

# THE EFFECT OF PROBLEM POSING APPROACH TO THE GIFTED STUDENTS' MATHEMATICAL ABILITIES

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## ABSTRACT

Improvement and development of mathematically gifted students' mathematical abilities has always been one of the main duty of a secondary school mathematic teachers in Kazakhstan. Because The Ministry of Education organizes the Republic Olympic competition at mathematics every year. Secondary school teachers try to develop the mathematical skills of their students. The aim of this study is to give some directions for teachers to move up their students' level by using a problem posing approach which has two dimension. First special problem posing tasks were prepared for students and second, face to face interaction with them. As a result, the usefulness of this approach will be discussed for secondary school teachers in order to use method in their special courses and second how a special curriculum can be prepared for the gifted students. Finally the method of problem posing may be used in the identification process of a gifted student.

**Key words:** Problem posing, Mathematically gifted students, Problem posing approach (special tasks, face to face interaction)

## INTRODUCTION

A primary goal of mathematics teaching and learning is to develop the ability to solve a broad range of complex problems (Stanic, Kilpatrick 1988). One of the most important emphases in NTCM standards (1989) is to make problem solving or problem posing a central focus of school mathematics. Also recent recommendations for reform in mathematics education suggest the inclusion in instruction of activities in which students generate their own problems in addition to solving pre-formulated problems (NTCM, 2000). Because the problem posing is the main target of mathematics education, our way should be what is really problem posing. In literature there are many definitions of problem posing. Problem posing involves the generation of new problems about a situation or the reformulation of a given problem (English, 1997; Silver & Cai, 1996). In our study we don't use problem solving itself "because problem posing is intellectually a more demanding task than solving problem tasks" (Mestre, 2002). By ordinary problem solving, students just use some ways that are learned before. They use the steps to reach the result. But problem solving is not a linear method. Research studies provided evidence that problem posing has a positive influence on the students' ability to solve word problems (Leung & Silver, 1997) and provides the opportunity for teachers to get an insight of students' understanding of mathematical concepts and processes (English, 1997). It was also found that students' experience with problem posing enhances their



perception of the subject and produces excitement and motivation (English, 1998: Silver 1994). Shortly, Problem posing has many effects on students' thinking, problem solving skills, attitudes and confidence in mathematics and mathematical problem solving and contributes to a broader understanding of mathematical concepts (English, 1997, 1998). Because problem posing also involves problem solving we prefer the tasks that are compatible with posing. Stoyanova (2000) identified three categories of problem posing experiences that can increase students' awareness of different situations to generate and solve mathematical problems 1. free situations 2. semi-structured situations and 3. structured problem –posing situations. In free problem posing situations students pose problems without any restriction. An example of the free problem posing situations

Are the tasks where students are encouraged to write problems for friends to solve or write information by giving it meaning or creating relations between provided information. semi-structured and structured situations in which students are asked to generate problems from a presented stimulus that includes quantitative information. Problem posing is also described by Dunker (1945) as the generation of a new problem or the formulation of a given problem. In the same meaning Silver (1993) described and added posing occurs before, after and during the problem solving.

Problem posing skills could be developed by giving students an ill-formulated or a partially formulated problem and asking them to restart it (Silver, Kilpatrick and Shlesinger, 1990). Although the idea is not new, not much more work done on problem posing. Dillon (1988) and Krutetskii (1976) has the same way of manipulating the given conditions and the goals of prior posed problems

Hashimoto (1987) asking “What-if “and” What if not “and Brown Walter (1983): assuming new relationship of supply new story components during the looking back stages (Polya 1945).

The definition of a mathematically gifted student is really difficult. Because every student is unique. However, diverse definitions are made by many researchers (Bluton, 1983; Miller, 1990; Gagne, 1991) and the definition of Gagne is more suitable for our study as “students who are distinguished by experts to have excellent ability and potential for great achievements”. Another educational researches (Krutetskii, 1976; Sriraman, 2003; Lee 2005) that observed and analysed the thinking characteristics of mathematically gifted students, their problem solving and reasoning are displayed very differently from those of ordinary students in terms of speed and depth. In our study we mean the gifted student as students with high mathematical abilities.

## METHODOLOGY

### Design

The study aims the problem posing approach gives a high correlation with the Mathematical Problem Solving Ability Test (MPSAT)



## **Participants**

The participants of this study are 40 eighth grade students in Kazakh Turkish high schools. Every student passed the entrance exam last year and finished the prep class. The students are all candidates for Olympics competitions will be held at the end of the year. The subjects of mathematics to the students in the past are taught by traditional methods and sometimes they are selected to the special program by IQ tests which sometimes don't give correct results mostly.

## **Procedure**

The study takes 16 hours over 8 weeks with problem posing activity. In the classroom atmosphere, the approach of students to each question is analyzed. The first question is given to every student for 5 minutes and question is written to the board after each 5 minutes and teacher ask many questions to the class. Because the questions are prepared according to posing techniques, there are several of subquestions for each posing questions. Although we are trying to distinguish the students with having high mathematical ability, not all questions from the area of mathematics that is the nearly half of the questions from physics and statistics. One assistant person during problem posing stages took notes by just putting ticks if the student answers the question.

## **Purpose of the study**

1. The study aims the identification of students with the high mathematical potentials by using the problem posing method(s). And compare the selected students' results with the Mathematical Problem Solving Ability Test (MPSAT)
2. To develop a suitable differentiated mathematical curriculum for olympiads programs.
3. How the mathematics teachers use problem posing techniques in their special course of Olympiads preparation.

## **Data collection**

Data is collected by the teacher and assistant person during the problem posing process. A mark is put to the student when he answers the question. At the end of each lesson scores are added and students are evaluated. After 8 weeks, The students are given Mathematical Problem Solving Ability Test (MPSAT). The results of classroom activities and (MPSAT) are compared to investigate whether a statistically significant relationship exists or not.

## **Data analysis**

In data analysis, The correlation of problem posing abilities and Mathematical Problem Solving Ability Test (MPSAT) is investigated. The paired sample t test was performed to investigate the effect of problem posing methods to mathematical problem solving ability test (MPSAT). Data was processed through SPSS/PC 16K statistic program for Windows.

## **RESULTS AND DISCUSSION**

In this research the problem posing tasks are prepared from the identification of Stoyanova(2000) who stated three categories of problem posing experiences that

can increase the student's awareness of different situations to generate and solve mathematical problems free situations, semi-structured situations and structured problem-posing situations. The answers of students are collected and evaluated and the average for each student is processed to the program SPSS. At the end of the course A mathematical ability tests average results with the same manner is loaded.

Table 1 : The average results of PPOSE and MPSAT

| Paired Samples Statistics |       |        |    |                |                 |
|---------------------------|-------|--------|----|----------------|-----------------|
|                           |       | Mean   | N  | Std. Deviation | Std. Error Mean |
| Pair 1                    | PPOSE | 5.4000 | 40 | 1.69161        | .26747          |
|                           | MPSAT | 6.5250 | 40 | 1.13199        | .17898          |

PPOSE:problem posing; MPSAT:mathematical problem solving ability test

Here in the table of paired samples statistics the averages of marks given during problem posing sections and mathematic ability test is not so close But it is not the sufficient to understand more clearly we consider paired samples correlations in table 2

Table 2: The correlation between paired samples

| Paired Samples Correlations |               |  |    |             |      |
|-----------------------------|---------------|--|----|-------------|------|
|                             |               |  | N  | Correlation | Sig. |
| Pair 1                      | PPOSE & MPSAT |  | 40 | .691        | .000 |

Unfortunately this is not enough we should also consider the last data of paired sample test because the significance is less than 0.01 that is 0.00 we conclude that the problem posing method is more effective in the improvement of mathematical abilities of the students .



## Paired Samples Test

|                      | Paired Differences |                |                 |                                           |         |        |    |                 |
|----------------------|--------------------|----------------|-----------------|-------------------------------------------|---------|--------|----|-----------------|
|                      | Mean               | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference |         | t      | df | Sig. (2-tailed) |
|                      |                    |                |                 | Lower                                     | Upper   |        |    |                 |
| Pair 1 PPOSE - MPSAT | -1.12500           | 1.22344        | .19344          | -1.51627                                  | -.73373 | -5.816 | 39 | .000            |

## CONCLUSIONS

We found significant differences between problem posing method used during the special course ,that has a positive effect on mathematics tests .

The teachers can use the problem posing methods not only in the identification of gifted students but also prepare special problem posing questions for their students. And the head of mathematics department can prepare for their programs.

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### Summary

Improvement and development of mathematically gifted students' mathematical abilities has always been one of the main duty of a secondary school mathematics teachers in Kazakhstan. Because The Ministry of Education organizes the Republic Olympic competition at mathematics every year. Secondary school teachers try to develop the mathematical skills of their students. The aim of this study is to give some directions for teachers to move up their students' level by using a problem posing approach which has two dimensions. First special problem posing tasks were prepared for students and second, face to face interaction with them. As a result, the usefulness of this approach will be discussed for secondary school teachers in order to use the method in their special courses and second how a special curriculum can be prepared for the gifted students. Finally the method of problem posing may be used in the identification process of a gifted student.