Fen, Matematik, Girişimcilik ve Teknoloji Eğitimi Dergisi
Journal of Science, Mathematics, Entrepreneurship and Technology Education
https://dergipark.org.tr/tr/pub/fmgted
© ISSN: 2667-5323

The Effect of Using Verbal Games in Distance Education Mathematics Instruction on 6th Grade Students' Mathematics Achievement*

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**This research was presented as an oral presentation at the "5th International Symposium of Turkish Computer and Mathematics Education" symposium held in Alanya-Antalya-Turkey on 28-30 October 2021. This research is an enlarged manuscript version of the oral presentation presented.*

ABSTRACT
This study examined the effect of using verbal games in distance education mathematics instruction on students' mathematics achievement. The study was designed as a pretest-posttest quasi-experimental model with a control group. The study group consists of 40 students attending 6th grade of a public school of a medium-level socio-economic group in the Central District of Bartin province during the 2020-2021 academic year. There were 20 students in the experimental group (EG) and 20 in the control group (CG). Mathematics Achievement Test (MAT) and verbal games about the circle were used as data collection tools. In EG, the instruction was carried out using verbal games prepared for teaching the circle subject in distance education, whereas traditional expository teaching was used in CG. The courses were conducted online, using one of the distance education applications in an online platform. Wilcoxon Signed Rank Test was used for dependent groups, and the Mann-Whitney U test for independent groups. A statistically significant difference was observed between all students' MAT scores before and after the application. Accordingly, it can be said that verbal games increased students' mathematics achievement in the circle subject. Using verbal games in mathematics education in different subjects and also at various grade levels can be suggested in this context.

ARTICLE TYPE
Research

ARTICLE INFORMATION
Received: 25.07.2022
Accepted: 30.09.2022

KEYWORDS:
Verbal games, mathematics achievement, secondary school students, distance learning.

Uzaktan Eğitimde Sözel Oyunların Kullanılması ile Yapılan Öğretimin 6. Sınıf Öğrencilerinin Matematik Başarılarına Etkisi

ÖZ
Bu araştırmada, uzaktan eğitim ile yapılan matematik öğretiminde sözel oyunların kullanılmasının öğrencilerin matematik başarılarına etkisi incelenmiştir. Araştırmada nicel araştırma yöntemlerinden deneysel yöntem kullanılmıştır. Araştırmanın modeli kontrol gruplu ön test son test yarı deneysel model olarak belirlenmiştir. Araştırma grubu, 2020-2021 eğitim öğretim yılında Türkiye'de Bartın ili Merkez İlçesinde bulunan orta düzey sosyo- ekonomik çevredeki bir devlet okulunun 6. sınıfında öğrenim gören 40 öğrenciden oluşmaktadır. Deney grubunda (DG) 20 ve kontrol grubunda (KG) 20 öğrenci bulunmaktadır. Veri toplama araçları olarak Matematik Başarı Testi (MBT) ve çember

MAKALE TÜRÜ
Araştırma

MAKALE BİLGİLERİ
Gönderilme Tarihi: 25.07.2022
Kabul Edilme Tarihi: 30.09.2022

konusunda hazırlanmış sözel oyunlar kullanılmıştır. DG'de uzaktan eğitimde çember konusunun öğretimi için hazırlanan sözel oyunlar kullanılarak öğretim yapılırken, KG'de geleneksel yaklaşıma dayalı açıklayıcı öğretim yöntemi kullanılmıştır. Derslerin yürütülmesi dijital bir platformdaki uzaktan eğitim uygulamalarından birinin çevrimiçi kullanılmasıyla gerçekleştirilmiştir. Veriler SPSS 22.0 paket programı ile analiz edilmiştir. Bağımlı gruplar arasındaki analizlerde Wilcoxon İşaretli Sıralar Testi, bağımsız gruplar için Mann Whitney U testi kullanılmıştır. Analizler sonucunda öğrencilerin uygulama öncesi ve sonrası MBT'den aldıkları başarı puanları arasında istatistiksel olarak anlamlı bir farkın olduğu görülmüştür. Bu sonuca göre sözel oyunların öğrencilerin çember konusundaki matematik başarılarını artırdığı söylenebilir. Bu bağlamda matematik eğitiminde sözel oyunların farklı konu ve sınıf seviyelerinde de kullanılması önerilebilir.

ANAHTAR KELİMELER:
Sözel oyunlar, matematik başarısı, ortaokul öğrencileri, uzaktan eğitim.

Introduction

One of the models developed to solve the problems in education systems is distance education, in which the teacher and the student do not have to be in the same places (Parsad & Lewis, 2008), and educational activities are carried out through information and communication technologies (İşman, 2011). Alkan (1987) defined distance education as a teaching method implemented when traditional learning and teaching methods are limited and in-class activities are impossible; the communication and interaction between the planners and practitioners of educational activities and learners are managed from a center using specially prepared teaching modules. Distance education may be carried out synchronously or asynchronously; its components are the learning management system, e-content, virtual classroom, and assessment and evaluation (Demir, 2014; Nichols, 2003). According to Demir (2014), although each of these components has its own characteristics, there is a spiral structure between them. Success in distance education can be achieved by building this spiral structure properly.

Many studies outlined the advantages and disadvantages of distance education (Dumford & Miller, 2018; Gossenheimer, Bem, Carneiro, & de Castro, 2017; Naidu, 2019; Santana de Oliveira, Torres Penedo, & Pereira, 2018). The advantages of distance education are; supporting autonomy and self-learning (Dumford & Miller, 2018), being flexible in terms of time and place (Gossenheimer et al., 2017; Santana de Oliveira et al., 2018), being relatively cheaper than traditional education, attracting learners more than traditional methods, and providing suitable learning environments for learners with special needs in education (Naidu, 2019). On the other hand, the disadvantages of distance education are the distractions due to the lack of complete control of the teacher over the teaching situations, the shortcomings of the teacher, and the learners' technical skills, which reduce the quality of distance education (Dumford & Miller, 2018;), and failure to establish social interaction and teacher-student and student-student communication (Dumford & Miller, 2018; Gossenheimer et al., 2017).

Despite the disadvantages of distance education, there are substantial advantages, and distance education is preferable in situations where conducting education face-to-face is difficult. Distance education is flexible in terms of time and place and provides advantages for individuals with different needs, making distance education attractive. The world had to deal with a challenging situation towards the end of 2019. During this period, when the Covid-19 pandemic started, education and training were also affected by this development.

In recent years, the Covid-19 pandemic has affected the world. Therefore, face-to-face education has not been possible, so distance education replaced face-to-face teaching, which affected mathematics instruction, like every other course. In the literature, many studies state that students perceive mathematics as a challenging course (Baki, 2014, 2018; Gafoor & Kurukhan, 2015; Santos, Diaz, & Belecina, 2015; Usta, 2014). The new order added the disadvantages of distance education to these cognitive loads of students, which might be unbearable, especially for secondary school students.

Distance education seems likely to bring the following problems; failure to adequately establish student-student and student-teacher communication in distance education (Dumford & Miller, 2018; Gossenheimer et al., 2017), difficulties with digital and technical infrastructure

(Gossenheimer et al., 2017; Naidu, 2019), students are not used to the process, students cannot express themselves comfortably, and they get alienated from the lesson (McMillan & Chavis, 1986; Ilgaz & Aşkar, 2009; Öztürk & Deryakulu, 2011), students experience difficulty in having a sense of community and various pedagogical-communication problems (McMillan & Chavis, 1986; Öztürk & Deryakulu, 2011), lack of sufficient motivation, and families with insufficient economic level fail to provide the technological tools and equipment required for distance education. Especially students who do not have a sense of community and belonging are isolated from the system, which creates a significant obstacle for students to participate in activities and discussions (Ilgaz & Aşkar, 2009). According to Moore (1989), students should take responsibility for their learning in distance education, be determined, and exhibit an active process. Students who actively participate in lessons and learning environments feel that they belong to this environment and can communicate more efficiently with their friends and teachers (Holmberg, 1997). Therefore, evaluating different mathematics instruction methods in distance education is crucial. One alternative method is teaching mathematics with games. Playing games is an indispensable activity for children and young learners.

Games have started to be used in mathematics teaching in recent years because they educate and teach while entertaining. They are an essential tool that supports the child's developmental areas (Pehlivan, 2005). Research reveals that teaching with games significantly increases achievement, motivation, and performance. The increase in participation in the learning environment also increases achievement (Charles, Bustard, & Black, 2009). According to Hays (2005), using games in the learning process and integrating them with teaching objectives creates an enjoyable course environment. Such an environment increases students' motivation throughout the lesson, supports their performance, and makes it easier for them to make sense of mathematical knowledge (Randel, Morris, Wetzel, & Whitehill, 1992). Teachers providing mathematics experience to their students through games stated that solid mathematical knowledge is established by practicing cultural games and using them in mathematics lessons; they also suggested including the games in the mathematics curriculum (Nabie & Sofo, 2009). Another example is the study results about the use of games in teaching (Russo, Bragg, & Russo, 2021), addressing the opinions of Australian mathematics teachers, where mathematical games are widely used. Accordingly, Australian mathematics teachers use games at least once a week to increase students' motivation, attract their attention, make sense of mathematical concepts and knowledge, reinforce mathematical fluency and understanding, and improve problem-solving and reasoning skills. Although there is an increase in the use of digital games in mathematics instruction, 246 of the 248 Australian mathematics teachers participating in the study stated that their favorite games are the ones played with minimum materials, especially the ones played with playing cards and/or dice, pencil, paper, and verbal games.

Studies have shown that teaching with games effectively increases students' achievement (Aksoy, 2014; Charles, Bustard, & Black, 2009; Hanbaba & Bektaş, 2007; Kaya & Elgün, 2015; Omeodu & Fredrick, 2019; Song, 2002, Usta et al., 2018). In this context, using games in mathematics instruction is quite beneficial (Lovitt & Clark, 1988, cited in Lee, 2008).

Usta et al. (2018) reported that mathematics instruction with games positively affects the mathematics achievement of 7th-grade students. Song (2002) studied motivating students to explore mathematical concepts by designing interactive mathematics learning environments; he reported that playing games helped students understand mathematical concepts better. There was a statistically significant difference in test scores. Similar studies show that mathematics teaching with games is effective in structuring students' mathematical knowledge (Akkuş Sevigen, 2013; Aksoy, 2014; Köroğlu & Yeşildere, 2002; Rutherford, 2015; Shi, 2003). On the other hand, in a study by Vankúš (2008), teaching with games did not cause a significant increase in mathematics achievement, both in the experimental and control groups. However, the mathematical attitudes of the experimental group students improved. For this reason, Vankúš (2008) suggested designing new games and conducting more research to achieve the teaching process's objectives.

Playing is very important for developing children's decision-making, group work, communication, discussion, and planning skills (Kirriemuir & McFarlane, 2004). Moreover,

intelligence games improve strategic thinking and logical reasoning (Bottino & Ott, 2007). Devecioğlu and Karadağ (2014) state that intelligence games develop children's critical thinking skills, verbal intelligence, and visual intelligence. They provide a learning environment where students can create unique solutions and develop alternative approaches, designs, and tactics.

The literature shows that mathematics instruction with games increases student achievement. However, there is no study on using verbal games, one of the intelligence games, in distance education and mathematics teaching. A verbal game is a mind and intelligence game in which the players play using their vocabulary and general culture together by drawing logical inferences (Ministry of National Education [MoNE], 2013). In this research, anagram, cipher games, word search, and word placement games were used in teaching the circle subject. Brief information about these games is given below.

The objective of the anagram game is to generate new meaningful words by replacing the letters in the words and phrases (MoNE, 2013). In cipher games, the text is converted into an encrypted text (Karaahmetoğlu, 2010; Yerlikaya, Buluş, &Buluş, 2006). The objective of this game is to decrypt the text by finding the password (Katrancı & Özdemir, 2013). The most well-known encryption methods are "Caesar Cipher," "replacement," and "letter substitution" (Bahadır & Özdemir, 2012; Göktepe Yıldız & Özdemir, 2015). In the Caesar Cipher, each letter is replaced with the third letter coming after it. Substitution is replacing the letters in a word/text with other letters. The objective of the word search game is to find meaningful words hidden in a letter jumble given as a rectangle/square. The words sought in this game can be given as a list, or a generic theme can be named (MoNE, 2013). Students find meaningful words in the word placement game by adding certain letter groups before, between, or after the given words (MoNE, 2013).

It is unthinkable that the possible disadvantages of distance education would not affect the mathematics course as other courses. Considering the disadvantages of distance education and the fact that mathematics is generally seen as a difficult and disliked course by students, this course can become a burden for secondary school students. It is thought that the game, an activity that students love, should be activated at this point to fight these difficulties. This study aims to make mathematics teaching enjoyable with games in distance education, which has become mandatory due to the Covid-19 pandemic. Thus, it was decided to use the method of teaching mathematics with games in distance education. In addition, no study has been found in the literature on the teaching of the circle subject by using verbal games in distance education. For these reasons, this study examined the effect of using verbal games in distance education mathematics instruction on 6th-grade students' achievement. In this context, this study was thought to contribute to the literature.

Purpose of The Study

There are experimental and control groups in this study. Teaching was carried out by using verbal games in EG. In CG, on the other hand, the method used is based on Ausubel's (1963) traditional approach, expository teaching, where learners create meaning from the material provided to them (Ausubel, 2000). In this process, the teacher should select and organize the lesson's content, make it meaningful for the learner, and present and explain the content to the student with various materials. The research was carried out following Secondary School Mathematics Curriculum's learning outcomes (MoNE, 2018). It examined the effect of using verbal games in teaching the circle subject, a sub-learning area of the 6th-grade "geometry and measurement" learning field, on the students' mathematics achievement. In this direction, the sub-problems of the research are given below.

1. Is there a statistically significant difference between MAT pre-test scores of EG and CG?
2. Is there a statistically significant difference between MAT post-test scores of EG and CG?
3. Is there a statistically significant difference between MAT pre and post-test scores of EG?
4. Is there a statistically significant difference between MAT pre and post-test scores of CG?

Methods

Model of The Study

The study includes measurements between groups (experiment-control) and within groups (pretest-posttest); therefore, it was structured as a 2x2 split-plot factorial design and given in Table 1. Students' mathematics achievement was measured twice, before and after the application, using the same tool. The study is based on the pretest-posttest quasi-experimental model with a control group. In quasi-experimental models, two ready-made groups are compared and analyzed for certain variables (Büyüköztürk, 2006).

Table 1

Model of the Research

	Pre-test		Posttest
Groups	MAT	Implementation	MAT
EG	✓	Instruction by using verbal games	✓
CG	✓	Instruction by using the expository teaching method	✓

Study Group

The study group consists of 40 students attending 6th grade of a public school, in a middle socio-economic environment in the Central District of Bartın, Turkey, during the 2020-2021 academic year. There are 20 students in EG and 20 students in CG. The end-of-term mathematics grades of EG and CG students were close. Then, one of the two classes was randomly set as EG and the other CG (by lot). The same teacher instructed the lessons in both classes.

Data Collection Tools

The Mathematics Achievement Test (MAT) and verbal games about the circle were used as data collection tools to measure the method's effectiveness on students' mathematics achievement in the subject of the circle. Data collection tools in the study were prepared by the researchers.

MAT

The learning outcomes and concepts related to the circle sub-learning area of the Secondary School Mathematics Curriculum (MoNE, 2018) were examined to prepare MAT. The questions in the test were developed from the Secondary School Mathematics Curriculum (MoNE, 2018), mathematics teaching books (Altun, 2014; Baki, 2014, 2018; Baykul, 2014; Van de Walle, 2014), and the literature. An 18-item test covering all learning outcomes of the circle subject was prepared. A pilot study was conducted on 96 7th and 8th-grade students from the same region to check the validity and reliability of the test. TAP analysis showed that the differentiation levels of the 13th, 14th, and 15th questions were low, and these questions were removed from the test. MAT's final Cronbach's Alpha reliability coefficient was .72, and the test was finalized as 15 questions (see Appendix 1). Table 2 shows the learning outcomes of the circle subject in the Secondary School Mathematics Curriculum (MoNE, 2018) and its relationship with the questions in the MAT.

Table 2

The Learning Outcomes of the Circle and Its Relationship with The Questions in The MAT

Learning Outcomes	MAT	Number of Question
Draws a circle and knows the center, radius, and diameter.	Q2, Q4, Q7, Q15	4
Shows that the ratio of the length of a circle to its diameter is a constant value by measuring.	Q13	1
Solves problems that require calculating the length of a circle with a given diameter or radius.	Q1, Q3, Q5, Q6, Q8, Q9, Q10, Q11, Q12, Q14	10

Verbal Games

Table 3 shows the learning outcomes of the circle and the names of 11 verbal games used in teaching the subject.

Table 3

Verbal Games Used in The Study and Related Learning Outcomes

Learning Outcomes	Verbal Games
Draws a circle and knows the center, radius, and diameter.	Circle Anagram I Find the Words; I Know the Circle Find the Code, Match Definitions Find Definition, Generate the Code Find Hidden Concepts Who am I
Shows that the ratio of the length of a circle to its diameter is a constant value by measuring.	Find the Code, Match Definitions Find Definition, Generate the Code Who am I
Solves problems that require calculating the length of a circle with a given diameter or radius.	Circle Puzzle Coding Circumference Length Ali Baba's Farm Ring Derive from Circle

One of the verbal games used in the research is "Find the Code, Match Definitions." Table 4 shows the Turkish Alphabet used in this game.

Table 4

Turkish Alphabet

A	B	C	Ç	D	E	F	G	Ğ	H	I	İ	J	K	L	M	N	O	Ö	P	R	S	Ş	T	U	Ü	V	Y	Z

The definitions of the concepts related to circle and encrypted words are given in mixed order in Table 5, and students are asked to find the word by deciphering the code.

Table 5

Find The Code, Match Definitions

Definitions	Encrypted word	Deciphered word
A closed shape formed by points equidistant from a fixed point in the plane	BÇKZÇÖ	?
A line segment that joins the center of the circle with any point taken on the circle	ÜYÖĞBYO	?
A fixed point in the middle of a circle equidistant from every point on the circle	KÇÖİÇV	?
A line segment that joins any two points on the circle through the center of the circle	BCS	?

The words are decrypted by replacing each letter with the second letter following it in the Turkish Alphabet. Table 6 shows the process and the results.

Table 6

The Cipher and Words Obtained After Decryption

Encrypted word	Code: The letters formed meaningful words by replacing the letter that came after or before them in a specific order.	The word obtained after decryption
BÇKZÇÖ	B → Ç, Ç → E, K → M, Z → B, Ç → E, Ö → R (two letters forward)	ÇEMBER (CIRCLE)
ÜYÖĞBYO	Ü → Y, Y → A, Ö → R, Ğ → I, B → Ç, Y → A, O → P (two letters forward)	YARIÇAP (RADIUS)
KÇÖİÇV	K → M, Ç → E, Ö → R, İ → K, Ç → E, V → Z (two letters forward)	MERKEZ (CENTER)
BYO	B → Ç, Y → A, O→ P (two letters forward)	ÇAP (DIAMETER)

Definitions of some basic concepts of the circle are given in the first column of Table 5. The second column of the table includes the words/concepts corresponding to these definitions in encrypted form. The objective of this game is to decipher the given words/concepts and match them with the relevant definition. Definitions and ciphers in Table 4 are given in mixed order. The students will independently or together decipher the letters' backward or forward movements. After working alone for a certain period, the solution is decided by group work. The student or group that solves the code and makes the matches first is the winner of the game. The teacher should guide and direct the students throughout the game, ask them to explain their answers and reasons, and monitor the group work. At the end of the game, the teacher should make a general assessment. "Find Hidden Concepts," one of the games used in the research, is briefly introduced in Appendix 2.

Experimental Stage

In EG, the instruction was carried out using verbal games prepared to teach the circle subject. On the other hand, in CG, the instruction was performed using the traditional expository teaching following the Secondary School Mathematics Curriculum (MoNE, 2018). The fieldwork was completed in 10 lesson hours for each group. The lessons were conducted online using one of the

distance education applications. The forms could be filled in only once, and students were prevented from submitting more than one answer. The duration of the test was set as 1 lesson hour.

Before starting the lesson, the games were briefly introduced to the students. Students were asked to have paper and pencil with them and play the games projected on the screen individually or as a group by following the rules. The "Circle Anagram" game below is an example of how the game is played in the online learning environment. "Circle Anagram" is a game designed to find the circle's center, radius, and diameter by drawing a circle. It can be played in groups or individually. Before starting the game, the rules of the game are explained. The game's objective is to answer the question correctly and produce meaningful words from this answer. The player or group that derives the highest number of meaningful words wins the game.

A certain time is given at each stage regarding the class and the players. The questions are projected onto the screen in the online application, and students are expected to answer all questions. The answer is explained when the time is over, and the activity is finalized by discussing the game under the teacher's guidance. The necessary materials for the "Circle Anagram" game are the computer, the game card on which the questions are reflected, and the paper and pencil to write the answers. Below there are some example questions:

Question: What shape is formed by the set of points equidistant from a fixed point in the plane? Derive 4-letter and 3-letter words using the letters of your answer.
Question: How do you call the point in the middle of the circle? Derive 5-letter and 4-letter words using the letters of your answer.
Question: How do you call the half of the diameter in a circle? Derive 6, 5, 4, and 3-letter words using the letters of your answer.

MAT was administered in the experimental and control groups twice, before and after the application, as pre-test and post-test. Table 6 describes the stages of the experimental study.

Table 7

Stages of the Experimental Study

Applications	1st week	2nd week	3rd week	4th week
MAT pilot study-Finalizing MAT	✓			
Administration of MAT as the pre-test		✓		
Instruction of the circle subject in EG using verbal games		✓	✓	
Instruction of the circle subject in CG using the expository teaching method (MoNE, 2018)		✓	✓	
Administration of MAT as the post-test				✓

Data Analysis

Quantitative data analysis techniques were employed to reveal whether students' mathematics achievements differ according to the applied method. The data were analyzed in the SPSS 22.0 program. In this study, non-parametric tests were used to analyze the data since the number of students in the experimental and control groups was low, and the data did not show a normal distribution. Since the assumption of normality of the distribution should be met for parametric statistics, non-parametric statistics should be used if the researcher does not have sufficient evidence about the normality of the distribution; in other words, if the distribution is skewed (Büyüköztürk, 2006, 8). Morgan et al. (2004, 49) stated that the skewness and kurtosis coefficients between -1 and +1 indicate normal distribution. In this study, normal distribution curves and skewness and kurtosis values of the data showed a skewed distribution. Wilcoxon Signed-Rank Test was used to analyze dependent groups, and the Mann-Whitney U test for independent groups. In small-sample

experimental studies with independent measurements, non-parametric statistics are preferred if the normality of the distribution cannot be proven (Büyüköztürk, 2006). Mann-Whitney U-test is used instead of the independent t-test (Büyüköztürk, 2006), and Wilcoxon signed-rank test is used instead of the dependent t-test.

Findings and Comments

In this part of the study, the findings of the sub-problems are presented and interpreted.

Findings and Comments on the First Sub-Problem

Mann-Whitney-U test was used to see whether there is a statistically significant difference between the pre-test scores of EG students taught with verbal games and CG students taught with the traditional approach. The findings are given in Table 8.

Table 8

Mann Whitney-U Test Results of EG and CG's MAT Pre-Test Scores

Groups	N	Mean Rank	Sum of Ranks	U	p
EG	20	23.38	467.50	142.500	.109
CG	20	17.63	352.50		

Regarding Table 8, there is no significant difference between MAT pre-test scores of EG and CG (U=142.500, p>.05).

Findings and Comments on the Second Sub-Problem

Mann-Whitney-U test was used to test the difference between the post-test scores of EG and CG students. The results are shown in Table 9.

Table 9

Mann Whitney-U Test results of EG and CG's MAT Post-Test Scores

Groups	N	Mean Rank	Sum of Ranks	U	p
EG	20	28.10	562.00	48.00	.000
CG	20	12.90	248.00		

According to Table 9, there was a significant difference at the end of the experimental study between MAT post-test scores of both EG students, where the teaching was carried out by using verbal games, and CG students, to whom this method was not applied (U=48.00, p<.05). Regarding the mean rank, EG students' mathematics achievement is higher than CG students. This finding shows that teaching mathematics with verbal games was more effective in increasing EG students' mathematics achievement.

Findings and Comments on the Third Sub-Problem

Wilcoxon signed-rank test results regarding whether there is a statistically significant difference between the pre-test and post-test MAT scores of EG, where the instruction was carried out with verbal games, are given in Table 10.

Table 10

Wilcoxon Signed-Rank Test Result of EG's Pre-Test and Post-Test MAT Scores

Post-Test- Pre-Test	N	Mean Rank	Sum of Ranks	z*	p
Negative rank	16	10.13	162.00	-3.340	.001
Positive rank	2	4.50	9.00		
Equal rank	2	-	-		

* Based on positive ranks

The analysis results show a significant difference between EG's MAT scores before and after the application ($z=3.340$, $p<.05$). According to Table 10, it can be said that the application has a significant effect on increasing EG students' mathematics achievement.

Findings and Comments on the Fourth Sub-Problem

Wilcoxon signed-rank test results for the significance of the difference between the pre-test and post-test MAT scores of CG, where the instruction was carried out by expository teaching using the traditional approach following the Secondary School Mathematics Curriculum (MoNE, 2018), are given in Table 11.

Table 11

Wilcoxon Signed-Rank Test Result of CG's Pre-Test and Post-Test MAT Scores

Post-Test- Pre-Test	N	Mean Rank	Sum of Ranks	z	p
Negative rank	9	5.00	45.00	-2.692*	.007
Positive rank	0	.00	.00		
Equal rank	11				

* Based on positive ranks

Regarding Table 11, a significant difference is observed between CG's pre-test and post-test MAT scores ($z=2.692$, $p<.05$). Students' mathematics achievement also increases when the expository teaching method is effectively used following the Secondary School Mathematics Curriculum (MoNE, 2018). However, reviewing the tables together better shows the effect of teaching practice with verbal games.

Results and Discussion

This study examined the effect of using verbal games in distance education mathematics instruction on students' mathematics achievement. The study was designed as quasi-experimental research with pre-test, post-test, and control groups. A statistically significant difference was observed between students' MAT scores before and after the application. According to this result, it can be said that verbal games increase students' mathematics achievement in circle subject.

The results of this study show similarities with those suggesting that the method of teaching with games is effective in increasing student achievement (Aksoy, 2014; Charles, Bustard, & Black, 2009; Hanbaba & Bektaş, 2007; Kaya & Elgün, 2015; Song, 2002, Usta et al., 2018). However,

considering that these studies were carried out in systems other than distance education, more studies should be performed on teaching mathematics with games in distance education.

On the other hand, the study by Vankúš (2008) concluded that teaching mathematics with games was ineffective because it did not create a significant difference in mathematics achievement in both experimental and control groups. From here, it can be said that the results of Vankúš's (2008) and our study do not show parallelism in terms of the increase in mathematics achievement. However, Vankúš (2008) also reported that experimental group students' attitudes towards mathematics improved. For this reason, Vankúš (2008) suggested designing new games to achieve the teaching process's objectives and conducting more research. In this context, comprehensive studies about mathematics instruction in distance education should be carried out by also considering students' affective characteristics.

An interesting result of this study is the use of verbal games in teaching the circle subject and their impact on increasing mathematics achievement. This study, in which verbal games were used in distance education during the Covid-19 process, revealed a statistically significant difference between the groups, which may provide a different perspective for future research. Ingroup analysis revealed a statistically significant difference in both groups. It can be concluded that the effective use of any method in teaching increases students' mathematics achievement. However, regarding the results of the between-group analysis, the instruction made by using verbal games was more effective in increasing mathematics achievement than the instruction by expository teaching. This result may have occurred because the games made the course environment enjoyable. Therefore, students' motivation and performance increased, making it easier to make sense of mathematical knowledge (Randel et al., 1992; Russo et al., 2021). In a study conducted with Australian mathematics teachers (Russo et al., 2021), most teachers preferred games played with simple materials rather than digital games and named verbal games as their favorite games, which provides evidence for the results of this research.

It is thought that the result of this study, which was conducted with a limited number of students, in which the effect of verbal games in distance education on the success of students in the circle subject was examined, is important in terms of providing a different perspective. With the effective use of verbal games, the specific disadvantages of distance education are not seen in the results of this study. On the contrary, distance education supports autonomy and self-learning (Dumford & Miller, 2018) and is flexible in terms of time and space (Gossenheimer et al., 2017; Santana de Oliveira et al., 2018), suggesting that it contributes to the success of students. Students tried to solve the problem by seeing the question in front of the digital screen and did this by playing a game, which is a favorite activity, which may have been effective in this result. Studies show that children can express themselves more efficiently and communicate better while playing. In this context, it can be said that despite the disadvantages of distance education, students comfortably communicated with each other and could express themselves thanks to the game in this study. In other words, it can be said that students do not become alienated from the lesson in distance education and do not have difficulty developing a sense of community. Because students who are alienated from the lesson (McMillan & Chavis, 1986; Ilgaz & Aşkar, 2009; Öztürk & Deryakulu, 2011) and do not have a sense of belonging (McMillan & Chavis, 1986; Öztürk & Deryakulu, 2011) also find it challenging to participate in activities (Ilgaz & Aşkar, 2009). It is difficult for students who do not participate in activities and games to be successful. In this study, students participated in verbal game activities, and their success in the games is reflected in the results of the test about the circle.

As a result, it can be said that the active participation of the students in the games and the use of the game's power in learning have pushed some disadvantages of distance education to the back. The presentation of verbal games by integrating them with the mathematics lesson is thought to increase students' mathematics achievement significantly.

Recommendations

Distance education practices involving verbal games positively affected the mathematics achievement of 6th-grade students. In the study, teaching was carried out using certain verbal games, namely "anagram," "cipher games," "word search," and "word insertion." Repeating this study with different types of verbal games may be suggested. Using verbal games at different subjects and grade levels in mathematics education is also recommended, and conducting qualitative and quantitative studies. This study was carried out with a small number of students. It can be repeated by increasing the number of students, and the results can be compared. In addition, further qualitative research can reveal different ideas by analyzing student and teacher views in depth. "Permanence of learning" should be investigated to examine the long-term effect of using verbal games in distance education on learning mathematics subjects. The effects of distance education, blended learning, and existing teaching approaches on students' mathematics achievement can be investigated at different grade levels, and the results can be compared. It is recommended to conduct studies examining the effects of verbal games on children's ability to make decisions, work in groups, communicate, discuss and plan.

References

Akkuş Sevigen, F. (2013). *Researching the effect of mathematical education programme based on playing, on the child's mathematical* [Unpublished master's thesis]. Gazi University.

Aksoy, N. C. (2014). *Effects of digital game-based mathematics teaching on 6th grades students' achievement, motivation, attitude and self-efficacy*. [Unpublished doctoral dissertation]. Gazi University.

Alkan, C. (1987). *Açıköğretim.* Ankara University Journal of Faculty of Education Sciences Publications. No:157. https://dergipark.org.tr/en/pub/auebfd

Altun, M. (2014). *Teaching mathematics in secondary schools (5th, 6th, 7th and 8th grades).* Actual Publishing.

Ausubel, D. P. (1963). *The psychology of meaningful verbal learning: An introduction to school learning.* New York: Grune & Stratton.

Ausubel, D. P. (2000). *The acquisition and retention of knowledge: A cognitive view.* Kluwer Academic Publisher.

Baki, A. (2014). *Mathematics education from theory to practice.* Letter Education Publishing.

Baki, A. (2018). *Knowledge of teaching math.* Pegem Academy.

Bottino, M. R. & Ott, M. (2006) Mind games, reasoning skills, and the primary school curriculum. *Learning, Media and Technology, 31* (4), 359-375, doi: 10.1080/17439880601022981

Büyüköztürk, Ş. (2006). *Sosyal bilimler için veri analizi el kitabı.* Pegem Academy.

Bahadır, E. & Özdemir, A. Ş. (2012). Examining of applicabilitiy of encryption activity about substitution cipher and student's views on the activity. *Kalem International Journal of Education and Human Sciences, 2* (2), 53-90.

Charles, M. T., Bustard, D. W., & Black, M. (2009). *Experiences of Promoting Engagement in Game-Based Learning. In Proceedings of ECGBL 2009: 3rd European Conference on Games Based Learning* (397-403). Academic Conferences and Publishing International. http://uir.ulster.ac.uk/21214/2/preview.png

Demir, E. (2014). Overview of distance education. *Dumlupınar University Journal of Social Sciences, 39,* 203-211.

Devecioğlu, Y. & Karadağ, Z. (2014). Evaluation of mind puzzle course at the context of goals, expectations and recommendations. *Bayburt Üniversitesi Eğitim Fakültesi Dergisi, 9*(1), 41- 61.

Dumford, A. D. & Miller, A. L. (2018). Online learning in higher education: exploring advantages and disadvantages for engagement. *Journal of Computing in Higher Education, 30,* 452–465. https://doi.org/10.1007/s12528-018-9179-z

Gafoor, K. A. & Kurukhan, A. (2015). *Why high school students feel mathematics difficult? An exploration of affective beliefs.* Paper presented in UGC Sponsored National Seminar on Pedagogy of Teacher

Education- Trends and Challenges at Farook Training College, Kozhikode, Kerala. https://files.eric.ed.gov/fulltext/ED560266.pdf

Göktepe Yıldız, S. & Özdemir, A. Ş. (2015). An example of using encryption activity in mathematics lessons and students' opinions about this implementation. *Turkish Studies - International Periodical for the Languages, Literature and History of Turkish or Turkic 10*(7), 427-446, http://dx.doi.org/10.7827/TurkishStudies.8045

Gossenheimer, A. N., Bem, T., Carneiro, M. L. F., & de Castro, M. S. (2017). Impact of distance education on academic performance in a pharmaceutical care course. *PLoS ONE*, *12*(4), e0175117. https://doi.org/10.1371/journal.pone.0175117

Hanbaba, L. & Bektaş, M. (2007). The effects of the teaching by games method on achievement and attitudes in the social studies course. *Abant izzet Baysal University Journal of Faculty of Education.*, *12*(1). 115-128. https://dergipark.org.tr/tr/download/article-file/16819

Hays, R. T. (2005). The effectiveness of instructional games: a literature review and discussion. Accessed on 11.07.2016. http://faculty.uoit.ca/kapralos/csci5530/Papers/hays_instructionalGames.pdf

Holmberg, B. (1997). Distance education theory again. *Open Learning*, *12*(1), 31-39. https://doi.org/10.1080/0268051970120105

Ilgaz, H. & Aşkar, P. (2009). The development of a community feeling scale toward online distance education environments. *Turkish Journal of Computer and Mathematics Education, 1*(1), 27-35.

İşman, A. (2011). *Uzaktan eğitim [Distance learning] (Improved 4th edition).* Pegem Academy.

Karaahmetoğlu, O. (2010). *The importance of algebraic equations on secret key cryptosystems design and cryptanalysis* [Unpublished doctoral dissertation]. Trakya University.

Katrancı, Y. & Özdemir, A. Ş. (2013). Strengthening the subject of modular arithmetic with the help of RSA encryption. *Kalem International Journal of Education and Human Sciences,3*(1),149-186.

Kaya, S. & Elgün, A. (2015). The influence of instructional games in science teaching on primary students' achievement. *Kastamonu Education Journal, 23*(1), 329-342.

Kirriemuir, J. & McFarlane, A. (2004). Literature review in games and learning. Hal-00190453, *futurelab series, report 8*. https://telearn.archives-ouvertes.fr/hal-00190453/document

Köroğlu, H. & Yeşildere, S. (2002, September). *İlköğretim II. kademede matematik konularının öğretiminde oyunlar ve senaryolar.* Paper presented at the 5th National Science and Mathematics Education Congress, METU Culture and Congress Center, Ankara.

Lee, Y. L. (2008). Educational game themes of a fraction brick game. *In Hello! Where are you in the landscape of educational technology? Proceedings ascilite Melbourne 2008.* http://www.ascilite.org.au/conferences/melbourne08/procs/lee-poster.pd

McMillan, D. W. & Chavis, D. M. (1986). Sense of Community: A Definition and Theory. *Journal of Community Psychology, 14*(1), 6-23.

Ministry of Education [MoNE]. (2013). *Ortaokul ve İmam Hatip Ortaokulu Zekâ Oyunları Dersi (5., 6., 7., 8. Sınıflar) Öğretim Programı* [Secondary School and Imam Hatip Secondary School Intelligence Games Lesson (5th, 6th, 7th, 8th Grades) teaching program]. Ankara: Ministry of National Education, Board of Education

Ministry of Education [MoNE]. (2018). *Teaching mathematics (1, 2, 3, 4, 5, 6, 7 and 8th grades) program.* Ankara: Ministry of National Education, Board of Education.

Morgan, G. A., Leech, N. L., Gloeckner, G., W., & Barret, K. C., (2004). *SPSS for Introductory Statistics: Use and Interpretation.* Second Edition. London, Lawrance Erlbaum Associates.

Moore, M. G. (1989). Editorial: Three types of interaction. *American Journal of Distance Education, 3*(2), 1-7. https://doi.org/10.1080/08923648909526659

Nabie, M. J. & Sofo, S. (2009). The use of games by Ghanaian teachers for teaching mathematics. *Journal of Education, 1*(2), 1-16.

Naidu, S. (2019). The changing narratives of open, flexible and online learning. *Distance Education, 40* (2), 149-152. https://doi.org/10.1080/01587919.2019.1612981

Nichols, M. (2003). A theory of eLearning. *Educational Technology & Society, 6*(2), 1−10.

Omeodu, M. D. & Fredrick, F. C. (2019). Effect of game teaching method on student's mathematics achievement in Aboh-Mbaise Local Government Area, Imo State. *International Journal of Innovative Social & Science Education Research, 7*(3), 18-23.

Öztürk, E. & Deryakulu, D. (2011). The effect of type of computer mediated communication tools on social and cognitive presence in online learning community. *Hacettepe University Journal of Education, 41*, 349-359.

Parsad, B. & Lewis, L. (2008). *Distance Education at Degree-Granting Postsecondary Institutions: 2006–07* (NCES 2009–044). National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education.

Pehlivan, H. (2005). *Oyun ve öğrenme.* Anı Yayınları.

Santana de Oliveira, M. M. & Torres Penedo, A. S. & Pereira, V. (2018). Distance education: Advantages and disadvantages of the point of view of education and society. *Dialogia, 29,* 139-152. doi: 10.5585/dialogia. N29.7661 https://doi.org/10.5585/dialogia.N29.7661

Santos, M. L. K. P., Diaz, R. V., & Belecina, R. R. (2015). Mathematical modeling: effects on problem solving performance and math anxiety of students. *International Letters of Social and Humanistic Sciences, 65,* 103-115. https://doi.org/10.18052/www.scipress.com/ILSHS.65.103

Shi, Y. (2003). Using voleyball games as examples in teaching mathematics. *Teaching Mathematics Applications, 22*(2), 53-62.

Song, Z. (2002). *Designing game-based interactive mathematics learning environments for children.* [Unpublished master's thesis]. The University of British Columbia.

Randel, J., Morris, B., Wetzel, C., & Whitehill, B. (1992). The effectiveness of games for educational purposes: A review of recent research. *Simulation & Gaming, 23* (3), 261–276.

Russo, J., Braggb, L. A., & Russo, T. (2021). How primary teachers use games to support their teaching of mathematics. *International Electronic Journal of Elementary Education, 13*(4), 407-419. Doi: 10.26822/iejee.2021.200

Rutherford, K. (2015). *Why play math games?* Accessed on 17.11.2016, http://www.nctm.org/publications/teaching-children-mathematics/blog/why-play-mathgames

Usta, N. (2014). According to students participating to bartin province mathematics contests for junior high schools, the factors allowing them to be successful in mathematics. *Bartin University Journal of Faculty of Education, 3*(2), 153-173. doi: 10.14686/BUEFAD.201428176

Usta, N., Işık, A., Şahan, G., Genç, S., Taş, F., Gülay, G., Diril, F., Demir, Ö., & Küçük, K. (2018). The effect of teaching mathematics with games on the mathematics achievement of secondary school 7th grade students. *Elementary Education Online,17*(4), 1972-1987. Doi 10.17051/ilkonline.2019.506917 http://ilkogretim-online.org.tr

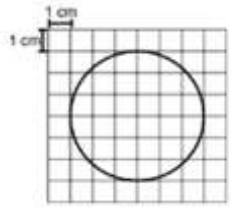
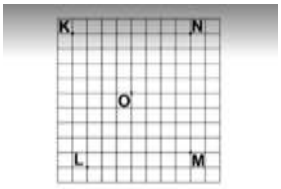
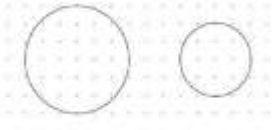
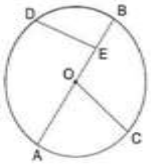
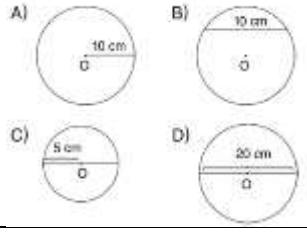
Van de Walle, J. A., Karp, K. S., & Bay-Williams, J. M. (2014). *Elementary and middle school mathematics, teaching developmentally* (trans. from 7th edition). (Trans. Ed. S. Durmuş). Nobel Yayınları.

Vankúš, P. (2008). Games based learning in teaching of mathematics at lower secondary school. *Acta Didactica Universitatis Comenianae Mathematics, 3,* 103-120.

Yerlikaya, T., Buluş, E., & Buluş, N. (2006, February). *Asimetrik şifreleme algoritmalarında anahtar değişim sistemleri.* Akademik Bilişim.

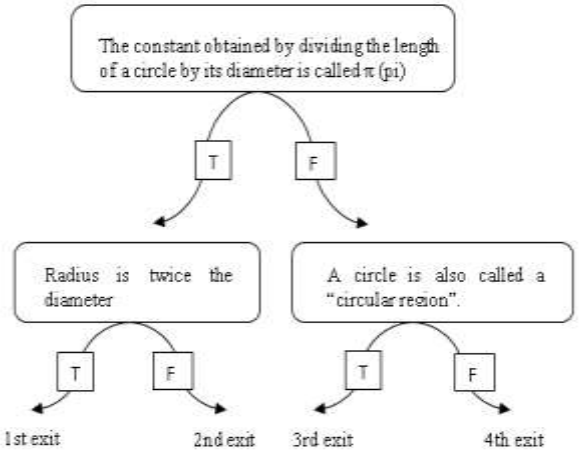
Appendices

Appendix 1. MAT

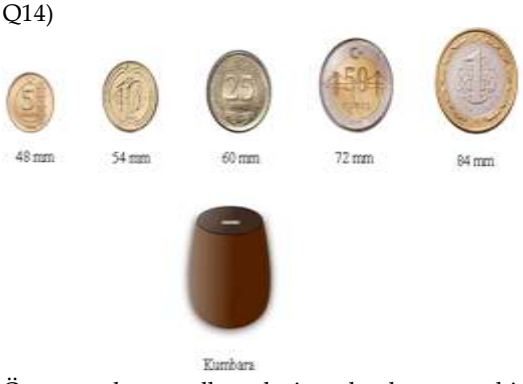
Question No/Questions	Question No/Questions
Q1)  What is the radius of the circle given on the squared paper above? A) 3, B) 4, C) 5, D) 6	Q2)  Three of the K, L, M, and N points shown on the squared paper are located on the circle with center O; which point is not on this circle? A) K, B) L, C) N, D) M
Q3)  What is the distance between the centers of the circles drawn on the squared paper in the figure above? A)7, B) 8, C)10, D)11	Q4)  Which of the segments given in the circle with center O is not a radius? A) [OA], B) [OB], C) [DE], D) [OC]
Q5) What is the diameter of a circle with a radius of 16 cm? A) 8, B) 12, C) 24, D) 32	Q6) Which of the circles below with center O has a diameter of 10 cm? 
Q7) Which of the following is a circle model? A) Jar lid B) Bracelet C) Coin D) Ball	Q8) What is the radius of the largest circle that can be drawn inside a square whose perimeter is 32 cm? A) 4, B) 5, C) 6, D) 8
Q9) What is the length of the circumference of a circle with a radius of 4 cm? (π=3). A) 8, B) 12, C) 18, D) 24	Q10) Two equal circles are formed by cutting a wire of 132 cm. What is the radius of the formed circles? (π =3) A) 7, B) 11, C) 14, D) 22
Q11) A runner does two laps around a circular track with a diameter of 124 meters runs. How many meters does he run? (π =3) A) 248, B) 372, C) 744, D) 1488	Q12) How many turns does a wheel with a diameter of 80 cm should make for a car to travel 720 m? (π=3) A) 150, B) 300, C) 420, D) 600

Q13) Which exit is reached when you take the "T" path if the statement given below is true and the "F" path if it is false?

A)1. B) 2. C) 3. D) 4.



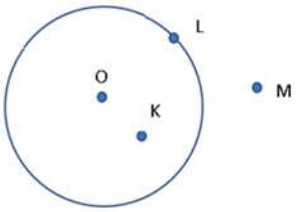
Q14)



Ömer made a cardboard piggy bank to save his coins and opened a 2 cm gap on the top of the piggy bank to put the coins into the piggy bank. According to this, how many of the coins, whose circumferences are given above, can Ömer put in his piggy bank? (π=3)

A) 5, B) 4, C) 3, D) 2

Q15)



What point can be the center of the circle given above?

A) O, B) M, C) L, D) K

Appendix 2.

Find Hidden Concepts

This verbal game serves students to recognize the circle and its elements and show them by drawing. Thus, by drawing the circle, the student will recognize its center, radius, and diameter. The following table contains several concepts related to a circle; they are used more than once. The game is played individually. The table is projected on the digital screen, and each student has a paper and pen to take notes. The students are asked to find the concepts in the table and the number of each concept in the given time and show them in the figure. The student who completes the answer in the given time gets 10 points for each correct answer, and the student with the most points wins the game. The answers are discussed at the end of the game, and students are asked to prepare a similar game for the next lesson.

R	Z	E	K	R	E	M	P	B	P	C	D
E	F	G	R	H	P	İ	A	İ	A	R	E
B	P	İ	E	R	R	Y	Ç	M	Ç	E	Ç
M	A	E	B	P	M	A	I	E	I	B	M
E	Ç	E	M	B	E	R	R	İ	R	M	E
Ç	I	K	E	Z	R	I	A	Ç	A	E	R
Z	R	E	Ç	P	K	Ç	Y	E	Y	Ç	K
E	A	İ	P	K	E	A	Y	M	D	A	E
K	Y	K	N	A	Z	P	İ	B	P	B	Z
R	B	A	P	İ	T	O	Z	E	Ç	K	T
E	Ç	Z	F	K	L	M	E	R	K	E	Z
M	İ	Y	A	R	I	Ç	A	P	B	A	K

Conflict of interest: The authors declare no competing interests.