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The Effect of Problem Solving Method on Improving Primary Students Mathematics achievement and Creativity

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ABSTRACT

Problem solving method is a student-centered learning model which develops active learning and creative thinking. Using this method has very importance to the discipline of mathematics and it is the nature of mathematical thinking. The purpose of this research is the study of effectiveness of using problem solving method on improving mathematics achievement and creativity of 5th grade primary school students. The sample of the research was consisted of 60 5th grade female primary school students in shahr-Rey, Iran. These students were selected using simple random assignment. In this study quasi-experimental design was implemented which had pre-test/post-test and control group. Experimental group (30 students) was taught problem solving method but control group (30 students) was instructed same science content as traditional teaching methods for same length of time. The Torrance's test of creative thinking (TTCT) and mathematical achievement test were administered to both groups before and after the instruction as a pre and post test. Results of the study reveal that experimental group students have higher mean scores than control group students in post achievement test and post TTCT test while there is no significant difference between experimental and control groups students' pre achievement test and pre TTCT test scores.

Introduction

In recent years, it can be seen that problem solving method was widely used in science teaching (Akınoğlu & Tandoğan, 2007; Guven & Cabakcor, 2013; Ince Aka et al., 2010; Nordstrom & Korpelainen, 2011; Xin et al., 2011). Problem solving method is the center of the science curriculum, which would affect the whole curriculum.

Problem solving method is a learning model which centers on student, develops active learning, skills of problem-solving and field knowledge, and it is based on understanding (Johnson & Malinowski, 2001; Major, Badenand & Mackinnon, 2000).

Problem solving method includes process of scientific thought. Problem solving method shows thought in advanced level when this method is described as a scientific process in terms of finding, inquiry, critical thought (Kemertas, 2001). Problem solving is defined as the process of interpreting a situation mathematically, which usually involves several iterative cycles of expressing, testing, and revising mathematical interpretations and of sorting out, integrating, modifying, revising, or refining clusters of mathematical concepts from various topics within and beyond mathematics (Lesh & Zawojewski 2007: 782).

Ability of problem-solving is generally viewed as the ability to reason analytically, to think critically and to create productively, which all involves quantitative, communicative, manual and critical-response skills (AAAS, 1993). Problem solving has been considered as higher order cognitive process that requires detecting steps or processes "between the posing of the task and the answer" (Goldin, 1982: 97).

The problem solving method has very importance to the discipline of mathematics and it is the nature of mathematical thinking. Problem solving is a relevant and significant perspective and context through which to introduce students to mathematics therefore it increasingly becomes important for teachers to reflect on ways to analyze the role of problem solving in students' comprehension and development of mathematical concepts, and to discuss the use of this educational tool in students' learning and achievement. Thus, using problem solving method may be beneficial for increasing students' academic achievement and developing creativity in our education system.

On the other hand, according to the "genius" view of creativity, creative acts are viewed as rare mental feats, which are produced by extraordinary individuals who rapidly and effortlessly use exceptional thought processes (Weisberg, 1988). The genius view of creativity suggests both that creativity is not likely to be heavily influenced by instruction and that creative work is more a matter of occasional bursts of insight than the kind of steady progression toward completion which tends to be valued in school (silver, 1997). But this view of creativity has been questioned in recent researches, and it is no longer the only view of creativity available for application to education.

A new view of creativity suggests that creativity is closely related to deep, flexible knowledge in content domains; is often associated with long periods of work and reflection rather than rapid, exceptional insight; and is susceptible to instructional and experiential influences (Holyoak & Thagard, 1995). This view of creativity also suggests that persons who are creative in a domain appear to possess a creative disposition or orientation toward their activity in that domain. That is, creative activity results from an inclination to think and behave creatively (silver, 1997). This emerging view of creativity provides a much stronger foundation on which to build educational applications. In fact, this view suggests that creativity-enriched instruction might be appropriate for a broad range of students, and not merely a few exceptional individuals.

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The purpose of this research is the study of effectiveness of using problem solving method on improving mathematics achievement and creativity of 5th grade primary school students. In this research, we was studied the effect of problem solving method on the mathematics learning and achievement of primary school students and also discuss the use of this educational tool in students' fostering creativity.

Methodology

In this study, quasi-experimental design was implemented which had pre-test/post-test and control group. The sample of the research was consisted of 60 5th grade female primary school students at the first term of 2012-2013 educational year in shahr-Rey, Iran. The population of the research is consisted of all 5th grade primary school students on first term of 2012-2013 educational year in shahr-Rey, Iran. These students were selected using simple random assignment. Experimental group (30 students) was taught problem solving method for 12 weeks. According to Woolfolk (2006:325), we used a problem solving method that contained 5 stages: (1) identifying problems and opportunities; (2) Defining goals and representing the problem; (3) Exploring possible strategies; (4) Anticipating outcomes and acts; and (5) looking back and learning. Two types of problems were posed in the classroom. In first type of problems, the learners were used a similar and familiar situation for solving a particular new problem (analogical reasoning). They benefit from this method or sometimes brain storming method in the third stage (Exploring possible strategies). In other type of problems, the teacher gave a problem to the students and asks them to propose their solutions. Before presenting all solutions by students, teacher and students don't discuss about solutions. Then, a criterion was specified for judgment for potential solutions. This criterion was used for selecting the best solution of the problem (Schunk, 2011).

Control group (30 students) were taught by the same researchers same science content (mathematical problems) through the methods such as the direct telling, and asking-answering (traditional teaching methods) for same length of time.

Two instruments were used in this study including mathematical achievement test and the Torrance's test of creative thinking (TTCT). The Torrance's test of creative thinking (Torrance, 1990) and mathematical achievement test were administered to both groups before and after the instruction as a pre and post test. We used form A of the Figural TTCT that consists of four activities: (1) synthesis of a picture by using figures (2) synthesis of incomplete figures (3) synthesis of a picture by using circles (4) synthesis of pictures using parallel lines. We also used a mathematical achievement test that consists of 15 questions.

Results and Discussion

The mathematical achievement test was prepared by the researchers including 15 questions. Questions' difficulty degree was found as (pj)= 0.47 and means item discrimination index as 0.73. The opinion of several experts was sought for extent validity. The reliability of the test is determined by Cronbach coefficient alpha as 0.82 for pre test and 0.87 for post test. The reliability coefficient (r) of the Torrance's test of creative thinking (TTCT) was calculated for each of four subscale scores through pearson correlation coefficient. These are r_1=0.876 (fluency); r_2=0.705 (flexibility); r_3=0.814 (originality); and r_4=0.632 (elaboration).

The mathematical achievement test was administered to both groups before and after the instruction as a pre and post test and results are shown in table 1.

Table 1. Results of pre-test and post- test achievement scores

Group	Variable	N	Pre test		Post test	
			M	S.D.	M	S.D.
Experiment	achievement	30	12.217	3.843	17.183	2.066
Control	achievement	30	12.35	3.908	15.483	2.857

According to the results are shown in table 2, there is no significant difference between experimental (M=12.217) and control group (M=12.35) students mathematical achievements' pre-test scores (α=0.01).

Table 2. Independent sample t-test results of pre test achievement scores.

Group	M	S.D.	t	Df	α
Experiment	12.217	3.843	-0.133	58	0.01
Control	12.35	3.908			

Independent sample t-test results of experimental (M=17.183) and control group (M=15.483) students mathematical achievements' post test scores shows that experimental group students have higher mean scores than control group students (Table 3).

Table 3. Independent sample t-test results of post test achievement scores

Group	M	S.D.	t	Df	α
Experiment	17.183	2.066	-2.814	58	0.01
Control	15.483	2.587			

The results obtained for the TTCT test (Table 4 and 5, for pre test and post test, respectively) reveals that while there is no significant difference between experimental and control groups students' pre TTCT test scores; experimental group students have higher mean scores than control group students in post TTCT test (Table 5, t_1= -5.267, t_2= 3.658 , t_3= -3.687, t_4= 4.213 , α<0.001).

Table 4. Independent sample t-test results for pre TTCT test

	Group	M	S.D.	t	df	α
Fluency	Experiment	8.97	4.27	-1.867	58	0.01
	Control	11.07	3.94			
Flexibility	Experiment	7.1	3.66	1.825	58	0. 01
	Control	5.08	4.45			
Originality	Experiment	3.67	4.67	-2.103	58	0. 01
	Control	6.3	5.01			
Elaboration	Experiment	37.9	21.43	1.39	58	0. 01
	Control	30.7	18.54			

Table 5. Independent sample t-test results for post TTCT test

	Group	M	S.D.	t	df	α
Fluency	Experiment	9.7	2.77	-5.267	58	0.001
	Control	13.57	2.92			
Flexibility	Experiment	11.23	2.87	3.658	58	0.001
	Control	8.63	2.63			
Originality	Experiment	6.5	2.85	-3.687	58	0.001
	Control	9.3	3.03			
Elaboration	Experiment	45.7	14.57	4.213	58	0.001
	Control	31.47	11.4			

Conclusions

In conclusion, results of the research show that there are significant differences in scores of both post achievement and TTCT between experimental and control group students after treatment (Tables 3 and 5). These results prove that both problem solving and traditional teaching methods have positive effect on students' achievement and creativity but problem solving method is more effective than traditional teaching methods. The results of the study showed that both achievement and creativity of students of experimental group treated with problem solving teaching strategy improved more than students of control group who were taught through traditional methods. The findings of the recent studies by Ali et al. (2010), and

Nordstrom & Korpelainen (2011) also favor the findings of this study as they also concluded that students in the experimental group developed their achievement and creativity after the treatment of problem solving teaching. On the basis of the results of this study and others it is recommended that the primary teachers may incorporate the problem solving teaching strategy during teaching mathematics to improve the achievement and creativity of the students.

References

Akınoğlu, O. & Tandoğan, R. O. (2007). The Effects of Problem-Based Active Learning in Science Education on Students' Academic Achievement, Attitude and Concept Learning. *Eurasia Journal of Mathematics, Science & Technology Education*, 3 (1), 71-81.

Ali, R., Hukamdad, Akhter, A. & Khan, A. (2010). Effect of Using Problem Solving Method in Teaching Mathematics on the Achievement of Mathematics Students. *Asian Social Science*, 6(2), 67-72.

American association for the advancement of science (AAAS) (1993). *Benchmarks for science literacy*. New York: Oxford University Press.

Goldin, G. A. (1982). The measure of problem-solving outcomes. In *Mathematical problem solving: Issues in research* edited by F. K. Lester and J. Garofalo, (pp. 87–101). Philadelphia, PA: The Franklin Institute Press.

Guven, B. & Cabakcor, B. O. (2013). Factors influencing mathematical problem-solving achievement of seventh grade Turkish students. *Learning and Individual Differences*, 23, 131-137.

Holyoak, K. J., & Thagard, P. (1995). *Mental leaps: Analogy in creative thought*, Cambridge, MA: MIT Press.

Ince Aka, Guven, E., E. & Aydogdu, M. (2010). Effect of Problem Solving Method on Science Process Skills and Academic Achievement. *Journal of Turkish Science Education*, 7(4), 13-25.

Johnson, M. C. & Malinowski, J. C. (2001). Navigating the active learning swamp. *Journal of College Science Teaching*, 31(3), November.

Kemertas, I. (2001). *Uygulamalı genel öğretim yöntemleri (Practical general teaching methods)*, Istanbul: Birsen Press.

Lesh, R. & Zawojewski, J. (2007). Problem solving and modeling. In *The Second Handbook of Research on Mathematics Teaching and Learning* edited by F. Jr. Lester, (pp. 763–804). The National Council of Teachers of Mathematics, Charlotte, NC: Information Age Publishers.

Major, C. H., Badenand, M. S. & Mackinnon, M. (2000). Issues in problem based learning: a message from guest editors. *Journal on Excellence in College Teaching*, 11(2), 1-14.

Nordstrom, K. & Korpelainen, P. (2011). Creativity and inspiration for problem solving in engineering education. *Teaching in Higher Education*, 16(4), 439-450.

Schunk, D. H. (2011). *Learning Theories: An Educational Perspective* (6th. Ed.), London : Allyn & Bacon.

Silver, E. A. (1997). Fostering Creativity through Instruction Rich in Mathematical Problem Solving and Problem Posing. *ZDM*, 25(3), 75-80.

Torrance, E. P. (1990). *The Torrance tests of creative thinking norms—technical manual figural (streamlined) forms A & B.* Bensenville, IL: Scholastic Testing Service, Inc.

Weisberg, R. W. (1988). Problem solving and creativity. In R. J. Sternberg (ed.), *The nature of creativity* (pp. 148–176). New York: Cambridge University Press.

Woolfolk, A. (2006). *Educational Psychology* (10th Ed.). (p. 325), Boston: Allyn & Bacon.

Xin, Y. P., Whipple, A., Zhang, D., Si, L., Park, J. Y. & Tom, K. (2011). A Comparison of Two Mathematics Problem-Solving Strategies: Facilitate Algebra-Readiness. *The Journal of Educational Research*, 104, 381–395.