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INVESTIGATION OF THE EFFECT OF GAMES AND ACTIVITIES ON ROUNDING AND ESTIMATION SUBJECT[1]

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ABSTRACT

The main object of this study is to study the effect of games and activities on rounding and estimation subject in second grade mathematics lesson. The research has been carried out in accordance with pre-test and post-test design control groups. The study was conducted on the 2nd grade students at a primary school in one of the towns of a southeast city of Turkey. Four classes, two of which are the test groups and the other two are the control groups were determined randomly, including 120 students in total, 61 of whom are from the experiment group and 59 of whom are the control group. The scale to determine the attitude of students against mathematics, achievement test carried out in pre-test and post-test design to test the performance of students, observational and semi-formed interview forms as well as video records constitute the means of gathering data for the research. At the end of the research, the performance of the experiment group increased, while there was no change in their attitudes against mathematics. The games and the activities practiced within the research have been shown to have a positive impact on students. The stagnation in the attitude of the students against mathematics is estimated to be caused by the shortage of time allocated for the study and the articulation inability of students. As a result of the study, it has been concluded that games and activities could be of utmost significance in all sorts of school subjects and that enriching the learning environment with matching games and activities could promote permanent learning.

Keywords: Mathematics, mathematics teaching, teaching with games and activities, achievement, attitude.

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INTRODUCTION

Mathematics is a subject and science that every student who starts school is exposed, but some students hate and fear from while others love (Umay, 2002). Math is a study in which relations and structures are in harmony, an art of harmony, and a language of symbols and terms (Pesen, 2003). It is very difficult to make a single definition for mathematics. Everybody has made a definition of mathematics in their own opinions. Some have thought that they have defined mathematics by listing some features. However, just listing some features does not reflect the nature of mathematics. Indeed, those who study mathematics are surprised when they encounter aspects of mathematics that they did not recognize (Umay, 2002).

A definition of mathematics, which is believed to be the basis of all sciences, is that mathematics is to intellectualise the relationship between the multiplicity of numbers and to divide science into branches such as arithmetic, geometry, algebra, etc. (TDK, 1998). According to the definition by Yıldırım (1988), abstract objects are the subject of mathematics. This is why children have been afraid of mathematics throughout history. As mathematics is an abstract science, children in the period of concrete operations find it even more difficult and horrific. This difficulty can be overcome only by concretizing the concepts of mathematics (Yiğit, 2007). Trying to teach mathematics without concretizing mathematical concepts will cause our existing failure to continue in the same way and will lead to failure in international examinations.

Countries take their place in international comparison exams in order to identify their levels in science and mathematics education. Our country also appears in these exams. One of those exams is the PISA (Program for International Student Assessment), which is conducted to determine the levels of 15-year-old students in mathematics, science and reading skills. It measures the extent to which they can apply these skills to life problems rather than the skills themselves and it is done every three years (EARGED, 2005).

In terms of Mathematical literacy in PISA, Turkey was able to get 423, 424 and 445 points in 2003, 2006 and 2009 respectively. As for the PISA Mathematics project area, Turkey ranked as the 33rd out of 41, 43rd out of 57 and 41st out of 65 countries in 2003, 2006 and 2009 respectively (Eşme, 2008). While it was on the 44th rank with 448 points in 2012, it was on the 50th rank with 420 points in 2015.

TIMSS (Trends in International Mathematics and Science Study) also functions with a similar purpose to PISA. TIMSS, which is held every four years, aims to evaluate science and mathematics achievements on country basis. Turkey first participated in the 1999 TIMSS on the 8th Grade basis and became the 31st out of 38 countries across in terms of mathematics. Turkey did not participate in TIMSS in 2003. As for the results of the TIMMS exams in 2007, 2011 and 2015, Turkey was ranked the last, 21st and 24th with 432, 452 and 458 points respectively.

As the development levels of countries are directly proportional to the importance given to scientific studies and support, it is necessary for our country to train individuals who have mathematical, creative, critical thinking skills as well as research, questioning and high-level thinking skills so that our country can have a say among the world

countries. For this purpose, the education system should be arranged accordingly. Although the general objectives of the primary school mathematics course aim to raise individuals with all these skills, unfortunately the desired results cannot be achieved. The fact that Turkey's average scores in PISA are low shows that Turkish education system fails to provide individuals with skills such as effective thinking, perception, communication and problem solving, which must be among the most fundamental educational purposes (Aydın et al, 2012).

When the deficiencies of the Turkish education system are examined, some striking facts are observed. For example; it is seen that students who fail to completely understand a subject have more difficulty in mathematics because the mathematical subjects are in a sequential structure and a new concept cannot be learned before its prerequisite concept is learned (Altun, 1998). In our country, students who are expected to learn many mathematics subjects in a short time tend to memorize the subjects in order to gain speed, instead of understanding and learning them in depth (Özdaş, 1997). Since the memorized knowledge cannot be understood and interpreted, it will not form a basis for new subjects and this will cause students to have more difficulty in new subjects, which will result as fear against mathematics.

Considering all these reasons, it is understood that we have not reached the desired level of mathematics achievement in our country. Especially children who exhibit negative attitudes towards mathematics are the bleeding wounds of our society. Various researches have been conducted to help students who develop fear against and have difficulty in mathematics. These studies have put forward many methods to make mathematics fun, increase the permanence of mathematics and facilitate learning mathematics.

Educational games and activities are among those methods. Although once considered as waste of time, games are considered to be a very important factor in the development of children. Foulquie (1994) described the game as mental and physical activities, which generally had no purpose other than pleasure and usually given by rules. Bruce (1994), on the other hand, described the game as one of the ways of gaining skills and control in order to keep the child in various emotions and to cope with these emotions, and argued that parents were often unable to conceal the astonishment of the game.

Children also develop many skills while playing games. Very important cognitive skills such as observation, reasoning, problem solving and strategy development are some of them. (Gander and Gardiner,1993). Newson and Newson (1979) explained the effect of play on creativity in these words: "The child engaged in the game creates his/her own habits. At the time of the game, the child may be completely out of habit while displaying these behaviors. The most important feature of the game that affects creativity is this excellent flexibility." Thousands of different definitions have been made on the game and the definitions vary from person to person. All of these are true in their own right. If we combine these definitions into a single definition, it would be correct to say that; the game is a replica of life that gives pleasure to the child, provides a pleasant time, helps the child develop in the fields of mental, cognitive, affective and creativity, and develops experimental methods such as planning, problem solving, decision making and critical thinking.

Although the benefits of the game are known, in some circles the game can be seen as an aimless, time-consuming activity. Therefore, there is a need to define the characteristics of the educational game. Vygotsky (1978) strongly opposed the view of adults that the game is only a source of entertainment. Vygotsky argued that there may be activities that give the child pleasure and not named as play, as well as activities that do not give pleasure but called as play. According to Vygotsky (1978), the basic features of the game should be as follows:

1. The game is not exactly always the same as real life, but may also include imaginary products.
2. The games have clear or secret rules that must be followed.
3. The game is a completely different environment independent of the situation and the environment.
4. In the game, people take on roles.

Similar to this definition Rubin, Fein and Vandenberg (1983), Crookall et al. (1987) and Fromberg (1999) have also emphasized that playing games through education needs rules. According to Aral (2000), play is extremely important for children and gives clues about their development. In this respect, play is one of the indispensable activities for children and educators. Wood (1999), argued that the game should be combined with the educational curriculum and the activity used in education, and that games should be used in comprehensive learning.

Consequently, one of the most important factors that play a role in teachers' achieving educational goals is game. (Saracho and Spodek, 1995). It is the teachers' responsibility to manage the game in accordance with the rules in order to make use of the games as desired. (Sandberg et al., 2012). Teachers effect the games directly or indirectly (Bodrova and Leong, 2006). In the games, children are prepared for real life by following the instructions, searching for examples, reaching conclusions within the framework of logic and reaching a decision. Through the game, the child develops problem solving skills both in the classroom and in real life. Children achieve success in real life with their problem solving skills developed through play and enjoy this feeling of success (May, 1993). Pitino (2004) argued that mathematics is easier to understand and less frightening for students who develop fear in mathematics, if they are found to be part of everyday life.

According to Köroğlu and Yeşildere (2002), a student who grow away from mathematics once in elementary school and does not like mathematics, will not like and take care of mathematics throughout his life. Therefore, especially in elementary school mathematics teaching should be very carefully and mathematics lesson should contain fun. Geer (1992) argued that a teacher who uses the game will add more students to the lesson, increase their motivation even more, and gain experience improving mathematical performance. In primary school, the most effective and first way that can attract children's attention is the game.

Like many other researchers, Foster et al. (2011) and Dunn et al. (2003) have emphasized the important effect of games for mathematics education. Despite the difficult structure of mathematics curriculum, the best way to

incorporate students into studies is to help children make connections with their world by using games. Because games often offer the most effective way to make math lessons fun and attractive for children.

For all these reasons, this study was conducted to prepare a learning environment in which children love math, learn it by using games and activities and to make the almost abstract mathematics course understandable. The research is based on estimation and rounding outcomes (MEB, 2009), one of the topics considered abstract in mathematics (EARGED, 2005). There is an increasing emphasis in mathematics education on the importance of estimation abilities of children (Forrester et. al., 2006; Tatto, 2013). In this way, determining the impact of teaching and games and activities on an abstract subject will contribute more to the literature.

Problem

The general occupation of children in preschool period is games and children's need for playing games does not decrease when they start school. As the child grows, it still continues by just changing shape. Therefore, it is a wrong foresight to assume that starting school is the end of the games. In fact, it is wrong to make primary school first year students sit at their desks without moving for hours. This is undoubtedly the shortest way to disincline a child to school. Therefore, instead of this method, games should be used to support the learning process. A child who craves after games is not ready for the education at school (Yörükoğlu, 1998: 72). If the maths education of the children who are at the game age is not supported with games, they may not understand mathematics and they may perceive mathematics as a difficult lesson.

It is possible to change the students' opinions that mathematics is a difficult course, have them develop positive attitudes towards mathematics and enable them to gain mathematical skills by educational games (Soylu, 2001). Today, the increasing number of studies and researches on games have revealed that games are an essential tool for the development of individuals, not a means of wasting time, and it is thought that games can be used in education as well. From this idea, the concept of educational games has emerged (Uğurel and Moralı, 2008).

Any problem can be solved more easily if the subjects that students have difficulty in understanding and develop negative attitudes are taught within and through games (Dede and Yaman, 2003). It has been revealed by several researches that both success and interest in mathematics course are low in our country. This can be clearly seen in the results of international examinations. The focus of this research is the students at primary school, where the foundations of this deficiency are laid. The old methods are found to be insufficient for students at the concrete operations stage to understand mathematics course, which consists of abstract subjects.

The aim of this study is to use a teaching method with games and activities and teaching in order to overcome the deficiency described above.

Problem Statement

Two main problems and related sub-problems were determined for the purpose of the research.

A. To what extent does teaching rounding and estimation subjects in mathematics course affect the academic achievement of elementary school 2nd grade students?

A.1. What is the difference between the pre-test scores of the experimental group who are taught mathematics with games and activities and those of the control group who receive normal education?

A.2. What is the difference between the pre-test and post-test scores of the control group who receive normal education?

A.3. What is the difference between the pre-test and post-test scores of the experimental group who are taught mathematics with games and activities?

A.4. What is the difference between the post-test scores of the experimental group who are taught mathematics with games and activities and those of the control group who receive normal education?

B. Does teaching rounding and estimation subjects in mathematics course affect the elementary school 2nd grade students' attitudes towards Mathematics course positively?

B.1. What is the difference between the attitudes of the control group who receive normal education towards Mathematics course before and after the teaching/learning process?

B.2. What is the difference between the attitudes of the experimental group who are taught mathematics with games and activities towards Mathematics course before and after the teaching/learning process?

B.3. What is the difference between the attitudes of the experimental group who are taught mathematics with games and activities and those of the control group who receive normal education towards Mathematics course after the teaching process?

METHOD

In this part; the research model and pattern, the study group, the development of the measurement tools, the characteristics and application of the measurement tools and the analysis of the data are presented.

Research Model

Qualitative and quantitative research methods were used together in this study, which aims to reveal the effect of games and activities on achievement in the subjects of rounding and estimation at the 2nd grade mathematics course. The research was conducted with quasi-experimental method.

Population and Sampling of the Research

The population of this study consists of primary school students studying in a district of a province in the South-Eastern Anatolia Region. The sampling of the study consists of 120 students randomly selected from the 2nd grade classes of a school in this centre of the district.

Data Collection Tools

The data in this research, which was designed with a quasi-experimental design, was collected through Aşkar's (1986) Scale of Attitude towards Mathematics used to determine the attitudes of students towards mathematics course, a pre-test and post-test achievement test, observation and semi-structured interview forms, and video recordings.

Data Collection Process

This research was conducted with 120 primary school students at the 2nd grade and 4 teachers. It was decided that the application should start with 4 out of 5 classes in a primary school in the district centre (one class was not included in the study because they had already studied the subject).

Before the application, it was decided to start the subject at the same time and to apply the scales at the meeting was held with the teachers of 2 experimental and 2 control group classes whose equivalency was determined with pre-tests and which were selected randomly. While the lessons in the experimental group are taught with the games and activities (Number Rounding Hill, Roll to Your Friend, Rounding Traffic Plate Cards, Rounding Cartoon Characters, Ludo, Estimate the Subtraction, Addition and Subtraction Cards) (Çalışkan, 2019) that are prepared by the help of the professional support and literature, normal (traditional) teaching methods were used in the control group.

Aşkar's (1986) Scale of Attitude towards Mathematics used to determine the attitudes of students towards mathematics course, a pre-test and post-test achievement test, observation and semi-structured interview forms, and video recordings were used to collect the data. Attitude scale and achievement test were applied to 120 students in the 2nd grade of the school in the district centre as pre-test and post-test. The students were grouped as low level, medium level and high level according to the pre-test and post-test results. The semi-structured interview form and the video recordings of the interview were applied to 12 students including these low – medium - high level students selected from the students grouped in accordance with the pre-test and post-test results.

The procedures for scoring and data analyses are described below.

Achievement Test (Student Level Determination Tool)

In order to collect data on dependent variables, achievement test was prepared, developed and applied within the scope of expert opinions and literature. For this purpose, the achievements related to rounding and estimation in 2nd grade mathematics course were determined and the scope validity of the test was tried to be ensured. There are 3 learning outcomes in the 2nd grade curriculum on number rounding and estimation. These are; 'Determines which two-digit natural numbers are closer to which decimal number', 'Estimates the sum of two natural numbers up to 100 and compares the estimation with the result of the transaction.' and 'Estimates the result of subtraction with natural numbers up to 100 and compares the estimation with the result of the transaction.' 20 open-ended questions, which were prepared on the basis of achievements, were developed according to expert opinions.

The achievement test was applied to the control and experimental groups as pre-test and post-test both before and after the activities. Pre-test and post-test were applied to experimental and control groups simultaneously. In the achievement test, 5 points were given for correct answers, 4,3,2,1 according to accuracy and 0 points for completely incorrect answers. The highest score from this test is 100 and the lowest score is 0. The scores are sorted from high to low, so two listed scores are handled for pre and post-test application of achievement test. Analyses of this data is made by independent sample test statistics.

Attitude Scale

The attitude scale developed by Aşkar (1986) was used to measure students' attitudes towards mathematics. The scale consists of 20 items. The items were coded as 'I totally agree', I agree ' I am undecided', I disagree ' and ' I totally disagree'. The highest score that can be obtained from this scale is 100 and the lowest score is 0. The attitude scale was applied to the experimental and control groups both before and after the applications. The data is analysed by paired sample test.

Structured Interview Forms

Structured interview questions were prepared as 2 questions and sub-questions for each of the 3 achievements related to number rounding and guessing with the help of expert opinions and it was applied to both experimental and control groups before and after the applications. The applications were recorded and interviews were written down. In the data analysis of the interviews, the students' skills to relate the subject to daily life and expressions that will reveal meaningful learning levels were examined.

Data Analysis

Technological tools such as written documents, video recorder and computer were used for data collection and analysis. After this stage, the data collected from the conceptual framework of the research questions were

examined in detail and the findings were formed. Finally, some comments were made about the findings and to explain the relationships between these findings.

FINDINGS (RESULTS)

In this section, the data about the sub-problems collected before and after the activities were analysed with appropriate statistical methods and presented in a tabulated form.

Findings about the A.1 Sub-problem of the Research

The A.1. sub-problem of the research is stated as "What is the difference between the pre-test scores of the experimental group who are taught mathematics with games and activities and those of the control group who receive normal education?"

In order to find an answer to this question, both the experimental group and the control group were pre-tested and the results of the pre-tests were compared. The result of this comparison is shown in the table below.

Table 1. Group Statistics

	Groups	N	Mean	Std. Deviation	Std. Error Mean
Pre-test	1,00	61	9,8852	2,49064	,31889
	2,00	59	9,3559	2,21097	,28784

As can be seen in Table 1, the average of the experimental group was 9.88, while the average of the control group was found to be 9.35. These results shows that the groups were very similar at the beginning of the activities.

Table 2. The Independent t-test Results About the Comparison of The Pre-Test Applied to Experimental and Control Groups

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Pre-test	Equal variances assumed	1,138	,288	1,230	118	,221	,52931	,43045	-,32309	1,38171
	Equal variances not assumed			1,232	117,151	,220	,52931	,42959	-,32145	1,38008

According to the findings in Table 2, Significance (2-tailed) value is greater than 0.05, which means that the difference between the two groups is not statistically significant. As a result, it can be said that there was no significant difference between the experimental and control groups before the study and the levels of the two groups were close to each other.

Findings about the A.2 Sub-problem of the Research

The A.2 sub-problem of the research is stated as "What is the difference between the pre-test and post-test scores of the control group who receive normal education?"

In order to answer this question, a pre-test was applied to the control group before the process and a post-test was applied after the process. The results were compared with independent T-test.

Table 3. Paired Samples Statistics for A.2 Sub-problem

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pre-test Post-test	9,3559	59	2,21097	,28784
		11,3390	59	2,91613	,37965

Table 4. Paired Samples Correlations for A.2 Sub-problem

		N	Correlation	Sig.
Pair 1	Pre-test and Post-test	59	,577	,000

Table 5. Paired Samples Test for A.2 Sub-problem

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	Pre-test and Post-test	-1,98305	2,43885	,31751	-2,61862	-1,34748	-6,246	58	,000

As seen as Table 3, 4 and 5; the pre-test average of the control group was found to be 9.35, while the post-test average was 11.33. Significance (2 tailed) value is seen to be .000 which means that there is a 95% statistically significant difference. As a result, it can be said that teaching in the control group has also made some progress in children.

Findings about A.3 Sub-problem of the Research

A.3. sub-problem of the research is stated as "What is the difference between the pre-test and post-test scores of the experimental group who are taught mathematics with games and activities?"

As in the control group, the pre-test was applied to the experimental group as well and the post-test was applied after teaching with games and activities. Test results were obtained by independent T test and interpreted.

Table 6. Paired Samples Statistics for A.3 Sub-problem

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pre-test	9,8852	61	2,49064	,31889
	Post-test	16,0164	61	3,89226	,49835

Table 7. Paired Samples Correlations for A.3 Sub-problem

		N	Correlation	Sig.
Pair 1	Pre-test and Post-test	61	,542	,000

Table 8. Paired Samples Test for A.3 Sub-problem

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	Pre-test and Post-test	-6,13115	3,29381	,42173	-6,97473	-5,28756	-14,538	60	,000

In Tables 6, 7 and 8; changes in the test results of the experimental group before and after the activities are presented. While the experimental group made an average of 9.88 in the pre-test, they reached an average of 16.01 after the activities. Significance (2-tailed) value is 0.000 and as it is less than 0.05, it can be said that there is a statistically significant difference between the pre-test and post-test results of the experimental group. Average scores of both groups in post-test were higher than the average scores they got in the pre-test. For example, the control group's pre-test average score was 9.35 and post-test average score was 11.33. Considering the differences between the two groups' pre-test and post-test result, it is seen that the experimental group was more successful than the control group.

The Findings related to the A.4 Sub-problem of the Research

A.4 sub-problem of the research is stated as "What is the difference between the post-test scores of the experimental group who are taught mathematics with games and activities and those of the control group who receive normal education?"

Table 9. Group Statistics for A.4 Sub-problem

Groups		N	Mean	Std. Deviation	Std. Error Mean
Post-test	1,00	61	16,0164	3,89226	,49835
	2,00	59	11,3390	2,91613	,37965

Table 10. Independent Samples Test for A.4 Sub-problem

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Pre-test	Equal variances assumed	8,035	,005	7,431	118	,000	4,67741	,62945	3,43092	5,92390
	Equal variances not assumed			7,466	111,130	,000	4,67741	,62649	3,43600	5,91882

In Tables 9 and 10, it can be clearly seen that there is a difference between the post-test results of the groups. While the post-test mean score of the experimental group was 16.01, the post-test mean score of the control group was 11.33. Sig. (2-tailed) value was found to be 0,00, which means that the results were statistically significant at 95%. In this study, it can be concluded that the method of teaching with games is successful.

Findings related to B.1 Sub-problem of the Research

The sub-problem B.1 of the study was formed as "What is the difference between the attitudes of the control group to the pre-process and post-process mathematics course?". In order to find an answer to this question, attitude tests were applied to the control group both before and after the activities. Table 11 compared the results of those attitude tests applied to the control group.

Table 11. Paired Statistics Test for B.1 Sub-problem

	Attitude	Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Before	72,1356	59	11,56162	1,50519
	After	71,9153	59	12,26052	1,59618

Table 12. Paired Samples Correlations for B.1 Sub-problem

	Attitude	N	Correlation	Sig.
Pair 1	Before and After	59	,927	,000

Table 13. Paired Samples Test for B.1 Sub-problem

	Attitude	Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	Before and After	,22034	4,59035	,59761	-,97591	1,41659	,369	58	,714

The results of Tables 11, 12, 13 shows that the mean attitude of the group was 72.13 before the activities while it was 71.91 after the activities. Contrary to the expectation of the researchers, it was seen that the average score of the group in the test conducted after the teaching program decreased.

Findings related to B.2 Sub-problem of the Research

B.2 Sub-problem of the research was formed as "What is the difference between the attitudes of the control group who receive normal education towards Mathematics course before and after the teaching process?"

In order to find an answer to this question, an attitude test was applied to the experimental group both before and after the activities. Table 14 compares the attitudes of the experimental group students before and after the activities.

Table 14. Paired Statistics Test for B.2 Sub-problem

	Attitude	Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Before	70,8197	61	13,76652	1,76262
	After	71,6721	61	14,15712	1,81263

Table 15. Paired Samples Correlations for B.2 Sub-problem

	Attitude	N	Correlation	Sig.
Pair 1	Before and After	61	,924	,000

Table 16. Paired Samples Test for B.2 Sub-problem

		Paired Differences							
	Attitude				95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	Before and After	-,85246	5,44315	,69692	-2,24651	,54160	-1,223	60	,226

When Tables 14, 15, 16 are examined, it can be seen that while the experimental group's average score from the attitude test before the activities was 70,81, the average score of the same group from the attitude test after the activities was 71,67. Since the Sig. (2-tailed) value was greater than 0.05, the result was not statistically significant at 95% confidence level. In other words, it was observed that there was no change in students' attitudes towards mathematics course. As in the control group, the experimental group did not show the expected increase either.

Findings related to B.3 Sub-problem of the Research

The B.3 sub-problem of the research was stated as "What is the difference between the attitudes of the experimental group who are taught mathematics with games and activities and those of the control group who receive normal education towards Mathematics course after the teaching process?"

To achieve this result, attitude test was applied to both groups after the activities and the results were then compared.

Table 17. Group Statistics for B.3 Sub-problem

	Groups	N	Mean	Std. Deviation	Std. Error Mean
Post-test	1,00	61	71,6721	14,15712	1,81263
	2,00	59	71,9153	12,26052	1,59618

Table 18. Independent Samples Test for B.3 Sub-problem

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	MeanDifference	Std. Error Difference	Lower	Upper
Post-test	Equal variances assumed	1,971	,163	-,100	118	,920	-,24312	2,42106	-5,03748	4,55123
	Equal variances not assumed			-,101	116,601	,920	-,24312	2,41525	-5,02657	4,54033

Both experimental and control groups were applied an attitude test before and after the teaching process. When the tables (17, 18) comparing the attitudes of the groups after the teaching process are examined, it is seen that the mean score of the experimental group was 71.67 while that of the control group was 71.91. Since sig (2-tailed) is greater than 0.05, it can be stated that the difference between the attitudes of the groups towards mathematics after the teaching process is not statistically significant, which means that the attitudes of the two groups towards mathematics course are similar. Both groups displayed approximately the same result in the scale after the teaching process.

Results of the Structured Interview

The structured interview was conducted one week after the completion of all activities and tests. The structured interview test consisted of 2 questions for each of the 3 achievements. Sub-questions were also determined and 20 questions were asked to the students in total. Some students from both the experimental and the control group were selected for the interview according to their achievement test scores as it would take too long to interview with all the students.

The experimental group and the control group were divided into lower, middle and upper level groups according to the post-test results and 2 students were selected to represent each group. A structured interview test was applied to 12 students in total and the interviews were recorded. Afterwards, the video recordings were examined and the answers of the students were scored.

Each question is evaluated together with their sub-questions and given 10 points. The highest score to be taken from the interview is 60 and the lowest score is 0. In Table 19, the scores of the students are presented.

Table 19. Interview Scores of Control and Experimental Groups

Experimental Group	Interview Scores	Control Group	Interview Scores
D1	58	K1	48
D2	58	K2	36
D3	15	K3	28
D4	53	K4	10
D5	12	K5	10
D6	9	K6	6

In order to increase the clarity of structured interview scores, a sample excerpt from the interview records of one student at the upper level of the control and experimental groups is presented in Table 20 below:

Table 20. A Sample Excerpt of Structured Interview of Upper Level Students

Outcome 1: Determines which two-digit natural numbers are closer to which decimal number.
Question 1: Ahmet's workplace is situated between two restaurants on the eastern part of the city. Restaurant-A is 20 kilometres far from the city and restaurant-B is 30 kilometres far from the city. Ahmet's workplace is on the eastern part of the city and 24 kilometres far from the city.
Researcher (A): Which restaurant do you think does Ahmet go for dinner?

Control Group – Student K1	Experimental Group – Students D4
(K1): He goes to restaurant-A. A: Why does he choose restaurant-A? K1: Because it is closer. A: Which restaurant would he go to if his workplace were at the 25th kilometre? K1: It's in the middle A: Which subject in Mathematics helped you answer this question? K1: Rounding. A: Does this subject help us in real life? K1: Yes.	(D4): He goes to restaurant-A. A: Why does he choose restaurant-A? D4: Because 24 is closer to 20. A: Which restaurant would he go to if his workplace were at the 25th kilometre? D4: He would go to restaurant-B. A: Why would he go to restaurant-B? D4: Because 25 is closer to 30. A: Which subject in Mathematics helped you answer this question? D4: It seems like rounding A: Does this subject help us in real life? D4: It does.

6 basic questions and their sub-questions were asked to each of the 12 students and their answers were compared and examined like the one in Table 20. As a result of this analysis, the evaluation for the upper level students can be summarized as follows: The student in the experimental group started the interview confidently and answered almost all the questions correctly. When he heard about the subject rounding, his confidence increased.

The student in the control group started the interview normally but was incompetent in the questions although he/she was able to do the rounding operation. For example, while the experimental group student gave the correct answer to the second question of the first achievement, the student in the control group had difficulty in understanding the question. The questions of guessing the sum and difference in the last two achievements revealed the difference between the two students.

Although he/she could calculate the sum and the difference without using a pen, the senior student in the control group gave the wrong answer because he/she guessed the answer without rounding. However, the student in the experimental group got full marks by first rounding and then adding or subtracting.

When the data of the middle-level experimental and control groups were examined in a similar way, a similar result to the data of the upper-level students was observed. When it was asked to which subject was the 1st question for the 1st achievement related, the experimental group student answered as 'rounding' while the student in the control group stated "I do not remember". As a result, it can be assumed that the subject retention is achieved in the experimental group students but the same situation is not the case for the control group.

In the 2nd and 3rd achievements (guessing the sum and the subtraction), there was a difference between the students again. The experimental group student performed addition and subtraction by rounding the guessing questions, but the control group student did the addition and subtraction directly without rounding. In this respect, unlike the control group students, the experimental group made operations in accordance with the achievement. Therefore, it can be said that the control group students were found insufficient in achieving the achievement.

Finally, when the lower level students of the experimental and control groups were compared, it was found that the difference between them was not significant. The control group student was the most indifferent student to the interview and the questions, and gave irrelevant answers to the questions without thinking. For example; when he/she was asked "Why does he go to restaurant-A?, he answered "In order to eat".

The experimental group student both made the rounding incorrectly and made addition and subtraction without rounding in the guessing the sum and difference questions. On the other hand, the student in the control group could not make any rounding operations and could not guess the sum and the difference. When the data of the low level students are examined, it cannot be said that teaching with games and activities has reached the expected result in this group.

In the interviews, a difference was observed in favour of experimental group students in general. When the data of upper, middle and low level students are compared, it is seen that the experimental group students are master the subject better. Teaching with games and activities can be thought to be effective in the whole experimental group except for the students in the low level experimental group.

CONCLUSION and DISCUSSION

Primary school students are at concrete operational stage. However; compared with other courses, Mathematics course contains more abstract concepts. That's why students state that they have difficulty in Mathematics course. Therefore, teachers should pay attention to concretize the subjects particularly in primary school Mathematics courses.

Materials, activities and especially games help us explain abstract subjects in Mathematics. The fact that primary school students are in the game period can be considered as the main reason for using games and activities in the lessons. In this research, number rounding and guessing subjects in Mathematics course were taught with games and activities. After the teaching process, it was seen that the experimental group was more successful than the control group.

The main problem of this research is expressed as 'To what extent does teaching rounding and guessing subjects in mathematics course affect the academic achievement of elementary school 2nd grade students?' Results about the sub-problems of this research problem are as following:

According to the data related to the first sub-problem, there was no difference between the pre-test scores of the experimental group and the control group. Therefore, it can be said that the study was carried out between equivalent groups.

Considering the data related to the second sub-problem, it was seen that the success level of the control group increased at the end of the teaching process. There is a significant difference between the two scores. However, in the experimental group, the difference between the pre-test and post-test mean scores was lower. Moyles (1997) emphasized that in teaching through play, students do their best and learn much better. He also argued that teaching with play is one of the methods of learning through trial and error. In recent research, it has been found that students who learn through trial and error learn better than students who learn with other methods (cited in Çakmak, 2000).

When the results of the third sub-problem were examined, it was seen that the pre-test and post-test means scores of the experimental group were 9,88 and 16,01 respectively, which indicates an obvious increase in the success of the experimental group after the teaching process. Also, compared with the pre-test and post-test mean scores of the control group, it was seen that the increase was in favour of the experimental group, which is thought to have resulted from the fact that the experimental group received Mathematics education through games and activities. In this case, it can be claimed that games and activities have been effective in achieving the

target success. Similarly, Kamii (2003) observed that the game increases the students' logical mathematical relationships by reducing the difficulties encountered in mathematics.

When the results of the fourth sub-problem are examined, it can be said that the mean score of the experimental group is much higher than that of the control group. The instruction with games and activities that the experimental group received, helped the students increase their success. While the control group had an average of 11.33 in the post-test, the experimental group increased its' mean score up to 16.01, which points to a higher level of success in the experimental group. In accordance with this result, it can be stated that the games and activities used in Mathematics course have a positive effect on student achievement. Similar results have been obtained in several studies examining the effect of games and activities on success (May, 1995; Karabacak, 1996; Carroll, 1996; Ercanlı, 1997; Aytekin, 2001; Shi, 2003; Taşlı, 2003; Altunay, 2004; O'Brien and Barnett, 2004; Tural, 2005; Kılıç, 2007).

When the results of the other sub-problems are analysed, it is not possible to say that students' attitudes towards mathematics course are positively affected by teaching through games and activities. The control group had a mean score of 72.13 from the attitude test before the teaching process and 71.91 from the attitude test after the teaching process. The experimental group also had a similar result with mean scores of 70.81 and 71.67 from the attitude tests before and after the teaching process respectively. When the scores of the two groups were compared, the differences were found 95% insignificant. In other words, the attitudes of both groups towards Mathematics course did not improve as expected. While teaching mathematics with games and activities positively affected the success of the experimental group, it did not contribute to the students' attitudes towards mathematics either positively or negatively. In literature, there exist several studies with similar results (Çankaya and Karamete, 2008; Hanbaba and Bektaş, 2011). However Cornell (2000) has expressed that motivation and success is increased when students have fun and enjoy learning. Also Pitino (2004) stated that mathematics has become less frightening when it is shown to children that mathematics is an integral part of daily life.

The students in the experimental group showed great interest in the activities and games in the lesson and had a lot of fun. In fact, they didn't leave the games even during the break times. When the lecture was over and the teachers passed on to other subjects, the students asked for the activities and games in practice again. However, no significant difference was found in favour of experimental group in the results of the attitude test after the teaching process. This is thought to have resulted from the students' having problems in reading comprehension and not being able to reflect what they think on paper, which is supported by the fact that students show negative attitudes towards Mathematics course while they are willing attend the class.

The results of the structured interviews were also in favour of the experimental group. The students in the control group participated in the interview more reluctantly than the students in the experimental group did. The students in the experimental group gave more confident and accurate results to the questions and had a higher mean score.

Teaching Mathematics with games and physical activities is thought to be the reason why the interview and achievement test results of the experimental group were higher than those of the control group. It was seen from their facial expressions and excitement that the students who participated in the games were happy. It was also observed that the tediousness of monotonous lectures can be overcome with games and physical activities. While the control group students' desires to attend the course were at the same level as before, there was a noticeable difference the experimental group students' desires. Students competed with each other to take part in the games. When the teachers who applied the teaching with games and activities in the lesson were asked for feedback, they stated that; thanks to the games, the students became more interested in the lesson, they gave a cutthroat struggle to participate in the games, did their homework completely and asked their teachers to take the games to the next lessons. However, when the students in the control group were observed, it was seen that the lessons were conducted in the same atmosphere as the previous lessons and that the interests and desires of the children did not change after the teaching process. The teachers of the control groups stated that their students who saw that the experimental group was teaching with games and activities demanded the same games from their teachers.

RECOMMENDATIONS

Based on the results of the research, recommendations for researchers and educators can be listed as follows:

1. Teaching based on games and activities has influenced the rounding and guessing subjects in mathematics course positively. For this reason, research can be done to examine the effects of teaching based on games and activities on other subjects of mathematics course.

2. It is found that teaching based on games and activities increases student achievement in mathematics course. It is recommended that games and activities should be used in teaching other courses as well.

3. This research was applied to the students at the 2nd grade of primary school. When the literature is examined, it is seen that teaching with games is mostly focused on primary school students. Therefore, researchers are also recommended to conduct studies investigating the use of games and activities in teaching students at secondary school.

4. This research was applied to crowded classes. It would be useful to conduct similar studies in classrooms with fewer students.

5. Games and activities were used in this study. The researchers recommend that further studies using digital games should be conducted.

6. This research was carried out in a district centre in Southeast Anatolia Region. Similar studies should be conducted on students from different socio-economic cultures in different regions and provinces.

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