

Effects of Some Properties 5. Grade Students on the Performance of Mathematical Problem Solving

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Abstract: The aim of this study was to investigate the mathematical problem solving performances of 5th. grade students according to the variables of gender, attitude towards mathematics, knowledge and skill acquired in lecture of mathematics and reading comprehension. The sample of this study was formed as 5th grade students of any primary school in Eskişehir. 73 students were participated to this study.

The tools used to collect findings in this study are following:

1. Mathematical Problem Solving Performance Test (MPSP).
2. Problems for Knowledge and Skill acquired in lecture of Mathematics (KSM).
3. Attitude Towards Mathematics Scale (ATM).
4. Reading Comprehension Test (RC).

At the end of this study, it was found that the knowledge and skill acquired in lecture of mathematics is the most important variable increased the performance for solving of mathematics problems. It was found that skills of reading comprehension have a meaningful doping on problem solving performance. Besides, it was seen that there weren't any important effect of gender and attitude towards mathematics on mathematical problem solving performance.

Introduction

Human holds back from the subject, which aren't well known and especially couldn't be understood easily. Because of its content and its symbols, mathematics is a discipline, which couldn't be understood easily by everyone. From this point of view, the most people hold back from mathematics. One of the ways by which holding back mathematics started in childhood could be coped is to acquire the skill of mathematical problem-solving. In many researchers it was asserted that problem solving was the principal reason of studying mathematics. According to many people, mathematics could be defined as problem solving. In addition to that, it was determined that problem solving makes a relation among the events, the algorithms and the problems concerned with real life (Krulik and Rudnick, 1988).

Various definitions of problem and problem solving were given Problem is a situation that required thought and a synthesis of previously learned knowledge to solve. Problem solving is a process that is the means by which individual uses previously acquired knowledge, skills, and understanding to satisfy the demands of an unfamiliar situation (Krulik and Rudnik 1996). Since the beginning of the twentieth century, many researches have been realized and many theories have been asserted to explain problem solving. According to Skinner problem solving is a complex behaviour which is made up of a set of simple reasons. Many complex behaviour-procedures may be defined as the rules of induction, deduction, hypothesis statement. He defined problem solving as the knowledge-processing expressed by the symbolic procedures in the situations in which responses could be controlled (Skinner, 1968). Problem solving defines a procedure. In examining the papers relating to problem solving processes, it was seen that, in almost all the studies, the subjects went through the same stages. The process mostly accepted in this subject Polya's four stages of the problem-solving process (i.e., understanding the problem, devising a plan, carrying out the plan and looking back). The studying form, fitting to these four stages in problem solving, brings to solving easily. Mathematical problem solving is the complex area of human behaviour. However, the main goal of learning mathematics at each level is to solve problems. When the students met any mathematical problem, mostly they try to remember any rule to solve this problem. This is not a positive attempt. Because there isn't any rule to solve problem, but there is a systematic to solve problem. The main task of teacher is to introduce this systematic and strategy and to teach to use this systematic and strategy to the students (Altun, 1997).

According to Piaget the skill of problem solving couldn't be taught. Instead, the rules of experimentation and the rules of problem solving must be invented by each student. The rules of theories investigated on the area of any subject must be noticed by individual (Piaget, 1973). Different individuals have different problem solving conceptions. For this reason, on the same or different subjects, different interpretations of problem solving could be maintained (Randhawa, 1994). However, the usage of various types of problems, definition of problem solving in different manners, the complexity of problem solving procedures has caused the confusion in the generalisation of the research subjects. Thus, the mathematical problem solving needs the knowledge of skilful definition and analysis (Lester, 1980).

Aiken found that there is an important relationship between problem solving and the skill of reading comprehension. Reading ability has an important role on the definition of problem solving (Aiken, 1972).In the solving of verbal problems, the relationship between reading comprehension ability and arithmetic computation ability was investigated by Glynn According to the results of this study, while the students' reading abilities was increased, the time spent to set up and solve problems was decreased (Glynn, 1982).

Gender differences in mathematics have been discoursed about educational equity issues. Starting in first grade there were strong and consistent gender differences in the strategies used to solve problems. Girls tended to use more concrete strategies and boys tended to use more abstract strategies. In third grade, the girls used more standard algorithms than did the boys (Fennema, E, et al. 1998). Hyde, Fennema, Lamon investigated gender difference in mathematics performance (Hyde et al. 1990). They concluded that boys perform better on mathematics test and complex problem solving than girls do. On the contrary, girls showed superiority in computation in elementary school and middle school. There were no gender differences in problem solving in elementary or middle school; differences favouring boys emerged in high school and in college. Gallagher investigated gender differences in mathematical problem solving performances (Gallager, 2000). He found that boys were more able to use various strategies than girls. Major gender differences in performance don't appear until in adolescence, and they are exhibited on tasks of multistep problem solving (Gallagher, and De Lisi, 1994). Beller and Galli investigated the gender effect on problem solving. They have found that boys' performances were better than girls and there was a correlation between gender effects voluminous and hard item in boy's favour (Beller and Galli, 2000).

The relationship between mathematical problem solving performance and the organisation of students' knowledge were investigated by Lawson and Chinnapan They have stated that the disposition of students' knowledge is associated with better problem solving performance (Lawson and Chinnapan, 2000). Davenport and Howe stated that, in mathematical problem solving children perform consistently better when using back-up strategies to solve a problem, e.g. using fingers when adding or subtracting, than when using procedural information. Because of there is the need to find some way of tackling the ongoing problem of linking the conceptual and procedural components of mathematical problem solving (Davenport and Howe, 1999). Penelope, Carpenter, Fenneme showed that the significant positive relationships between teachers' knowledge of students' knowledge and students' mathematics problem-solving achievement (Penelope, et al. 1989). Some researchers investigated the utilization of problem solving strategies of teachers. There was an important relationship among teachers' attitudes towards mathematics and teachers' attitudes towards problem solving and their mathematical background. Some teachers suppose that the problem solving is part of the learning process. According to many teachers, students' development of mathematical problem solving is the main subject of learning (Schofeld,1992) (Grouws, and Cramer,1989).

Problem What are the effects of gender, attitude towards mathematics, knowledge-skill acquired in lecture of mathematics, and reading comprehension on the mathematical problem solving performance.

Subject of the Study The subjects of the present study consisted of 73 fifth grade students in Primary School in Eskişehir. The study was carried out during 2002-2003 academic year.

Measuring Instruments In this study, the following measuring instruments were used:

1. Mathematical Problem Solving Performance Test (MPSP).
2. Problems for Knowledge and Skill acquired in lecture of Mathematics (KSM).
3. Attitude Towards Mathematics Scale (ATM).
4. Reading Comprehension Test (RC).

Mathematical Problem Solving Performance Test (MPSP) and Reading Comprehension Test (RC) was developed by selecting the items included in the 1995,1996, 1997 Anadolu High School Entrance Examinations. The purpose of the MPSP was to assess the use of mathematical problem solving skills by the subjects. MPSP consisted of 20 items. The purpose of the RC measured subjects' ability to comprehend written material. RC consisted of 20 multiple-choice items. Problems for knowledge-skill acquired in lecture of mathematics (KSM) was prepared by the researcher. The problems were created to conform in detail with the curriculum for Primary 5. The topic areas covered by the problems were money, time, weight, and distance. Besides, the mathematical operations were also paid to the structure of the problems. The purpose of the KSM was to assess the use of knowledge and skills by the subjects in the elementary school curriculum. KSM consisted of 20 open-ended questions. Attitude Towards Mathematics (ATM)was developed by Aşkar (1986). ATM consisted of 20 likert-type items.

Results Linear regression analysis was used to investigate the effects of the variables gender (G), attitude towards mathematics (ATM), knowledge-skill acquired in lecture of mathematics (KSM), and reading comprehension (RC) to the mathematical problem solving performances (MPSP)

Table I. Results of regression analysis for MPSP

Model	Unstandardized Coefficients		t	Sig.
	B	Std. Error		
(Constant)	-5,702	2,936	-1,942	0,061
KSM	0,952	0,254	3,747	0,001
RC	0,679	0,243	2,791	0,009
ATM	-0,008	0,018	-0,463	0,647
G	-0,848	0,546	-1,552	0,130

The correlation coefficients for each variable are found that:

KSM : 0,952, RC : 0,679 ATM : - 0,0008 G : - 0,848

The results of the regression analysis indicated that KSM and RC are significant to explain MPSP, other variables aren't significant.

According to this results, it can be seen that independent variables KSM (B= 0,952, p= 0,001) and RC (B = 0,679, p= 0,009) significantly affected to MPSP.

Table II . Results of regression analysis for MPSP use scores in KSM and RC

Model	Unstandardized Coefficients		t	Sig.
	B	Std. Error		
(Constant)	-2,875	2,293	-1,254	0,218
KSM	1,038	0,283	3,666	0,001
(Constant)	-7,847	2,620	-2,995	0,005
RC	0,964	0,255	3,773	0,001
KSM	0,718	0,234	3,068	0,004

According to data in Table II the following relations were obtained:

$$\text{MPSP} = - 2,875 + 1,038 \text{ KSM}$$

$$\text{MPSP} = - 7,847 + 0,964 \text{ KSM} + 0,718 \text{ RC}$$

While there were only variables KSM and RC, the regression coefficients are found that, 0,964 and 0,718.

Table III. Regression analysis for all variables.

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	75,750	4	18,937	7,263	0,000
Residual	83,439	32	2,607		
Total	159,189	36			

According to linear regression analysis the general model isn't significant.

Discussion and Implications:

The main purpose of this study were to investigate the mathematical problem solving performance of fifth grade students according to the variables of gender, attitude mathematics, knowledge-skill acquired in lecture of mathematics and, reading comprehension.

According to the results of this study, the main causes of failure to solve problems reliably are not to apply mathematical knowledge and not to understand the problem statement. It is seen that, successful students applied the knowledge and skill gained in lecture of mathematics to new problems. Therefore, knowledge and skill are necessary for problem solving and also using various problem-solving strategies. Generally, in mathematics lessons, a particular problem type is taught instead of particular solution strategies. This may prevent students to produce new strategies when a nonroutine question is asked. The problems in KSM are real problems which created to conform in detail with the curriculum for Primary 5 that require students to use previously learned principles, rules, and information.

The results showed that, there was significant relation between the problem solving skill performances and knowledge-skill acquired in lecture of mathematics. Particularly, knowledge-skill acquired in lecture of mathematics plays important role in to determine the problem. Besides, it was found that skills of reading comprehension have a meaningful doping on problem solving performance. It can be concluded that students' knowledge-skill acquired in lecture of mathematics and reading comprehension ability can be correlated with their mathematical problem solving performance. On the other hand, as many researchers stated that, there was not significant relationship between the problem solving performance and, attitude towards mathematics and, gender.

A problem is understood by solving it not by pondering it (Krulik, Rudnik, 1996). Then, to increase the problem solving performances we must teach to the student strategies of problem solving, instead of problem solving.

References

- Aiken, L.W. (1972). Language Factors in Learning Mathematics. *Review of Educational Research*, 42, 3, 359-385.
- Altun, M., (1997). İlköğretimde Problem Çözme Öğretimi. *Milli Eğitim*, 26-30
- Aşkar, P., (1986). Matematik Dersine Yönelik Tutum Ölçen Likert Tipi Bir Ölçeğin Geliştirilmesi. *Eğitim ve Bilim*, 31-36.
- Beller, M. Gafni, N. (2000). Can Item Format Account for Gender Differences in Mathematics Achievement? *Sex Roles*, 42, 1-2.
- Fennema, E. et al. (1998). New Perspectives on Gender Differences in Mathematics. *Educational Researcher*, 19-21, June-July.
- Gallagher, A.M., and De Lisi, R. (1994). Gender Differences in the Scholastic Aptitude Test-Mathematics Problem Solving Among High-Ability Students. *Journal of Educational Psychology*, 86, 204-211.
- Gallagher, A.M., et al. (2000). Gender Differences in Advanced Mathematical Problem Solving. *Journal of Experimental Psychology*, 75, 165-190.
- Glynn, K.D. (1982). Reading Comprehension Ability and Solution of Arithmetic Word Problems. *Dissertation Abstracts International*, 42, 8, 3524 A.
- Hyde, J.S., Fennema, E., Lamon, S.J. (1990) Gender Differences in Mathematics Performance: A Meta-Analysis. *Psychological Bulletin*, 107, 2, 137-155.
- Krulik, S., Rudnik, J.A. (1996). *Assesing Reasoning and Problem Solving. A Source Book for Elementary School Teachers*. Mc Tighe, Jay.
- Krulik, S., Rudnik, R.J.. (1988). *Problem Solving, A Handbook for Elementary School Teachers*, Needham Heights, MA.: Allyn and Bacon.
- Lawson, M.J. and Chinnapan, M. (2000). Knowledge Connectedness in Geometry Problem Solving. *Journal for Research in Mathematics Education*, 31, 1, 26-43.
- Lester, F.K. (1980). Research on Mathematical Problem Solving. *Journal for Research in Mathematics Education*, 25, 6, 660-675.
- Meier, S., Hovde, R., Meier, R. (1996) Problem Solving Teachers' Perceptions Content Area Models, and Interdisciplinary Connections School Science and Mathematics, 96, 5, 230-237.
- Penelope, L.P., Carpenter, T., Fennema, E. (1989). Teachers' Knowledge of Students' Knowledge in Mathematics Problem Solving: Correlational and Case Analyses. *Journal of Educational Psychology*, 81, 4, 558-569.
- Piaget, J. (1973). *To Understand is To Invent: The Future of Education. Theory into Practice*, New York: Macmillan Publishing Company.
- Randhawa, B.S. (1994). Theory, Research, and Assessment of Mathematical Problem Solving. *The Alberta Journal of Educational Research*, 40, 2, 213-231.
- Schoenfeld, A.H. (1992). *Learning to Think Mathematically: Problem Solving, Metacognition, and Sense Making in Mathematics*. Handbook of Research on Mathematics. Teaching and Learning, New York Macmillan Publishing Company.
- Skinner, B.F. (1968). *The Technology of Teaching*. New York, MacMillan Publishing Company.