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The Effect of Problem Based Learning by using Demonstration Method on The Ability of Problem Solving

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Abstract

The purpose of this study was to determine the effect of PBL model by using the demonstration method on the problem-solving skills to elementary school students. The study applied quasy experimental research method with pretest-posttest control group design. The population of this study was the fourth grade students of Diponegoro cluster in Kudus, Central Java in the academic year 2017/2018. The samples taken for this study were the fourth grade students of SD 1 Kajeksan and SD 2 Demaan with the total number of 30 students for each school. The sampling technique used in this study was Nonprobability Sampling technique. The data collection technique applied in this study was test in the form of essay, as well as non-test technique which consists of observation and documentation. The data were analyzed by using gain score and t-test. The results showed that there is significant influence of PBL model by using demonstration method to student problem solving ability, this is supported by N-Gain result = 0.59 that is categorized as medium category. Then, pretest-posttest results of problem-solving ability by using PBL model with the demonstration method were t_{value} = 7.667. Furthermore, there was a difference betwen students' ability in solving the problems by using PBL model within and without demonstration method (t_{value} (3,801) > t_{table} (1,672)). This is supported by the result of observation to the student engagement which was 81.11%. It indicates that the PBL model by using demonstration method affects the problem solving abilities.

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INTRODUCTION

Learning mathematics becomes one of the subjects which is always taught in every level of education from elementary to high school. National Council of Teachers of Mathematics (NCTM) mentions that the mathematical skills include: problem solving ability, reasoning and proof, communication capability, connection capability, and representation. NCTM (2000) puts the problem-solving skills as the main purpose of mathematics education. According to Branca in Tarigan (2012), problem solving is the basic skills in mathematics. Based on research conducted by Hino (2007) in Japan, problem solving helps to: (1) deepen and expand the knowledge on students' thought and learning processes; (2) stimulate our efforts to develop teaching materials and effective ways to organize learning to problem-solving; (3) provide a way for assessment process of thought and attitudes. Based on those literatures, mathematical problem solving is considered important, however, students often have difficulty in solving math problems. According to Lambertus (2010) another weakness found is the lack of student in analyzing the problem, monitoring the problem solving process, and evaluating the results. In other words, students are not interested in the technique but rather to prioritize the completion of the final result.

Based on preliminary observations conducted with the teacher of fourth graders of elementary school in the Diponegoro cluster, Kudus, Central Java, math essay is the most difficult matter to be understood by students. The fact showed that the students tend to memorize concepts (formulas) that had been given by the teacher, and they were not able to use the concept if they encountered problems associated with the concept of contextual that they faced. Therefore, in working on with math essay, most students use simple steps and immediately write down answers to the questions provided in the essay. In fact, many students tend not to be able to determine what the problem is and how to define it. This condition causes the math students problem solving ability is low. Those matters is resulted the education outcome nowadays have not achieved yet the expectation and need of society. In this case, the researcher observed the students mathematical problem solving of geometry in the fourth grade of SD 1 Kajeksan and SD 2 Demaan. Both two schools were chosen since the average score of UAS or final examination is less than the Minimum Criteria Standard. After having discussions with the class teacher, it can be concluded that students had low ability in solving mathematical problems that consist of width and round of flat figures.

Those in accordance with the research facts found by Zaini (2016) that mentioned the lower value of Minimum Criteria Standard of students is due to the lack of students curiosity in mathematics learning process and low ability of students in solving problems. Meanwhile, Kodariyati (2016) in her observations found that the learning process done by teachers, especially the mathematics teacher showed that teachers still apply expository learning such as lecturing, discussing and giving task so that the learning is less stimulating to develop the skills to solve problems in their daily life. Some students are also less interested in studying mathematics, they consider mathematics to be a set of formulas and calculate the numbers only when working on the problem. In addition, students are less creative in developing the answer and cannot understand the concept of mathematics being taught completely.

Research conducted by Najihah, et al. (2016) showed that PBL has given positive impact on primary school students in math and can be applied to various domains of knowledge in mathematics. Akinoglu, et al. (2007) stated that the implementation of PBL models has a positive effect on student achievement and attitudes in science learning. Here, the PBL learning model also affects students' conceptual development positively. Frederick, et al. (2011) stated that Student Engagement is used to determine the extent of students involvement in the learning process in schools. Student's engagement in the learning process may assess students during a lesson on how they follow the lesson, therefore, it is not only seen from the output. Yanto, et al. (2011) in his research results

showed that student engagement also has a positive impact on student accounting competence. Based on several studies that have been put forward, it was found a research gap in the form of limitation in the previous studies. There were not any studies specifically apply the model of PBL by using the demonstration method for teaching the material of width and round of flat figures to measure students' problem-solving abilities. Therefore, the researcher intended to implement the model of PBL by using demonstration method for the material of width and round of flat figures to find out whether the results remain consistent to increase the problem-solving ability of students or would show the different results that inconsistent the previous studies.

Based on the facts that have been discussed above, it is necessary to implement a learning model that provides a stimulus for students to enhance students' problem-solving abilities, such as the model of PBL by using demonstration method. According to Arends (2008), Problem Based Learning is a form of learning that has the essence of presenting a variety of authentic and meaningful situation problems to students. The application of PBL models in this study is accompanied by a demonstration method as facilities for students to express what they know from the concepts that they learned before. According to Sagala (2009) demonstration method is a method of teaching in which there are performances on the occurrence of an event or object to the appearance of behavior which is exemplified to be known and understood by the students significantly. Students are guided to express their thought, and therefore they will find it easy to solve contextual problem related to the concepts that they have learned before. The benefit of this study is to help students understand the learning material through problems solving learning by using the method of demonstration.

METHODS

This study applied quasy experimental research method with pretest-posttest control group design that used two classes as the experimental group. The control group was only given treatment of PBL learning model, whereas the experimental group was given treatment of PBL learning model by using the method of demonstration. The population of this study was the fourth grade students of elementary school in the Diponegoro cluster, Kudus, Central Java. The samples were taken from two different elementary schools by using purposive sampling technique and considering several aspects such as: (1) the curriculum applied by the school, (2) the number of students, (3) the average score of UAS of the first semester, (4) the qualification of classroom teachers who teach in the school. Based on those considerations, two elementary schools choosen were SD 1 Kajeksan and SD 2 Demaan with 30 students for each school.

The data collection technique was using test technique. The instruments used for collecting the data were pretest and posttest examination in the form of essay (to measure the problem solving ability), and documentation. The technique of data analysis used in this study was pre-requisite test (validity, reliability, normality, and homogeneity), N-gain test and t-test.

RESULTS AND DISCUSSION

The of result of this study is in the form of posttest scores obtained from the measuring instrument, the test of students' problem solving ability. The result of posttest scores obtained on the problem solving ability can be seen in the following Table 1.

Table 1. The Results of Posttest Score

Group	N	Mean	Std. deviation	Std. error mean
Experimental	30	84.17	9.921	1,811
Control	30	74.00	10.780	1.968

Based on Table 1, the average value of the experimental class is higher than the control class average. This is because of the difference in treatment between the experimental class and the control class. The treatment of experimental class was using PBL Model within demonstration method while the control class was not. Anis (2017) stated that learning with PBL model

within demonstratiom method is better in increasing students verbal abilities. This model could help students who have difficulties in understanding the path of a case, so that could deepen their understanding of math essay they face.

Sumarno in Husna (2013) stated that the indicators of problem solving as follow: (1) identify the elements that are known, asked, and the adequacy of the elements, (2) create a mathematical model, (3) implement a strategy to solve the problem within/outside of mathematics, (4) explain/interpret results, (5) complete the mathematical model and real problems, (6) use math significantly. Problem solving is also a very important activity in mathematics since the learning objectives to be achieved in the problems solving is related to everyday life. Based on the disscussion above, it could be concluded that problem solving ability is effort to find out the solution of situation faced in order to achieve the goal.

The problem solving ability of students in this study was measured by using test or examination in the form of essay (description) with 5 items and by using 3 indicators of problem solving including; (1) identify the elements that are known, asked, and the adequacy of the elements; (2) implement a strategy to solve the problem within/ outside mathematics; and (3) explain/interpret the results. The step of problem solving in this study refers to Saad & Polya Ghani (2008), which includes; (1) understand the problem; (2) plan for the solution; (3) implement the solution plan; and (4) re-examine the process and results.

The problem solving ability of students can be raised through a learning process by using PBL models with demonstration methods. Sularmi (2013) argues that the model of PBL can enhance the problem-solving abilities in math essay. Arends (2008) sets out five phases or steps in the learning model of PBL which include; (1) students orienting on the issue or problem; (2) organizing the students to learn; (3) assisting with the investigation independently and in groups; (4) developing and present work; and (5) analyzing and evaluate the problem solving process.

Prerequisites Test

The trial test of instrument of problem solving tests was carried out in the trial class which was conducted in SD 1 Barongan. Essay test that consisted of 8 questions was given previously for finally getting 5 valid and reliable multiple choice questions.

Normality And Homogeneity Test

The normality test was done by using the SPSS of Kolmogorov-Smirnov which showed sig 0.157 > 0.05, which means that H_0 is accepted, the distribution of data was normal. The results of homogeneity test are summarized as follows: The data of pretest score of the problem-solving abilities in the experimental and control classes were homogeneous, with a significance value of 0.082 (0.082 > 0.05).

N-Gain Test

The magnitude of the increase of students' problem-solving ability was found by comparing pretest and posttest scores for each student by using normalized gain test. Based on the calculation of the gain score, obtained the data as presented in Table 2.

Table 2. N-Gain Calculation result

Grup	Average value		Normal gain (%)	Criteria factor G
	Pretest	Posttest	Pretest - Posttest	Pretest – Posttest
Experimental	60.83	84.17	59.6	Medium
Control	58.17	74.00	37.8	Medium

From Table 2, there is an average increase of problem solving score in the experimental class with 23.33 as N-gain values being in medium criteria. Also, there is an increase in the average increase of problem solving in the control class with 15.83 as N-Gain values being at medium criteria. Thus the results, show that the improvement of problem solving ability in the experimental class is higher than the control class. This is supported by research conducted by Ruchedi, et al. (2016) stated that students who get Problem Based Learning (PBL) learning have improved their ability of problem solving

heuristic strategy and better mathematical attitude compared to students who get conventional mathematics learning. Astriani, et al. (2017) also showed that the Problem Based Learning (PBL) model had a significant influence on the ability of mathematical problem solving.

Independent Sample Test

The problem-solving ability which was measured in this study include cognitive domains which were obtained based on the pretest and posttest of students in the process of learning. Based on the pretest and posttest results that have been implemented, then the pretest and posttest results were analized to find the similarities and diversification test of the two average value by using independent sample t-test. The result of t-test can be seen in Table 3.

Table 3. t-Test of Pretest – Posttest

Test	Group	Average	dk	t	t_{table}
Pretest-posttest	Control	58.17 62.31	58	4.309	1.67
Pretest-posttest	Experimental	60.83 84.17		7.667	

Based on Table 3 in pretest and postest session, it could be seen that $t_{value} > t_{table}$ with significant level of 0.05 because after the different treatment method was given the pretest and posttest were obtained. Those, it could be concluded that H_a is accepted. It means, there is a significant difference betwen the average of experimental and control classes. Furthermore, Table 3 shows that the result of pretest and postest result in the experimental class were higher than the control class' pretest and post test.

Research which was conducted by Rudtin (2013) described the Problem Based Learning can enhance the students ability to solve math essay of rectangle by appliying Polya steps that consist of understanding the problem, planning the plan, doing the plan, and evaluating the result.

Furthermore, the difference betwen posttest results of experimental and control classes were calculated by using SPSS 25 of independent sample test, seen on Table 4.

The researcher took 60 students as the sample of this study, with the level of significance 5%, to measure two tests side results. So, it can be known the t_{table} value is in the point of 1.672. From those calculation, $t_{value} > t_{table}$ or significant value < 0.05, it can concluded hypothesis testing H_0 is rejected. The conclusion from Table 4 states that there is a significant difference of problem solving test result betwen experimental and control class students. It was caused by learning using PBL model within demonstration method is gives more influence to the students ability in problem solving than learning using PBL mode without demonstration method.

Table 4. t-Test of Posttest of Experimental and Control Class

		t-Test for equality of means						
		t	df	Sig. (2-tailed)	Mean difference	Std. error difference	95% Confidence interval of the difference	
							Lower	Upper
Value	Equal variances assumed	3.801	58	.000	10.16667	2.67474	4.81260	15.52073
	Equal variances not assumed	3.801	57.604	.000	10.16667	2.67474	4.81182	15.52152

The result of this study is in accordance with the research results of Juliawan, et al. (2017) who stated that there is an influence and a significant difference between the mathematical problem solving ability of groups of students taught by using the model of PBL from the group of students taught by using conventional learning models in grade III.

In this study, PBL was combined with demonstration method in order to show to the students about a way to solve the problem and provide a place for students in expressing their own ideas. Dahyana (2014) argued that the demonstration method can improve learning outcomes accompanied with an increasing of students' learning activities, such as: activeness in

taking note of the subject matter, in demonstrating the critical attitude in asking and answering question with other students and teachers, in conducting demonstrations, and activeness in concluding the subject matter. Demonstration method is a learning method that can improve students understanding. The study of Hendikawati, et al. (2016) strengthens those conclusion that students' mathematical problem solving ability can reach Minimum Standard Criteria individually by using PBL. Also, it is supported by the students learning independence which has positive influence.

Besides, the result of student engagement has been done by observation to see how big the involvement of students in participating in the learning process. In the control class, the students involvement was at 70.70% and in the experimental class was at 81.11%.

CONCLUSION

Based on the result of the study that has been described previously, it can be concluded that the learning model of problem based learning method within demonstration method has more influence on students' problem-solving ability than without demonstration method. It was approved by the difference average of problem solving ability score, the value of N-Gain of experimental class that was higher than control class'. Besides, there was the difference betwen students problem solving ability in the experimental and the control classes, it could be seen that t obtain of experimental class was higher than control class.

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