INVESTIGATION OF THE EFFECTS OF CREATIVE GAMES AND ACTIVITIES ON MATHEMATICS ATTITUDES AND ACHIEVEMENTS IN PRIMARY SCHOOL

Büşra USLUOĞLU[1], Veli TOPTAŞ[2]
[1]Kırıkkale University, Social Sciences Institute (Turkey)
[2]Kırıkkale University, Faculty of Education (Turkey)
busrausluoglu38@hotmail.com, vtoptas@gmail.com

Abstract

In this study, the effects of primary school students' creative mathematics activities on their attitudes and achievements towards mathematics were examined. In the research, a quasi-experimental design with pretest-posttest control group was used. The aim of the study, which is carried out with primary school 3rd grade students, is to develop children's reasoning skills and to develop their love for mathematics through fun activities, games and activities. In the study, the significance of the difference was revealed by measuring the mathematical attitudes and academic achievements of the students before and after the application. In the study, the 'Attitude Scale Towards Mathematics Lesson' scale and the mathematics academic achievement test for the 3rd graders developed by the researchers to scale the academic achievement in mathematics were applied as a pre-test and post-test. Considering the findings of the research, it is seen that the program is effective on the mathematics attitude and mathematics academic achievement of the students in the experimental group who participated in the study of improving mathematics attitude and mathematics academic success through creative mathematics activities. Before the experimental application, the attitudes of the students in both the experimental and control groups towards the mathematics lesson were quite high.

Keywords: primary school, math lesson, creative games, creative math activities

1. Introduction

Mathematics is generally perceived as a difficult and feared course. The most important reason for the formation of this perception is the thought that mathematics consists of only rules and procedures that are disconnected from daily life, therefore, one must have a very strong memory and memorization ability in order to learn. According to Toptas et al. (2020), in order to break this perception, the mathematics learning-teaching process should be made meaningful, fun and discoverable. Even the fact that it is suitable for the process is an important step in itself for this purpose. Mathematics is a naturally entertaining and creative science that helps to understand life.

Especially the primary school period, when the love or anxiety of mathematics is formed, is one of the periods when educators should take more responsibility. In Piaget's words, primary school children are in the concrete operational stage and are open to perceiving everything around them concretely. In addition, during this period, children take great pleasure in playing and learning through games. Chandel et al. (2015) concluded in their study that children find teaching with games more enjoyable. However, Kavasoğlu (2010) mentioned that the fear of mathematics can turn into love in the mathematics lessons taught with games. Therefore, it is very important to reduce a lesson that includes numbers, operations, shapes and symbols, which are abstract such as mathematics, to a concrete basis for primary school children.

The studies conducted in recent years (Usluoğlu and Toptaş, 2020; Bozkurt and Ateş, 2021; Şengül and Kıral, 2023; Tıraş, 2023) have revealed that the activities in mathematics textbooks are generally operational and conceptual. This means that children are successful by memorizing operations and concepts related to mathematics, but they are insufficient in having metacognitive skills in transferring mathematics to daily life. In order to eliminate this inadequacy in a healthy way, the mathematics course should be designed and taught according to the development levels and readiness levels of the children. Children love to play games. Therefore, it is useful for them to play with mathematics.

Creativity is the process that is unique to individuals and that emerges as a result of the interaction and restructuring of the individual's own thoughts and the environment (Chae, Sea, & Lee, 2015). Although creativity often reminds innovations discovered in laboratory environments, it actually covers emotional states of creativity and activities beyond this (Silvia & Kaufman, 2010). Conner et al. (2018) concluded in their study that creativity activities not only have new information discovered, but also have positive psychological benefits. They also emphasized that daily creative activities are a way to improve positive psychological functioning. Therefore, it can be interpreted that creative activities are very effective tools in completing this process and achieving a result. The concept of creativity, which focuses on making the process productive rather than its results, actually expresses the attitude and success of the time spent to the work done.

In this study, it is aimed to teach mathematics achievements with games and creative activities in order to prevent mathematics fear and anxiety in primary school students and to improve their love for mathematics. The aim of the study, which is carried out with primary school 3rd grade students, is to develop children's reasoning and reasoning skills and to develop their love for mathematics with fun activities, games and activities. In this study, the significance of the difference was revealed by measuring the mathematical attitudes and academic achievements of the students before and after the application.

1.1. The Problem of Research

Does a teaching practice blended with creative games and activities in primary school 3rd grade mathematics lesson have an effect on students' attitudes towards mathematics lesson and academic achievement?

2. Method

2.1. Research Pattern

In the research, a quasi-experimental design with pretest-posttest control group was used. This model is based on the principle that an experiment and a control group are formed by pairing one or more groups, impartially (Büyüköztürk, 2002: 206). Within the scope of the study, two groups were determined and after the pre-test application was made, a mathematics teaching application blended with creative games and activity contents was applied in the experimental group for 11 weeks, and traditional teaching was applied in the control group. At the end of 11 weeks, the results of both groups were compared by applying the post-test.

2.2. Working Group

In the study, convenient sampling method was preferred. In this method, the researcher chooses a situation that is close and easy to access and is often used when the researcher does not have the opportunity to use the other sampling method (Kılıç, 2013). In this study, 42 3rd grade students studying at a public school in Kırıkkale formed the study group. Random control and experimental groups were determined without making any selection between 3/A and 3/B

branches. 23 students in the 3/A branch were determined as the experimental group, and 19 students in the 3/B branch were determined as the experimental group. The classroom teachers of both groups are experienced teachers with almost the same seniority years.

2.3. Data Collection Tools

In the study, the 'Attitude Scale Towards Mathematics Lesson' scale developed by Aşkar (1986) to measure students' mathematics attitudes, and the mathematics academic achievement test, pre-test and post-test for 3rd graders developed by the researchers to scale their mathematics academic achievement were applied. Information on the scales is as follows:

Attitude Scale Towards Mathematics Lesson: There are 20 items in the scale. There are 10 negative and 10 positive items in the scale, in which a 5-point rating system is used. The reliability coefficient of the scale is 0.96 (Cronbach Alpha). This result shows that the scale is reliable.

Academic Achievement Test: In the test developed by the researchers, there are 20 items for the subjects, units and experimental work to be done on the basis of the 3rd grade mathematics course work. In the test, there are 3rd grade subjects that the students have not yet received their education in the light of the academic calendar carefully calculated before the study. These subjects are, in order, multiplication with natural numbers, division with natural numbers, fractions, money and time measurement. The distribution of the 20-item questions applied as a pre-test and post-test is as follows: 6 questions on multiplication and division with natural numbers, 5 questions on fractions, 5 questions on money and 4 questions on measuring time.

2.4. Application Process

In order to determine the study groups before the application, it was aimed to measure the attitudes of the classes towards mathematics and their academic achievements. For this reason, before the application, the researchers observed the mathematics lessons in the classrooms, asked mathematics questions to the students and determined the experimental-control groups. The academic calendar, activities and games determined before the study were shared with the teacher of the class, which was the experimental group, and long speeches were made on the subjects. Based on the predetermined topics for the study, activities and games were arranged in a way that children could understand more easily. Thus, the 11-week implementation process was started. The researchers shared the necessary materials and activities with the classroom teacher the day before the application every week and personally participated in the application the next day. During the application, the researchers accompanied and observed the classroom teacher and students in a way that would not disrupt the teaching and learning flow in the classroom. During and after the activity, feedback questions were asked to the students about whether the outcome was given or not, and all the activities were recorded in the observation report. Each activity or game lasted 1 lesson hour. Below are examples of creative activities applied to the experimental group:

1. Mathematical Achievement: Doing quick multiplication by 10 and 100.

Game/Activity Suggestion

Required Materials: Colored paper/cardboard, scissors, glue, colored beads, rope (for bracelet making)

Before the activity starts, children's bracelets, some with a single bead and some with two beads, are made with colorful beads and thread. Each student is randomly given a wristband. Students wear the bracelets given to them on their arms (Figure 1). Single-beaded bracelets

represent multiplication by 10. On the other hand, bracelets with two beads represent shortcut multiplication by 100. The teacher randomly selects two students.

Students take turns saying one, two or three digit numbers to each other. The other student multiplies the number by 10 if his bracelet has a single bead, and multiplies it by 100 if it has double beads. Then the turn passes to the other student and he/she says a number. For example, let's say that one of the two students coming to the blackboard has a bracelet with a single bead (student with code name A) and the bracelet of the other with two beads (student with code name B). A tells B the number 5. Since B's bracelet has double beads, she multiplies 5 by 100 and gives the answer 500. Since the answer is correct, it is B's turn to say the number. Then, let B tell A the number 36. Since A's bracelet has a single bead, she multiplies the number 36 by 10 and gives the answer 360. Thus, since both students gave the correct answer, they sit in their seats and the teacher chooses other students.

Figure 1. Bracelets prepared for students

2. Mathematical Achievement: Solve problems that require two operations, one of which is division. Studies aimed at posing problems are also included.

Game/Activity Suggestion

Required Materials: Egg carton, pasta

The class is divided into four or six groups. Each group is given egg cartons with different containers and mixed numbers of pasta. Each group puts equal amounts of pasta into their egg containers. If there is any remaining pasta, they place it in a bowl (Figure 2). Afterwards, the groups change places. Each group (station) creates a problem sentence about the egg case and pasta in front of them and leaves the paper on that table. Afterwards, the groups return to their first table and read and solve the problem sentence created. At the end of the game, each group reads the problem sentences out loud and solves them.

Figure 2. Pasta divided equally into egg cartons

2.5. Analysis of Data

After measuring the subjects included in the study, the results obtained from the inventory were scored by the researchers. The raw scores of the students participating in the experimental and control groups from the pre-test and post-test applications were tabulated and the arithmetic mean, minimum-maximum values and standard deviation scores of the groups were calculated. The difference between the pretest and posttest mean scores of the experimental and control groups was tested in the comments on whether the creative activity and game work applied in the mathematics lesson were effective, and the t value was calculated, and it was investigated whether it was significant at the .05 level. The pre-test and post-test mean scores of the experimental group and the control group were compared with the dependent t-test and it was examined whether it was significant at the .05 level.

3. Results

3.1. The Results of the Application on Students' Attitudes to Mathematics

Table 1. Findings Regarding the Pre-Test and Post-Test Scores in the Experimental Group

Statistical Value	**N**	*x*	**Min.**	**Max.**	**sd.**	**t value**
Pre Test	23	60,26	50,00	81,00	7,34	1,29
Post Test	23	68,26	57,00	80,00	5,95	

p < .05

As can be seen in Table 1, there is a significant difference between the pretest mean score (60.26) and posttest mean score (68.26) of the experimental group in favor of the posttest results. In order to determine whether the difference between the mathematics attitudes of the students before the experiment and their mathematics attitudes after the experiment was significant, the mean scores of the pre-test and post-test were compared with the dependent t-test. The calculated t value is significant at the .05 level. Accordingly, the difference between the pretest and posttest mean scores of the experimental group is significant.

This result shows that there is a significant difference between the pre-test and post-test results of the experimental group students participating in the creative mathematics activities in terms of the level of mathematics attitudes.

Table 2. Findings Regarding the Control Group Pre-Test and Post-Test Scores

Statistical Value	**N**	*x*	**Min.**	**Max.**	**sd**	**t value**
Pre Test	19	55,59	39,00	65,00	6,84	−1,48
Post Test	19	57,63	47,00	65,00	5,57	

p < .05

In Table 2, it is seen that there is a very low difference in the mathematics attitude levels of the control group students compared to the pre-test and post-test mean scores. In order to test the significance of this difference, it was seen that the t value was not significant at the .05 level when the pretest and posttest mean scores were tested with the dependent t test. This result shows that there is no significant difference between the pre-test and post-test mathematics attitudes scores of the control group.

Table 3. Findings Related to the Differences in the Pretest and Posttest Mean Scores of the Experimental and Control Groups

Statistical Value	**n**	**pretest *x* - sd**	**posttest *x* - sd**	**pre-post test *x* diff.**	**t value**
Experimental group	23	60,26 - 7,34	68,26 - 5,95	−8,00	−2,95
Control group	19	55,59 - 6,84	57,63 - 5,57	2,04	

p < .05

As shown in Table 3, the t-value was calculated by testing the difference between the pre-test and post-test mean scores of the experimental and control groups in order to determine the effect of creative mathematics activities and the study of improving mathematics attitude and mathematics academic achievement on the mathematics attitude levels of primary school third grade students. The calculated t value (−2.95) is significant at the .05 level. The gain of the experimental group from the program is significantly higher than the control group. This result shows that creative mathematics activities and the study of improving mathematics attitude and mathematics academic achievement are effective on the mathematics attitude levels of primary school third grade students.

3.2. The Results of the Application on the Mathematics Academic Achievement of Students

Table 4. Findings Regarding the Pre-Test and Post-Test Scores in the Experimental Group

Statistical Value	**N**	*x*	**Min.**	**Max.**	**sd**	**t value**
Pre Test	23	58,95	34,00	90,00	16,29	−7,02
Post Test	23	75,82	36,00	98,00	16,66	

p < .05

In Table 4, there is a significant difference between the pretest mean score (58.95) and the posttest mean score (75.82) of the experimental group, in favor of the posttest results. Pre-test and post-test mean scores were compared with the dependent t-test in order to determine whether the difference between the students' mathematics academic achievement before the experiment and their mathematics academic achievement after the experiment was significant.

The calculated t value (−7.02) is significant at the .05 level. Accordingly, the difference between the pretest and posttest mean scores of the experimental group is significant. This result shows that there is a significant difference between the pre-test and post-test results of the experimental group students participating in the creative mathematics activities in terms of the level of academic achievement in mathematics.

Table 5. Findings Regarding the Control Group Pre-Test and Post-Test Scores

Statistical Value	**N**	*x*	**Min.**	**Max.**	**sd**	**t value**
Pre Test	19	58,78	31,00	87,00	15,02	−5,68
Post Test	19	59,15	39,00	95,00	16,52	

p < .05

In Table 5, it is seen that there is a very low difference in the mathematics academic achievement levels of the control group students compared to the pre-test and post-test mean scores. In order to test the significance of this difference, it was seen that the t value was not significant at the .05 level when the pretest and posttest mean scores were tested with the dependent t test. This result shows that there is no significant difference between the pre-test and post-test mathematics academic achievement scores of the control group.

Table 6. Findings Regarding the Differences in the Pre-Test and Post-Test Mean Scores of the Experimental and Control Groups

Statistical Value	**n**	**pretest *x* - sd**	**posttest *x* - sd**	**pre-post test *x* diff.**	**t value**
Experimental group	23	58,95 - 16,29	75,82 - 16,66	16,86	3,01
Control group	19	58,78 - 15,02	67,15 - 15,52	8,36	

p < .05

As shown in Table 6, the t-value was calculated by testing the difference between the pre-test and post-test mean scores of the experimental and control groups in order to determine the effect of creative mathematics activities, mathematics attitude and mathematics academic achievement work on the mathematics academic achievement levels of primary school third grade students. The calculated t value (3.01) is significant at the .05 level. The gain of the experimental group from the program is significantly higher than the control group. This result shows that creative mathematics activities and the study of improving mathematics attitude and mathematics academic achievement are highly effective on the mathematics academic achievement levels of primary school third grade students.

4. Conclusion

When the findings of the study are examined, it is seen that the program has an effect on the mathematics attitude and mathematics academic achievement of the students in the experimental group who participated in the development of mathematics attitude and mathematics academic achievement through creative mathematics activities. Before the experimental application, the attitudes of the students in both the experimental and control groups towards the mathematics lesson were quite high. The fact that the mathematics lesson attracted the attention of students because it includes the solution of many problems they encounter in daily life may have caused this situation. Since they find a piece of the lesson in every moment of their life, it is expected that they have a positive attitude towards the lesson. Attitude pretest results also confirm this. When the literature is examined, the studies (Tural,

2005; Duran, Sidekli and Yorulmaz, 2018; Galiç, 2020; Ceylan and Karahan, 2021) show consistency with the findings obtained from this research.

Mathematics lessons with creative mathematics games and activities contribute significantly more to students' academic success than the traditional method. Another result of this study is that significant academic success was achieved in mathematics lessons taught with creative activities. It is directly proportional to the findings obtained as a result of the study conducted by Erdoğan (2018).

As a result, it can be said that if the learning environment blended with creative activities is used in the mathematics lesson, it can contribute positively to the academic achievement and attitudes of the students. Since mathematics is based on abstract operations, formulas and figures, it may be difficult for students to understand and make sense of it. For this reason, it is very important that the mathematics lessons associated with real life, especially in the concrete operational period, are made by touching, feeling and doing it personally, both in the mathematics lessons in the classroom and in the mathematics practice applications at home. Concrete practices are increasing in the classroom, and since the opportunity to do different activities arises, it becomes easier for students to gain achievements. For this reason, the attitude towards the course may increase as it contributes to the academic success in the course and makes the course fun. In this context, it can be suggested that teachers use the blended learning approach in mathematics lessons.

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