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Determining of problem solving strategies used by primary 8, grade students' in mathematics class

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Abstract

The purpose of this research is to investigate the effect using a combination of different levels of problem solving strategies on primary 8. grade students in math class applied to the teaching of problem solving strategies. For this purpose, 22 eight grade students were taught problem solving strategies throughout 4 weeks (15 hours). In this process, problem solving strategies were introduced to students and were solved the problems that can be solved by different solutions. The strategies that taught in this study are Working Backwards, Finding a Pattern, Adopting a Different Point of View, Making a Drawing, Guess and Check, Accounting for All Possibilities and Organizing Data. Initial and the final of the application, the research problems developed by the researcher were given to students as pre and posttest. According to results, students' problem solving strategies used by the pre-test was very limited, this situation improved in the final test, students were able to use different solutions.

Keywords: problem solving strategies, mathematics education, primary education, teaching methods.

1. Introduction

With an increase of complexity in technologic and social life, mathematics reflected the school program. This reflection, on the one hand effect on the purposes of mathematics in the level of primary and secondary school curricula, for example the problem solving is more important day by day, on the other hand leads to the addition of new topics in program. (Yıldızlar, 2011).

Instructional programs from prekindergarten through grade 12, should enable all students to; (NTCM,2000)

- Build new mathematical knowledge through problem solving;
- Solve problems that arise in mathematics and in other contexts;
- Apply and adapt a variety of appropriate strategies to solve problems;
- Monitor and reflect on the process of mathematical problem solving

For this behavior is gained, several studies is made in our country and around the world. Thus; students' problem solving process is aimed using a combination of mental and physical skills.

Solution method of each of the problem is different. In this context, Posamentier and Krulik (1998), separated the problem solving strategies into the following categories;

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These are;

1. Working backwards
2. Finding a pattern
3. Adopting a different point of view
4. Solving a simpler analogous problem
5. Considering extreme cases
6. Making a drawing (visual representation)
7. Intelligent guessing and testing
8. Accounting for all possibilities
9. Organizing data
10. Logical reasoning

The strategies used for this study are described below.

1.1. Working Backwards:

Students, most of their mathematical lives, they have been taught to start at the beginning of the problem and carry the action through on a step by step basis. However, the working backward strategy, takes the opposite turn. The students begin with the end result of the problem, and carry the action to find conditions at the beginning.

Example problem related to strategy:

1.2. Finding a Pattern:

Finding a Pattern is a strategy in which students look for patterns in the data in order to solve the problem. Students look for items or numbers that are repeated, or a series of events that repeat (www.teachervision.com).

Example problem related to strategy:

Give the next five numbers in the sequence: 1, 2, 4, 8, ...

1.3. Adopting a Different Point of View:

This strategy is excellent ways to teach new concepts and reinforce old ones (www.teachervision.com).

Example problem related to strategy:

Find the value of; $3.1416 \times 2.7831 + 3.1416 \times 12.27 - 5.0531 \times 3.1416$.

There is a common factor in each term, namely, 3.1416. If we factor out 3.1416, we obtain the answer .

1.4. Making a Drawing:

The draw a picture strategy is a problem-solving technique in which students make a visual representation of the problem (www.teachervision.com).

Example problem related to strategy:

“Among 40 Girl Scouts in one division at Camp Ellwood, 14 fell into the lake, 13 came down with poison ivy, and 16 were lost on the orientation hike. Three of these had poison ivy and fell into the lake. Five of them fell into the lake and got lost. Two of them experienced all three mishaps. How many of the Girl Scouts in this division escaped with none of these mishaps?” (Krulik & Posamentier, 1998).

1.5. Guess and Check:

Students can use to solve mathematical problems by guessing the answer and then checking that the guess fits the conditions of the problem in this strategy (www.teachervision.com).

Example problem related to strategy:

“Two positive integers differ by 5. If their square roots are added, the sum is also 5. What are the two integers?” (Krulik & Posamentier, 1998).

1.6. Accounting for All Possibilities:

‘Accounting for all possibilities is a strategy in which students remove possible answers until the correct answer remains.’ (www.teachervision.com).

Example problem related to strategy:

“A digit is inserted between the digits of a two-digit perfect square number, to form another perfect square. Find the three-digit squares formed in this way.” (Krulik & Posamentier, 1998).

1.7. Organizing Data:

We use often in daily life in this strategy. For example; when we go to the shopping and want to make the best use of the time available, we use this strategy. We organize the items to be purchased in order that makes the most sense to avoid crowds of people or minimize the travel time. (Krulik & Posamentier, 1998).

2. Literature Review

There have been many important research related to the problem solving and teaching of problem solving strategies.

Pugalee (2004); investigated the impact of writing during mathematical problem solving. The study was analyzed of ninth grade algebra students' written and verbal descriptions of their mathematical problem solving processes. At the end of the result, concluded that students who wrote descriptions of their thinking were significantly more successful in the problem solving tasks than students who verbalized their thinking.

Hino (2007), investigated how to teach the problem solving strategies in Japan and gave information about using lesson plan. He observed that the teacher who realize a classroom in which the students are actively engaged in the activity of solving problems and developing mathematics.

This researches show that teaching problem solving strategies cause the students to develop positive attitudes towards mathematics and increase students' achievements. (Altun, 2005; Arslan, 2002; Yaşa, 2010; Yazgan ve Bintaş, 2005; Yıldızlar, 1999). But, when teaching problem solving strategies, only one solution of every problem is explained to students.

This research is similar to other research with the teaching problem solving strategies, but different from to use the problem that is formulated so as to have multiple correct answers.

3. Purpose Of Study

The purpose of this researches to investigate effect using a combination of different levels of problem solving strategies on primary 8. Grade students in math class applied to the teaching of problem solving strategies.

4. Study Group

The universe of this study is consisted of 22 eight grade students who were selected randomly from a public school from Esenler district in Istanbul Directory of National Education. The most important factor for choosing this school is the school is one of the most successful schools in Esenler district. In order to carry out a sound research, students should pass the question and answer phase and solve the questions by using various solution strategies. The success level is determined by using 7th grade placement test scores and 8th grade mathematics lesson year-end mean scores. While the 7th grade placement test mean score is 456, 77, 8th grade mathematics lesson year-end mean score is 92, 63.

5. Introduction Of The Experimental Study

The experimental study was carried out for 1 month (15-hours) in the second term of 2010-11 academic years.

Problem solving strategies such as Working Backwards, Guess and Check, Adopting a Different Point, Making a Drawing, Accounting for all Probabilities, Organizing Data and Finding a Pattern were told throughout the first one and a half week (6 hours). Since the problems that could be solved by using more than one strategy were essential, the strategies which were used in such problems were selected. Later on, mixed problems were solved in the classroom and the solutions of these problems were discussed. The problems solved in the classroom were created by scanning the web sites explaining problem solving strategies, different textbooks and magazines. The lessons were carried out by discussing how the problems could be solved by using which suitable strategy learned in the classroom. During the discussion, each student was recognized and various strategies found were written on the blackboard. The other problem was performed only after understanding that all the students grasped all the strategies explained in the classroom. The lesson plans were prepared by using the example lesson plans of Hino (2007) and Japanese Lesson Plans during the application process.

In the research, in order to determine the problem strategies that were used by students, research problems which had more than one solution were selected. These problems were especially selected since they could be solved by using more than one strategy. It consisted of both routine and non-routine problems. An expert’s opinion was taken for the content and structure validity of the research problems.

During the application process, in order to analyse the contribution of strategies to students the control group was not formed and the group was compared with itself.

6. Data Analysis

The data of the research was obtained from research problems which were used before and after the experimental study and from the observations of the researcher.

Research problems were created by using 10 open-ended problems. Each problem has more than one solution. Problems were selected from Hall (2002), Posamentier and Krulik (1998) and www.illuminations.nctm.org. These problems were carried out to students as pre-test and post-test before and after teaching problem solving strategies.

Each problem was coded according to the different solution strategies. As a result of this coding, how the students could solve the problem by using which strategy and whether they could find a different solution strategy were examined after pre-test and pos-test.

7. Findings

Problem	Pre-Test (n = 22).						Post-test (n = 22).						
	No Solution		Solution with One Way		Solution with Two Different Ways	Solution with Three Different Ways	No Solution		Solution with One Way		Solution with Two Different Ways		Solution with Three Different Ways
	f	%	f	%	%	%	%	f	%	F	%	%	
1	11	50.0	11	50.0	--	--	4.5	1	54.5	9	40.9	--	
2	2	9.1	18	81.8	9.1	--	4.5	1	50.0	10	45.5	--	
3	11	50.0	10	45.5	4.5	--	13.6	1	77.3	1	4.5	4.5	
4	14	63.6	8	36.4	--	--	27.3	1	63.6	2	9.1	--	
5	10	45.5	12	54.5	--	--	9.1	1	77.3	3	13.6	--	
6	6	27.3	16	72.7	--	--	27.3	7	31.8	8	36.4	4.5	
7	9	40.9	13	59.1	--	--	27.3	1	68.2	1	4.5	--	
8	9	40.9	13	59.1	--	--	9.1	2	90.9	--	--	--	

9	5	22.7	17	77.3	--	--	4.5	1	59.1	8	36.4	--
								3				
10	5	22.7	16	72.7	4.5	--	13.6	1	72.7	2	9.1	4.5
								6				

As a result, students' levels to solve problems by using various strategies were low before executing teaching process.

When coded problems were analysed, it was seen that students mostly used strategies like Setting up an Equation and Guess and Check Strategy but they were not able to use some strategies. Besides, when we looked at the pre-tests, it was seen that students prefer to use same problem solving strategies. They could either not solve the problem or the same strategy was used by the ones who could solve the problem. This is an indication that they could not develop different perspectives.

After teaching, a positive improvement was observed in the situation, students were able to approach questions from different perspectives, and each student could find new solution ways according to themselves.

8. Conclusion and Implications

Eight grade students' level of ability to solve one problem by using different strategies is considerably low. As it is seen from the table above, while most of the students could solve the problems only by using a single strategy, the strategy that they used was generally the strategy of Setting up an Equation. It was observed that they could not create a logical interpretation to problem and they could not draw a diagram for understanding the problem. Besides during pre-test and post-test application, when students tried to find the solution by guessing, it was observed that students found the solution by writing all the operations that they carried out on their desks until finding the correct solution. This could be because of the fear of solving the problem incorrectly.

Using various strategies for solving a problem can be a method that requires active participation of students to the lessons. In the classroom, after students had found a different strategy for the solution, solving the problem by using their own way at the blackboard could make students more enthusiastic during the lesson.

Using different techniques and methods together not only in mathematics lessons but also in other lessons can contribute to the development of the mental structures of the students.

The effect of the teaching method which is used by the teacher, the structure of the learning environment and the materials used in teaching to the problem solving attitude of students can be analysed. Besides, the difference between students who can use different strategies and students who can solve a problem by using a single strategy can be analysed and the reasons of these differences can be searched.

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