general information about the current situation. In addition, this study provides the opportunity to examine in detail the methods and findings related to education with games in mathematics

education within the scope of the thesis. This study is important in terms of guiding those who want to try different programs in line with the findings, those who want to study in this field or those who want to have information about educational games.

The aim of this study is to evaluate all postgraduate thesis studies on digital and non-digital educational games published within the scope of YÖK from a holistic perspective. In addition, among the theses examined, it is aimed to examine the ones related to mathematics education in depth according to different criteria.

METHOD

Research Design

In this study, the document analysis method was used as a qualitative data research model, as it was aimed to investigate graduate theses with a holistic approach and to evaluate and discuss the theses made in the field of mathematics education according to the determined criteria. In document analysis, the data of the study can be presented using numerical expressions through various categorization (Yıldırım & Şimşek, 2018).

Data Analysis

In this study, a general evaluation was made as a result of classifying all the postgraduate theses published within the scope of YÖK on digital educational games and non-digital educational games according to the course in which they were applied, the type of the thesis, the university they were published, the year they were published, the target audience, and the type of games used. Then, among these theses, the theses related to mathematics education were examined in depth, and the evaluations were made as a result of the classification of the educational games according to the types of educational games, the target audience and the methods used by the consultants conducting the thesis.

In order to obtain the study data, the words of digital game and educational game were entered in the search button of the national thesis center and the theses were questioned. 102 postgraduate theses on the educational game title and 94 on the digital game title were reached. A total of 196 graduate theses were determined. Later, a total of 108 graduate theses were determined by selecting the theses for teaching a course (mathematics, science, social, Turkish, etc.). These graduate theses determined by using Excel; The course was classified according to the course applied, the type of the thesis, the university where it was conducted, the year it was published, the target audience, and the type of games used. Four species were determined as the target audience in the study. These are primary school, secondary school, high school and university. As it can be seen in Table 5, four thesis studies were coded separately since they were intended for both secondary school and primary school. It is seen that the theses made are used in 16 different course contents. These are; Physical Education, Social Studies, Religious Education, Science Education, Foreign Language, Mathematics, Turkish, Music, Chemistry, Fine Arts, Geography, Computing, Special Education, Self Care, Physics and History. Finally, by examining the summaries of the theses made before 2015, the word primary education has been changed to primary school or secondary school in accordance with the new education system. The listed theses were then examined by two academicians, one in the field of mathematics education and one in the field of educational administration, and it was checked whether the theses were coded in accordance with the list. The tabulated thesis list was interpreted by the researchers, the theses made in the field of mathematics education and the data obtained from these theses were analyzed by meta-analysis method. The meta-analysis method is based on analyzing the results of studies conducted around certain criteria (Borenstain et al., 2009).

RESULTS / FINDINGS

The findings obtained from the theses examined within the scope of the study according to various variables are given in the tables below.

Table 1. Distribution of Educational Games by Courses In Which They Are Used

Lesson	f	%
Science Teaching	25	23.1
Physical education	14	13
Turkish	14	13
Foreign language	13	12.1
maths	9	8.4
Social studies	8	7.4
Religious education	8	7.4
Computer	5	4.7
special education	4	3.7
Music	2	1.8
Chemistry	1	0.9
Fine Arts	1	0.9
Geography	1	0.9
Self care	1	0.9
Physics	1	0.9
History	1	0.9
Total	108	100

When Table 1 is examined, it is seen that educational games are mostly performed in science education (23.1%), physical education (13%) and Turkish (13%). 50% of postgraduate theses have been done in these fields. Mathematics education is in the fifth place and includes only 8.4% of the postgraduate theses.

Table 2. Distribution of Educational Games by Thesis Type

Thesis type	f	%
Post graduate	89	82.4
Doctorate	19	17.6

When Table 2 is examined, it is seen that 82.4% of the postgraduate theses in which educational games are used consist of master's theses and a small part (17.6%) of doctoral theses.

Table 3. Distribution of postgraduate studies in which educational games were used, by university and type

University	Yüksek lisans (f)	Doktora (f)	%
Gazi University	10	6	14.8
Ataturk University	5	3	7.4
Marmara University	7	1	7.4
Inonu University	2	2	3.7
Bahcesehir University	4		3.7
Firat University	4		3.7
Bartın University	3		2.8
Erciyes University	3		2.8
Hacettepe University	3		2.8
Ondokuz Mayıs University	2	1	2.8
Hatay Mustafa Kemal University	1	1	1.85
Istanbul Aydın University	2		1.85
Muğla Sıtkı Koçman University	2		1.85
Necmettin Erbakan University	2		1.85
Nigde Omer Halisdemir University	2		1.85
Recep Tayyip Erdogan University	2		1.85
Selcuk University	2		1.85
Anatolian University	1	1	1.85
Balikesir University	1	1	1.85
Dumlupınar University	0	2	1.85
Adiyaman University	2		1.85
Cumhuriyet University	2		1.85
Canakkale Onsekiz Mart University	2		1.85
Afyon Kocatepe University	1		0.9
Abant İzzet Baysal University	1		0.9

Ağrı İbrahim Çeçen University	1		0.9
Mediterranean University	1		0.9
Bogazici University	1		0.9
Bolu Abant İzzet Baysal University	1		0.9
Bursa Uludag University	1		0.9
Celal Bayar University	1		0.9
Cukurova University	1		0.9
Dokuz Eylul University	1		0.9
Erzincan University	1		0.9
Eskisehir Osmangazi University	1		0.9
Fatih Sultan Mehmet Foundation University	1		0.9
Gaziosmanpasa University	1		0.9
Hitit University	1		0.9
Istanbul Gelisim University	1		0.9
Kahramanmaras Sutcu Imam University	1		0.9
Kirikkale University	1		0.9
Kirsehir Ahi Evran University	1		0.9
Mersin University	1		0.9
Middle East Technical University	0	1	0.9
University of Trakya	1		0.9
Yeditepe University	1		0.9
Zonguldak Bulent Ecevit University	1		0.9
Total	108		100

When Table 3 is examined, most of the graduate theses are; It is seen that it is conducted in Gazi University (14.8%), Atatürk University (7.4%) and Marmara University (7.4%). Almost 30% of the postgraduate theses have been prepared in these universities. Turkey's leading game and give importance to education with the help of this university providing quality education is also worth considering. In terms of doctoral dissertations, the highest number is respectively; Gazi University (6 theses), Atatürk University (3 theses) and İnönü University (2 theses).

Table 4. Distribution of Educational Games by Publishing Years and Thesis Type

Years	Master (f)	Doctorate (f)	%
1990-1994	1		0.9
1995-1999	1		0.9
2000-2004	1		0.9
2005-2009	3		2.8
2010-2014	17	6	21.2
2015-2019	64	13	71.2
2020	2		1.8

When Table 4 is examined, it is seen that only 6 graduate theses were made between 1990 and 2009 and the ratio of theses made since 2010 to all theses is 94.4%. According to this finding, it can be said that the number of theses related to educational games has increased over time. As a result, although the interest in educational games has increased over time, it is seen that the number of doctoral dissertations does not increase as much as master theses.

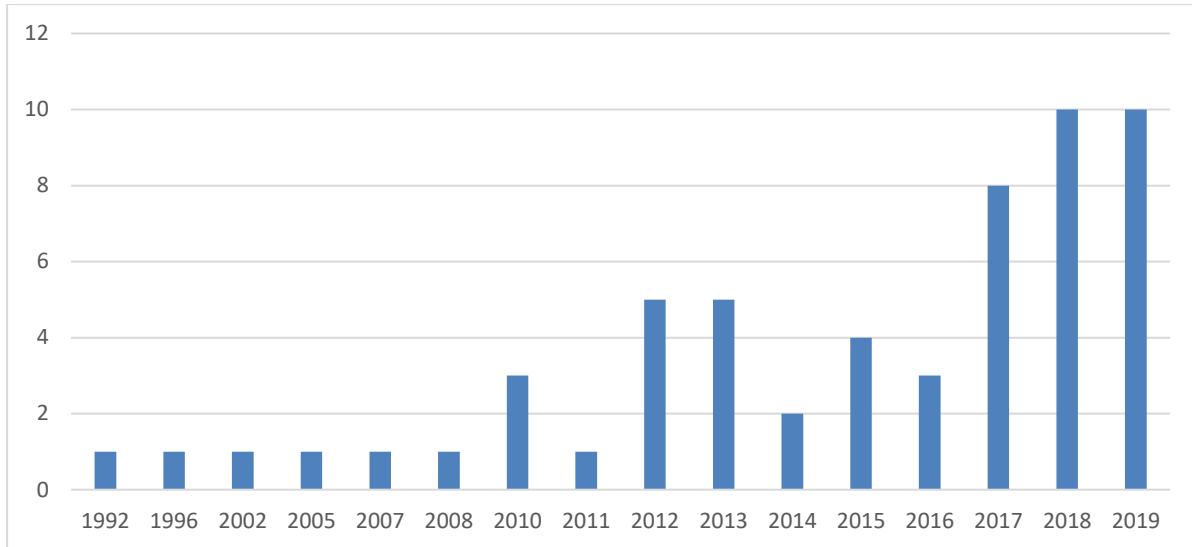


Figure 1. Distribution of Postgraduate Studies On Non-Digital Games by Years

When Figure 1 is examined, it is seen that postgraduate theses on educational games have started to be studied in universities since 1992. It can be said that a remarkable increase in post-2010 studies on the subject took place after 2010.

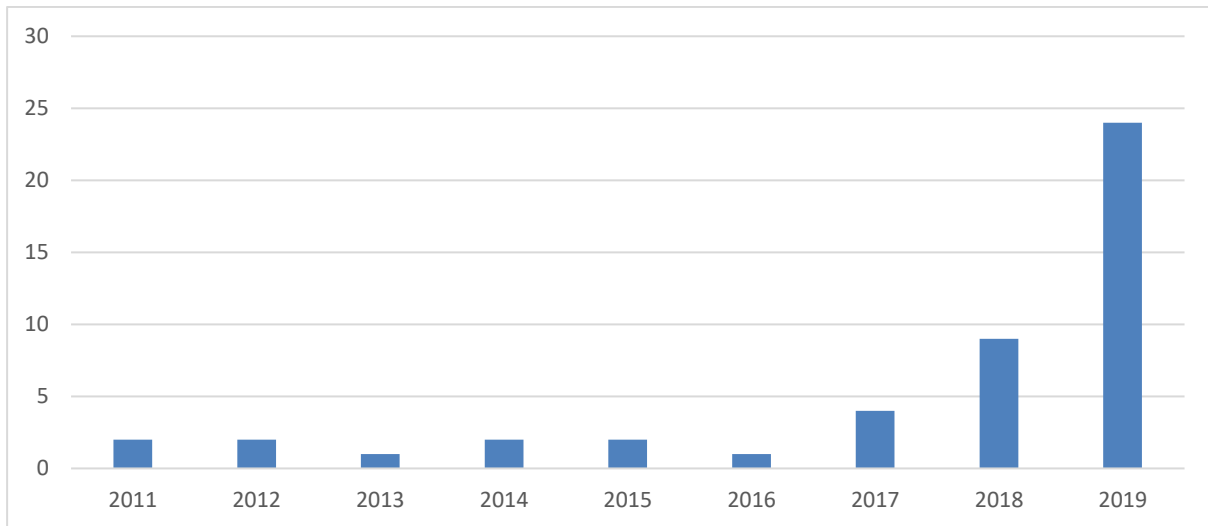


Figure 2. Distribution of Postgraduate Studies on Digital Games by Years

As seen in Figure 2, while the first thesis on digital games was prepared in 2011, it is seen that this number has increased considerably in postgraduate studies in 2017 and after. Although studies on educational games have started to be included in postgraduate research since 1992, it can be said that the importance of digital games was only given after 2010.

Table 5. Distribution of Educational Games by School Levels In Which They are Used

School Level	f	%
Pre-school	7	6.4
Primary school	24	22.2
Elementary Schools	4	3.7
Secondary School	51	47.2
High school	8	7.4
Special education	3	2.7

University	11	10.18
Total	108	100

When Table 5 is examined, it is seen that almost half of the postgraduate theses were made for secondary school students, and then they were prepared at primary school and university level. This may be due to the fact that digital games are more suitable for the secondary school level, and primary and preschool students are thought to be smaller for the use of digital games. Similarly, at the high school level, it may be thought that students will not attract attention in terms of games and that they are great for digital games. The most important reason for the increase in the number at the university level is thought to be the knowledge or teaching of the game design stages.

Table 6. Types of Educational Games Across the Analyzed Theses

Educational Game Type	f	%
The Digital One	49	45.4
Non Digital	59	54.6

When Table 6 is examined, it is seen that more studies are made on non-digital educational games. This may be due to the fact that working with digital games is more difficult.

Table 7. Types Of Educational Games Used In Mathematics Education

Educational Game Type	f	%
The Digital One	6	66.6
Non Digital	3	33.4

When Table 7 is examined, it is seen that 66.6% of the studies on mathematics education are related to educational games that are digital. In general, when all theses are examined, it can be said that the percentage of digital educational games in mathematics education is higher than in other fields.

Table 8. Distribution Of Educational Games Used In Mathematics Education By Grade Level And Thesis Types

School Type	Yüksek Lisans	Doktora
Pre-school	0	1
Secondary School	4	3
High school	1	

When Table 8 is examined, it is seen that most of the studies are at the secondary school level and there are no studies at the primary school and university level.

Table 9. The Type Of Theses Made In Mathematics Education And The Area Of Expertise Of The Advisor

Consultant's Field of Expertise	Yüksek Lisans	Doktora
Math education	3	2
Computer Teaching Technologies Education (BÖTE)	2	
Educational Sciences		1
Industrial Design		1

When Table 9 is examined, it is observed that the postgraduate theses made are generally carried out by experts in the field of mathematics education as consultants. In addition, it was determined that an expert consultant in the field of industrial design conducted a doctoral thesis with non-digital educational game study.

Table 10. Method, Findings, Expertise Of The Advisor And Types Of Theses Used In Graduate Theses Prepared In Mathematics Education

Methods Used and Findings	Consultant's Field of Expertise	Master	Doctorate
Conceptual development and digital game design are explained with qualitative research towards the development of the concept. As a result of the study, it was observed that the concept was acquired by the students with digital games.	Mathematics Education		1
With the semi-structured experiment, the academic achievements and attitudes of non-digital games were examined. As a result of the study, it was observed that academic achievement and attitude increased.	Mathematics Education	1	
Semi-structured experiments were conducted and conceptual development digital games were designed, but the design process was not fully explained. As a result of the study, it was observed that academic achievement increased.	Mathematics Education	1	
A semi-structured experiment was made, then a semi-structured interview was conducted and a mixed design was used in this way. In this way, achievement test, achievement motive, attitude and self-efficacy were evaluated. The games were made available on the internet. As a result of the study, there was no significant difference between the success of the students, but it was observed that the success motivation, attitude and self-efficacy values increased in favor of the experimental group.	Mathematics Education		1
The semi-structured experimental design was used and the academic achievement, self-efficacy and spatial skills of the ready-made digital game were examined. It has been observed that there is an improvement in every concept researched in the study.	BÖTE	1	
In the study, a design with unequaled control group among the semi-experimental models was used. My academic achievement and tour has been reviewed. Ready-made digital games are used. As a result of the study, it was observed that academic achievement and attitude increased.	Education Science		1
Semi-structured design was used with non-digital educational game and learning strategy, motivation and academic success were evaluated. As a result of this study, it was observed that he developed academic success but not attitude.	Mathematics Education	1	
A ready-made digital game-related activity was designed and student opinions were taken. The students expressed a positive opinion about the digital game.	BÖTE	1	
An educational toy was designed and the ethics of the toy was evaluated by a quasi-experimental method. It has been observed that he has developed the concept of direction and space.	Industrial Design		1

When Table 10 was examined, it was observed that semi-structured experimental designs were used the most in the studies. There are two studies that include the digital game design process in the study. However, in only one of these two studies, the design process was explained in depth. There is a study on toy design. In this study, the design process is explained in depth. In four of the studies, ready-made digital educational game taken from the internet environment was used. It has been observed in almost all of the studies that educational games contribute to learning. It was observed that academic achievement in only one study and attitude in another study did not make a statistically significant difference.

CONCLUSION AND DISCUSSION

According to the results of the research, science, physical education and Turkish education are at the top of the studies on educational games. Half of the studies have been carried out in these fields, and mathematics education ranks fifth in this field. Most of the theses on educational games are master theses. Except for 6 of the postgraduate studies, all other graduate studies were carried out after 2010. Nearly half of the theses on the subject have been prepared at secondary school

level. While more than half of the studies focused on non-digital games, the studies on mathematics education were found to be related to educational games that were digital with a significant rate of two-thirds. Almost all of the consultancy of the theses in the field of mathematics education was carried out by the academicians of the maths field education. In the studies on the subject, mostly semi-structured experimental design was preferred. While ready-made games are generally used in the studies, the results that educational games reflect positively on learning have been revealed.

In line with the findings of the research, it is seen that the postgraduate theses about educational games published within the scope of YÖK are mostly concentrated at the graduate level. Similar results were obtained in the educational game studies that Zorluoğlu and Elbir (2019) had examined until 2017.

As Naik (2014a) stated, interest in digital educational games is higher than non-digital educational games, but this finding contradicts with the fact that the number of non-digital educational games is higher in the study. In another study, Naik (2014b) stated that the production and management of the non-digital educational game increases the demand because it is easier and requires less skill. This finding seems to support the findings of the study.

Boyle et al. (2014) stated that in the literature they scanned in their own culture and geographies, the number of digital educational games is much higher than the number of non-digital educational games. Despite this, they stated that there is a common opinion that there are not enough academic studies.

Byun and Joung (2018), on the other hand, stated in the literature they reviewed in their own culture and geographies that most of the studies in the field of mathematics education were carried out by technology educators instead of mathematics educators. This finding contradicts with the findings obtained from this study. Because Turkey's fifth in total 8 studies conducted related to mathematics education mathematics educators. This shows that it contains 62.5% of the studies, that is more than half.

Naik (2014a) stated that studies on digital games are more numerous than non-digital studies. Although this finding is contrary to the overall evaluation of this study, parallel results are obtained when evaluated for mathematics education.

When the studies and postgraduate theses are examined, it is seen that students have developed concepts such as academic achievement, motivation and attitude. This situation is consistent with the literature and Connolly et al., (2012); Clark et al., (2016) stated in their studies that digital educational games in mathematics education improve concepts such as academic achievement, motivation and attitude.

Ke (2019) stated that the number of studies discussing education and game mechanics is small. This finding supports the findings of this study. that the number of studies in the business of digital game design studies conducted in Turkey is quite small. In this study, only two of the postgraduate theses on digital games in mathematics education were included in the design process and game mechanics.

RECOMMENDATIONS

Some suggestions in line with the research findings are given below.

Although the number of postgraduate theses has increased over the years, their number is not sufficient. Although digital games in particular are less numerically, interest has increased over the years and it can be said that the interest will increase even more in the future. Therefore, students who want to work on this subject can be encouraged.

Studies show that the games are generally made for secondary school levels. However, as educational games, especially digital games, will attract the attention of all levels, the number of studies for primary and high school levels can be increased.

There are very few studies on mathematics education, especially at the doctoral level. Their number should be increased in postgraduate studies.

When the studies on mathematics education were examined, the effectiveness of only existing digital games was examined. However, it has not been fully explained why the game is effective. Which features of digital games are effective should be examined in studies.

When the studies on mathematics education are examined, it is seen that they do not include digital game design. With digital games designed by mathematics educators, the development of students will be better studied.

When the studies on mathematics education are examined, it is seen that the number of non-digital educational games is very low. It can be said that there is a huge gap in this area. Therefore, postgraduate studies on non-digital educational games can be encouraged.

REFERENCES

- Altun, M. & Bozkurt, I. (2017). Matematik okuryazarlığı problemleri için yeni bir sınıflama önerisi. *Eğitim ve Bilim*, 42(190), 171-188.
- Baki, A. (2006). *Kuramdan uygulamaya matematik öğretimi*. Trabzon: Derya Kitabevi Yayıncılık.
- Borenstein, M., Hedges, L. V., Higgins, J. P., & Rothstein, H. R. (2011). *Introduction to meta-analysis*. John Wiley & Sons.
- Boyle, E. A., MacArthur, E. W., Connolly, T. M., Hailey, T., Manea, M., Kärki, A., & Van Rosmalen, P. (2014). A narrative literature review of games, animations and simulations to teach research methods and statistics. *Computers & Education*, 74, 1-14.
- Byun, J. & Joung, E. (2018). Digital game-based learning for K-12 mathematics education: A meta-analysis. *School Science and Mathematics*, 118(3-4), 113-126.
- Connolly, T. M., Boyle, E. A., MacArthur, E., Hailey, T. & Boyle, J. M. (2012). A systematic literature review of empirical evidence on computer games and serious games. *Computers & Education*, 59(2), 661-686.
- Clark, D. B., Tanner-Smith, E. E. & Killingsworth, S. S. (2016). Digital games, design, and learning: A systematic review and meta-analysis. *Review of Educational Research*, 86(1), 79-122.
- De Hoyos, M., Gray, E., & Simpson, A. (2002). Students assumptions during problem solving. *Paper presented at the 2nd International Conference on the Teaching of Mathematics*. Crete, Greece.
- Ke, F. (2019). Mathematical problem solving and learning in an architecture-themed epistemic game. *Educational Technology Research and Development*, 67(5), 1085-1104.
- Fırat, S. (2011). *Bilgisayar destekli eğitsel oyunlarla gerçekleştirilen matematik öğretiminin kavramsal öğrenmeye etkisi* (Yayımlanmamış yüksek lisans tezi). Adıyaman Üniversitesi, Adıyaman, Türkiye.
- Korkmaz, E. (2017). *Dönüşüm geometrisinin gerçekçi matematik eğitimi etkinlikleriyle öğretiminin akademik başarıya ve matematik tutumuna etkisi* (Yayımlanmamış doktora tezi). İnönü Üniversitesi, Malatya, Türkiye.
- Korkmaz, C. & Şahin, M. (2013). 2009 PISA başarılarına göre ülkelerin genel ve insani gelişmişlik düzeyleri arasındaki ilişki. *Mustafa Kemal Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, 10(22), 225-247.
- Malta S. E. (2010). *İlköğretimde kullanılan eğitsel bilgisayar oyunlarının öğrencilerin akademik başarılarına etkisi* (Yayımlanmamış yüksek lisans tezi). Sakarya Üniversitesi, Sakarya, Türkiye.
- Milli Eğitim Bakanlığı (2018). *MEB matematik dersi öğretim programı*. Ankara.
- Naik, N. (2014a, October). Non-digital game-based learning in the teaching of mathematics in higher education. *In European Conference on Games Based Learning* (Vol. 2, p. 431). Academic Conferences International Limited.
- Naik, N. (2014b, October). A comparative evaluation of game-based learning: Digital or non-digital games?. *In European Conference on Games Based Learning* (Vol. 2, p. 437). Academic Conferences International Limited.
- Özcan, D. (2014). *Anadolu lisesi öğrencilerine uygulanan matematik tarihiyle zenginleştirilmiş öğretim programının matematik başarısına etkisi* (Yayımlanmamış yüksek lisans tezi). İstanbul Sabahattin Zaim Üniversitesi, İstanbul, Türkiye.
- Özçelik, A. (2015). *7. Sınıf yüzdeler ve faiz konusunun GME'ye dayalı olarak işlenmesinin öğrencilerin başarı ve tutumlarına etkisi* (Yayımlanmamış yüksek lisans tezi). Fırat Üniversitesi, Elazığ, Türkiye.
- Santos-Trigo, M. (1996). An Exploration of Strategies Used by Students To Solve Problems with Multiple Ways of Solution. *Journal of Mathematical Behavior*, 15(3), 263-84.

- Soydan, Ş. N. (2019). *Tam sayılar öğretiminde eğitsel oyun kullanımının 7.sınıf öğrencilerinin akademik başarıları ve derse karşı tutumu üzerine etkisinin araştırılması* (Yayımlanmamış yüksek lisans tezi). Gazi Üniversitesi, Ankara, Türkiye.
- Sönmez, M. (2012). *6. Sınıf matematik derslerinde web üzerinden sunulan eğitsel matematik oyunlarının öğrenci başarısına etkisi* (Yayımlanmamış yüksek lisans tezi). Çukurova Üniversitesi, Adana, Türkiye.
- Şahin H. B. (2016). *Eğitsel bilgisayar oyunları ile destekli matematik öğretiminin öğrencilerin akademik başarılarına ve duyuşsal özelliklerine etkisi* (Yayımlanmamış yüksek lisans tezi). Eskişehir Osmangazi Üniversitesi, Eskişehir, Türkiye.
- Türk Dil Kurumu (2019). *Güncel Türkçe sözlük*. Ankara: TDK.
- Tutak, T. (2008). *Somut nesnelere ve dinamik geometri yazılımı kullanımının öğrencilerin bilişsel öğrenmelerine, tutumlarına ve van hiele geometri anlama düzeylerine etkisi* (Yayımlanmamış doktora tezi). Karadeniz Teknik Üniversitesi, Trabzon, Türkiye.
- Tutak, T. & Güder, Y. (2014). Matematiksel modellemenin tanımı, kapsamı ve önemi. *Turkish Journal of Educational Studies*, 1(1), 174-175.
- Uğurel, I.(2003). *Ortaöğretimde oyunlar ve etkinlikler ile matematik öğretimine ilişkin öğretmen adayları ve öğretmenlerin görüşleri* (Yayımlanmamış yüksek lisans tezi). Dokuz Eylül Üniversitesi, İzmir, Türkiye.
- Vershaffel, L., De Corte, E., Lasure, s., Vaerenbergh, Bogaerts, H. & Ratinckx, E. (1999). Learning to solve mathematical application problems: a desing experiment with fifth graders. *Mathematical Thinking and Learning*, 1(3), 195-229.
- Yıldırım, A. & Şimşek, H. (2013). *Sosyal bilimlerde nitel araştırma yöntemleri*. Ankara: Seçkin Yayıncılık.
- Zorluoğlu, S. L., & Elbir, B. Ç. (2019). Eğitsel oyuncak ve eğitsel oyun içerikli araştırmalardaki eğilimler: içerik analizi. *Bayburt Eğitim Fakültesi Dergisi*, 14(27), 1-22.