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The Mathematical Problem-solving Ability of Elementary Students Using Problem-based Learning Model with Open-Ended Approach

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Abstract

This study has a purpose of determining the effectiveness of problem-based learning models with open-ended approach on students' mathematical problem-solving abilities; the comparison of the effectiveness of problem-based learning with open-ended approach and discovery learning on students' mathematical problem-solving abilities; describe the students' mathematical problem-solving abilities. This type of research was a quantitative narrative with a true experimental design. Quantitative data collection was done using a test and interview. Based on the analysis and discussion, it can be concluded that the problem-based learning models with open-ended approach were effective in improving the students' mathematical problem-solving ability, it can be seen from the classical completeness of the experimental class which is more than 75%, the average of experimental class's problem-solving ability was higher than the class with discovery learning, the students with high problem-solving ability were able to meet all the indicators of problem-solving, the students with moderate problem-solving ability were not able to write down the problem-solving steps, and the students with low problem-solving ability were still making a mistake in the calculation and drawing conclusion.

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INTRODUCTION

Mathematics for some students was still considered as difficult subject to understand, because they have to deal with numbers and formulas (Setyaningrum, 2012) and then Program for International Student Assessment (PISA) in 2015 (Organisation for Economic Co-operation and Development, 2016), showed that Indonesia was ranked 62 out of 70 participating countries with an average score of 386 for math with an average score of international was 490. Other factors of less satisfying Indonesian student performance in PISA is the weak ability to solve non-routine or high level. Problem tested PISA consists of 6 levels (level 1 the lowest to the highest level 6). While students in Indonesia just got used to the routine questions on level 1 and 2.

Maftukhah (2018) NCTM (National Council of Teachers of Mathematics) states the general purpose of learning mathematics: learn to communicate (communication), learn to reason (reasoning), learn to solve problems (problem-solving), learn to associate the notion of ideas (connection), have a positive attitude towards mathematics (positive attitudes toward).

Students problem-solving ability based on observations and interviews with teachers fifth grade second semester of the academic year 2018-2019 Inpres Elementary School Tamalanrea 1 Makassar, there are some facts that mathematics learning outcomes were still under minimal pass score (70). It was proved that students lack in mathematics. Students still had difficulties to solve the mathematics problems. They were also having difficulties when asked to connect objects and concepts in mathematics. Therefore, the students need more encouragement and motivation from the teachers so their ability could be developed.

Problem-solving abilities should be owned by every student to familiarize facing various problems, both problems in mathematics, as well as the existing problems in other subject areas as well as problems in everyday life. Therefore, the mathematical problem-solving abilities need to be trained gradually so that students can solve their problems. One of the efforts made to provide innovation in learning by selecting the appropriate model that models problem-based learning (Hikmasari, Kartono, and Mariani, 2018).

The problem-based learning model is a learning model that can provoke students to engage in solving a problem through the stages of the scientific method so that students can learn the knowledge about such issues and also have problem-solving skills (Lubis, 2018). Problem-based learning was selected because some advantages, such as: can develop interpersonal relationships during group work, can improve students' critical thinking skills, and be able to develop the attitudes and skills of students to solve the problems that are given, particularly those associated with ordinary life in his environment. With the hope of using the model of problem-based learning can improve students' mathematical problem-solving ability.

According to Baden and Major cited by Farhan, and Retnawati (2014) the characteristics of PBL as follows: (1) the issues presented are complex issues related to the rill, (2) students learn in groups in order to identify and develop problems, (3) students acquire new knowledge of the problem situation, (4) the teacher acts as a facilitator, and (5) the issues presented in the form of problem-solving.

Problem-based learning will be better if combined with an open-ended approach because of the problems in mathematics are close and open. The close-ended problem has only one correct answer, while the open-ended problem has more than one correct answer or have many steps completion. In connection with the use of open-ended approach, a teacher must be intelligent in applying approaches that facilitate students to explore diverse problem-solving skills in ways that is true. The open-ended approach gives students the freedom to answer questions in various ways (Rustyani, Komalasari, Bernard, and Akbar, 2019). Alamiah, and Afriansyah (2017) said that the open-ended approach is a lesson that is given to students to gain knowledge or experience of finding, identifying, and solving problems in different ways. From some of the above opinion can be concluded that the open-

ended approach is learning that begins with the provision of an open problem where students are required to solve the problems by using various means that he believes according to his ability.

From the results of observations conducted by researchers at grade V Inpres Elementary School Tamalanrea 1 Makassar, there are some problems in the learning process. Among other problems in the field memorized concepts students have not been able to use in real life while having problems, as well as the students, get used to looking for the right answer only. Meanwhile, the problems of mathematics open (open-ended) are rarely given in the learning process of mathematics. Also, previous learning model has not been able to improve students' mathematical problem-solving process and outcomes. Students strive to operate the numbers that exist in the matter, but students do not understand what the problem is.

This is consistent with the results of research that has been done by Sumartini (2016) which concluded a few mistakes made by the students when working on the problems relating to the ability of mathematical problem solving: first, careless and less careful; second, errors transformed information; Third, the error process skills; and fourth, to understand about the error.

Further research Arief, Maulana, and Sudin (2016) suggest learning mathematics by using problem-based learning is significantly better than the study of mathematics by using the conventional approach in improving students' motivation. That makes researchers interested in researching with the reform.

It can be concluded that problem-solving ability is very important in the learning process by using models and approaches to learning more focused and efficient. Problem-based learning model open-ended learning expected the approach to improve math problem-solving skills of elementary school students.

Based on the above formulation of the problem of this research are: (1) Is the learning of problem-based learning with open-ended approach effective on the problem-solving ability of students?, (2) Is problem-based learning with open-ended approach is more effective problem-solving ability compared to discovery learning?: (3) How is the mathematical problem-solving ability of students?

In accordance with the formulation of the problems mentioned above, the purpose of this study is to determine: (1) The effectiveness of the learning of problem based learning with open-ended approach on the students' problem solving ability, (2) The comparison of the effectiveness of problem based learning with open-ended approach and discovery learning, (3) Describe the problem solving ability of students.

METHODS

The method used in this study was the quantitative narrative, with true experimental design. This study was using post-test only.

The study population was fifth-grade students of Inpres Elementary School Tamalanrea 1 Makassar in the academic year of 2018/2019. This study was using random cluster sampling, to obtained grade VB as an experimental class using the problem-based learning model with the open-ended approach and grade VA as a control class using discovery learning model.

The data collection techniques were done by using problem-solving ability tests, interviews, and documentation. Quantitative analysis techniques include test completeness and different test average. In this study, the subjects were selected by using purposive sampling and categorized according to their problem-solving ability as high, moderate, and low.

RESULTS AND DISCUSSION

Completeness Test

Data of the study include the initial capability data and post-test mathematical problem-solving abilities gained from the student grade VA and VB Inpres Elementary School Tamalanrea 1 Makassar in the academic year of 2018-2019. Post-test data obtained from the test item description of mathematical problem-solving ability consist of 5 questions.

The learning process of problem-based learning model with an open-ended approach applied in the grade VB into experimental class, and grade VA being applied control class of discovery learning. At the end of the second study was completed classes given a final test or post-test.

VB class learning completeness test based on the value $z_{value} = 2.386$ compared with the z_{table} with a 5% error level is 1.64. Because $z_{value} > z_{table,}$ which means that H_0 rejected and accepted H_1 where students who received problem-solving ability test scores (TKPM) of at least 70 is more than 75%.

The Average Different of Mathematical Problem-solving Ability

Different test to determine differences in the mathematical problem-solving ability of students in a class with the learning of problem-based learning with open-ended approach (experimental class) and classroom learning with discovery learning (control group). The results of the post-test for all three categories of mathematical problem-solving abilities are presented in table 1.

Table 1. Mathematical Problem Solving Ability Students by Category

Class	Category	The number of students	Mathematical problem-solving ability	
			Average	Standard deviation
Experiment	High	7	98.85	1.57
	Moderate	20	84.2	7.19
	Low	4	67.25	6.13
Control	High	7	92.42	4.15
	Moderate	16	75.25	4.00
	Low	8	61.37	1.18

The result of the calculation of the average difference test using SPSS, as shown in table 2.

Table 2. Test of Independent Sample t-test Post-test

$\bar{x}_1$	$\bar{x}_2$	t_{value}	t_{table}	Criteria	Conclusion
75.55	85.32	3.401	2.039	$t_{value} > t_{table}$	H_1 accepted

Table 2 shows that the average value of the post-test VB class problem-solving abilities and VA are 85.32 and 75.55. Test results of the different test using independent sample t-test concluded that $t_{value} > t_{table}$ or 3.401 > 2.039, which means an average of students 'mathematical problem-solving ability VB class higher than the average of students' mathematical problem-solving ability VA class.

Problem Solving Ability of Students Category High

Students who have problem-solving capabilities in the high category showed satisfactory results. Based on information obtained from figure 1 answers, the subject can understand the problem very well. Seen the subject can write what they know and asked of matter. Polya is capable of troubleshooting steps exactly and systematically described, which includes understanding the issues, strategic planning, perform calculations, and to re-examine the process and results. Figure 1 listed higher category of students' work.

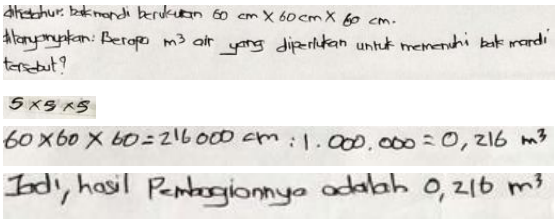

Figure 1. Results of TKPM of High Student Category

Based on interviews found that students with serious problem-solving ability can explain the back problems of mathematics and conclude the work that has been done.

Problem-solving Ability of Students Category Moderate

Students who have problem-solving skills in the middle category showed good results.

Based on information obtained from figure 2 answers, the subject can understand the problem well. Seen the subject can write what they know and asked of matter. Polya capable of troubleshooting steps outlined quite well that includes understanding the issues, strategic planning, perform calculations, and to re-examine the process and results. Subjects are experiencing difficulties at the stage of planning a strategy, not a subject he wrote the formula used directly perform calculations. Figure 2 listed intermediate category of students' work.

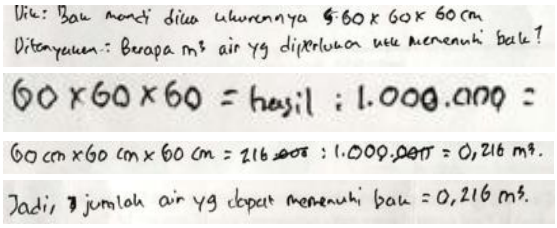

Figure 2. Results TKPM Secondary Students Category

Based on interviews found that students with a secondary problem-solving ability can explain the back problems of mathematics and conclude the work that has been done, but it does not explain the formula used.

Problem Solving Ability of Students Category Low

Students who can be problem-solving in the low category showed unfavorable results. Based on information obtained from figure 3 answers, the subject can understand the problem well. Seen the subject can write what they know and asked of matter. Polya capable of troubleshooting steps outlined quite well that includes understanding the issues, strategic planning, perform calculations, and to re-examine the process and results. Subjects experiencing difficulties at this stage of calculation, he is mistaken when converting centimeters to meter and erred in doing conclusion. Figure 3 listed intermediate category of students' work.

Based on interviews, it was found that students with the low problem-solving ability do not understand when explaining returned mathematical problems and summarize the results of the work already done but did not explain how he had the time of calculation.

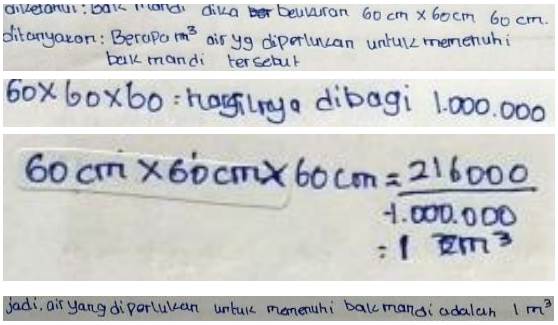

Figure 3. Results of TKPM of Students Category Low

CONCLUSION

Based on the description and discussion of the results of the study be concluded that: the ability of mathematical problem-solving with the learning of students in the class of problem-based learning with open-ended approach achieve the completeness of the learning; the mathematical problem-solving ability of students in a class with a learning of problem-based learning with open-ended approach was better than classroom learning with discovery learning; students with high problem-solving abilities were able to complete and explain the problem of properly and clearly; students with problem-solving ability in the medium category does not write the steps of completion used, and students with problem-solving capabilities in the low category were still making a mistake in doing calculations and conclusion.

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