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Seventh Grade Students' Attitudes and Opinions Towards Mathematics Course Enriched with Educational Games

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Abstract

The aim of the study is to examine the effects of students' attitudes and opinions towards mathematics classes enriched with educational games. For this purpose, in this experimental study, a mixed research method including both quantitative and qualitative research was used. The participants of the research consisted of 32 seventh grade students, 16 of whom are experimental and 16 of whom are control group, studying in a public school in Karapınar district of Konya province in Turkey. As a result of the research, the attitudes of the students in the experimental-control groups were measured quantitatively, and the opinions of the students in the experimental group, whose mathematics lesson was enriched with educational games, were investigated via qualitative methods. The Mathematics Attitude Scale and Student Opinion Form were used as data collection tools in the study. When the data obtained were analyzed, no significant difference was found between the test scores of the pre-attitude and post-attitude test towards mathematics applied in the experimental group to which the educational games were applied and the control group in which the current teaching method was applied. From this point of view, it has been concluded that the educational game method in the teaching of mathematics achievements has no effect on the attitudes of the students. However, based on the interviews in the experimental group in which the educational games were applied, it was concluded that the students' interest in mathematics increased, and their fear of mathematics was replaced by a sense of self-confidence towards mathematics.

Keywords: Mathematics teaching, educational games, Polygons, Mathematics attitude

1. Introduction

Mathematics is a universal language that we need to understand and improve our environment in the world. Both teaching and learning is the most important things for

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all countries. So, the countries give importance to teach mathematics education as much as teach their own language (Karaçay, 2000). The belief that especially technology and science continue to develop show that mathematic education needs to develop and adapt time that we live. For the development and change of education, the new generation; it requires a structure that produces rather than consumes information, is versatile, can solve problems, has a different point of view, is assertive, determined and contributes to society (MEB, 2018). Mathematic education that performs effectively and efficiently, has an important effect that develop different perspectives to problems and show high-level thinking ability to solving problems at the same time increase the self-confidence of the person (Baydar & Bulut, 2002). Despite the importance of mathematics, mathematic lesson always a feared and avoided which cannot create the schema in mind due to being intangible (Ersoy, 2013). This prejudice against mathematics in society creates a great obstacle to learning mathematics and a tendency to be indifferent towards the subject.

According to social science and education research done in recent years, the reason why students do not actively participate in the subject that they are interested in is not only the attractiveness of the subjects but also different education methods (Yücel, 2019). Mathematics lessons that taught with traditional methods cause students to be bored because they are not interesting, they cannot pay attention because they are passive in the lesson, permanent learning does not take place because they cannot associate what they learn with daily life, and thus students form negative attitudes towards mathematics (Yağmur, 2020).

In traditional teaching methods, individuals are passive because they receive information directly, and memorizing information is at the forefront instead of learning and making sense of it. Of course, any knowledge that is only retained by memorization cannot be used in daily life. As a result, it is important to design realistic learning settings that allow students to reflect on their experiences in their daily lives, represent the real world, and offer a diversity of activities. Students actively engage in the learning process in authentic learning environments, and this increases their motivation, feeling of accountability, and experiences. They gain a different perspective on problems. Therefore, when teaching, it should be taken into consideration that the aim is to realize effective and efficient learning. For this, teachers need to create a deliberate or constructed teaching process plan and guide only the student throughout the teaching process (Duman, Peker Ünal, 2017; Fer et al., 2014).

In order for the teaching to proceed as a whole, the plan and program should be very well adjusted. In fact, knowing the basic objectives of a subject, its place in the mathematics curriculum and the sub-learning area to which it belongs contributes to both the learning and teaching process. Mathematics consists of five sub-learning areas. One of these sub-learning areas is geometry and measurement. Many situations we encounter in our daily lives require the ability to use geometry. Geometry, which is one of the basic learning areas of mathematics course, and the sub-learning area of polygons, is one of the subjects that we are constantly intertwined in our lives and need to learn. Geometry has an important effect on individuals in their daily lives by providing them with problem solving, critical thinking, reasoning and cause-effect skills (Türnüklü & Berkün, 2013). It is known that recognizing and making sense of geometric shapes with their properties makes great contributions in solving problems encountered both in daily life and in other areas of mathematics (NCTM, 2000).

For this reason, instead of traditional methods in mathematics teaching, it is important to create learning environments in which students are involved one-on-one, create their own methods by associating mathematics with daily life, and exhibit positive attitudes (Umay, 1996). It is necessary to create an effective learning environment where students can actively participate in the process, obtain information through their own experiences, and transfer it to daily life. Considering these, it is thought that mathematics teaching supported by games can be one of the most effective methods.

This study aims to investigate how teaching polygons through educational games affects the attitudes and perceptions of 7th grade students about mathematics. The educational games created for this purpose are believed to be helpful to other math educators, teachers, and aspiring teachers who want to investigate how educational games affect students' attitudes and opinions by offering sample applications.

The following sub-problems were chosen for the study's purposes;

1- What is the impact of educational games to teach mathematics have on students' attitudes toward the subject?
2- What is the effect of mathematics teaching enriched with educational games on students' opinions about the class?

2. Method

2.1. Research Model

Explanatory sequential design, one of the mixed research techniques that combines the use of quantitative and qualitative data gathering tools, was used in this study. According to this pattern, quantitative data is acquired and processed first, followed by qualitative data. Qualitative data is utilized to support quantitative data in this pattern, where quantitative results are more prominent (Creswell & Plano Clark, 2020).

In this study, a quasi-experimental model with an unequalized control group was adopted from quantitative research methods to examine the impact of mathematics teaching enhanced with educational games (X, independent variable), on attitudes toward mathematics (Y, dependent variable). By using the aforementioned paradigm, the experimental group of students received a learning environment assisted by educational games for the study of polygons, while the control group continued using the standard approach to teaching mathematics. In the qualitative part, student opinions about the process were used to support and explain the quantitative findings. At the end of the study, the experimental group's students were asked about their thoughts on the use of educational games in the classroom using the Student Opinion Form (SOF). Table 1 provides information about the implementation process of the research.

Table 1. Application Process of the Research

Group	Pre-Test	Experiment Stage	Post Test	Post Experiment
Control Group	Pre-Attitude Test	Teaching the Subject of Polygons According to the Current Teaching Method	Final Attitude Test	-
Experiment Group	Pre-Attitude Test	Teaching Polygons in a Learning Environment Enriched with Educational Games	Final Attitude Test	SOF

2.2. Population and Sample

The target population for this research is seventh graders enrolled in public secondary schools in Konya for the 2021–2022 school year. In two seventh grade branches of a secondary school connected to the Ministry of National Education (MEB) in the Karapınar district of Konya, there are 32 students total—15 girls and 17 boys—who make up the sample. The distribution of the sample is displayed in Table 2.

Table 2. Gender Distribution of the Sample

Gender	Class		Total
	Experimental Group	Control Group	
Female	7	8	15
Male	9	8	17
Total	16	16	32

The students who were equal to one another were chosen by simple random technique after the examination of the Mathematics Attitude Scale (MAS) pre-test results, and 16 of them made up the control group and 16 the experimental group. The pre-test findings are displayed in Table 3 below.

Table 3. MAS Pre-attitude test Independent Groups t-Test Results

Groups	N	$\bar{X}$	Sd	df	t	p
Control	16	85,62	8,609	30	1.579	.125
Experiment	16	80,06	11,156			

*p<0,05

Examining the T test findings in Table 3 reveals that the difference among the groups is not statistically noteworthy (t (30) = 1.579 p> 0.05) and that the p value indicating the significance level is higher than 0.05. According to the results, it is interesting that before the application, the attitudes of both control and experimental groups about mathematics were similar, meaning that the groups had similar views toward mathematics.

2.3. Data Collection Tools

To determine how the method used in the study affected students' attitudes, the MAS created by Önal (2013) was used. Additionally, the experimental group's SOF was utilized to gather qualitative data in order to supplement the quantitative data.

The MAS consists of 22 items, 11 positive and 11 negative, and 4 dimensions: interest, anxiety, necessity, and study. The response options on the scale are "Strongly Agree," "Agree," "Undecided," "Disagree," and "Strongly Disagree" on a 5-point Likert scale. By measuring it with the Cronbach's Alpha index, Önal (2013) determined the reliability of the internal consistency of the items in this attitude scale to be .90. The scale's sub-areas with the highest alpha coefficients are "Interest" (10 items), "Anxiety" (5 items), "Study" (4 items), and "Necessity" (3 items).

Table 4. MAS Pre-attitude-Post-attitude and MAS Sub-Dimensions Cronbach's Alpha Values Applied in the Study

MAS Test		Cronbach's Alfa
MAS Pre-Attitude		0,779
MAS Pre-Attitude Sub-Dimensions	Interest	0,791
	Anxiety	0,733
	Study	0,696
	Necessity	0,712
MAS Final Attitude		0,888
MAS Post- Attitude Sub-Dimensions	Interest	0,85
	Anxiety	0,768
	Study	0,705
	Necessity	0,723

The Cronbach Alpha the coefficients of MAS sub dimensions are greater than 0.70, as can be seen in Table 4, further demonstrating the validity of the test.

In order to determine how educational games affected students' perceptions of mathematics, SOF was employed at the conclusion of the process. The questions prepared to obtain students' opinions about the mathematics course supported with educational games at the end of the process were examined by two academicians who are experts in the field and two mathematics teachers working in the MEB. The SOF, which consisted of 13 questions sent to get opinions before the research, was edited in line with the feedback received and reduced to 8 questions, and after the implementation, it was applied to all students in the experimental group who received lessons with educational games. Based on the content analysis, categories, codes and sub-codes were created.

2.4. Data Collection

In this study, the control group and the experimental group were subjected to the MAS created by Önal (2013) prior to and after the application. "I completely agree" received a score of 5, "I agree" received a score of 4, "I am undecided" received a score of 3, and "I strongly disagree" received a score of 2. 1. "I completely agree" was used in the analysis of the negative items. Points were awarded for "I agree," "I am unsure," "I disagree," "I strongly disagree," and "I disagree." There are 10 items in the Interest sub-field, 5 items in the Anxiety sub-field, 4 items in the Study sub-field, and 3 items in the Necessity sub-field. This attitude scale has a maximum total score of 110 and a minimum total score of 22.

The SOF was utilized for gathering feedback from the students on the mathematics course that included educational games at the conclusion of the procedure. As a result of the content analysis, categories, codes and sub-codes were formed.

2.5. Analysis of Data

The normality test was computed in the first stage of the data analysis. The kurtosis and skewness values of the data are in the range of +2 to -2, which forms the basis for the assumption of normal distribution in this case (George & Mallery, 2010).

The fact that the number of people in the research group is less than 50 requires the application of the Shapiro-Wilk test in the study, and in the event that this test yields a p significance value greater than 0.05, it is assumed that the group has a normal distribution. Thus, it is decided that parametric tests can be used in-group research (Büyüköztürk, 2016). In the light of this information, the fact that the number of students in the study was less than 50 necessitates the use of the Shapiro-Wilk test in calculating the normality value. The arithmetic mean ($\bar{X}$), standard deviation (SD), kurtosis and skewness values of the scores obtained from the MAS, which was used as the pre-attitude test and the post-attitude test for the control and experimental groups, respectively, and the p result from the normality test. Values were calculated and these values are given in Table 5.

Table 5. Descriptive Statistical Results for Experimental and Control Groups

Groups	Test	$\bar{X}$	Sd	Kurtosis	Skewness	Shapiro-Wilk (p)
Control (N=16)	MAS Pre-attitude	85,62	8,609	0,664	-0,989	,216
	MAS Post-attitude	84,31	13,917	-0,999	0,029	,665
Experiment (N=16)	MAS Pre-attitude	80,06	11,156	-0,236	-0,386	,573
	MAS Post-attitude	89,37	13,445	-0,618	-0,582	,312

*p <0,05

Based on the information in Table 5The pre-attitude-post-attitude test scores given to the groups' Shapiro-Wilks p values are greater than 0.05, and the values for kurtosis and skewness are between -2 and +2, indicating that the data is distributed normally. This is why, when comparing the control group and the experimental group, the "Independent Sample T Test" was employed, and the "Dependent Sample T Test" was used when comparing pre-test and post-test results within the groups.

The fact that the p value of the data in the research is below 0.05 draws attention to the significant differences in the result. However, while this result gives us that, the result is significant and significant; it cannot give us any information about the extent of the difference between the groups and the magnitude of the effect. In such cases, the Cohen d value is widely used to determine the difference between the groups and to calculate the effect size (Kılıç, 2013).

By dividing the difference between the group means by the sum of the group standard deviations, Cohen's d value is determined. The outcome demonstrates the magnitude and direction of the difference between the groups (Cohen, 1988).

When interpreting the effect size, Cohen d value;

- If it is less than 0.2, it is low,
- 0.5 is medium,
- If it is greater than 0.8, it is stated that the effect is high.

In research, it is advised that the effect size (also known as Cohen's d) value should be less than 0.5. If the Cohen's d value is ≥0.5, it is concluded that there are large differences between the groups involved in the process that can be considered scientifically significant (Cohen, 1988). For these reasons, in order to obtain more efficient results, Cohen's d value was calculated and interpreted in the sub-dimensions that were found significant in the final attitude test of the groups.

When examining the qualitative data, the analysis of content was done using the information from the SOF created to gauge the attitudes of the experimental group of students toward educational games. The data obtained from SOF were coded first by the researcher and then by two academicians. In order to determine the reliability of these data coded by different people, the percentage of agreement between the coders was calculated with the formula [Similar opinion / (Similar opinion + Different opinion) x 100] (Miles & Huberman, 1994). The percentage of agreement calculated in the study was found to be 83% and since this rate was more than 70%, it was concluded that the results of the analysis would be reliable. After the categories were determined according to the similarities or differences between the codes, the sub-codes expressed by each code were created. The 16 students in the study's experimental group were not identified by their full names but rather as follows: S1, S2, S3, ... The results were tabulated by looking at the frequency percentage of the data obtained in line with the answers given by the students.

3. Findings

3.1. Findings of the First Sub-Problem

The study's initial sub-issue, " What is the effect of mathematics teaching with educational games on students' attitudes towards mathematics course?" The experimental and control groups underwent MAS pre- and post-attitude tests, and an independent sample t-test was run for comparisons between the groups' pre- and post-attitudes in order to gather data on the problem at hand. Additionally, a dependent sample t-test was used to analyze the comparison of test scores from the control group and the experimental group for the sub-dimensions of the pre-attitude and post-attitude scale.

Table 6. *Independent Sample t-Test Analysis Results for Preliminary Attitude Scores of Experimental and Control Group Students*

Groups	N	$\bar{X}$	Sd	df	t	p
Control	16	85,62	8,609	30	1.579	.125
Experiment	16	80,06	11,156			

*p<0,05

When Table 6 is looked at, it can be observed that the pre-attitude test for the MAS for the control group averaged 85.62, while it averaged 80.06 for the experimental group. It was determined that the difference between the groups prior to the application was not significantly different [t (30) =1.579, p>.05] because the significance level p value was greater than 0.05. According to the results, it can be seen that before the application, the attitudes of the control and experimental groups toward mathematics were fairly similar.

Table 7. *Independent Sample t-Test Analysis Results for Final Attitude Scores of Experimental and Control Group Student*

Groups	N	$\bar{X}$	Sd	df	t	p
Control	16	84,31	13,917	30	-1.046	.304
Experiment	16	89,37	13,445			

**p<0,05*

Looking at Table 7, according to the MAS post-attitude test values applied to the experimental and control groups, the post-attitude test average of the control group was 84.31, while the post-attitude test average of the experimental group was 89.37. The p value, which is the significance level, was found to be 0.304, and since this value is greater than 0.05, it can be said that the result obtained is not significant and that the attitudes of both groups towards mathematics were similar after the application [(t (30) =-1.046, p> .05]. While the arithmetic mean of the control group was 85.62 in the pre-attitude test, a partial decrease was observed in the post-attitude test and it was 84.31. On the contrary, while the average of the experimental group's pre attitude test was 80.06, it was 89.37 in the post attitude test with a significant increase.

The table below shows whether there is an important distinction between the pre-attitude scores for the MAS sub-domains applied before any application in the experimental and control groups in order to more thoroughly examine the impact of the applied method on attitudes.

Table 8. Independent Sample t-Test Analysis Results for Experimental and Control Group Students' Pre-Attitude Test Sub-Dimensions

Sub-Dimensions	Groups	N	$\bar{X}$	Sd	t	df	p
Interest	Control	16	41,325	3,876	1,601	30	.120
	Experiment	16	38,125	6,955			
Anxiety	Control	16	15,187	3,798	,762	30	.452
	Experiment	16	14,062	4,523			
Study	Control	16	16,375	1,857	,384	30	.703
	Experiment	16	16,062	2,670			
Necessity	Control	16	12,750	2,081	1,188	30	.244
	Experiment	16	11,812	2,372			

*p<0,05

Looking at Table 8, it can be observed that the control group's mean pre-attitude score in the MAS interest subdomain was 41.325 prior to the application, whereas the experimental group's mean pre-attitude score in the MAS interest subdomain was 38.125. Based on these findings, it can be observed that there was no statistically significant distinction between the pre-attitude scores of the control and experimental groups in the MAS interest subdomain prior to the application [t (30) = 1,601, p>.05].

Prior to the application, the control groups mean pre-attitude results in the MAS anxiety sub-field were 15.187, while the experimental group's mean pre-attitude scores in the MAS anxiety sub-dimensions were 14.062. According to these findings, there was no statistically significant distinction between the pre-attitude scores of the MAS anxiety sub-dimensions in the control and experimental groups prior to the application [t (30) = 0.762, p>.05].

Prior to implementation, the control groups mean pre-attitude results in the MAS study sub-dimensions were 16.375, while the experimental group's mean pre-attitude scores in the MAS study sub-dimensions were 16.062. These findings demonstrate that there is no statistically significant distinction in pre-attitude results between the control and experimental groups in the MAS study sub-dimensions prior to application [t (30) = 0.384, p>.05].

The control group’s average pre-attitude results in the MAS necessity sub-dimension were 12.75, while the experimental group's average pre-attitude scores in the MAS study sub-dimension were 11.812. According to these findings, there was no significant distinction between the experimental and control groups' pre-application MAS study sub-dimension attitude scores [t (30) = 1,188, p>.05].

Based on the results, In terms of interest, study, necessity, and anxiety attitudes toward mathematics before the application, it can be said that there was no appreciable difference between the control and experimental groups; in other words, they were equal in terms of the sub-dimensions of attitudes toward mathematics.

The table below shows whether there is a significant difference between the final rating of attitude of the MAS sub-dimensions made after the application in the control and experimental groups, allowing us to more thoroughly examine the impact of the method used in the mathematics lesson on attitudes.

Table 9. Independent Sample t-Test Analysis Results for Experimental and Control Group Students' Post Attitude Test Sub-Fields

Sub dimensions	Groups	N	$\bar{X}$	Sd	t	df	p	Cohen d
Interest	Control	16	39,875	6,701	-,607	30	.548	
	Experiment	16	41,375	7,265				
Anxiety	Control	16	14,125	5,239	-2,067	30	.047	0,7307
	Experiment	16	17,562	4,098				
Study	Control	16	16,812	3,655	-,458	30	.650	
	Experiment	16	17,312	2,386				
Necessity	Control	16	13,500	2,190	,433	30	.668	
	Experiment	16	13,125	2,680				

*p<0,05 *d≥0.5

As shown in Table 9, the mean of the final attitude scores in the MAS interest sub-dimension for the control group was 39.875, while the mean of the final attitude scores in the MAS interest sub-dimension for the experimental group was 41.375. According to these findings, there is no significant distinction between the experimental and control groups' post-application attitude scores for the MAS interest sub-dimension [t (30) =-,607, p>.05].

Following application, the control group's mean final attitude scores in the MAS anxiety sub-dimension were 14.125, while the experimental group's mean final attitude scores in the MAS anxiety sub-dimension were 17.562. According to these findings, there is a difference that is statistically significant between the experimental and control groups' post-application attitude scores for the MAS anxiety sub-dimension [t (30) =-2,067, p.05]. Additionally, Cohen's d value was discovered to be 0.73, indicating that the effect on anxiety is significant in the experimental group.

Following application, the control group's average final attitude score on the MAS study sub-dimension was 16.812, while the experimental group's average final attitude score on the same sub-dimension was 17.312. According to these findings, there is no significant statistically difference between the experimental and control groups' post-application attitude scores for the MAS working sub-dimension [t (30) =-,458, p>.05].

After the application, while the average of the final attitude scores in the MAS necessity sub-dimension in the control group was 13.5, the average of the final attitude scores in the MAS necessity sub-dimension in the experimental group was 13.125. According to these findings, there is no statistically significant difference between the experimental and control groups' post-application attitude scores for the MAS necessity sub-dimension [t (30) =-,607, p>.05].

According to the findings, using educational games to teach mathematics positively impacted the anxiety sub-dimension but had no impact on the interest, study, or necessity sub-dimensions.

Table 10. Dependent Sample t-Test Analysis Results

Tests	N	$\bar{X}$	Sd	df	t	p
Pre-Attitude	16	80,06	11,156	15	-2.057	.058
Post-attitude	16	89,43	13,366			

*p<0,05

Table 10 shows that the experimental group's pre and post attitude test results for the SOF showed an increase in the students' test averages from 80.06 to 89.43 and a p value of.058. These findings demonstrate that there is no statistically significant distinction between the pre- and post-application attitudes of the students in the experimental group. [t (15) =-2.057, p> .05].

Table 11. Dependent Sample t-Test Analysis Results for Control Group Students' Pre-Attitude-Post Attitude Scores

Tests	N	$\bar{X}$	Sd	df	t	p
Pre-Attitude	16	85,62	8,609	15	.302	.767
Post-Attitude	16	84,31	13,917			

*p<0,05

According to Table 11, the test averages of the students decreased from 85.62 to 84.31, and the p value was 0.767, in the MAS pre-attitude-post-attitude test values applied to the control group. These findings show that there is no statistically significant difference between the attitudes of the students in the control group before and after the application. [t (15) =.302, p> .05]. In other words, it can be said that the applied method has no impact on the students in the control group's attitudes toward mathematics.

Table 12. Dependent Sample t-Test Analysis Results for the Mathematics Attitude Test Sub-dimensions of the Experimental Group Students

Sub-dimensions	N	Tests	$\bar{X}$	Sd	t	df	p	Cohen d
Interest	16	Pre-Attitude	38,125	6,955	-1,206	15	.245	
		Post-Attitude	41,375	7,265				
Anxiety	16	Pre-Attitude	14,0625	4,523	-2,140	15	.049	0.8109
		Post-Attitude	17,5625	4,098				
Study	16	Pre-Attitude	16,0625	2,670	-1,654	15	.119	
		Post-Attitude	17,3125	2,386				
Necessity	16	Pre-Attitude	11,8125	2,372	-1,366	15	.192	
		Post-Attitude	13,125	2,680				

*p<0,05 *d≥0.5

The mean pre-attitude score in the MAS interest dimension in the experimental group was 38.125 before teaching with educational games compared to 41.375 after application, with a p value of 0.245. This viewpoint leads to the conclusion that the interest sub-dimension did not change in a statistically significant way when educational games were used as a teaching tool [t (15) =-1,366, p>.05].

The mean pre-attitude score in the MAS anxiety dimension was 14.06 in the experimental group before the use of educational games, but it increased to 17.56 afterward, with a p value of 0.049 [t (15) =-2,140, p.05]. Additionally, the Cohen's d value was 0.81, and it was determined that the effect on anxiety was greater in the experimental group. These findings indicate that using educational games while teaching had a highly beneficial impact and produced a statistically significant difference in the students' anxiety sub-dimension. In other words, it is possible to infer that educational games positively influence students' perceptions of math anxiety.

In the experimental group, the mean pre-attitude score in the MAS study dimension increased from 16.06 prior to the instruction with games that were educational to 17.31 after the application, with a p value of 0.119. According to the results, it can be seen that using educational games during instruction did not result in a statistically significant difference in the study sub-dimension (t (15) =-1,654, p>.05).

At the experimental group, the mean pre-attitude score in the MAS necessity sub-dimension was 11.81 before the instruction with games that were educational, but it increased to 13.12 after the application, with a p value of 0.192. According to these findings, it can be seen that using educational games during class did not result in a statistically significant difference in the necessity sub-dimension (t (15) =-1,366, p>.05).

Table 13. Dependent Sample t-Test Analysis Results for the Sub-Dimensions of the Mathematics Attitude Test of the Control Group Students

Sub-Dimensions	N	Tests	X̄	Sd	t	df	p
Interest	16	Pre-Attitude	41,325	3,876	,673	15	.511
		Post-Attitude	39,875	6,701			
Anxiety	16	Pre-Attitude	15,187	3,798	,674	15	.511
		Post-Attitude	14,125	5,239			
Study	16	Pre-Attitude	16,375	1,857	-,449	15	.660
		Post-Attitude	16,812	3,655			
Necessity	16	Pre-Attitude	12,750	2,081	-1,065	15	.304
		Post-Attitude	13,500	2,190			

*p<0,05

The mean pre-attitude score in the MAS interest dimension in the control group was 41.325 before the current curriculum was implemented, but it dropped to 39.875 after that, with a p value of 0.511, according to Table 13. This makes it possible to draw the conclusion that using the current curriculum while teaching did not result in a difference that is statistically significant in the interest sub-dimension [t (15) = 0.673, p>.05].

The mean pre-attitude score in the MAS anxiety dimension was 15.187 in the control group prior to the implementation of the current curriculum. It fell to 14.125 after the implementation, with a p value of 0.511. The teaching of the current curriculum, according to this perspective, did not result in a statistically important distinction in the anxiety sub-dimension [t (15) =0.674, p>.05].

The mean pre-attitude score in the MAS study dimension was 16.375 in the control group prior to the implementation of the current curriculum. After the implementation, it was 16.812 with a p value of 0.660. From this perspective, it is evident that using the present curriculum to teach did not result in a change with statistical significance in the study sub-dimension [t (15) =-0.449, p>.05].

The mean pre-attitude score in the MAS necessity dimension was 12.75 in the control group prior to the implementation of the current curriculum. It increased to 13.5 after the implementation, with a p value of 0.304. This viewpoint leads to the conclusion that the necessity sub-dimension did not change in a statistically significant way due to the present curriculum [t (15) = 0.304, p>.05].

3.2. Findings of the Second Sub-Problem

In order to examine the second sub-problem of the study, "What is the effect of mathematics teaching enriched with educational games on students' opinions?", SOFs consisting of 8 questions were distributed to determine the opinions of the students in the experimental group about the mathematics course taught with educational games after the implementation. Content analysis was made by looking at the answers given by the students to this opinion form and the results are given in the table below.

Table 14. Content analysis obtained from the SOF

Category	Code	Sub-Codes	f	%
Positive Opinions	Impact/Contribution to Learning	Fun, memorable, positive.	16	%100
		Gave a different perspective.	13	%81
		I understand the subject better.	15	%94
	Interest/ Motivation	It made me happy.	16	%100
		It boosted my motivation.	15	%94
		My participation in the class increased.	13	%81
	The Difference of Math Lesson with Games	More fun and understandable.	14	%88
		I want to play every subject with the game.	14	%88
Negative Opinions	Impact/Contribution to Learning	I didn't gain a different perspective.	3	%19
		I don't understand the subject.	1	%6
	Interest/ Motivation	I was not interested.	1	%6
		It didn't affect my attendance much.	3	%19
	The Difference of Math Lesson with Games	The questions I couldn't do were boring.	2	%12
		It can be boring to cover every topic with a game.	2	%12

According to Table 14, student opinions were divided into two groups as positive and negative opinions, and these groups were analyzed in three codes as "Contribution to learning", "Interest / Motivation" and "Difference of the mathematics lesson taught with games".

The questions related to the contribution to learning were "Did the teaching with games contribute to you? If you think it contributed, what kind of contributions did it make?", Did the mathematics lessons taught with games give you different perspectives? How do you think mathematics lessons supported by games will affect the success in your lessons?" Between 81% and 100% of the students answered these questions as "It was fun, memorable, positive." I gained a different perspective", "I understood the subject better". However, it was also observed that some of the students gave negative answers such as "I did not gain a different perspective" and "I did not understand the subject". Some of the students' responses to these questions are given below.

"Did teaching with games contribute to you? If you think it contributed, what kind of contributions did it make?" Some of the answers given by the students to the question:

S1: "Thanks to the games, I learned the subject in a fun way."

S4: "Yes, teacher, first of all, you made the games you prepared with labor. Health to your efforts. Of course, it is fun, it is always in my head when I go home."

S5: "I think it contributed to us a lot because the lesson became more fun and better, it made us love the math lesson."

S13: "I started to learn more easily and in a fun way and I feel like repeating the subject and I am happy."

S14: "Thanks to the games, math lessons became more fun and more memorable.

S15: "It was very exciting to play the games in groups. Thanks to the games, I both understood the subject and my love for mathematics increased."

Some of the answers given by the students to the question "Did the math lessons taught with games give you different perspectives?"

S2: "I still can't do math; I didn't gain a different perspective."

S10: "Yes, it affected me to solve the questions differently. Mathematics used to be complicated, but now it is more fun."

S13: "Yes, I learn by having fun and I played many games. The games really contributed."

S14: "Yes, it increased my love and confidence in mathematics."

Some of the answers given by the students to the question "How do you think mathematics lessons supported by games will affect the success in your lessons?"

S3: "It makes us participate in the lesson and make it more efficient."

S7: "I think my math lesson is bad, so I am undecided."

S13: "I think it affects positively because I participate happily."

S16: "The games were fun, but I was confused in some games and I could not grasp the subject."

The questions related to interest/motivation were "Were you happy to teach mathematics with games? Why? How did teaching mathematics with games affect your interest and attitude towards mathematics? How did mathematics lessons with games affect your participation and motivation? The questionnaire was formed as follows. It was observed that between 81% and 100% of the students gave positive answers to these questions as "It made me happy", "It increased my motivation", "My participation in the lesson increased". However, it was also seen that some of the students gave negative answers such as "It did not interest me" and "It did not affect my participation in the lesson much". Some of the students' responses to these questions are given below.

"Were you happy to teach math with games? Why?" some of the answers given by the students:

S4: "Of course it did, we taught with laughter with friends. Especially the games in which you participated with us were more fun. My love for mathematics increased."

S8: "For the first time, I wanted the bell not to ring in math lessons. The lessons were very enjoyable. It was more fun to play games in groups."

S9: "It made me very happy. Because always just lectures are sometimes boring. I liked the lesson more with games."

Some of the answers given by the students to the question "How did teaching mathematics with games affect your interest and attitude towards mathematics?"

S2: "I was not interested because there were questions, I could not do."

S3: "It affected me very well; I think playing games is one of the best things that can be done in the lesson."

S4: "I study more willingly when I go home after playing games."

S5: "I didn't like the mathematics lesson very much before because we used to just lecture, now we both lecture and play games and it is very fun."

Some of the answers given by the students to the question "How did the math lessons taught with games affect your participation and motivation in the lesson?"

S5: "I started to participate more in the lesson and since we are going to play games, I repeat the previous day and solve tests."

S7: "Actually, I had fun in the lessons, but it did not affect my participation in the lesson."

S8: "I want to participate more in the lesson now."

The questions related to the Difference of the Mathematics Lesson Taught with Games were "Have you ever taught mathematics with games in your lessons? What is the difference between mathematics lessons in which mathematics teaching is done with games and mathematics lessons in which this teaching is not done? Would you like to teach mathematics with games in other mathematics subjects? If you want it to be done in other subjects, briefly explain which subject you would like this subject to be." It was seen that 88% of the students gave positive answers to these questions as "It is more fun and understandable" and "I would like to play every subject with games". However, it was also seen that some of the students gave negative answers such as "It was boring in the questions I could not do." and "It can be boring to cover every subject with a game." Some of the students' responses to these questions are given below.

"Have you ever taught mathematics with games in your lessons before? What is the difference between mathematics lessons in which mathematics teaching with games is done from mathematics lessons in which this teaching is not done?"

S5: "We have never played games in mathematics lessons before, but now I like mathematics lessons more. We are always active during the lesson"

S8: "When it is not done, it is difficult to understand the subject, but when it is done, I understand the subject very well. We exchange information with our friends and learn from each other."

S13: "It was very boring. It was very boring. My grades went down, but now it is the opposite, it is very fun and I think my grades have gone up."

S16: "No, it was not done. Some of the games were good, but the games where I cannot do the questions, I do not understand are boring."

"Would you like mathematics teaching with games to be done in other mathematics subjects? If you want it to be done in other subjects, briefly explain which subject you would like this subject to be." Some of the answers given by the students to the question:

S1: "Of course, I would be very happy if it was in every subject."

S5: "I think it would be nice to play games in the problems of rational numbers because I have a lot of difficulty in that subject."

S9: "I would like to play a game about ratio and proportion because it was a bit complicated."

S12: "Of course I would like to because I have a lot of fun, I think everyone has a lot of fun in the same way."

When the student opinions obtained from the experimental group regarding the mathematics lesson conducted with educational games are examined, it is seen that the majority of the students expressed positive opinions. For this reason, it can be thought that educational games have a positive effect on students' thoughts and attitudes towards mathematics.

4. Discussion and Conclusion

4.1. Conclusions and Discussions on Attitude Variable

Before the research, the mean of the MAS pre-attitude test of the control group was 85.62, while the mean of the pre-attitude test of the experimental group was 80.06. The p value, which is the significance level, was found to be 0.125 and it was concluded that the attitudes of the experimental group and the control group towards mathematics course were close to each other before the application. At the end of the research, according to the MAS post-attitude test values applied to the experimental and control groups, the post-attitude test average of the control group was 84.31, while the post-attitude test average of the experimental group was 89.37. The p value, which is the significance level, was found as 0.304. From this point of view, no significant difference was found when the pre-attitude and post-attitude test scores towards mathematics applied in the experimental group where educational games were applied and the control group where the current teaching was applied were compared. However, while there was a partial decrease in the scores of the students in the control group, there was a significant increase in the scores of the students in the experimental group. According to the findings obtained, it is said that teaching mathematics with games has no effect on students' attitudes towards mathematics course. The reason for this situation may be related to factors such as students' inability to reflect themselves in the attitude scale as desired, their level of readiness or lack of time. Similarly, Hanbaba & Bektaş (2011) found no significant difference in the attitudes of the students in neither the experimental nor the control group in their study in which they examined the effect of teaching with games on the achievement and attitudes of third grade students in life science course. They considered this situation as normal because both groups had high scores in terms of attitudes before the process and it was difficult for attitudes to change further. Çalışkan (2019) investigated the effect of game-activities on student achievement and attitudes in second grade rounding and estimation of numbers. In the study, it was concluded that while there was no change in the attitude of the experimental group towards the mathematics course, their course achievement increased. Supporting the findings of this study, Çankaya & Karamete (2008) did not find a significant difference between students' attitudes before and after playing the educational games developed on the subject of ratio and proportion.

When the literature is examined, contrary to the result found in this study, it is possible to reach many studies in which teaching enriched with games positively affects student attitudes and significant differences are observed. Kılıç (2007) found that teaching with games in mathematics increased students' mathematics achievement and had a positive effect on their attitudes towards mathematics compared to the traditional method, Aksoy (2010) found that mathematics teaching with a game-supported learning approach in the fractions unit had a positive effect on the mathematics attitudes of sixth grade students, Yağmur (2020) found that a differentiated and game-enriched learning environment on prime numbers for 6th graders made students more enthusiastic towards the lesson, Türkan (2019) found that gamification method in 6th grade made students more motivated and enthusiastic towards the lesson, and Türkan (2019) found that gamification method in 6th grade made students more motivated and enthusiastic towards the lesson. In his study examining the effect of gamification method on students' motivation, achievement and attitudes, Rahayu & Widodo (2016) stated that the mathematical Bingo Game, which they prepared in order to improve the multiplication ability of primary school 3rd grade students, made students eager for the lesson because they clearly presented their ideas in the learning process developed with games compared to the previous learning processes, asked the parts they did not understand and were actively involved in the process. Therefore, although there was no significant change in the attitude scores in this study, when the results of other studies in the literature are examined, it is predicted that it would be useful to use educational games for teaching purposes in any course, subject or field, since educational games generally affect students' attitude scores positively.

When MAS sub-dimensions were examined in both the experimental and control groups in order to reach more detailed information in the research, it was seen that neither in the experimental group nor in the control group, the scores in the MAS interest, study, necessity sub-dimension did not create any significant difference before and after the application. However, when the MAS anxiety sub-dimension was examined, the mean pre-attitude score in the MAS anxiety sub-dimension in the control group before the application was 15.187, while the mean pre-attitude score in the MAS anxiety sub-dimension in the experimental group was 14.062 and the p value was 0.452. At the end of the application, the mean post-attitude scores in the MAS anxiety sub-dimension in the control group was 14.125, while the mean post-attitude scores in the MAS anxiety sub-dimension in the experimental group was 17.562 and the p value was 0.047. Based on these results, it is seen that the experimental and control groups, which had similar attitudes towards anxiety before the application, had positive effects on the anxiety attitude of the students in favor of the experimental group with the effect of educational games after the application. While the attitude scores of the control group in the field of anxiety were 15.187 before the application, they decreased to 14.125 at the end of the application, while in the experimental group, the anxiety attitude score, which was

14.062 before the application, increased to 17.562 after the application. When the significance level in the anxiety sub-dimension of MAS pre-attitude-post-attitude in the experimental group was evaluated, it was found that the p value was 0.049. Based on this result, it can be concluded that educational games reduce anxiety in students. In support of this result, Boyacıoğlu, Köroğlu & Alkan (2001) emphasized the importance of educational games by stating that mathematics lessons carried out with games and activities positively affect students' attitudes and reduce their anxiety. Again, Romine (2004) argued that classroom activities supported by educational games create a classroom climate that entertains, motivates and supports learning, unlike the usual, worrying and anxiety-provoking classroom environments.

Thus, she/he concluded that students stayed active and engaged throughout the lesson by encouraging themselves and their friends to learn because they were not afraid of giving wrong answers. For this reason, she suggested that teachers should try to incorporate games and other fun activities into their classrooms to create the most engaging environment possible, as increased student motivation is the greatest reward in the process of strengthening both academic and social skills.

4.2. Conclusions and Discussions Student Opinions

The opinions of the experimental group students who were taught polygons with educational games were analyzed through open-ended questions in the SOF. The students generally stated that they were prejudiced and disliked the mathematics lesson before the application; after the teaching with games, they said that the lesson was fun, they wanted to participate in the lesson, they came prepared and their motivation increased. Students also said that their fear of mathematics was replaced by self-confidence in mathematics in the mathematics lesson taught with games.

When the content analysis of the SOF was analyzed as a result of the research, it was seen that between 81% and 100% of the students gave positive responses about the contributions of teaching with educational games as "It was fun, memorable, positive." I gained a different perspective.", "I understood the subject better." Similar to these results, according to Akın & Atıcı (2015)'s interviews with students after the instruction in digital game-based learning environments, teaching mathematics with educational computer games was found to be interesting and fun by the students, and the students stated that they felt free and reduced their math anxiety and fear. Naturally, it was concluded that educational games had positive effects on students' perspectives towards mathematics. Canbay (2012) also stated that in teaching with educational games, students created their own learning strategies and made sense of the subject from their own perspectives.

In the questions about the effect of games on interest and motivation, it was observed that between 81% and 100% of the students gave positive answers such as "It made me happy", "It increased my motivation", "My participation in the lesson increased". Similarly, Başün (2016) applied an opinion form to the students in the experimental group regarding the teaching of mathematics lesson with games, and as a result of the analysis, it was observed that the students who were taught with games increased their interest in the lesson. In support of the findings in this study, Songur (2006), in his study investigating the effect of mathematics teaching supported by puzzles and games on student achievement, stated that students who had prejudices before starting the application increased their interest in mathematics in the process, they were more active in the lesson with the desire to play games, and their confidence in mathematics improved. According to the findings of Bayırtepe & Tüzün (2007), teaching with games relaxed the students and they were able to pay attention to the lessons better in a stress-free environment.

It was seen that 88% of the students gave positive answers such as "It is more fun and understandable." and "I would like to play every subject with games." in the questions asked to the students about the difference of the mathematics lesson taught with educational games. Likewise, Özgenç (2010) stated that students' participation in the lesson increased significantly in teaching with playful activities in mathematics lessons. Çetin (2016) investigated the mathematical game development processes with middle school students on students' mathematics achievement, problem solving strategy and attitude towards the course and concluded that the attitudes of the students in the experimental group towards the course were positive. Ramos, Casillas, and Rabago (2021), according to the data obtained from the survey results, observed that the gamification strategy determined the readiness of the students, enabled them to learn, and increased student participation by making the subject fun with teamwork.

As a result, based on the data obtained from the research and the literature review, it is seen that the use of educational games in lessons is generally welcomed positively by students. It was concluded that the educational games used in the lessons attract students' interest, integrate students into the lesson, motivate students, make them active in the process, reinforce the information, reach the information by doing-experiencing, and as a result, increase their success by making sense of the information.

5. Suggestions

In the light of these results, the following suggestions are presented in order to provide ideas for researchers who will conduct studies related to the subject;

- It was concluded that seventh grade students were positively affected in terms of attitudes towards polygons in mathematics teaching with educational games. For this reason, the effect of educational games on student achievement at different grade levels in other subjects of mathematics can be investigated.

- In this study, in which teaching was done with educational games for the acquisition of polygons, a detailed lesson plan was made in addition to how to play the games and teaching was done in accordance with this plan. Considering the time to be spent for games in other studies, it would be useful to plan the lessons and make arrangements in the annual plan in order not to cause subject deficiencies in the curriculum.
- It was observed that students actively participated in the lessons by having fun, away from stress, unlike monotonous learning environments in mathematics teaching with educational game method. A planning can be made under the name of educational games course as an elective course for both mathematics and different courses in schools.
- A different study can be conducted by reorganizing the games in line with the problems seen in the application of educational games or any negative feedback.
- The games in this study included concrete educational games. Computer games that attract students' interest can be developed and different research can be conducted on this subject.
- Studies can be conducted to guide researchers in different fields about the difficulties encountered while implementing educational games, the difficulties experienced while designing games and the process of implementing games.

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This study was approved by the Niğde Ömer Halisdemir University Ethics Committee (approval number 2021/18-06) and all data was collected with participants' informed consent.

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