The Effect of Problem Based Learning Model Application Reviewed From Mathematical Reasoning Ability

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Abstract. Problem from this research was whether there is a significant effect of problem based learning model application reviewed from mathematical reasoning ability of grade VIII. Objective in this research was to find out the effect of problem based learning model application reviewed from mathematical reasoning ability of grade VIII. This research was experimental research. Population in this research was all of grade VIII students which consist of 2 classes with total 68 students. Sample in this research was taken with using purposive sampling technique. Sample in this research was class VIII.1 as control class which consisted of 33 students and class VIII.2 experimental class which consisted of 35 students. Instrument which used in this research was test. Research Outcomes which obtained were: 1) pretest result for experiment class obtained mean score was 71,43 and posttest obtained mean score 97,75; 2) pretest result for control class obtained mean score was 12,69 and posttest obtained mean score 81,25; 3) based on the result of hypothesis test with using t test obtained t_{count}-4.061 and obtained significant value 0,000<0,05 so that can be concluded that H_0 was rejected and H_1 was accepted. Therefore, there was a significant effect of problem based learning model application reviewed from mathematical reasoning ability of grade VIII students.

1. Introduction

Education is on of main basic priority in life. In the globalization era, the education becomes main factor in mastering technology, management, and strengthening the capacity of human resource. Enhancing the human resource of Indonesia has high competition power in international level. The Indonesian government, especially the Ministry of Education, always enhance the quality of education. It can be seen from the change of curriculum which is expected to be able to answer the global challenge of the world of education. Therefore, students are demanded to have the ability to search and to process a Mathematics knowledge in order to have the competitiveness. [1] said images of mathematics as perceived by a person develop his or her positive or negative attitude towards mathematics. As it is contained in the content standard of elementary and high school unit that to master and create a future technology, it is required a powerful Mathematics since early stage [4]. Besides the ability of mastering Mathematics, the studentsare also expected to have a critical thinking ability, logical thinking, high reasoning ability, positive attitude, and qualified achievement to support their future life. [3] said is one of the vast crises of the educational system in many countries, especially third world countries is the problem of low academic achievement. Beside that attitude of students can be influenced by the attitude of the teacher and his method of teaching [6]

According [2] are each of these practices entails mathematical reasoning, which is the process of making sense of and understanding mathematical ideas and concepts inherent to procedures. Students use reasoning when they engage in mathematical argumentation, a process that involves making and justifying mathematical claims. In term of supporting the students' Mathematics learning achievement, [4] defines five standards address the processes of problem solving, reasoning and proof, connections, communication, and representation. Based on the result of interview to one of teachers in MTsN 1 Mawasangka, the students still have low learning achievement. This is caused by the students' weaknesses, those are in doing problem or solving new problem, they tend to focus to the example of the problem given by their teacher before without doing the activity of reasoning, evaluating, analyzing, synthesizing, generalizing, connecting, and proving. In curriculum of 2013, the objective of Mathematics emphasizes on the ability of practicing the way of thinking or reasoning, improving the creative activity, the ability of solving problem, and communicating idea. The good way to solve the Mathematics problem is to involve the reasoning way. [7] states that reasoning was a process of thinking which tries to connect the facts known to get a conclusion. Furthermore, he defines that the reasoning is an activity, a process or a thinking activity to conclude or make a new correct statement on some statements which their facts can be proven from previous assumption.

In learning activity, a teacher needs to apply a learning activity which encourage students to plan a problem solving. The problem solving is with strategic and various way. This will support the students' mathematical reasoning ability. In line with the learning method applied by the teacher, the students are expected to activity involved in finding their own problem solving. The reasoning ability, according to [7], is logical thinking that uses induction and deduction to reach a conclusion. Besides, [8] states that the reasoning activity is asking students to think logically, critically, and rationally. Those types of thought are part of the realization of learning behavior which connects to the problem solving. In the problem solving of Mathematics, the students use their reasoning powers to find the solving concepts.

The mathematical reasoning is a thinking activity which is realized to an analysis, because in Mathematics topic, they are not separated from students' reasoning power. On Mathematics topic, it can be understood through reasoning and it can be practiced through a learning activity of Mathematics. The students can apply the reasoning ability of Mathematics if a Mathematics problem they face has been understood. Some indicators of mathematical reasoning in learning Mathematics are the students can: 1) draw a logical conclusion; 2) give an explanation with model, fact, characteristic, and connection; 3) predict the answer and solution process; 4) arrange and test a conductor; 5) arrange a valid argument; and 6) arrange direct and indirect proof and use mathematical induction. According to the rule of [F], there are four indicators of mathematical reasoning, namely: 1) presenting a statement in oral, written, picture, and diagram; 2) doing mathematical manipulation; 3) checking a validity of an argument; and 4) draw a conclusion from a statement. In this research, the indicator of the mathematical reasoning ability observed is the indicator contained in the rule of Depdiknas.

The Mathematics learning is not only a simply knowledge relating to an abstract calculation. It is more interactive to invite students in a thinking or reasoning process. A good comprehension process can be done through an interesting learning activity, which is making the abstract Mathematics to be the concrete one. The learning model which is expected to improve students' mathematical reasoning ability is using problem-based learning model. It is supported by one of the strengths of Problem-Based Learning model which is explained that is to build the skill in solving problem.

Problem-Based Learning model is one of learning approaches which has characteristics of scientific learning which is very appropriate to apply in learning Mathematics. This learning is emphasize on students that learning Mathematics in not only a rote learning, but also is stimulating the students' reasoning power, so that it is expected to be able to solve the mathematical problem well and correctly. Problem-Based Learning in the essence is a problem first provided by the teacher. The referred problem according to [9] is the problem which is a statement that must be answered. Furthermore, he states that not all questions automatically will be a problem, but a question will be a

problem if it indicates challenge which cannot be solved with routine procedure known by the students. According to The Center of Development and Empowerment of Mathematics Educator and Educational Staff to improve the ability of solving problem, it needs to improve the students' ability in understanding problem, making mathematical model, solving problem, and interpreting the solution. In line with Polya, there are four steps of solving problem, those are understanding problem, planning the problem solving, applying solving plan, and rechecking answer. Problem-Based Learning according to Bould and Felleti is a learning approach by making confrontation to the students with practical problems. According to Dewey, PBL is a process of interaction between stimulus and respond. The connection between two ways is learning and environment. The environment gives stimulus to the students relating to the problem, and through the learning activity, the students' brains are functioned to response the environment so that it is able to solve the problem faced through process of investigating, assessing, analyzing, and finding the problem solving. The characteristics of Problem-Based Learning are 1) submitting questions or problem; 2) focusing on connection interdiscipline; 3) authentic investigating; 4) generating product and displaying it; and 5) collaborating. [4] states that the steps of Problem-Based Learning are as follows:

Table 1. Steps of Problem-Based Learning

No	Stage	Teacher's Activity
1	Students' orientation on problem	Explaining learning objective and motivating students to involve in problem solving activity
2	Organizing students to learn	Helping students to define and to organize learning task relating to the problem
3	Guided individual/group experience	Encouraging students to collect appropriate information, doing experiment to get explanation, and problem solving
4	Developing and presenting result	Helping students in planning and preparing appropriate result such as report, model and help them sharing the task to their friends
5	Analyzing and evaluating solving problem process	Evaluating learning result about topic that has been studied, asking group to present it

2. Research Methods

This research used a quasi-experimental method with the independent variable was Problem-Based Learning and the dependent variable was students' mathematical reasoning ability. The research design used was posttest only control group design. This research was conducted in MTsN 1 Mawasangka, Central Buton regency on grade VIII students. Sample of the research was selected using purposive sampling technique, so that it took class VIII.1 as the experimental class and class VIII.1 as the control class with the number of students for each class were 35 students. The instrument used in this research was test of students' mathematics reasoning ability on the learning topic of theorem of Pythagoras which had eight items and observation sheet of teacher's and students' activity. Technique of data analysis used two analyses, those were descriptive and inferential analysis. Testing of research hypothesis used T test through SPSS 22 for windows. Criteria of drawing conclusion was $t_{count} < t_{table}$ H_0 was accepted, $D_f = n_1 + n_2 - 2$, $\alpha = 0.05$, or concluding H0 was rejected if the level of calculated significance < determined level of significance

3. Results And Discussion

Based on the result of students' posttest, it is obtained the result of students' mathematical reasoning ability descriptively that is in the experimental class the ideal score is 100, minimum score was 37.5, maximum sore is 93.75, mode is 75, mean is 70.5, median is 75, standard deviation is 13.7, and variance is 189.7. While in the control class, the ideal score is 100, minimum score is 31.25, maximum

score is 81.25, mode is 56.25, median is 56.25, mean is 12.69, and variance is 161.04. The result of students' mathematical reasoning in class VIII.1 and VIII.4 at MTsN 1 Mawasangka can also be seen in the following table:

Table 2. Distribution of Mathematical Reasoning Ability Score of Students who are taught by PBL and Conventional

Scoring Range	Level of Students Mastery	PBL		Conventional	
		Freq	(%)	Freq	(%)
$86 \leq X \leq 100$	Very Good	6	17.15	0	0
$71 \leq X < 86$	Good	12	34.28	5	14.28
$56 \leq X < 71$	Moderate	10	28.57	9	25.71
$42 \leq X < 56$	Poor	6	17.15	19	54.28
$0 \leq X < 42$	Very Poor	1	2.8	2	5.7

The result of inferential analysis indicates that the data generated is normally distributed based on the Kolmogorov-Smirnov test. So that both groups (experimental and control class) comes from class with the homogenous variance data based on the result of Levene test. Based on the result of hypothesis test using t test (Independent Sample Test), the result of analysis obtains t_{count} = 4.061 with the significance value was 0.000. If it is compared with the significance 0.00, it obtains the result of 0.000 < 0.05, H_0 is rejected or in other words, the Problem-Based Learning influences the students' mathematical reasoning ability in grade VIII of MTsN 1 Mawasangka on learning topic of theorem of Pythagoras.

Based on the observation result, the implementation of Mathematics learning by using Problem-Based Learning model on topic of theorem of Pythagoras is 83.36% in the first meeting, 90.90% in the second meeting, 95.45% in the third meeting, 100% in the fourth meeting, 100% in the fifth meeting, and 100% in the sixth meeting. While the students' learning activities at Problem-Based Learning in the first meeting until the sixth meeting in a row are 55%, 68.33%, 76.67%, 80%, 81.67%, and 85%. The result of observation in the experimental class obtained descriptively ca be concluded that there is an improvement of behavior/character of students' learning. Most of students have had character of believable, careful, appreciation, and sense of social responsibility, fair, and care. Of the learning process, it is also known that some students indicate some abilities, namely 1) students' way of asking to their teacher and friends is polite; 2) students appreciate different opinion; 3) students can show good idea/opinion; 4) students become good listener; and 5) students can collaborate with friends. Those fifth aspects can be relevant to the definitions of mathematical reasoning ability which are stated by some experts, those are [9], [5], and [8].

4. Conclusions
Based on the research result, it can be concluded that Problem-Based Learning model influence the students' mathematical reasoning ability in grade VIII of MTsN 1 Mawasangka on the learning topic of theorem of Pythagoras. Descriptively, the mathematical reasoning ability of students who are taught using Problem-Based Learning is in very good category.

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