The Effect of Teaching Mathematics through Polya's Problem Solving Process upon Attitudes of 4th Grade Students towards the Mathematics Lesson

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Abstract

Education is a factor changing the individuals in every sense as well as affecting their attitudes. Through the education, various terminal and spontaneous behaviors are possible to be given to the individuals. In this sense, teachers play an active role upon the attitudes of students. For that reason, teachers' measuring the attitudes of students towards a specific issue accurately and organizing the educational activities considering these attitudes increase the quality of education. It has been revealed in the studies carried out previously for several times that students have had difficulties in mathematics lesson and mostly developed negative attitudes towards this lesson. Student success' being at not a desired level upon especially mathematical problem solving has been revealed in reports organized internationally. The purpose of this research was to investigate teaching problem solving as one of the areas students had the most difficulty through Polya's phases upon students' attitudes towards the mathematics. In the study, "pre-test and post-test control-group design" as one of the research methods was used as semi-experimentally. The students who participated into the research were determined choosing one experimental group and one control group among the 4th grade students studying at two state elementary schools in Adana province in 2014-2015 academic year. Upon the selection of the schools and students, mathematics grade-point averages and standard deviations of the previous term were regarded. As the data collection tools, Attitude Scale for Mathematics Lesson and Information Form developed by the researchers for determining the gender and ages of the students were used. Obtained data were analyzed using SPSS 22 statistical software program. In order to determine gender and age distributions, statistical methods such as frequency and percentage were used. For determining to what extent employed implementation affected the attitude towards mathematics, pre-attitude and post-attitude variance analyses of the groups were analyzed. As result of the analyses, it was noticed that although scores of the experimental group students were higher in post-attitude variance analyses of the groups, this difference was not significant. This revealed that mathematics teaching through the Polya's phases provided a contribution upon attitudes of students towards the lesson; however, this contribution was not at a significant level; and the reason for this was the fact that changing of attitudes at a short period was difficult.

Key Words: Polya's problem solving phases, Mathematics teaching, 4th grade, Attitude

1. Introduction

Education is a factor affecting the attitudes of individuals as well as changing these attitudes in any sense. Through the education, various terminal and spontaneous behaviors are possible to be given to the individuals. In

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this sense, teachers play an active role upon the attitudes of students. For that reason, teachers' measuring the attitudes of students towards a specific issue accurately and organizing the educational activities considering these attitudes increase the quality of education. It has been revealed in the studies carried out previously for several times that students have had difficulties in mathematics lesson and mostly developed negative attitudes towards this lesson. Student success' being at not a desired level upon especially mathematical problem solving has been revealed in reports organized internationally.

On the other hand, Ministry of National Education's (MNE) 2012 mathematics teaching program vision included the expression of "Raising individuals who can use mathematics in life, solve problem, share the solutions and thoughts, work in teams, have self-reliance and develop positive attitude towards mathematics is remarkable." In the general purposes of the same program, the expression of "…developing problem solving strategies and using these for overcoming the problems in the daily life" was included. These expressions indicate that developing positive attitude towards problem solving skill in mathematics teaching and mathematics has been regarded in our country.

Özdoğan (2008) who mentioned that education was essential for changing the attitudes stated that teachers' knowing what are the attitudes of students towards their lessons and the other phenomenon in social life and how these would be measured played a remarkable role upon increasing the quality of education. According to Tural (2005), several students in Turkey get worried considering that mathematics was difficult and they could not achieve mathematics, and therefore developed negative attitude towards mathematics. And changing these attitudes is unfortunately not very easy.

Problem solving is a concept including several definitions inside. A great number of scientists have defined problem solving and associated it with other skills. According to Aydın (2006), problem solving was the method of finding efficient and beneficial behaviors among various possibilities in order to achieve the goals of learning experiences; for that reason, problem solving method required creative and scientific thinking skills. According to Aykaç (2005), learners developed their thinking skill and creativity during the problem solving process. In reference to these two definitions, it is possible to mention that problem solving is one of the skills that should be and be used in human life. According to Yazgan and Bintaş (2005), a qualified curriculum was expected to train "individuals who could solve problems," and acquisition of problem solving skills that had such an importance included a long process and required a systematical study.

Problem solving process is one of the inevitable parts of mathematics lesson. Each acquisition in mathematics is associated with the acquisition of problem solving process, and so acquisition of this skill is tried to be provided. However, problem solving activity is the leading of the problems students experience difficulties in mathematics. And it is a fact that fear and anxiety students feel affect their attitudes towards mathematics negatively. Problem solving process in mathematics course books studied in our country has been prepared in accordance with Polya's (1957) four-step problem solving process. These four steps are "understanding the problem," "devising the strategy related to the solution," "carrying out the strategy," and "looking back to the solution," respectively.

When the literature was reviewed, it was noticed that problem solving skill affected students with its different dimensions. Limitedness of the researches carried out on the functionality of this process used in problem solving was remarkable, and in this study, therefore, the dimension of Polya's four-step problem solving process upon affecting the attitudes of students towards mathematics was discussed within the framework of 4th grade elementary school students.

2. Method

2.1 Research Model

In this study, "pre-test and post-test control-group design" as one of the research methods was used as semi-experimentally. In semi-experimental designs, an experimental approach in which individuals are randomly grouped in experimental and control groups is present. However, participations' being at a closely similar qualification is regarded. In pre-test and post-test design model, the participant is included in only one of the experimental and control groups (Büyüköztürk, 2001). According to Özsoy (2012), experimental models were the ones in which the data required to be observed were created under the direct control of the researcher in order to determine the cause-result relationships.

In the research, pre-test and post-test control-group experimental design was used. According to this, the courses were lectured complying with the problem solving steps of Polya in the experimental group. And in the control group, the courses were lectured with the traditional teaching method.

2.2 Study Group

The study population included two elementary state schools in Adana province in 2014-2015 academic year. And the study sample included the students studying at the 4th grade of these two schools. The students who participated into the research were determined choosing one experimental group and one control group among the 4th grade students studying at two state elementary schools in Adana province. Upon the selection of the schools and students, mathematics grade-point averages and standard deviations of the previous term were regarded.

In the research, 41 students were chosen for the experimental group and 35 students for the control group from Cumhuriyet Elementary School, and 20 students were chosen for the experimental group and 20 students for the control group from Atatürk Elementary School. The reason for the number of students' being less in the control group in Cumhuriyet Elementary School was 6 students' having no regular school attendance.

2.3 Data Collection Tools

As the data collection tools, Attitude Scale for Mathematics Lesson developed by Özdoğan (2008) and Information Form developed by the researchers for determining the gender and ages of the students were used. Reliability studies of the scale were carried out, and the reliability was calculated to be 0.82. And this value indicated the scale to have adequate reliability to be used in the study.

Obtained data were transferred into computer environment using SPSS 22 statistical software program. Statistical methods such as frequency and percentage were used for determining the gender and age distributions. Pre-attitude and post-attitude variance analyses of the groups were performed in order to specify how employed implementation affected the attitude towards mathematics.

3. Findings

Table 1. *Distribution of Experimental and Control Groups Students in Cumhuriyet Elementary School According to their Gender*

| Groups	Female	Male	Total
Experimental Group	16	25	41
Control Group	15	20	35
Total	31	45	76

In Cumhuriyet Elementary School, there were 16 female and 25 male students in the experimental group, and 15 female and 20 male students in the control group.

Table 2. *Distribution of Experimental and Control Groups Students in Atatürk Elementary School According to their Gender*

| Groups	Female	Male	Total
Experimental Group	11	9	20
Control Group	9	11	20
Total	20	20	40

As could be seen in Table 2, there were 11 female and 9 male students in the experimental group, and 9 female and 11 male students in the control in Atatürk Elementary School.

Table 3. *Age Distribution of the Students in Experimental and Control Groups in Cumhuriyet Elementary School*
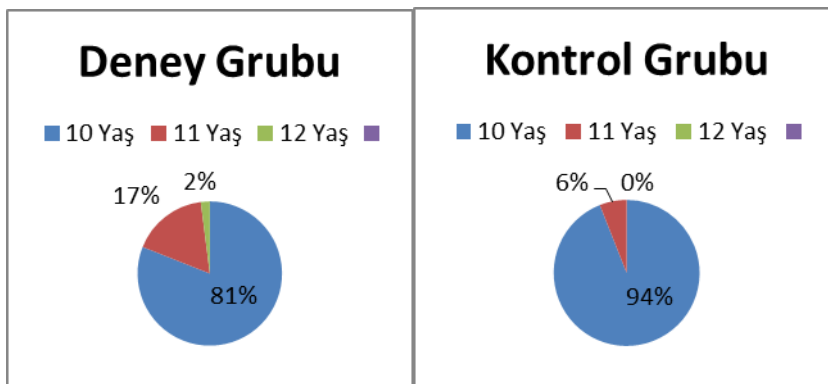
As could be seen here, majority of the students in Cumhuriyet Elementary School who participated into the study were at the age of 10. The other students were 11 and 12 years old.

Table 4. *Age Distribution of the Students in Experimental and Control Groups in Atatürk Elementary School*
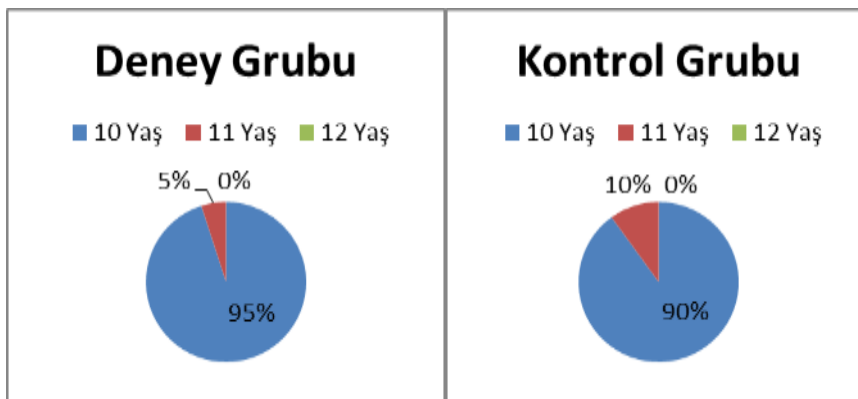
Majority of the students in Atatürk Elementary School who participated into the study were at the age of 10. The other students were 11 years old.

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Table 5. *Pre-Attitude Variance Analysis of the Groups*

Source of the Variance	SD	Sum of Squares	Average of Squares	F	P
Between Groups	34	5.169	.152		
Within Group	20	3.945	.197	.771	--
TOTAL	54	9.114			

According to Table 5, it was noticed that there was no significant difference between the groups in terms of pre-attitudes because the value indicated p>0.05.

Table 6. *Post-Attitude Variance Analysis of the Groups*

Source of the Variance	SD	Sum of Squares	Average of Squares	F	P
Between Groups	34	7.858	.225		
Within Group	20	5.073	.267	.841	.681
TOTAL	54	12.931			

According to post-attitude variance analyses of the groups, post-attitude scores of the students in the experimental groups were determined to be higher. However, this difference was not at a significant level.

4. Conclusion

The purpose of this research was to investigate teaching problem solving as one of the areas students had the most difficulty through Polya's phases upon students' attitudes towards the mathematics. Within the scope of that purpose, 4th grade students studying at two elementary schools in Adana province were chosen as experimental and control groups. In the research, 41 students were chosen for the experimental group and 35 students for the control group from Cumhuriyet Elementary School, and 20 students were chosen for the experimental group and 20 students for the control group from Atatürk Elementary School. The reason for the number of students' being less in the control group in Cumhuriyet Elementary School was 6 students' having no regular school attendance.

When gender distribution of the students who participated into the research was analyzed, it was noticed that there were 16 female and 25 male students in the experimental group and 15 female and 20 male students in the control group in Cumhuriyet Elementary School; and there were 11 female and 9 male students in the experimental group and 9 female and 11 male students in the control group in Atatürk elementary School. When age distribution of the students who participated into the research was analyzed, it was determined that majority of the students were at the age of 10, and the others were at the age of 11 and 12 in Cumhuriyet Elementary School; and majority of the students who participated into the research were at the age of 10, and the others were 11 years old in Atatürk Elementary School.

In order to investigate the effect of mathematics teaching through Polya's problem solving process upon the attitudes towards the mathematics lesson, the data obtained from Attitude Scale for Mathematics Lesson performed to experimental and control group students were analyzed, and pre-attitude and post-attitude variance analyses of the groups were carried out. According to the pre-attitude variance analysis results of the groups, there was no significant difference between the pre-attitude scores of the groups. According to the post-attitude variance analysis results of the groups, post-attitude scores of the students in the experimental group were found to be higher; however, this difference was not at a significant level. Turanlı, Karakaş Türker and Keçeli (2008) defined attitude as positive or negative manner of individuals towards an object, situation or event. Mathematics is a comprehensive discipline in terms of its content. Fears of students for mathematics negatively affect their attitudes towards the lesson. In order to change this attitude, it is necessary not to create this fear of students. Although experimental group post-attitude scores were higher in research results, this difference was not at a significant level, and that could be arisen from problem solving process' being a part of mathematics, not itself. Namely, for significant change of the negative attitude in students, the fear for the whole not to the part of mathematics should be overcome. In the study carried out by Gürsul (2008) in which the effect of different learning environments upon the attitude towards mathematics was investigated, no statistically significant difference was determined between pre-attitude and post-attitude scores. In the research carried out by İflazoğlu in 2000, it was concluded that the teachnique used in the study did not create a difference in favor of the attitude scores of the students; however, experimental group students studied mathematics more pleasure in terms of the scores. Another reason for this result to appear was attitude changes' taking much time. For that reason, implementation process of the research affected attitude scores; however, this difference was not at a significant level.

5. Suggestions

In accordance with the obtained results, those suggestions were offered for teachers, students and researchers:

Teaching by games (gamification) could be used in mathematics lesson as it could be benefited in any lessons providing to be appropriate to age and grade. Because games have educatory aspects, use of games especially during the problem solving studies could provide contributions upon positive change of negative attitudes.

Students can overcome their fear of mathematics through watching films and reading books on how mathematics appeared.

Because playing chess develop the skills of problem solving and decision making, students' spending some of their free time with this activity could be efficient upon providing them to entertain and learn.

Investigating the beliefs of teachers towards solving mathematical problems and providing them to be solved by the researchers could be beneficial in terms of reaching to the source of the problem.

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