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THE EFFECT OF PROBLEM POSING TASKS USED IN MATHEMATICS INSTRUCTION TO MATHEMATICS ACADEMIC ACHIEVEMENT AND ATTITUDES TOWARD MATHEMATICS

Selim GUVERCİN
Suleyman Demirel University, Engineering Faculty, Almaty, 040900, Kazakhstan, email: selim60us@yahoo.com

Viktor VERBOVSKİY
Suleyman Demirel University, Engineering Faculty, Almaty, 040900, Kazakhstan

ABSTRACT

The purpose of this research is to examine the effects of problem posing intervention on 8th grade students' mathematics achievement and attitudes toward mathematics. Word problems were used in the research as a tool to observe the differences between experimental and control groups. We analyzed the effects of problem posing instruction by specially designed tests on pre and post activities. Meanwhile we sought student responses through individual meetings.This study has been conducted with 8th grade students at a Kazakh High School for gifted students during the second semester of 2010-2011 academic years. There were 54 students in total that were divided into two groups. One of the groups was experimental and the other was control group. There was equal number of students in each group with a number of 27. The research took two months in the same school.The research used a mixed methods design with quantitative and qualitative components. Data from quantitative component that was pre and post test which were analyzed by using SPSS computer package. Qualitative design included data through which students were compared from pre to post intervention opinions. We used the Mathematics Achievement Test in order to measure the students' mathematics academic achievement. In order to measure students' attitudes toward mathematics, we used Mathematics Attitude Scale .The reliability of the tests were measured by special techniques and the value of Cronbach's Alpha constant was calculated as 0.83 for achievement test and 0.90 for attitude scale. During the problem posing instruction with experimental group students we used the activities that were specially designed word problems in the light of problem posing stages. Traditional educational methods were used in the control group. In addition, some questions were prepared for the students who got extreme scores from the activities. At the end of the research, data was evaluated by using paired sample t-test and the analyses of interview with students were conducted by using the descriptive methods.

Keywords: Problem posing, Mathematics academic achievement, Attitudes.

Educators and researchers are trying to find new methods in teaching and learning of mathematics education to improve and develop the students' problem solving abilities. Today many educators around the world agree that traditional methods of teaching and learning process cannot prepare individuals to the future. The aim of teaching mathematics is to develop cognitive abilities of children, logical thinking, self sufficiency and empowering the memory. Meanwhile to develop creative activities ; the ability to observe, compare, find similarities and differences; the ability to analyze, synthesize, generalize, abstract; the skills of mental arithmetic; the skills of proper and logical mathematical language. Generally, all curriculums about teaching and learning mathematics are agreed that the aim of teaching mathematics is to extend the students' ways of learning and to develop the students' abilities in problem solving and provide applicable mathematical knowledge, expertise and skills for future needs. Especially problem solving is accepted as the heart of mathematics education (NCTM, 2000). The students should understand their environment and world together and they should apply what they learn to real life. They have to use mathematical skills and mathematical knowledge in modern society. Otherwise students with traditional methods cannot solve the problems and cannot make relations between real life and their learning in rapidly changing world (MEB, 2011). Instead of teacher oriented, student oriented methods should be discussed. One of them is problem posing approach in math education. Problem posing is not independent from problem solving (Cai, J. Hwang,

S., 2002). There is a strong relationship between problem solving and problem posing as a cognitive process (Lowrie, T.A. 2002). Brown and Walter (1993) suggested a new approach to problem posing and problem solving in mathematics teaching by using the "What If Not" (WIN) strategy. The strategy is based on the idea that modifying the attributes of a given problem could yield new and original problems that may gives very interesting results. In this approach, the students are encouraged to go through three levels starting with the examining the problem to generate new problems. At the first level, the students are asked to write the list of the problem attributes. And at the second level the students should ask many questions about the attributes related "What If Not" question and then suggest alternatives to the listed attributes. The last level of problem posing, they pose new questions by making more generalization.

Brown and Walter (2005) also stated that one of the important consequences of mathematics education is to provide opportunities to the students in mathematics lessons for developing their problem posing skills. Because problem posing is not only to generate new problems from given situations but also reformulate given problem and generalize for the solution. Problem posing has too much interest because of its effect in creativity and mathematical ability (Silver, E.A., 1994). Problem posing in contrast to traditional problem solving methods reduces anxiety and common fears about mathematics and increases positive attitudes toward mathematics (Philippou, G.N. Nicolaou, 2004). Problem posing improves not only students but also teachers' attitudes; alleviate misunderstanding about the nature of mathematics. Problem posing activities gives more responsibility to the students who are motivated for the problems during the mathematics class. Problem posing methods of learning bring up the students for the future as social an individual that meets the expectation of modern society.

Method

In this part, research model, participants, measurement instruments, kinds of application of research design, data gathering and evaluation of collected data were considered.

Research design of the study

In this research quantitative and qualitative methods were used. In quantitative research, problem posing instruction and traditional methods of instruction were independent variables and Achievement Test results, Mathematics Attitude Scale results are dependent variables. In this research, the effect of independent variables on dependents variables will be controlled that is why research was experimental study. The study used the matching only pre-tests post-tests control group design.

Table I
Research Design of the Present Study

Group	Pre-test	Treatment	Post-test
EG	M1, M2	PPI	M1, M2
CG	M1, M2	TM	M1, M2

In Table I, the abbreviations have the following meanings:

EG: Represent experimental group that received instruction with the "Problem Posing" (PPI)

CG: Represent the control group, which received instruction with the Traditional

Method (TM). M1: Mathematics Achievement test (MAT); M2: Mathematics Attitude Scale (MAS);

The MAT, MAS were administered as pre-tests and post-tests.In experimental group problem posing

instruction was used while traditional teaching methods were used in control groups. In both groups, before instruction and after instruction Mathematics Achievement Test, Mathematics Attitude Scale was used as pre and post tests.

Subjects of the Study

The students who were participated to this study were from Kazakh high school. The number of the students who participated to the study was 54 students all of them from 8th grade. We divided the students into two groups as experimental and control according to Mathematics Equivalent Test results.. In qualitative part of the research, some students were selected to make interview conservation. Their opinions about problem posing were recorded in by video capture. The average value of the scores from the quizzes of problem posing activities determined the order of interview.

Steps of the Study

1- Before we begin the study, we apply a Mathematics Equivalent Test to divide the groups according to adjustment level. Their average results were compared and according to results, participants were divided into two groups as experimental and control groups.

2-The Mathematics Achievement Test (MAT), Mathematics Attitude Scale (MAS) were given to the students. The mathematics achievement test that includes word problems was prepared by experienced teachers and was controlled by experts. Mathematics Attitude scale was prepared as a reconfiguration of the Fennema Sherman and Aiken model of tests. There were four groups' questions. These are self confidence of esteem, value, enjoyment and motivation. Each part covered negative and positive type of questions.

3- The MAT, MAS were piloted with 128 students from 9th grade students at Kazak high school in Almaty. This pilot study allowed testing the reliability and validity of MAT. According to the results of this pilot study, the MAT was revised.

4- Activity sheets were prepared using appropriate problem posing statements as recommended by reports of research found in the literature. 5- Mathematics teachers administered the MAT to the students before and after the treatment during a mathematics lesson. The MAT test was applied to both groups before and after study. 6- The study ran into a period of seven weeks with 8 hours .The problem posing activities applied to the students 4 lessons per week.

Data collecting instruments

Data was collected in this research from the following instruments;

1. Mathematics Achievement Test: The test was prepared according to curriculum stated by Ministry of Education of Kazakhstan for 8 classes.. Factor analysis of the test and the questions was evaluated by SPSS computer program. And for each questions p (coefficient of difficulty index) and r (coefficient of differentiable index) were calculated by the equations

2. Mathematics Attitude Scale: Mathematics attitude scale was modified by Fennama and Sherman (Fennema E. And Sherman J. 1986)**.** The scale consists of four different types of questions that based on motivation, self esteem, value and enjoyment. There are 30 questions in the test which includes 10 questions from self esteem, 6 questions from value, 9 questions from enjoyment and 5 questions from motivation. Each part has positive and negative questions. There are 15 positive questions and 15 negative questions totally in the scale.

3. The reports of students in experimental group were about the problem posing method, as an application of method on word problems.

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4. The video record of the students in experimental group.

Findings and Recommendations.

In this part the results of mathematics achievement test, mathematics attitudes scale were discussed. Meanwhile the writings and video presentations of the students about problem posing and will be evaluated. Recommendations of the students about problem posing in individual meetings will also be presented. The averages and standard deviations of pre and post test shown in the table for experimental and control groups.

Table II

The sample paired t test results of Experimental and Control group students for Mathematics Achievement pre test

Pre -test results	N	X	Standard dv.	Standard er.	sd	t	p
Experimental G	27	11,33	3,94	0,75			
Control G	27	10,66	3,01	0,57	25	0,17	0,861

Table III

The sample paired t test results of Experimental and Control group students for Mathematics Achievement post test

Post-test Results	N	X	Standard dv.	Standard er.	sd	t	p
Experimental G	27	16,18	3,49	0,67			
Control G	27	10,66	3,01	0,57	26	2,92	0,007

In order to analyse the effect of problem posing instruction on students' academic achievement, the findings acquired in pre- and post application of the academic achievement test to the research and control groups were drawn in tables, and some comments were made in parallel to these findings. As it can be seen in the Table I, the arithmetic mean of the pre-test scores taken by the experimental group students was found 11,33 and the respected figure of the control group students was found 10,66. It is observed that there is a less point difference between group means and p value is more than 0.05. This indicates that there is no significant difference at the 0.05 confidence interval between the pre-test scores of the research group and control group students. By the fact that there is no significant difference between the pre-test scores of the experimental and control group students, the condition concerning the nearness of pre-knowledge level of the experimental and control groups before the research is fulfilled.

As it can be seen in the Table II, when post-test scores of the experimental group and control group students were examined, it was found that the arithmetic mean of the post-test scores taken by the experimental group students was 16,18 and the respected figure of the control group students was 10,66. It can be seen that there is more point difference between group means and p value (0,007) is less than 0.05. This indicates that there is a significant difference at the 0.05 confidence interval between the post-test scores of the research group and control group students on behalf of the former group.

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Table IV

The sample paired t test results of Experimental and Control group students for Mathematics Attitude pre Scale

Pre -test results	N	X	Standard dv.	Standard er.	sd	t	p
Experimental G	27	3,36	0,4	0,078			
Control G	27	3,38	0,39	0,077	0,12	25	0,752

Table V

The sample paired t test results of Experimental and Control group students for Mathematics Attitude post Scale

Post-test Results	N	X	Standard dv.	Standard er.	sd	t	p
Experimental G	27	3,78	0,32	0,06			
Control G	27	3,41	0,39	0,07	26	0	0,006

As it can be seen in the Table III, the arithmetic mean of the Mathematics scale pre-attitude scores revealed by the experimental group students was found 3.36 and the respected figure for the control group students was found 3,38. There is no significant difference between the pre-attitude scores of the research group and control group at the 0.05 confidence interval. As it can be seen in the Table IV, the arithmetic mean of the post-attitude scores revealed by the research group students was found 3, 78 and the respected figure for the control group students was found 3, 41.In this respect, there is a significant difference between the post-attitude scores of the research group and control group at the 0.05 confidence interval on behalf of the former group. Namely, it is observed that there is a positive change in the attitudes of the experimental group students towards science class. In addition to the data obtained, the opinions expressed by the research group students at the end of the applications performed also mirror the positive change in their attitudes. Some of the opinions expressed by students from this group during the activities carried out in the research process are given below.

Student 1: I liked problem posing class very much. The posing activities were enjoyable and more interesting. The problem posing activities made us to like problems. Group works were also good as well. I was very contented with the applications."

Student 2: "We were motivated more to study by writing the questions of problem posing that were fun and learning. In the problem posing method, it is so easy to produce questions and it is so good and fruitful to add our own ideas and discuss within group."

Student 3: "The problem posing instruction attracted me to the participation to the class activities. It is a good method. We both learn and have fun. We started to like solving problems.

Student 4: "I overcome the fears and anxieties about mathematics problems in problem posing lessons. I understand subject matters better. The problems seem to be so easy."

It can be said that there is no positive improvement in the control groups to which traditional teaching methods were applied. Yet, problem posing type of education employed in the experimental group brought about positive improvements in the conceptual development of the students. In the experimental group in which problem posing activities are applied, since students are in communication with their group members and other groups, they could find the opportunity to discuss and share their ideas. In this way, information transfer among students is accomplished. The examples given are chosen out of daily life and they are enriched by students.

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Conclusion and Discussion

Problem posing method of instruction has significantly increased students' mathematical academic achievement. The students who have been experimental class had high positive attitudes toward mathematics.. In problem posing instruction, students were not motivated not only finding the correct answers of the problems but also the ways that they followed through the solution period of the questions. They were also more social when they tried to pose the problems. This was provided by interaction with the students as well as with teachers. The students had a chance to ask questions to teachers that is why they cancelled some misconceptions and they were directed right way during the problem posing stages.

The result of this present research indicated that contrary to traditional teaching methods, problem posing instruction produces significantly positive results in students' attitudes toward word problems and mathematics and mathematics achievement. Active involment and more participation gave the students more confidence and positive attitudes. Eggen (2003) showed that problem posing instruction emphasizes students' active involvement in learning. Thus, problem posing teaching frequently express that the students learn by connecting new knowledge to the real world.Our findings were similar with English (1997a) claimed that the activities of problem posing had a strong emphasis on children being creative, divergent, and flexible in their thinking and students were encouraged to look beyond the basic meanings of mathematics with those activities. Dewey (1986) stated that there is a strong relation between interest and effort that is increase in motivation because problem posing instruction is based mostly on students who start to be interested people. Interest and motivation by this way can be formed together; interest produces motivation and motivation produces interest. Problem posing increases motivation and optimism (Brown & Walter, 1983). If you combine these two statements, you can say that problem posing has a positive influence on self efficacy. Moreover problem posing reduces anxiety that is a negative factor on self efficacy beliefs. Problem posing which gives students more freedom and dialogue with the teachers provides a good development for self confidence. Kliman and Richards (1992) accepted that problem posing enlarges the inner control of the students. Inner control is an effective component of self attitude construction.

In conclusion problem posing instruction proposed new teaching methods in order to teach word problems in mathematics education. The results of the study also showed that traditional teaching methods can't give them to the students. Because traditional methods don't cover the attitudes of the students that were basically can't consider the psychological sides of the students. It may be just concentrated the mathematics achievement. Of course in both type of educational system the role of the teacher can't be neglected. In addition to all parts of problem posing we should not forget that the main aim is not to create the best problem posers instead of this we need to use problem posing as a tool to produce good problem solvers.

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