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The Effect of Problem-Based Learning and Direct Instruction Learning on Creative Thinking and Mathematics Problem Solving Ability of Students

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***Abstract*— This purpose of this research to know differences: (1) improvement of creative thinking ability between students who are given problem based learning with students who are given direct learning. (2) improvement of problem solving abilities of mathematics students who are given problem-based learning with students who are given direct learning. This research is quantitative, with a kind of quasi experimental study. The sample in this study were 30 students in the class VII-1 and 30 students in the class VII-2. Data were analyzed by analysis of covariance (ANAKOVA). Conclusion of study is; (1) there is a difference in the improvement of the creative thinking ability of students who are given problem-based learning by direct learning. (2) there is a difference of improvement of problem solving ability of mathematics between students who are given problem based learning with direct learning.**

Keywords: Problem Based Learning, Creative Thinking Ability, Problem Solving Ability

I. INTRODUCTION

Improving the quality of mathematics learning, especially on intensity and quality in learning will build and develop students' basic mathematical abilities. The National Council of Teachers of Mathematics states that there are five basic mathematical abilities which are the standard process of mathematics education, namely "(1) the ability to solve problems (problem solving); (2) reasoning ability; (3) Communication skills; (4) Ability to make connections and (5) representation capabilities [8].

But the fact is that the basic mathematical abilities have not been achieved. The research results of Trends In International Mathematics and Science Study (TIMSS: 2011) showed that Indonesian students were ranked very low in the ability (1) to understand complex information, (2) theory, analysis and problem solving, (3) the use of tools, procedures and problem solving; and (4) investigating. Therefore there needs to be a change in improving students' basic mathematical abilities.

The main goal of students having basic math skills is to equip students with the ability to think logically, analytically, systematically, critically, and creatively, as well as the ability to cooperate in life in the future. In the current development, the problems encountered in mathematics learning more and more complicated and lead to the educational goals of the 21st century creative. So indispensable in the learning ability of creative thinking and problem solving, to be able to resolve the problem of mathematics

The ability to think creatively has been developed as a factor in the success of mathematics learning. In mathematics learning, student creativity is needed to solve complex and non-routine problems. Creative thinking is a mental activity that deals with sensitivity to problems, considering new information and unusual ideas with an open mind and can create relationships in solving problems [10].

Creative thinking as a combination of logical thinking and divergent thinking based on intuition in consciousness. So it can be concluded that the ability to think creatively is a high-level thinking ability that must be possessed from an early age is useful to generate new ideas from previous ideas as a solution to the problem [12].

In addition to the ability to think creatively, problem-solving ability becomes one of the abilities that must be developed in mathematics learning. That problem solving is not just a goal of learning mathematics but also a major tool for doing or working in mathematics [8]. Problem solving significantly plays an important role in the teaching and learning of mathematics. Through problem solving, students can improve their review of thinking skills, apply procedures, deepen their conceptual understanding [2]. This is in line with mathematical problem soving has long been seen as an important aspect of mathematics, teaching mathematics, and learning mathematics [6].

Based on the ability to think creatively and solve the above is an important aspect in the learning process and has a relationship with each other. But basically students who have good (high) students 'creative thinking skills do not guarantee that students' mathematical problem solving skills will also be high. Students who have not good (low) students' creative thinking skills also do not guarantee that they will have low mathematical problem-solving skills, as well as better. Therefore in this case it is necessary to review to see the effect of the relationship between the two capabilities.

The difficulty of improving students' creative thinking skills and problem solving students because the learning used by teachers in general in schools is teacher-centered learning. Direct teaching is a learning center that is teaching center. The direct teaching model is one of the teaching models specifically designed to support student learning processes related to well-structured declarative knowledge and procedural knowledge that can be taught with a gradual step-by-step activity pattern. Weaknesses in mathematics learning today students cannot connect mathematical concepts in schools with their daily experiences [15].

Mathematical learning is too formal, less related to meaning, understanding, and application of mathematical concepts, and fails to provide sufficient attention to reasoning and problem solving abilities [9].

The learning gives an impression that is not good for students, because it can cause negative attitudes of students towards mathematics. Mathematical learning is basically designed to provide continuous enjoyment and comfort for students without imposing anything on them [5].

To implement and improve the ability of creative thinking and problem solving students requires innovation and the right model One of them, with a problem-based learning model. According to Dewey problem based learning is the interaction between stimulus and response, is a relationship between two directions of learning and the environment. Provide feedback to the student environment in the form of aid and problems, while the nervous system of the brain function effectively interpert aid so that the problems encountered can be investigated, assessed, analyzed, and sought to solve well [15].

Problem-based learning begins with giving complex problems to students, thus providing opportunities for students to explore students' abilities and habits in solving a mathematical problem. Problem based learning has an effect on content knowledge which provides greater opportunities for students to learn with more involvement and increase student active participation, motivation and interest among students. This causes students to have a positive attitude towards mathematics and help them to improve their achievements for the most part and which will cause long-term memory [11].

Therefore, based on the description that has been explained, the purpose of this study was to determine the difference of improving creative thinking and mathematic problem solving ability students that given problem based learning with direct instruction

II. RESEARCH METHODS

The research is a quasi-experimental research (quasi experiment). Data analysis techniques used in the study is an analysis of covariance (ANACOVA) This research was conducted in SMP Negeri 1 Sei Kanan Labuhan Batu regency year 2017/2018 second semester of seventh grade at the rectangular material. Subjects in this study were class VII-1 as the experimental class 1 which received problem-based learning and class VII-2 as the experimental class 2 which received direct instruction. Experimental design in this research is the design of pretest-posttest control group

III. RESEARCH RESULTS

A. Creative Thinkng Ability

There was significant difference of improving mathematical creative thinking ability between students that given problem based learning and direct instruction at students SMP Negeri 1 Sei Kanan.

Based on the results of normality test, homogeneity test, independence test / significance test and alignment of regression models, the two regression alignment test was fulfilled so to test differences in creative thinking abilities taught by problem based learning with direct instruction can be analyzed using anacova as a modification analysis of variance. For this reason, an analytical hypothesis was formulated by estimating the distance between the two linear regression lines for experimental group 1 and experimental group 2 of each posttest score from the means of posttest scores the experimental group 1 and posttest scores the experimental group 2. The hypothesis is as follows:

$H_0 = \beta_1 = \beta_3$
$H_1 = \beta_1 \neq \beta_3$

To test the hypothesis several values need to be summarized in the results of the calculation of the mathematical creative thinking ability in eksperimental class 1 and experimental class 2 ANACOVA described in the following table 1 :

TABLE I. Covarian Analysis for the Complete Design of Creative Thinking anbility

Source of variation	**Sums of Squares or Products**			**Df**
	X	**Y**	**XY**	
Treatments	23491.47	18302.91	4620.07	1
Error	391.63	305.13	127.8	58
Total	23883.10	18608.05	4747.87	59
Source of variation	**Adjusted SS**	**Adjusted Df**		
Treatments	325.404	1		325.404
Error	263.429	57		4.62
Total	588.832	58		

Based the calculation of result to mathematical creative thinking ability in table I is obtained F_{count} = 70,43 and based on table F for $\alpha = 0{,}05$ obtained $F_{(0,95,1:61)}$ = 4,00. Because

$F^* \geq F_{(0,95,1:61)}$ then $H_0 : r_1 = r_2 = 0$ is rejected. It indicate that there was significant difference of improving mathematical creative thinking ability between students that given problem based learning and direct instruction.

To mathematical creative thinking ability obtained the pretest significant value is 0,00 < 0,05 ; it can be concluded that at the 95% confidence level the posttest results are influenced by the students' pretest ability before being given problem based learning.

Regression models that have been obtained for mathematical creative thinking ability in eksperimental class 2 is $Y_K = 5,39 + 0,34\ X_K$ and eksperimental class 1 is $Y_E = 8,24 + 0,32\ X_E$. Next, because both groups are homogeneous and the linear regression line equation constant for experimental group mathematical thinking 1 8.24 is greater than the experimental group 2 linear regression equation constant of 5.39, the geometrical regression line for experimental class 1 is above the experimental class 2 regression line.

It indicate that there was significant difference and and the hypothesis above is the difference in line height that is affected by the regression constant. The height of the regression line describes the student learning outcomes, that is when X = 0 the regression equation for mathematical creative thinking ability with problem-based learning is obtained Y = 8,24 and direct instruction regression equation is Y = 5,39. It means that it can be concluded that the ability of creative thinking in mathematics taught by problem-based learning is better than direct learning on rectangular material.

B. Problem Solving Ability

There was significant difference of improving mathematical problem solving ability between students that given problem based learning and direct instruction at students SMP Negeri 1 Sei Kanan.

Based on the results of normality test, homogeneity test, independence test / significance test and alignment of regression models, the two regression alignment test was fulfilled so to test differences in creative thinking abilities taught by problem based learning with direct instruction can be analyzed using anacova as a modification analysis of variance. For this reason, an analytical hypothesis was formulated by estimating the distance between the two linear regression lines for experimental group 1 and experimental group 2 of each posttest score from the means of posttest scores the experimental group 1 and posttest scores the experimental group 2. The hypothesis is as follows:

$H_0 = \beta_2 = \beta_4$
$H_1 = \beta_2 \neq \beta_4$

To test the hypothesis several values need to be summarized in the results of the calculation of the mathematical problem solving ability in eksperimental class 1 and experimental class 2 ANACOVA described in the following table 1 :

TABLE II. Covarian Analysis for the Complete Design of Problem Solving anbility

Source of variation	**Sums of Squares or Products**			**Df**
	X	**Y**	**XY**	
Treatments	227042.74	86406.6	36002.21	1
Error	8666.3336	6805.2	3276.267	58
Total	235709.07	93211.8	39278.477	59
Source of variation	**Adjusted SS**	**Adjusted Df**		
Treatments	7467.1435	1		7467.143537
Error	5566.6225	57		95.97625069
Total	13033.766	58		

Based the calculation of result to mathematical creative thinking ability in table I is obtained F_{count} = 77,80 and based on table F for $\alpha = 0,05$ obtained $F_{(0,95,1:61)}$ = 4,00. Because $F^* \geq F_{(0,95,1:61)}$ then $H_0 : r_1 = r_2 = 0$ is rejected. It indicate that there was significant difference of improving mathematical problem solving ability between students that given problem based learning and direct instruction.

To mathematical problem solving ability obtained the pretest significant value is 0,00 < 0,05 ; it can be concluded that at the 95% confidence level the posttest results are influenced by the students' pretest ability before being given problem based learning.

Regression models that have been obtained for mathematical creative thinking ability in eksperimental class 2 is $Y_K = 22,31 + 0,50\ X_K$ and eksperimental class 1 is $Y_E = 47,65 + 0,32\ X_E$. Next, because both groups are homogeneous and the linear regression line equation constant for experimental group 1 mathematical problem solving ability is 22,31 is greater than the experimental group 2 linear regression equation constant of 47,65 , the geometrical regression line for experimental class 1 is above the experimental class 2 regression line.

It indicate that there was significant difference and and the hypothesis above is the difference in line height that is affected by the regression constant. The height of the regression line describes the student learning outcomes, that is when X = 0 the regression equation for mathematical problem solving ability with problem-based learning is obtained Y = 47,65 and direct instruction regression equation is Y = 22,31. It means that it can be concluded that the ability of problem solving in mathematics taught by problem-based learning is better than direct learning on rectangular material.

IV. DISCUSSION

Based on the results of the study that the problem-based learning model is more effective and becomes an alternative in

improving the mathematical creative thinking ability and problem solving students. Problem-based learning is an active learning that emphasizes the process of thinking in solving problems.

The results of this study are in line with several previous studies, namely research related to the level of thinking ability can be seen in the study entitled : Analysis of Difficulty Students' Mathematical Creative Thinking Process in the Application of Problem Based Learning (PBL) Models. Thesis. Medan: PPs Medan State University. The results showed that: the level of creative thinking ability of 50 students with creative technology is very 38%, the ability to think creatively is 'low' as much as 4%, ability to think creatively 'medium' as much as 42%, creative thinking skills 'high' as much as 12%, and creative thinking skills 'very high' as much as 4%; analysis of the difficulty of the mathematical creative thinking process of this research is the difficulty in applying the principles and solving verbal problems along with the inability to detail problem solving that is characterized by the difficulty of principles and procedures which include inability to plan solutions; nability to carry out discovery activities; inability to abstract patterns, inability to express their meaning and unable to apply principles. n addition, there is an inability to provide many ideas, inability to solve problems from different perspectives, inability to solve problems in their own way, and the inability to develop or detail in a situation; the overall percentage of active activity of students has been at the ideal time tolerance interval set so that learning by applying the Problem Based Learning (PBL) model especially in the mathematical creative thinking process provides opportunities for students to explore various kinds of answers and ways of solving by taking into account fluency, flexibility, originality, and elaboration [13].

In the following study conducted in his research entitled Creative Wall Based On Thinking Process In Solving Mathematics Problem Model, the results showed 1) there were 23.33% students were not completed and only reached the preparation stage, called the low category group ;) there are 60% of students reach the illumination stage even though to get to this stage students need a long time, called the medium category; and 3) 16.67% of students have completed the verification stage, called the high category group. For students with low and medium ability categories, they still need assistance when experiencing obstacles in their creative thinking process, while high ability students need enrichment material [7].

Problem-based learning also has an effect on problem solving abilities such as research conducted by entitled The Effect Of Learning To Students' Problem Based Mathematical Problem Solving Ability also shows that there is an effect of using problem-based learning models on problem solving abilities Mathematics of Al-Yusriyah MTs students can be seen from the results of hypothesis testing, the results obtained by Ho are rejected and Ha is accepted. Decision making can be seen from table t (2,988) > t (1,684). It can be seen that the average mathematical problem solving ability of experimental class students is greater than the average control class. This means that students who have been given an experimental class teaching using problem-based learning, mathematical problem solving abilities are higher when compared to students' problem solving abilities in the control class with conventional learning. This means that there is an effect of using problem-based learning models on mathematical problem solving abilities of students of Al-Yusriyah MTs [1]. The same thing was found in the study entitled Improving the Students Mathematical Problem Solving Ability by Applying Problem Based Learning Model Learning Model in VII Grade at SMPN 1 Banda Aceh Indonesia [3].

V. CONCLUSION

The conclusions that can be presented in this research are as follows:

1. There was significant difference of improving mathematical creative thinking ability between students that given problem based learning and direct instruction. This can be seen from the results of the analysis of covariance (ANACOVA) for F count is 70.43 greater than F table is 4.00. The regression equation constant for problem-based learning is 8.24 greater than direct learning, which is 5.39. Descriptively obtained an average fluency aspect experimental group increased 0.47, flexibility aspect increased 0.96, elaboration aspect increased 0.94, originality aspect increased 1.46, while the overall aspect increased by 3.83. Whereas the fluency control group experienced an increase of 0.07, the flexibility aspect increased by 0.60, the elaboration aspect increased by 0.50, the originality aspect increased by 0.97, while the overall aspect increased by 2.00.
2. There was significant difference of improving mathematical problem solving ability between students that given problem based learning and direct instruction. This can be seen from the results of covariance analysis (ANACOVA) for F count is 77.80 greater than F table is 4.00. The regression equation constant for problem-based learning is 47.65 greater than direct learning, which is 22.31. Descriptively obtained an average of the experimental group I aspects of understanding the problem has increased 10.43, the aspect of planning the solution has increased 7.1, the aspect of calculating has increased 11.56, the aspect of re-examination has increased 6.06, while the overall aspect increased 29.17. While the experimental group II aspects of understanding the problem has increased 0.34 aspects of planning the solution has increased 4.37, the calculation aspect has increased 5.67, the aspect of re-checking has increased 2.2, while the overall aspect has increased 12.57.

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