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The Effect of Educational Digital Games on Academic Success and Attitude in 3rd Grade Mathematics Class

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Educational digital games are games designed for educational purposes. These games are used to provide students with certain knowledge, and designated with a with a view to improving their skills or to shaping their behavior. The aim of this study is to determine the effect of educational digital games Wordwall and Matific used in teaching primary school mathematics course on student achievement and attitude. Pre-test and post-test were applied to the experimental and control groups of the study in which quasi-experimental method was used. The study group consisted of 48 students studying in the 3rd grade of a public primary school. In the experimental group of the study, educational digital games Wordwall and Matific were used in the measurement unit of the mathematics course (length, perimeter, area, and liquid measurement). In the control group, the same subject was presented in accordance with the instructions in the third grade mathematics teacher's guide provided by Republic of Türkiye Ministry of National Education. The data were collected with the 20-question "Mathematics Achievement Test", which was jointly determined by the classroom teachers and the researchers, and the "Mathematics Course Attitude Scale" consisting of 13 items developed by Ayvaz (2010). In the analysis of the data, t-test for independent and dependent groups, which is one of the parametric tests appropriate to the research hypotheses, was applied. The findings of the study show the effectiveness of educational digital games in affecting students' academic achievement and attitudes. Based on this result, it is recommended that teachers should benefit from trainings in order to use educational digital games effectively in lessons.

Introduction

'Game', which has an important place in the lives of children, young people and even adults, is a multifaceted activity. Game, which is a structured activity that is usually done for entertainment, competition, education or reducing stress, is defined as physical, mental, and

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affective activities (Yıldırım, 2017). Koçyiğit, Tuğluk, and Kök (2007) defined game as a natural learning tool that supports all areas of development, which the individual participates in voluntarily and with pleasure, whether it has a purpose and rules, or a certain tool is used. Games can be used as an effective tool in teaching because their interactive structure and fun atmosphere attract students' attention and improve their cooperation and problem-solving skills. At the same time, games can reinforce learning while providing students with the opportunity to understand topics in more depth.

Games can be performed individually or in groups; cooperative games, competitive games, strategy games, sports games, games based on luck, entertainment, or educational games; games held indoors or outdoors; It can be classified into different types as games performed with various materials and tools (Ergül ve Erşen, 2023; Harikrishnan, Noor, Jamalludin and Shalini, 2019). Games that vary with age group, area of interest and cultural factors (Hussein, 2023) and are used in education systems to develop skills, gain knowledge, and support learning processes are called educational games (Demirel, Seferoğlu ve Yağcı, 2004). Educational games that make learning more effective and interesting are considered as entertaining activities that enable students to enjoy learning (Bayırtepe and Tüzün 2007). Educational games are also used to ensure learning at the beginning, middle and end of the lesson, or for reinforcement purposes, depending on the characteristics of the subject and the outcome to be achieved (Altun, 2019; Demirel, 2022). It can be said that educational games are the most natural method for students to learn by exploring and observing.

The study conducted by Licorish, Owen, Daniel, and George, (2018) reveals that educational digital games improve students' learning experiences in various subjects, support students at different stages of the course and reinforce concepts. The same study emphasizes that educational digital games provide students with multi-sensory, experimental and critical thinking skills and state that they increase student participation (Bressler and Bodzin, 2013). Moreover, studies have concluded that educational digital games, in addition to being socially fascinating and entertaining, also develop positive emotions in students regarding these games and increase cognitive development, even if they have difficulty or fail (Hoffman and Nadelson, 2009; Václavíková, 2020). In the research conducted by Selvi and Öztürk Çoşan (2018), students stated that educational digital games were informative, entertaining, and increased their desire to work with their friends. Li, Zhang, and Yu (2021) also concluded that integrating EDG into learning processes creates a learning environment that students enjoy, which improves learning results. EDG makes learning more interesting, enjoyable and effective by placing the student at the center of the educational experience (Pareja, 2021; Rakasiwi and Muhtadi, 2021).

Games, which have an important role in an individual's development, education, mental health and social relations, have undergone change. Since the 1970s, traditional game activities have started to be replaced by digital games due to reasons such as increasing urbanization, limitation of playgrounds, acceleration of technological advances, and widespread use of the internet (Gentile, 2009; Engin-Aldemir, 2023). Digital games have many benefits, from providing ego satisfaction with the pleasure of winning, to supporting creativity, and providing results and feedback in learning. These games are considered as effective tools to increase the academic achievement, problem solving skills, motivation and critical thinking skills of students representing today's generation who tend to use technology effectively (Gocheva, Somova, Angelova and Kasakliev, 2020; Kaynar, 2020).

Digital games, which attract attention with their potential to increase motivation and interest,

have gained an important place in teaching with their potential to develop scientific creativity, contribute to foreign language learning and increase conceptual understanding (Lu, Chang, Huang and Chen, 2011). Today, educational digital games (EDG) have become effective tools that contribute to learning processes at all levels of education as an alternative to traditional education methods. It is thought that using EDG makes students' learning experiences more interactive and fun and creates an important transformation in modern education systems by increasing competition while developing cooperation among students (Aksoy, 2014; Threlfall and Bruce, 2005). Within this context, it is accepted that EDG increase learning motivation. (Tsai, Yu and Hsiao, 2012). In the education system, primary school is an important process in which basic skills are acquired, and mathematics is an important component that is at the center of the education system at all levels. The use of EDG in mathematics lessons, which provide students with a better understanding of mathematical concepts by presenting them in a concrete and visual way, is attracting more and more attention. EDG create a deeper awareness in learning by providing students with the opportunity to experiment and make mistakes, making mathematics learning a more positive experience (Argın, 2020; Byun and Joung, 2018). While games played in groups or individually improve mathematical skills, elements such as rankings and rewards can create a healthy competitive environment among students and make them more motivated (Tokac, Novak ve Thompson, 2019). The use of educational digital games, which offer students an entertaining learning experience, in primary school mathematics classes allows students to learn the lesson more effectively and enjoyably, improve their mathematical skills and show more interest in the lesson.

When the literature is examined; A study conducted in 2017 emphasized that computer-based games promote mathematics learning more effectively than traditional approaches, which leads to better performance and higher levels of enjoyment in solving mathematical problems among students (Adams, McLaren, Mayer, & Forlizzi, 2017). Another study states that there is increasing interest in EDG due to their ability to present mathematical concepts in a concrete and visual way and lead to a deeper understanding among students. Moreover, it has been concluded that the use of EDG in primary school mathematics lessons significantly improves students' learning experiences and makes the lesson more effective and fun (Tokac et al., 2019). Byun and Joung (2018) emphasized that EDG offers students the opportunity to experiment and make mistakes and encourages a positive learning experience in mathematics. Another research report states that it contributes to the increase of mastery in mathematical knowledge by emphasizing the importance of using problem-solving strategies to help students understand the mathematical principles embedded in educational digital games (Deng, Wu, Chen, & Peng, 2020).

Today's elementary school students representing the Alpha generation, which is the continuation of Generation Z, which grew up as a direct part of mobile technology and the internet, especially the so-called "crystal generation", "internet generation, i-generation", “Google generation" (Vogel, 2015), spend a significant part of their lives in technology. The fact that the Alpha generation, who accept smartphones, social media, and digital platforms as a natural part of life, are actively and effectively involved in technology in their lives makes it important for teachers to include EDG in their lessons. However, the determinant of whether EDG have the expected effect in the educational process is undoubtedly the students. The use of EDG in the context of academic achievement has been a topic of interest in educational research. There are many studies investigating the effects of EDG on students' learning outcomes (Ar, 2016; Buckley and Doyle, 2014; Rouse, 2013; Turan, 2019; Yavuzkan, 2019). It should be ensured that students experience EDG in lessons, and it should be investigated whether these games affect students' attitudes and behaviors. In addition, the COVID-19

pandemic caused the connection of schools and the transition to distance education, and education and training were continued with interactive distance education over the internet. It has become important to conduct more research on Web 2.0 tools and educational digital games in order to adapt to changes in the education system after COVID-19 and to provide effective education. This research can contribute to a better understanding and improvement of the education system that informs teacher education, student achievement and motivation. This study is considered important because it examines the effect of EDG on student attitudes and achievements in the educational process.

The general purpose of the research is to examine the effectiveness of teaching with EDG in primary school mathematics teaching. In this context, it was aimed to examine the effects of teaching with EDG on students' academic achievement and attitudes towards mathematics in the 3rd grade mathematics course. Considering this aim, answers were sought to the following questions:

Regarding the groups in which EDG teaching method was applied

(1) Is there a significant difference between the pre-test and post-test achievement scores of the experimental group and the control group students who were taught traditionally?
(2) Is there a significant difference between the pre-test and post-test attitude scores of the students in the experimental group and the control group in which traditional teaching was applied?
(3) Is there a significant difference between the mean scores of the pre-test and post-test academic achievement and attitude scores of the experimental group students?
(4) Is there a significant difference between the averages of the pre-test and post-test mathematics course academic achievement and attitude scores of the control group students?

Method

Research design

In the study, a quasi-experimental method with pre-test post-test experimental-control group was used. “According to the results obtained from pre-tests and post-tests applied in experimental studies, the effect of the technique used on the experimental group can be investigated” (Büyüköztürk, 2023). Due to this feature, the experimental approach emerges as the most suitable method for the study's objectives.

In the experimental group of the study, EDG (Wordwall and Matific) were used in the measurement unit of the mathematics course (length, perimeter, area, and liquid measurement). In the control group, the same topic was taught in accordance with the instructions in the third-grade mathematics teacher's guide provided by the Ministry of National Education. In the study, the relationship between the use of EDG and students' course achievement and attitudes towards mathematics was examined. The study with pre-test - post-test and control group was designed in accordance with the experimental design as shown in Table 1.

Table 1. Quasi-experimental design with pre-test-post-test control group

Group	Pre-test	Process	Post-test
Experimental	-Academic Achievement Test - Attitude Scale	- Educational Digital Games (Wordwall and Matific)	- Academic Achievement Test - Attitude Scale
Control	-Academic Achievement Test - Attitude Scale	- Traditional Teaching	-Academic Achievement Test - Attitude Scale

Wordwall and Matific are Web 2.0 tools that can be used in mathematics classes to ensure that students learn effectively. Both platforms offer teachers the ability to create a variety of interactive games and activities. Wordwall includes math word puzzles, matching games or card matching games related to mathematical operations. Matific, on the other hand, contains math activities in more than 40 languages that can be used at different levels, from kindergarten to 6th grade. It is an interactive application consisting of rich and interesting meta games, activities for creating personal avatars, individual and group exercises, and tests for repetition. It also supports teachers in assigning homework, grading, and evaluating while providing lesson plans and activities. Both platforms help students develop basic mathematical skills, and thanks to the customization feature, course materials can be personalized to suit students' needs and levels. These platforms, which monitor and improve students' performances by providing instant feedback, can also be used in distance education and offer students the opportunity to practice mathematics at their own pace.

Participants

The study group of the research consists of 3rd grade students studying in a primary school in Safranbolu district of Karabük province. Experimental and control groups were selected among five 3rd grade classes in the primary school in the 2023-2024 academic year. In the selection of the classes, firstly, interviews were made with the teachers, and the 3B class (N=25), the class of the teacher who preferred to use EDG in his lessons, constituted the experimental group. The 3D class (N=23), whose math achievement was close to the 3D class, was selected as the control group.

The study group of the research consists of 3rd grade students studying in a primary school in Safranbolu district of Karabük province in the 2023-2024 academic year. The research was carried out in the school where EDG training was given by the researchers. The 3B class (N=25) of the teacher who volunteered to participate in the research and preferred to use EDG in his lessons constituted the experimental group. The 3D class (N=23) of the teacher whose mathematics success (exam grades) was close to the experimental group and who volunteered to participate in the research was selected as the control group.

Data Source and Data Collection

The acquisitions belonging to the sub-learning areas of length, area, perimeter, and liquid measurement in the 6th Unit "Measurement" learning area in the Primary School 3rd Grade Mathematics Curriculum were taken into consideration. The achievement test was created with a total of 30 questions prepared by 3B and 3D classroom teachers and selected by the researchers from the questions used in the literature. This achievement test, which was a preliminary form, was presented to four classroom teachers, one Turkish language expert academician and 12 third grade students for content and face validity, and necessary arrangements were made in the questions and options. The mathematics achievement test was

analyzed with 120 students for item analysis and reliability. The data obtained from this group were entered into the ITEMAN for Windows Version 3.50d package program and item analysis of the achievement test questions was performed. The number of questions in the achievement test was reduced from 30 to 20 by taking into consideration that good questions with item discrimination greater than .30 and difficulty index between .40-.60, good questions with item discrimination between .20-.29, difficulty index between .15-.39 and .61-.85 can be used in the test (Baykul, 2000). After the item analysis, the average difficulty index of the 20-question achievement test was .53, the average discrimination level was .68 and the reliability value was .86. The Cronbach Alpha coefficient of the mathematics achievement test was found to be .92, and the KR-20 was .88.

Data on students' attitudes towards mathematics course were obtained with the "Mathematics Course Attitude Scale" developed by Ayvaz (2010). The scale is 5-point Likert type and consists of 13 items and two dimensions. The dimensions of the scale are "Interest and Love for Mathematics" and "Insecurity and Fear in Achieving Mathematics". The scale is scored as (5) Strongly Agree, (4) Agree, (3) Undecided, (2) Disagree, (1) Strongly Disagree. The lowest score that can be obtained from the scale is 13 and the highest score is 65. A high score indicates that the students have a positive attitude towards mathematics course, while a low score indicates that they have a negative attitude towards the course. The Cronbach's Alpha coefficient of the scale was found to be .86 by the developer of the scale, and the Cronbach's Alpha coefficient of the scale was found to be .84 in this study.

Application Process

In the study, pre-test "Academic Achievement Test" and "Mathematics Course Attitude Scale" were applied to both groups before the experiment. During the last two weeks of November and December, Unit 6 consisting of 14 outcomes (length measurement 5, perimeter measurement 4, area measurement 2, liquid measurement 3) was taught in the experimental and control groups for 6 weeks and 28 lesson hours. Lessons were conducted by classroom teachers in both groups. While educational digital games (Wordwall and Matific) were used in the experimental group, the same subject was taught in the control group in accordance with the instructions in the third-grade primary school mathematics teacher's guide. Achievement test and attitude scale were applied as post-test in both groups in the fourth week of December.

Wordwall and Matific games used in the study were preferred by the experimental group teacher after the training on educational digital games given by the researchers. Lesson plans including “Wordwall” and “Matific” games were made together by the researchers and the experimental group teacher. Wordwall and Matific games and activities have been integrated into the processes of drawing attention, repetition, and group work in teaching together with the classroom teacher and researchers, according to the achievements in the learning area of Unit 6 "Measurement".

Data Analysis

In the analysis of the data obtained from the mathematics achievement test and attitude scale pre-test and post-test, it was first examined whether the data were normally distributed. As a result of the normality test, the pre-test skewness value (Skewness) of the mathematics achievement test was .59 and kurtosis value (Kurtosis) was .08; the post-test skewness value (Skewness) was .95 and kurtosis value (Kurtosis) was .04. As a result of the normality test conducted for the attitude scale, the pre-test skewness value (Skewness) was

found .01 and kurtosis value (Kurtosis) was found .65; post-test skewness value (Skewness)was found .35 and kurtosis value (Kurtosis)was found .96.

According to these values, both achievement test and attitude scale data show normal distribution. For the assumption of normal distribution, the kurtosis and skewness of the data should be between +2 and -2 (George & Mallery, 2003). In the pairwise comparisons of normally distributed data, independent samples t-test and paired samples t-test (Kwak and Kim, 2017), which are parametric tests appropriate for the research hypotheses, were used. In the statistical comparison of the data, the paired samples t-test was used between the scores of the experimental group students from the academic achievement test (pre-test post-test) and attitude scale (pre-test post-test), and the paired samples t-test was used between the scores of the control group students from the academic achievement test (pre-test post-test) and attitude scale (pre-test post-test). The pre-test scores of the experimental and control groups and the post-test scores of the experimental and control groups were compared using the unrelated samples t test. The significance level was accepted as .05 in the analysis of the data. All statistical tests of the study were carried out with SPSS version 25.

Ethics Committee Approval

This study was reviewed by Gazi University Ethics Committee on [04. 06. 2023 / Document Number: 648d9be8-ca1f-409d-970e-d7c62ccd9104] and was edited in accordance with ethical limits. Specific protocols and ethical rules to be followed during study isolation were clearly stated and accepted by the researchers.

Findings

This section includes the findings obtained by analyzing the data obtained as a result of the research. In experimental studies, it should first be examined whether the groups are equivalent to each other in the dimensions compared. In this study, before the curriculum was started to be implemented, it was examined with pre-tests whether the experimental and control groups were equivalent to each other in terms of achievement and attitudes towards mathematics. With the post-test conducted at the end of the instruction, it was examined whether the instruction with EDG provided a difference in student achievement and attitude compared to the traditional method.

Table 2. t-Test Results for the Mathematics Achievement Test

Measurement	Group	N	$\bar{X}$	S	sd	t	p
Achievement Test Pre-test	Experimental	25	82,00	10,60	46	,195	,84
	Control	23	81,30	13,99		,193	
Achievement Test Post-test	Experimental	25	92,40	9,14	46	3,17	,003
	Control	23	82,82	11,66		3,14	

When the pre-test results of the math achievement test in Table 2 are examined, it is seen that the average of the experimental group ($\bar{X}$=82.00) is slightly higher than the average of the control group ($\bar{X}$= 81.30). The achievement scores of both groups are quite close to each other. When the p value of the pre-test achievement mean scores of the experimental and control groups is analyzed (p=.84 >.005), it is seen that there is no significant difference between the mean scores. The values obtained may be an indication that the experimental and control groups are equal to each other in course achievement and that the groups were

selected unbiasedly.

At the end of the teaching of EDG to the experimental group and traditional method to the control group, it was determined that the achievement post-test average of the experimental group ($\bar{X}$= 92.40) was higher than the post-test average of the control group ($\bar{X}$= 82.82). As a result of the independent groups t-test, when the difference between the achievement test scores of the experimental group students and the scores of the control group students was examined to see if there was a significant difference, the p value obtained (p=.003 <.005) showed that there was a significant difference. According to the post-test scores of the groups, it can be said that the experimental group students were more successful than the control group students in the post-test. In other words, it can be stated that the experimental group class, in which EDG were used in addition to traditional teaching, increased the success of the experimental group class more than the control group class where only traditional teaching was done.

Table 3. t-Test Results for Mathematics Attitude

Measurement	Group	N	$\bar{X}$	S	sd	t	p
Attitude Pre-test	Experimental	25	3,57	,51	46	1,01	,314
	Control	23	3,74	,63			
Attitude Post-test	Experimental	25	4,56	,34	46	5,87	,000
	Control	23	3,96	,36			

When the pre-test results of the scores obtained from the mathematics course attitude scale in Table 3 are examined, it is seen that the average of the experimental group ($\bar{X}$=3,57) is slightly higher than the average of the control group ($\bar{X}$=3,74). The math course attitudes scores of both groups were quite close to each other. When the p value of the pre-test attitude mean scores was analyzed (p=.>.005) it was found that there was no significant difference between the mean scores of the experimental and control groups. It can be said that the mathematics course attitudes of the experimental and control groups were equal to each other before the teaching activities.

As a result of the independent groups t-test, it was determined that the post-test average of the experimental group ($\bar{X}$=4.56) was higher than the post-test average of the control group ($\bar{X}$=3.96). When it was examined whether there was a significant difference between the math course attitude scores of the experimental group students and the scores of the control group students, the p value (p=.000 <.005) shows that there is a significant difference between the attitude scores of the experimental and control groups. According to the post-test scores of the groups, it can be said that the experimental group students have a more positive attitude towards mathematics course than the control group students. In other words, it can be said that EDG increase the positive attitude towards Mathematics Course more than traditional teaching.

Table 4. Pre-Test Post-Test t-Test Results of the Experimental Group Mathematics Course Achievement Test

Group	Measurement	N	$\bar{X}$	S	sd	t	P
Experimental Group	Achievement Test Pre-test	25	82,00	10,60	24	7,07	,000
	Achievement Test Post-test	25	92,40	9,14			

According to Table 4, the experimental group's mathematics achievement test pre-test mean score ($\bar{X}$ = 82.00) was lower than the post-test mean score ($\bar{X}$ = 92.40). The post-test mean

score of the experimental group is significantly different from the pre-test mean score (p=.000<.005). Therefore, it can be said that the use of EDG mes in mathematics lessons has a positive effect on student achievement.

Table 5. Pre-test and Post-test t-Test Results of the Control Group Mathematics Course Achievement Test

Group	Measurement	N	X̄	S	sd	t	p
Control Group	Achievement Test Pre-test	23	81,30	13,99	22	1,57	,129
	Achievement Test Post-test	23	82,82	11,66			

According to Table 5, the control group's mathematics achievement test pre-test mean score ($\bar{X}$ = 81.30) was lower than the post-test mean score ($\bar{X}$ = 82.82). However, it is seen that the difference between the post-test mean score and the pre-test mean score of the control group is not significant (p=.129 >.005). It can be said that the traditional method in mathematics does not significantly change student achievement.

Table 6. Pre-Test Post-Test t-Test Results of the Mathematics Attitude Scale for the Experimental Group

Group	Measurement	N	X̄	S	sd	t	p
Experimental Group	Attitude Scale Pre-test	25	3,57	,51	24	8,38	,000
	Attitude Scale Post-test	25	4,56	,34			

According to Table 6, the mean pre-test score ($\bar{X}$ =3.57) of the experimental group was lower than the mean post-test score ($\bar{X}$ =4.56). The post-test mean score of the experimental group is significantly different from the pre-test mean score (p=.000<.005). It can be said that the use of EDG in mathematics lesson positively affects students' attitudes towards mathematics lesson.

Table 7. Pre-Test Post-Test t-Test Results of the Control Group Mathematics Attitude Scale

Group	Measurement	N	X̄	S	sd	t	p
Control Group	Attitude Scale Pre-test	23	3,74	,63	22	1,62	,118
	Attitude Scale Post-test	23	3,96	,36			

According to Table 7, the pre-test mean score ($\bar{X}$ =3.74) of the control group mathematics course attitude scale is lower than the post-test mean score ($\bar{X}$ =3.96). However, it is seen that the difference between the post-test mean score and the pre-test mean score is not significant (p=.118 >.005). It can be said that the traditional method in mathematics course did not significantly change students' attitudes towards mathematics course. This implies that the conventional approach might not be effective in altering students' perspectives on mathematics significantly.

Discussion, Conclusion and Recommendations

In the study, it was aimed to determine the effect of EDG (Wordwall and Matific) on the teaching process in primary school mathematics teaching through student achievement and attitude. According to the analysis of the data obtained in line with the objectives of the study, it is seen that the groups are equal to each other since there is no difference between the academic achievement and attitude pre-test scores of the experimental and control groups. At the end of the six-week application period, according to the results of the mathematics course

achievement test and mathematics course attitude analysis applied to both groups, it was determined that the scores of the experimental group students were higher than the control group. It was determined that this difference between the scores of achievement tests and attitude tests obtained from the two groups was significant. It is seen that the differentiation as a result of the applications is more effective in favor of the experimental group. This strengthens the internal validity of the study and supports the conclusion that the improvement observed in the post-test scores is indeed linked to the use of EDG. According to the findings, it can be said that EDG contribute positively to students' mathematics achievement and attitudes towards mathematics course.

When the pre-test and post-test scores of the groups are compared, it is seen that the post-test scores of the experimental group students in the mathematics course achievement test and mathematics course attitude scales are higher than the pre-test scores. It was determined that this increase in the achievement and attitude levels of the experimental group students with the EDG created a significant difference. According to the findings obtained in the study, the use of EDG in mathematics education has a positive effect on students' achievement and attitudes towards mathematics. In the control group, where the traditional teaching method was applied, there was a slight increase in students' achievement levels and attitudes from pre-test scores to post-test scores in the mathematics course, but this increase was not significant enough to show that the method applied was successful. Therefore, it can be said that traditional teaching methods did not significantly change or improve student achievement.

The findings of the study are consistent with the existing literature on the positive effect of EDG on mathematics student achievement and attitude. When the literature is examined, it is concluded that EDG are associated with a moderate to high positive effect on learning outcomes (Aykaç and Köğçe, 2020; Saraç, 2018; Şanlıdağ and Aykaç, 2021). EDG facilitate learning, increase interaction and motivation, and improve problem-solving skills (Prensk, 2007; Gee, 2005; Sitzmann and Ely, 2011; Hussein, 2023). In a study conducted with mathematics teachers, it was concluded that EDG improved cognitive performance and increased mathematics achievement (Değirmenci, 2023). In another study, it was determined that EDG increased the student achievement percentage of 5th grade middle school students (Yavuzkan, 2019). Studies have shown that the use of EDG in teaching processes improves students' concept perception, increases their active participation, and motivates them to learn in a more interactive environment (Ferrer, Martinez, and Ibáñez, 2020). EDG have the potential to be an effective tool in mathematics teaching due to their interactive nature (Buchori and Sudargo, 2016; Haruna, Abbas, Zainuddin, Hu, Mellecker, and Hosseini, 2021; Hwang, Chien, and Li, 2021; Hayati and Behnamnia, 2023; Yusof and Shahrill, 2021; Aktaş, Bulut and Aktaş, 2022; Videnovik, Vold, Dimova, Kiønig, and Trajkovik, 2022).

It is emphasized that EDG applications have a potential impact on students' attitudes towards mathematics course (Artun, Durukan and Temur, 2020; Şanlıdağ and Aykaç, 2021). Moreover, the use of EDG in mathematics education increases student motivation and makes the learning process more interesting and interactive (Dewi and Suryanto, 2023). In addition, studies emphasize that EDG reduce students' mathematics anxiety and make them have more positive attitudes towards mathematics (Dondio, Guseva, and Rochaa, 2022). Studies show that EDG can be used to support and enhance mathematics education, ultimately contributing to improved student achievement and learning outcomes (Hwang, et al. 2021; Hayati and Behnamnia, 2023). The data of this study show that the use of EDG in mathematics education has more positive effects on students' learning outcomes and attitudes.

EDG, which enable elementary school students, especially those in the concrete operations period, to better understand abstract mathematics subjects, provide an interactive combination of games and education by indicating how many mistakes students have made, what level they have reached, how many points they have reached, using audio and visual reinforcements such as "you succeeded", "congratulations", attracting attention with sound and visual effects, and creating a competitive environment as well as cooperation. However, the effective use of EDG in teaching means more workload for the teacher. It should not be forgotten that teachers should have techno-pedagogical competence in order to select appropriate EDG, use them, intervene where necessary, and plan where and how much feedback should be given.

On the other hand, when the studies in the literature are examined, it is emphasized that the expected success in teaching where the traditional method is used, as in this study, is achieved at a limited level (Duru, 2014). Hayırsever and Orhan (2018) stated that the traditional learning model, which focuses on presenting new content, generally cannot directly contribute to the development of higher-order thinking skills. This indirectly supports the idea that traditional methods may not significantly increase student achievement.

EDG should be classified in accordance with the mathematics curriculum and made available in the Education Information Network (EBA) system. Teachers need to be empowered to use EDG effectively in their lessons, and for this purpose, teachers should be trained on the selection and use of EDG. Necessary hardware and system arrangements should be made so that EDG can be used easily in every school. Teachers should be informed about the effects of EDG on students and they should develop positive attitudes towards the use of EDG. It should be taken into consideration that subjects or elective courses on teaching with EDG should be included in the programs of faculties of education. Studies regarding students' attitudes, achievements, and lasting learning outcomes related to educational digital games should be included. These studies can be conducted considering various grade levels, different types of schools (such as preschool, Anatolian high school, vocational high school, science high school, and alike), variables such as family, teachers, school management, technological resources. Studies can be conducted using the observation method on how teachers integrate digital games, how they manage student interactions during the lesson, how student participation and motivation increases with EDG, and how it affects learning processes.

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