

THE EFFECTIVENESS OF USING PROBLEM BASED LEARNING (PBL) IN MATHEMATICS PROBLEM SOLVING ABILITY FOR JUNIOR HIGH SCHOOL STUDENTS

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ABSTRACT

This research aims to know about the effectiveness of using PBL in measuring the ability of mathematics problem solving. This research was conducted in 7th grade of Junior High School. The variable in this study was PBL and the ability of mathematics problem solving. Instruments in this research were 5 essay tests of mathematics problem solving ability which were analyzed by testing the hypothesis with t-test. The result showed that average value students who taught by using PBL were higher than students who taught by using conventional model. By using t-test, we know that significant value is less than 0,05, it means that learning by using PBL effective in improving the ability of mathematics problem solving for students.

Keywords : Mathematics Problem Solving Ability, Problem Based Learning

1. INTRODUCTION

One of the purposes of mathematic subjects that contained in Junior High School mathematics standard subjects at Permendiknas Number 22 in 2006 is to make students can solve mathematics problem that include problem solving ability, designing mathematic models, finishing models and interpret the acquired solutions (Depdiknas, 2006). The problem solving ability need to be controlled by students in order to encourage them become a good problem solver, which is able to face daily life problem.

Problem solving is a tool to advance the ability of students thinking (Schoenfeld 1985). For example, in NCTM Standard of mathematics stated that : "*Solving problem isn't just the objective of learning mathematics, but also the primary way to do it. In daily life and in the work plac, become a good problem solver can lead to big profit. Problem solving is a part of learning mathematics.*"(NCTM, 2000, 52)

Mathematics problem solving is a complex cognitive. Some mathematics literature explain that problem solving as some activities which make patterns, interpreting numbers, develop geometric construction and prove the theorem (Willson, Fernandez dan Hadaway, 1993).

Problem solving were chosen to help develop, improve and built creativity. It is generally recognized that problem solving is an indicator of some countries in determining the ability of students to understand the concepts and learning ideas. Problem solving skills will develop quickly if a problem solver get a new experience from their activity. Student performance will increase in problem solving if they repeatedly encounter the same types of issues or if they can use their previous experience (Eysenck, 1993).

Problem solving is a center for school mathematics. Kilpatrick et al. (2001, p. 420) say that almost in every domain of mathematics show that problem solving give an important context which sudents can learn about number and

another math topics. Problem solving ability is improved when students have a chance to solve their problem and to see the problem solved. Further, problem solving can provide the site for learning new concepts and for practicing learned skills. Thus, problem solving is important as a way of doing, learning and teaching mathematics. If problem solving should be taught to students, then it should be taught to preservice teachers who are likely to not have been taught it in an explicit way. If it is to form a basis of teaching mathematics, then preservice teachers should understand it from a pedagogical perspective.

A teacher's attitude and the teaching strategies he/she uses significantly influence educational outcomes. Observations from schools suggest that pupils as well as teachers prefer problems in whose case the algorithm suitable for their solution is apparent, in whose case there are no doubts about the choice of the suitable algorithm (Novotna, 2000). In that case the class does not have to undergo the painstaking procedure of looking for this algorithm and can omit the often lengthy and difficult journey to grasping of the problem. The role of the teacher is simpler, he/she only has to detect the place where pupils make mistakes and assess correctness of their solutions. That is the reason why teachers often choose problems in whose case the search for the appropriate algorithm is easy and also often hint at the suitable solving procedure. This means pupils instead of solving a problem simply apply some algorithm chosen according to the signals from the assignment or the teacher. Then they fail if they are to solve non-standard problems whose assignment does not contain elements they are used to, elements that serve as indicators for selection of the right solving strategy. They feel helpless if they face an atypical, unusual problem or a problem set in an unknown context. Needless to say that this often happens in case of application problems, where pupils are expected to use mathematics for solution to problems from everyday life.

According to Polya (1962), solve the problem doesn't give a contribution to students' mental development. He believes that to provide the opportunity for students to develop high-order thinking in the process of understanding, analysis, exploration and application of mathematical concepts, non-routine problem should be employed. However, students are generally afraid of the idea of non-routine problem solving because this problem is usually non-standard, that involving an unexpected solution and foreign. In addition, students are also of concern, dismay and very uncomfortable because they are not able to remember and apply the learning procedure in a simple manner.

Generally, mathematical problem-solving ability is the ability or strategic competence that shown by students in understanding, selecting approaches and solving strategies and complete model to solve the problem. There are four basic steps in problem solving, such as :

1. Define the problem
2. Generate alternative solution
3. Evaluate and select an alternative
4. Implement and follow up the solution

In an effort to increase the ability of the mathematical problem solving of students, needed a good model in the learning process. One of the models that are considered appropriate to enhance the problem solving ability are PBL. This model is a model that present a contextual problem in order to stimulate students to learn. In classes that implement problem-based learning, students work in teams to solve real world problems. PBL is a learning that centered to analysis based learning approach, resolution and discussion about issues that are given. The PBL is an instructional approach centred on learners that empowers learners to do research, integrating theory and practice, and apply knowledge and skills to develop a viable solution in solving the problem. The steps of PBL usually like these : first, students will be given a problem, then students will discuss the problem with their friends. They try to collect the information as much as possible to solve the problem. Next, all of students are asked to say their own opinion to solve the problem, and finally, students will be asked to work independently to solve the problem according to discussion results.

Mathematic teachers have to teach students not only to solve the problem but also to learn about mathematic through problem solving. While many students are able to develop their procedural fluency, often lack a deep conceptual understanding, so it's necessary to solve problems or make new connections between mathematical ideas. It makes a new challenge for teacher. PBL gives change to teacher to meet this challenge. PBL exists as a teaching method based on the ideals of constructivism and student-centered learning. When using the PBL, teachers help students to focus on solving problems in the context of real life, encouraging them to consider the situation in which there is a problem and try to find a solution.

PBL is a teaching method that is focused to students in their involvement in the learning process. PBL is a constructivist model of learning, a learning approach that focuses on students by showing the reflection as well as skills in communication and collaboration, and require reflection from a variety of perspectives (Yelland, Cope, & Kalantzis, in Etherington, M.B, 2011). Students are faced with a real-life scenario, or a problem that needs a solution. Students analyze problems and context and then apply the deductive and inductive process to understand the problem and find a solution.

PBL is a learning approach that allows students to do research, integrating theory and practice, and apply knowledge and skills to develop a solution to the defined problem (Savery 2006, p.9). According Barrows (2002), the keywords of PBL are : (1) unresolved, structure problem that will give some thoughts about cause and solution, (2) student centered approach, in which students determine what they need for learn, (3) teachers as facilitators and tutors, (4) authentic problem and reflects the professional practice. Barrows also show that learning in PBL environment must be integrated from some sciences, so the students learn and integrate the information from some sciences that connect with understanding and solving the problem. Essentially, PBL is a learning approach in which students work together to find a solution to a complex problem (Ferreira & Trudel, 2012).

The steps of PBL are :

- a. Defining the problem
- b. Self learning
- c. Investigation
- d. Exchange knowledge
- e. Assessment

Based on the above description, researchers consider that in learning mathematics, students should be able to solve a problem in mathematics. One of the ways that it deems suitable to enhance the ability of mathematical problem solving of students is to use PBL.

2. METHOD

This type of research is quasi experiment. In this research, we do learning activities in experiment and control classes. Experiment class is a class that will be taught by using PBL. While, control class will be taught by using conventional model. Things are compared in this study is the student's problem solving ability. This research was conducted in Junior High School in January 2017 in 7th grade students. The population is the whole of students in 7th grade who attend the 2nd semester in 2017 which consists of eight classes, totalling 296 students. The sample in this research is 37 students that are given teaching with PBL. The variables in this study are a model of PBL and the ability of mathematics problem solving. The research procedure was divided into three stages, namely : a) preparation stage : do the observation, then determine sample class, prepare the device, do the validation, composing final test based on indicators of problem solving ability. b) implementation stage is doing the study like the scenario of learning that has been created in sample class. c) final stage : hold the test from both of the 2 samples, manipulate the data result from both 2 samples, make a conclusion with analysis data technic. Instruments in this research were 5 essay tests of mathematics problem solving ability which were analyzed by testing the hypothesis with t-test.

3. RESULTS AND DISCUSSION

The result from students test of mathematics problem solving ability that calculated by using SPSS 17, obtained this following data :

Table 1. The Result of the students test of mathematics problem solving ability

Group Statistics					
	PBL Models	N	Mean	Std. Deviation	Std. Error Mean
Problem_Solving	Eksperimen class	37	88.22	3.645	.599
	Control class	37	76.38	7.147	1.175

Based on the table above, we can see that the average value from the test in experiment class is higher than the average value from the test in control class. Standard deviation from the experiment class is lower than standard deviation in control class. It means that the dissemination of students learning in experiment class is less than control class. This thing identifies that if we see from the diversity of each data class, then the mathematics problem solving

ability in experiment class almost sama. It's look different with the mathematics problem solving ability in control class. Students test score of mathematics problem solving ability in experiment class and control class grouped by the indicators of problem solving ability. Each question has three indicators of mathematics problem solving ability.

Based on the normality and homogeneity test that is done by using SPSS 17, we know that the data is a normal and homogen distribution. By using t-test, we can see the result as follows :

Table 2. Independent Sample Test
Independent Samples Test

	Levene's Test for Equality of Variances		t-test for Equality of Means							
								95% Confidence Interval of the Difference		
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper	
Problem_ Solving	Equal variances assumed	14.840	.000	8.976	72	.000	11.838	1.319	9.209	14.467
	Equal variances not assumed			8.976	53.541	.000	11.838	1.319	9.193	14.483

Based on the table above, we know that $\alpha = 0,05$ obtained significant value for students mathematics problem solving ability by using PBL is 0,000. The significant value is less than 0,05 ($0,000 < 0,05$). Thus, it can be conclude that H_0 is rejected and H_1 is accepted. It means that using PBL in teaching mathematics is more effective in mathematics problem solving ability than teaching mathematics using conventional model.

4. CONCLUSION

Based on the results of the study that has been done, the students are taught using the PBL model, has a better mathematical problem solving ability than learning by using the conventional model. It can be seen from the average value of a test study of students who are taught by using the model of PBL is higher than the average value of students taught by using conventional learning model.

Significant value for mathematic learning by using PBL model is less than 0,05. Therefore, H_0 is rejected and H_1 is accepted. This means that, PBL can significantly enhance the ability of mathematics problem solving. Thus it can be concluded that the use PBL in teaching and learning is effective in enhancing the ability of mathematics problem solving for students. This is because when teaching with PBL, students are guided to find their own answer by following the steps of PBL model.

5. SUGGESTION

Based on the conclusions above, as a follow-up of the conclusions of this research the authors wants to give suggestions to the people who concerned in the process of teaching and learning mathematics. The sugestions are as follows :

1. Teachers are expected to focus on the different way of students learning in their abilities of mathematics problem solving.
2. To another researchers who want to make a research like this, you need to look for any other literature which connected with your paper, so the result can be more maximal.

6. REFERENCES

- [1] Barrows, H.S. 2002. A Taxonomy of PBL Methods. *Journal of Medical Education*, 20. 6
- [2] Depdiknas. 2006. *Jurikulum Tingkat Satuan Pendidikan*. Jakarta : Depdiknas
- [3] Eysenck, H. J., et al. 2001. *Encyclopedia of Psychology 2*. New York : Harder & Harder
- [4] Etherington, M. B. 2011. *Investigative Primary Science : A Problem Based Learning Approach*. Australian Journal of Teacher Education, Vol. 36, 9. British Columbia : Trinity Western University
- [5] Ferreira, M. M., & Trudell. 2012. The Impact of Problem Based Learning (PBL) on Student Attitudes Toward Science, Problem Solving Skills, and Sense of Community in the Classroom. *Jornal of Classroom Interaction*
- [6] Kilpatrick, J., et al. 2001. *Adding It Up : Helping Children Learn Mathematics*. Washington DC : National Academy Press
- [7] Novotna, J., et al. 2014. The Effect of Using an Explicit General Problem Solving Teaching Approach on Elementary Pre-Service Teachers' Ability to Solve Heat Transfer Problems. *IJEMST*, 2 (3), 164-174. University of Hong Kong
- [8] NCTM. 2000. *Principles and Standards For School Mathematics*. ISBN : 0-87353-480-8. America : The United State Of America
- [9] Polya, George. 1973. *How To Solve It. A New Aspect Of Mathematics Method*. Stanford University. USA
- [10] Savery, J. R. 2006. Overview of Problem Based Learning : Defenition and Distinctions. *The Interdisciplinary Journal of Problem Based Learning*, Volume 1, Number 1
- [11] Schoenfeld, A.H. 1985. *Mathematical problem solving*. Orlando, FL: Academic Press, Inc
- [12] Wilson, J. W., Fernandez, M. L., & Hadaway, N. 1993. *Mathematical Problem Solving. Research Ideas for the Classroom High School Mathematics*. 57-78. New York : Macmilan Publishing Company

