



THE EFFECT OF ACTIVITY-BASED TEACHING APPROACH ON THE ATTITUDES OF MATH-ACTIVITIES AND THEIR BELIEFS ABOUT MATHEMATICS OF ELEMENTARY SCHOOL FOURTH GRADERS

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Abstract: The aim of this study is to examine the effect of activity-based mathematics teaching on the attitudes of elementary school 4th graders towards mathematics activities and their beliefs about mathematics. The research is designed according to the quasi-experimental pretest-posttest control group design. The study group consisted of a total of 50 fourth graders, of which 25 were experimental groups, and 25 control groups. The Attitude Scale for Mathematics Activities and the Belief Scale for mathematics were used as pre-test and post-test tools for data collection. Additionally, the students' views on this application were taken at the end of the application. In the analysis of the obtained data the Mann-Whitney U test and the Wilcoxon Signed Ranks test were used. Content analysis has been used to evaluate student opinions of the application, and comments of the students were quoted directly. As a result of the analysis, it was concluded that students' attitudes towards mathematics activities and their beliefs about mathematics had a significant variation in favor of the experimental group while there was a significant difference between the pre-test and post-test average scores in favor of the final test while the experimental group's attitudes towards mathematics activities and their beliefs about mathematics. At the end of the study, it is found that the students of the experimental group have a positive opinion on these activities and also that the activities that the students intend to develop on the subject are similar to the studies activities. It is suggested that teaching with activities in which students are active is used more often in classrooms because of the positive impact on students' attitudes to mathematics activities and their beliefs about mathematics.

Keywords: Activity-based mathematics teaching, attitude towards mathematics activities, beliefs about mathematics

1. Introduction

1.1 Activity-based Learning

The importance of using student-centered approaches is increasing every day as it becomes apparent that teacher-oriented traditional education cannot solve problems (Keskin & Yıldırım, 2008; Yılmaz, 2004). According to the constructivist approach to learning, which is a student-centered approach, a person "constructs" his or her knowledge and learning process on the basis of his or her previous experience. This approach suggests that learning takes place when an individual's psychological environment interacts with a particular structure. It obliges students to take part in a variety of activities in an active classroom while constructing the process (Abdelhamid, 2003, Murray, Donohoe, & Goodhew, 2004). One of the effective teaching strategies of the constructivist approach, as can be seen, is activity-based teaching. It is a learning approach that encourages an individual to judge on the basis of their own activities and observations (Mert Cüce, 2012). Activity-based learning can be defined as a teaching method in which students are seamlessly integrated into regular teaching materials and methods to efficiently incorporate them into their teaching/learning or teaching

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processes with different types of activities that are appropriate for specific subjects (Suydam & Higgins, 1977). Activity-based learning allows students to interact with and process information in a way that will understand and enhance information about a particular subject (Hariharan, 2011). Instead of sitting as passive listeners, students actively participate in the learning experience (Harfield, Davies, Hede, Panko, & Kenley, 2007). Communication is one-way in traditional teacher-centered approaches. Students are passive and independent, and students are not encouraged to think creatively. The individual differences of the students are therefore ignored. Activity-based teaching is therefore adopted (Festus cites from Orji, 2007, David, Orobosa, & Olatunji, 2013).

1.2. Activity-based teaching in mathematics education

The activity-based method is suitable for teaching mathematics in small classrooms, and teaching is done with the help of concrete things and examples. Many subjects of mathematics can be successfully taught by this method (Kaur & Sankhian, 2017). In mathematics teaching, learning becomes more perfect when conceptual knowledge can be improved through activity-based teaching (Matthew, 2009; Simon & Tzur, 2004). Therefore, teachers also need to use activity-based learning strategies in mathematics classes (Festus, 2013).

The use of activities in a learning environment; puts the students in the center, offers richer learning opportunities, objectifies the abstract mathematics, ensures that students are interested in mathematics and love mathematics, makes teaching mathematics enjoyable, enables students to know the real-life reflections of mathematics and its fields of use, provides the opportunity to write and discuss mathematics, and increases student motivations (Avşar-Tuncay, 2019; Bozkurt, 2012; Gürbüz, Çatlioğlu, Birgin, & Erdem, 2010; Gürbüz & Toprak, 2014). Activity-based learning enables students to develop high-level thinking skills, reasoning, communication, problem solving, associating, modelling and interpreting skills, and conceptual knowledge (Ersoy, 2006; Mert Cüce, 2012; Ocak & Dönmez, 2010; Olkun & Toluk, 2003). At the same time, students will feel that their solutions are valued and their confidence in how they can do mathematics will increase as they practice mathematics activities and gain success (Ocak & Dönmez, 2010). That is why the teaching programs in Turkey emphasizes that it is important for students to be responsible for their own learning and for students to be active in the learning process. In this context, an activity-based plan for mathematics education is envisaged (MEB, 2005a, 2005b, MEB, 2018; Umay, Akkuş, & Duatepe Paksu, 2006).

1.3. Beliefs about Mathematics And Attitudes Towards Mathematics

The development of positive beliefs and attitudes about learning mathematics in mathematics education is just as important as learning mathematical field knowledge. Because, in the process of learning mathematical knowledge, mathematical beliefs and attitudes towards mathematics play an important role (Sezgin- Memnun, 2015). Many of the students stay away from mathematics activities for fear of making mistakes and fail. The activities contribute to the preservation of the interest and excitement of the students and influence the positive development of students' attitudes towards mathematics in the mathematics course where they will construct the knowledge themselves (Mert-Cüce, 2012; Moore, 2005; Tural, 2005).

He describes the affective domain in mathematics as 'emotions', 'attitudes' and 'beliefs'. Emotions are more affective and beliefs are more cognitive. On the other hand, he defined attitudes somewhere between beliefs and emotions (Cites from McLeod, 1992; McLeod 1994, Kandemir, 2011). There is a cause and effect relationship between beliefs and attitudes. (Tavşancıl, 2005). Students' learning is strongly correlated with their beliefs and attitudes about mathematics (Furinghetti & Pehkonen, 2003). Studies indicate that students' belief about mathematics has an effect on their learning environment and success (Frykholm, 2003; Toluk Uçar, Pişkin, Akkaş, & Taşçı, 2010). According to Kloosterman & Stage (1992), the beliefs of the students about the mathematics course are affecting their mathematics learning process. Beliefs are explained as part of attitude (Pehkonen & Törner, 1996; Ruffell, et al., 1998). In other words, it can be said that beliefs play a role in the formation of attitudes (Crawley & Koballo, 1991). Moreover, Furinghetti and Pehkonen (2003) state that belief is a kind of

attitude. According to Raymond (1997), belief about mathematics is “one's personal judgments about mathematics shaped by one's experiences of mathematics”. Beliefs about mathematics also help students develop positive attitudes towards mathematics (Raymond, 1997). Since beliefs affect attitudes, students' beliefs about mathematics are very important in terms of mathematics education (Bayrak & Hacıömeroğlu, 2018; Schoenfeld, 1989; Schommer, Duell & Huter, 2005; Moscucci, 2007). Ernest (1989) talks about two kinds of beliefs. The first is beliefs about the nature of mathematics. These beliefs are about what mathematics does and what its qualities are. The other one is beliefs about teaching mathematics. It is about how to teach mathematics.

Although there has been an increase in the number of studies conducted on activity-based mathematics teaching (Avşar-Tuncay, 2019; Çakıcı, 2018; Ebret, 2015; Gürbüz, Çatlıoğlu, Birgin, Erdem, 2010; Noreen & Rana, 2019; Yadav, 2015), there have been separate studies such as “a study examining the attitudes of middle school students to mathematics activities based on activity” (Çelik, 2018; Duran, Sidekli, & Yorulmaz, 2018; Ocak & Dönmez, 2010; Tural, 2005; Uşun & Gökçen, 2010) and studies examining the opinions of elementary school students about their beliefs about mathematics (Bayrak & Hacıömeroğlu, 2018) and constructivist learning environment and their beliefs about mathematics (Aksu, Demir, & Sümer, 2002). It was thought that it was important to study the activities of elementary school students studying activity-based mathematics and their beliefs about mathematics. From this point of view, the results of this research were thought to contribute to the literature. In the light of all of these, the aim of the study is to examine the effect of activity-based mathematics teaching on the attitudes of fourth-graders to mathematics activities and their beliefs about mathematics. Answers to the following research questions were sought for that purpose:

1. Is there a significant difference between students' attitudes towards mathematics activities and their belief about mathematics in pre-test mathematics scores?
2. Is there a significant difference between students' attitudes to mathematics and their post-test scores of belief about mathematics?
3. Is there a significant difference between the attitude towards mathematics activities of the experimental and control groups and the belief pre-test and post-test scores about mathematics?
4. What are the opinions of the experimental group students on mathematics?

2. Method

In the study, the experimental pattern with pretest-posttest control group, which is one of the Quasi-Experimental Design, was determined as the research design. Studies designed using a Quasi-Experimental Model require random selection of groups due to the difficulty of artificially forming groups. The researcher randomly determines one of the groups under normal conditions as an experimental group and the other as a control group. Preliminary tests are applied to the selected groups. Experimental activities are carried out in the experimental group, and then the differences are examined by applying the posttests to the groups (Creswell, 2013). In addition, in the qualitative dimension of the research, it was added that students think about activity-based math applications. “Hawthorne Effect”, which is defined as one of the factors affecting external validity in experimental studies, can be defined as the participants show some reactions that they will not show under normal conditions as a result of the physical and psychological effects created by the experimental environment. In this case, it is interpreted that the participants are aware that an experiment has been carried out on them, leading them to develop a group action style. Participants can show these behaviors, as they are selected for the experimental group (Eren, 2004). There is a control group in this research. For this, the students in the control group of the research and the researchers spent time so that the experimental group did not feel that they were in an application. Therefore, it was tried to prevent the students in the application group from obtaining a belief that only changes related to them were made within the scope of the research.

2.1. Study Group

On the 11th of April 2012, all educational levels were changed with the education law that came into force after being published in the official newspaper in Turkey. With the new education periods expressed as 4 + 4 + 4, primary, secondary and high school trainings were rearranged (Kol, 2019). With the legal arrangement made in 2012, the primary school start age is 6 years and the education period is 4 years. Primary school is in the scope of compulsory education (MEB, 2019). Study group of the research; Turkey's Istanbul in an experimental group of 25 schools providing education at primary level is composed of a total of 50 fourth-grade students in the province, including 25 control groups. One branch of a primary school was chosen as the experimental group and the other branch was randomly selected as the control group. The research was carried out in 4 weeks and 13 lessons in the 2019-2020 academic year. The aim of this study, considering the education levels of the students and the teaching methods used; it was thought that the sample of the research of the fourth grade students who are in the last grade of primary school would be appropriate. To create the study groups, students were paired and separated into two groups, experimental and control groups. Information about the content of the study was given to the principal and classroom teacher of the school where the application will be carried out. The classroom teacher also informed the parents of the students about the research. The research has been started with their approval. Volunteering was taken as a basis for students to participate in the research. In the photographs used in the research, it was paid attention to hide students' identities. The distribution of the sample by gender is as given in Table 1.

Table 1. Gender of Students

	Girl		Boy		Total
	f	%	f	%	
Experimental	13	52	12	48	25
Control	13	52	12	48	25
Total	26		24		50

Both the experimental group and control group consist of 13 girls (52%) and 12 boys (48%). The number of students in the groups and their gender distributions are the same as shown in Table 1.

2.2. Data Collection Tool

“Attitude Scale for Mathematical Activities” and “Belief Scale about Mathematics” were used as data collection tools in the research. Additionally, the experimental group was asked at the end of the application to express what they thought about the application through an “Activity Evaluation Form”.

Attitude Scale for Mathematical Activities: The “Attitude Scale for Mathematical Activities” developed by Ocak and Dönmez (2010) was used in the research to determine student attitudes towards mathematical activities. The scale consists of 19 items, 10 positive and 9 negative. The scale consists of three sub-dimensions: “Trust”, “Independence” and “Interest”. This scale was developed by Ocak and Dönmez (2010) rated as a 5-point Likert scale with ‘strongly agree, agree, neither agree nor disagree, disagree, strongly disagree’. However, this scale was included in Sidekli & Yorulmaz (2018) research as ‘agree (3)’, ‘neither agree nor disagree (2)’ and ‘disagree (1)’. Therefore, it has been used in this research as well. Ocak and Dönmez (2010) calculated the reliability coefficient of this scale as 0.91 and the reliability coefficient of this study was calculated as 0.93.

Belief Scale about Mathematics: This scale, developed by Aksu, Demir and Sümer (2002), consists of 20 positive substances. The scale is rated as ‘completely suitable (5)’, ‘suitable (4)’, ‘neither suitable or unsuitable (3)’, ‘Unsuitable (2)’, ‘completely unsuitable (1)’. In this way, the lowest 20 and highest 100 points can be scored from the scale. Aksu, Demir and Sumer (2002) found the reliability coefficient of this scale as 0.75 and the Cronbach alpha coefficient as 0.83 in this research.

Activity Evaluation Form: This form was prepared by the researchers for the post-application opinions of the experimental group students. The students were asked structured questions such as “Do you like the application?”, “What's your favorite activity?”, “Which activity do you dislike?”, “Can you please

write down in one sentence, what activities were like?” and finally “If you had developed an activity on this subject, what kind of activity that would have been? Please describe.” and their opinions about the application were collected.

2.3. Research process and materials

The work consists of three phases. In the first phase, students received the “Attitude Scale towards Mathematics Activities” and the “Belief Scale about Mathematics” as pre-tests. With the scales applied in this way, students’ attitudes towards pre-application mathematics activities and their beliefs about mathematics have been sought. The next phase of the research was the implementation of activities by researchers who previously applied activity-based mathematics teaching in their classrooms.

In line with the aim of the study, appropriate activities related to the ‘Measuring’ learning field in the elementary school 4th grade mathematics education program, including ‘measuring length, measuring circumference and measuring area’ in the sub-learning fields were developed by the researchers. According to the elementary school mathematics program in Turkey, “determining the characteristics to be measured, making comparisons and sorting, first making measurements using non-standard units then using standard units and finally applying and interpreting this information reflects the progress of the field of “measurement’ learning” (MEB, 2018, p.11). According to the program, it is aimed to make a comparison and sort based on intuition at first, then to make measurements using non-standard and non-standard units (MEB, 2018). According to the curriculum applied in Turkey, the content of ‘length measurement, circumferential measurement and area measurement’ is as follows (MEB, 2018, p.48-49):

- Length Measurement
 - Specifies the usage areas of millimeters from standard length measurement units.
 - Explains the relationships between units of measuring length and converts these units.
 - Estimates a length that it can measure directly with the most appropriate unit of measuring length and controls its estimate by measuring.
 - Solves problems that require up to three processes using length measurement units.
- Circumferential Measurement
 - Explains the relationship between the perimeter lengths of the square and rectangle and the edge lengths.
 - Creates different geometric shapes with the same circumference length.
 - Solves problems related to calculating the circumference lengths of shapes
- Area Measurement
 - Specifies that the fields of the shapes are the number of units covering this area.
 - Relates the area of the square and rectangle with addition and multiplication.

First of all, in order to recognize the length of measurements, students are ensured that they objective the concept of the circumference by having them follow the circles of various objects in the classroom. In order to avoid the variability of the result in length measurements, it is provided that it is measured with a constant value and that it is experienced and discovered. Students are provided to perform drama by telling past and present differences, in order to compare methods of measuring by combining and measuring by meter. Students measure the circumference of objects according to their length measurements by folding ropes and finding out for themselves what values they correspond to. For example, “students measure the given shape with a single layer of rope and then measure it with two or three layers of rope and say how many times that is, and express it numerically”.

Then they are asked to create a shape, and they are asked to measure the circumference of the shapes they created with the rope. For circumferential measurement trials, different lengths of bars (10 and 20 cm) are placed in some areas of the schoolyard for students to find. Students will find the bars and form a square with them, and the circumferential measurement will be made in the resulting square. Students have fun both by moving in the garden and by practicing in accordance with the rules of teamwork, they are provided with the knowledge of how to measure the circumference of the shape. Students have been encouraged to create shapes such as apartments, robots, using their imagination

with the sticks they find. The works are presented as a group according to their own wishes. Thus, it is aimed that students realize both mathematical and abstract artistic thinking skills in their studies. For field measurement studies, students are asked to draw any geometric shape on distributed papers. These shapes are expected to find their areas by filling them with the given unit squares. In this activity, the students' level of processing of information was deemed sufficient, so that they could perform the activity both with the unit frames that the researchers cut out and with the unit frames that they drew themselves. Therefore, the missing pieces were completed with the knowledge of creating unit frames by team working. Students were then divided into groups of 4 and given cards with 12 cm, 20 cm, 24 cm, 32 cm, 40 cm, 44 cm written on them in an envelope. The numbers on these cards are said to be circumference lengths.

1. Students are asked to think about the squares whose circumference length is these numbers might be.
2. They create these squares by cutting the colored cartons.
3. They are allowed to speak on the frames they create.
4. The students are asked to think about the rectangles, which are also these numbers, which are the length of the circumference.
5. They form these rectangles by cutting colored cartons.
6. They form rectangles with the largest and smallest edge lengths.
7. They are asked to find areas of the shapes they create.
8. They compare squares and rectangles with equal circles that they create (cut).
9. When they form a "square" or a "rectangle", they find that a larger edged shape emerges.

In this way, students will reach the answer to the question "What to do when finding edge lengths of squares/rectangles given circumference lengths?" by exploring. It also emerges to the knowledge that measuring the circumference length is the same for all shapes. It is expected that they will consider the question "If the edge lengths of the shapes with the same circumference lengths are changed, will their areas change?" Then they are asked to create a pattern in different ways with the rectangles and squares they found in the previous lesson. They are expected to find the circumference of this pattern. At the end of this activity, they are also asked to create land or garden with the squares they create. Children are asked to create a geometric shape with the measurements given (Bengu: 5 m, Ela: 2 m, Hasan Emir: 10 m etc.) and to find its circumference. They then have a picnic in this created area.

Finally, students create different geometric shapes with the same circumference length. Students are given various regular and irregular shapes in a box and placed in different places in the classroom. They are asked to choose from these shapes to measure the circumference lengths they want. Then, circumferential measurement results are arranged to measured equal sometimes is discussed by creating a class discussion environment.

The activities were prepared together by researchers who are mathematics educators and classroom teachers. The prepared activities were applied to a student at the fourth grade level beforehand. Activities were finalized with feedback from him. After the week of completion, the same data collection tools were applied to all students as the post-test was applied to the final phase of the research. In addition, at the end of the application, the experimental group students were asked to write their opinions on the application on the activity evaluation forms.

2.3. Data Analysis

Statistical solutions of quantitative data collected in the study were made using SPSS 16.0. Before starting the analysis, the Kolmogorov-Smirnov test was performed in the normality test of the distribution of the data, and also the skewness - kurtosis values of the scores were examined. According to the results of the Kolmogorov-Smirnov test, it was observed that the data did not show normal distribution since the significance value was greater than .05 and the skewness flatness coefficient was not between +2.0 and -2.0 according to George and Mallery (2010) and nonparametric tests were used in this context. At the same time, considering the number of data is less than 30, nonparametric techniques are thought to be appropriate (Pallant, 2005). In the analysis of the data, Mann Whitney-U Test and Wilcoxon Marked Ranks Test were used. Descriptive analysis was used in

the analysis of the qualitative forms in which the students in the experimental groups were directly quoted from their views about the application. The students' forms were examined separately by the researchers and the results were included.

3. Findings and Comments

The findings were analyzed based on four questions that created the research problem. The findings of the first sub-problem are as in Tables 2 and 3.

Table 2. Mann-Whitney U Test Results According to Scale of Attitude Directed Towards The Application of Mathematical Activities Pre-test Scores

Pre-test	N	Mean Rank	Sum of Ranks	U	z	p
Control	25	25.02	625.50	300.500	-.233	.816
Experimental	25	25.98	649.50			

There was no significant difference between mean Scale of Attitude Directed towards the Application of Mathematical Activities pre-test scores of the groups ($U = 300.500$, $p > 0.05$). Based on this data, it can be said that the pre-test scores of the groups are equivalent.

Table 3. Mann-Whitney U Test Results According to Belief Scale about Mathematics Pre-test Scores

Pre-test	N	Mean Rank	Sum of Ranks	U	z	p
Control	12	25.42	635.50	310.500	-.039	.969
Experimental	12	25.58	639.50			

There was no significant difference between mean Belief Scale about Mathematics pre-test scores of the groups ($U = 310.500$, $p > 0.05$). Based on this data, it can be said that the pre-test scores of the groups are equivalent.

The findings of the second sub-problem are given in Table 4 and Table 5.

Table 4. Mann-Whitney U Test Results According to Scale of Attitude Directed Towards The Application of Mathematical Activities Post-test Scores

Post-test	N	Mean Rank	Sum of Ranks	U	z	p
Control	25	20.70	517.50	192.500	-2.346	.019
Experimental	25	30.30	757.50			

There was significant difference between mean Scale of Attitude Directed towards the Application of Mathematical Activities post-test scores of the groups ($U = 192.500$, $p < .05$). Accordingly, that the experimental group was higher than the control group mean attitude mathematics are shown in Table 4.

Table 5. Mann-Whitney U Test Results According to Belief Scale about Mathematics Post-test Scores

Post-test	N	Mean Rank	Sum of Ranks	U	z	p
Control	12	18.46	461.50	136.500	-3.416	.001
Experimental	12	32.54	813.50			

There was significant difference between mean Belief Scale about Mathematics post-test scores of the groups ($U = 136.500$, $p < .01$). Accordingly, it can be seen in Table 5 that the mathematics belief average of the experimental group is higher than the belief average of the control group.

The findings of the third sub-problem are given in Table 6, Table 7, Table 8 and Table 9.

Table 6. Wilcoxon Marked Ranks Test Results of the Control Group According to Scale of Attitude Directed Towards The Application of Mathematical Activities Pre-Test and Post-Test Scores

	Ranks	N	Mean Rank	Sum of Ranks	Z	p
Control Pre-test - Post-test	Negative Ranks	8	10.25	82.00	-2.167	.030
	Positive Ranks	17	14.29	243.00		
	Ties	0				
	Total	25				

There was significant difference between the Scale of Attitude Directed towards the Application of Mathematical Activities Pre-Test and Post-Test scores of the control group ($z = -2.167$; $p < .05$).

Table 7. Wilcoxon Marked Ranks Test Results of the Experimental Group According to Scale of Attitude Directed Towards the Application of Mathematical Activities Pre-Test and Post-Test Scores

	Ranks	N	Mean Rank	Sum of Ranks	Z	p
Experimental Pre-test - Post-test	Negative Ranks	3	4.33	13.00	-4.027	.000
	Positive Ranks	22	14.18	312.00		
	Ties	0				
	Total	25				

A significant difference was found between the Scale of Attitude Directed towards the Application of Mathematical Activities Pre-Test and Post-Test scores of the experimental group ($z = -4.027$; $p < .01$). Accordingly, it is seen that activity-based mathematics teaching increased the attitudes of the experimental group towards the mathematical activities in favor of the post-test.

Table 8. Wilcoxon Test Results of the Control Group According to Belief Scale about Mathematics Pre-Test and Post-Test Scores

	Ranks	N	Mean Rank	Sum of Ranks	z	p
Control Pre-test - Post-test	Negative Ranks	11	9.77	107.50	-1.215	.225
	Positive Ranks	13	14.81	192.50		
	Ties	1				
	Total	25				

There was significant difference between the Belief Scale about Mathematics Pre-Test and Post-Test scores of the control group ($z = -1.215$; $p > .05$).

Table 9. Wilcoxon Test Results of the Experimental Group According to Belief Scale about Mathematics Pre-Test and Post-Test Scores

	Ranks	N	Mean Rank	Sum of Ranks	z	p
Experimental Pre-test - Post-test	Negative Ranks	5	5.60	28.00	-3.619	.000
	Positive Ranks	20	14.85	297.00		
	Ties	0				
	Total	25				

A significant difference was found between the Belief Scale about Mathematics Pre-Test and Post-Test scores of the experimental group ($z = -3.619$; $p < .01$). Accordingly, it is seen that activity-based mathematics teaching increases the mathematics beliefs of the experimental group students in favor of the post-test.

Students' expression of what they think about the application posed the final bottom problem of the research. The experimental group students were asked the question "Do you like the application?" and all of the students ($f: 25, 100\%$) stated that they liked the practice. Students were asked the question 'What's your favorite activity?'. 2 (8%) students left this question blank and 13 (52%) students stated

that they liked all activities. The activities that the rest of the students like the most are given below with direct quotes from the students' responses:

S1: "I liked the unit square activity the most of the activities we did. Because it's so much fun to place and to calculate."

S2: "I like to square with wires the most. Because we did teamwork and I had a lot of fun doing it."

S3: "Circumferential measurement activity"

S4: "Unit squares, because it was a very entertaining instructive activity."

S5: "The most I liked to square them with wires of the activities we did and place them on cardboard. Because we had fun and learned things."

S10: "Unit squares."

S12: "I liked the circumferential activity the most. Because we created squares and measured their circumferences."

S17: "I loved that activity because we felt like inches and had fun at that activity."

S18: "I liked the activity of making shapes with chenille and calculating the circumferences of the mathematical activities we did. Because it was fun and we learned how to calculate circumferences."

S20: "I liked the activity most of squaring it with wires and measuring its circumference and presenting. I love teamwork."

Students were asked the question "Which activity do you dislike?". 3 (12%) students left this question blank and 20 (80%) students stated that it was not an activity that they did not like, while the remaining 2 (8%) students stated that they did not like the activities that were written with direct quotes below:

S7: "The only thing I didn't like was making unit frames with the frame."

S19: "I didn't like problem activities because it's hard for me."

Students were asked to "write down how the activities were in one sentence" 3 (12%) students left this question blank and the remaining 22 (88%) students spoke positively of applications with phrases such as 'It was so beautiful.', 'It's been great fun.', 'It was amazing.', 'It was fun and instructive.', 'It was so easy because we did the applications with the group.' and 'I have now learned subjects that I didn't fully learn.'

Finally, students were asked the question "If you had developed an activity on this subject, what kind of activity that would have been?". 4 students (16%) left this question blank. 5 (20%) students replied 'I would do activities by entertaining'. The remaining 16 (64%) students' suggestions for the activities they wish to develop are as follows:

S1: "I would ask them to draw a large shape and estimate and calculate the area and circumference."

S2: "I would give my friends rectangles and squares. I would give them a rope, a square and a ruler. They would measure the circumference of the shapes with rope, and they would measure the area with unit squares."

S3: "I will give everyone a square but some will be in the same area and circumference. I'd call everyone to the chalkboard and show the wrongdoers the true answers."

S5: "I would have my friends measure the circumference of a square or a triangle."

S7: "I would entertain the children first. I mean, I'd teach it by game. I would bring one cube, etc., and have some students measure their circumference by thinking of cubes, some of them square, etc."

S8: "I would buy one plastic thing and have them measured with rope."

S10: "I would give a square and say: "Measure how many units there are with the pen.""

S11: "I would give squares and rectangles. I'd ask them to measure their area and their circumference."

S12: "I would tell them to find their circumferences by giving shapes to the board on the subject of circumferential measurements."

S13: "I would combine the geometric object and ask its circumference and its area."

S14: "I would give everyone 1 carton and 5-10 ropes. And I would give everybody different numbers. I would also give one ruler and have them find the circumference."

S15: "I would give squares and rectangles on a piece of paper. I would apply activities like finding the area and its circumference."

S17: "I would give my friends paper and shulin to make the shapes (square and rectangle) and ask them to paste it on paper and measure the edges and circumferences."

S19: "I would do square- and rectangular-activity."

S23: "I would say the circle of a square and ask them to find an edge of the square and then find the area of that square."

S24: "I would have developed an activity measuring the circumference and area of something."

4. Conclusion, Discussion and Implications

In this research, which was carried out to examine the effect of activity-based mathematics teaching on the attitudes towards mathematics activities and the beliefs about mathematics of primary school fourth grade students, when we look at the difference between the attitudes towards mathematics activities and belief posttest scores about mathematics, both the attitude towards mathematics activities and the belief about mathematics in the experimental group. It is concluded that there is a significant difference in favor of. Accordingly, it can be said that activity-based mathematics teaching has a more positive effect on the traditional way, that is, the attitudes towards mathematics activities of the teacher, where the teacher is more active, and beliefs about mathematics. The research of Duran, Sidekli, & Yorulmaz (2018) also indicated that the general attitudes of elementary school 4th graders towards mathematics activities were positive and that they liked doing mathematics activities. Students have stated that mathematics activities will add a lot to them and that mathematics activities make them happy. Similar to the results in this research, Yadav (2015) concluded that at the end of activity basis mathematics teaching with 120 4th graders, the experimental group students were more successful than the control group students. Tural (2005) also concluded that there was a significant difference in third-grade mathematics teaching in the experimental group, which was taught with games and activities, in favor of the experimental group in the post-test attitude total score average for the mathematics course.

It was examined the attitude of the experimental and control group to the activities of mathematics and whether there was a significant difference between the pre-and post-test scores of beliefs about mathematics. It was concluded that there was a significant difference in attitudes towards mathematical activities in favor of post-tests in both the experimental and control groups. Students have been active in the course through the activities of the experiment group and, as a result, may have had a more positive attitude to teaching mathematics through activities. The high attitudes of the control group towards mathematics activities can also be achieved through classroom activities. Mert Cüce's (2012), "Reflections From Class Environment In Which Activity Based Instruction Is Performed: Action Research" showed that activity-based mathematics education positively affects students' interest, perception and attitude to mathematics, increases students' academic achievement and improves students' self-confidence. In addition, the results were obtained by increasing the students' awareness of responsibility and supporting their reasoning skills. In addition, the results were obtained by increasing the students' sense of responsibility and supporting their reasoning skills. Ebret's study (2015) of the effect of activity-based mathematics teaching on 3rd grade students' problem solving skills and attitudes towards mathematics showed a significant increase in

experimental and control group students' problem solving skills and attitudes towards mathematics in favor of the experimental group. The research also shows that activity-based mathematics teaching positively affects students' attitudes towards mathematics and mathematics activities, as in this research (Akbuğa, 2009; Balantekin, 2014; Çakıcı, 2018).

The study by Bayrak & Hacıömeroğlu (2018) revealed a weak but significant relationship between students' beliefs about mathematics and their opinions on the constructivist learning environment. Results from this study showed that the beliefs about mathematics of Grade 4 students at the elementary school level and their opinions on the learning environments in these courses were generally positive. Results from this study showed that the beliefs about the mathematics and the views of 4th graders at the elementary school level regarding their learning environment in these courses were generally positive. In their work, Perkins, Adams, Pollock, Finkelstein, and Wieman (2004) have examined the relationship between teaching methods and students' beliefs. As a result of the research, it was determined that the use of interactive learning methods and the courses supporting conceptual understandings positively affect the beliefs of the students.

Finally, the experimental group students were asked open-ended questions about what they thought of the applications. The answers to these questions formed the latest findings of the research. Accordingly, all of the students liked the activities. When asked which of the activities they liked the most, most of the students stated that they liked all of the activities. When they were asked to write their favorite activities directly, it was concluded that they liked "square-rectangle forming with wires", "making measurements" and "activities done with unit squares". As it can be seen, the activities that students are active in have been the ones that they enjoy the most. Again, it is one of the results of the answers given that there is no activity that most of them do not like. Only one student has expressed dislike of the 'unit squares activity', which is the activity the majority likes, and 'problem activities' as it is difficult for the student. When asked to interpret the activities in a single sentence, the majority gave answers such as 'It was so beautiful', 'It's been great fun', 'It was amazing', 'It was fun and instructive', 'It was so easy because we did the applications with the group' and 'I have now learned subjects that I didn't fully learn' for the activities. Finally, students were asked to develop an activity on this subject. Some of the students replied 'I would do activities by entertaining' while the rest of the majority had suggestions for activities. When the activities they wrote were analyzed, it was found that they were similar to the activities used in the applications and even suggested the same activities. Thus, it can be said that students are very impressed with activity-based methods, and that they can have ideas about teaching as they learn. The study of Gerez-Cantimer (2018), which aims to examine students' views on mathematics activities with mathematical content and overall holistic perspective, revealed that they want to increase the entertainment factor in lessons and that their views on activities diverge as the grade level changes. In their views, the students stated that they wanted to diversify the mathematical content at the point of the presentation, supporting operational knowledge in the courses as well as the practices they were active in, such as the experimental group students in this research, and that they wanted entertainment not to be ignored. In Aslan and Unlu's (2012) studies, which determine student views at the end of activity-based mathematics learning, many of the students have stated the activities used in mathematics teaching as tools that increase interest in the lesson, enable visualizations in the lessons, embody abstract concepts, and activate the student.

As a result, activity-based mathematics teaching appears to have a positive effect on students' attitudes towards mathematics activities and their beliefs about mathematics. Thus, as Avşar-Tuncay (2019) has stated, the teaching process with play and activities provides an educational environment that enables students to participate in the lesson in a cognitive, affective and psychomotor way. For this reason, teachers should use activities where students are active in learning environments.

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