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The Improving of Problem Solving Ability and Students' Creativity Mathematical by Using Problem Based Learning in SMP Negeri 2 Siantar

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Abstract
The purpose of this study was to determine: (1) the differences improving of problem solving ability and students' creativity mathematics through problem based learning with students who were through conventional learning, (2) the students' answers through problem based learning and conventional learning. Quasi experimental research with population was all of students in grade VII SMP N 2 Siantar that consist of 7 class, with a randomly class selected and selected class VII-2 as an experiment class and class VII-5 as a control class sample of each respondents were 30 people. Instrument problem solving ability and creativity of students in the description form had been qualified of validity and had a reliability coefficient was 0.858 and 0.857 for each test. By using different test and descriptive analysis of the results were as follows: (1) improving the ability of mathematical problem solving and creativity of students' who were taught with a problem based learning was higher than conventional learning, and (2) the students' answers were taught with problem-based learning were more varieties and better than conventional learning.
Keywords: Problem Based Learning, Problem Solving Ability and Creativity Mathematics

1. Introduction

Math is a basic science that has an important role in effort to mastery of science, technology and also in everyday of our life. The same thing also expressed by Soedjadi (2004) that mathematics education should pay attention to two purposes: (1) the purpose of which is formal, i.e the arrangement of reason and personal formation of students and (2) the purpose of which is material, the application of mathematics and mathematical skills in everyday life. This is similar to that expressed Cockroft (1982) argues that: "Mathematics should be taught to the students because of (1) is always used in all facets of life; (2) all areas of life requires appropriate mathematical skills; (3) is a powerful means of communication, concise, and clear; (4) can be used to present information in a variety of ways; and (6) give satisfaction to attempt to solve a challenging problem." however many students see mathematics as a field of study that is difficult to understand. This happens because of the mathematics presented in a form that is less appealing and seems difficult for students to learn; as a result students often feel bored and do not respond well lesson. In addition, methods of learning undertaken by teachers is less varied and tend to restrict students to be creative while learning to express his thoughts so that students are less interested in learning math and learning outcomes are less than optimal. As a result, students do not understand what the significance of mathematics in everyday life and students are less interested and less motivated to learn mathematics so that students are more passive when learning mathematics, reluctant, afraid or shy in expressing its ideas in mathematical problem solving. This is in accordance with the opinion of Abdurahman (2009) that: "Of the various fields of study that are taught in school, mathematics is a field of study that is considered most difficult by the students, both are not learning disabilities, and especially for the students who are learning disabilities".

The standard process of learning mathematics according to the National Council of Teachers of Mathematics (NCTM) (2000) is problem solving, reasoning and proof, communication, connections and the representation. Problem solving is a standard part of the mathematical process that very important because in the learning process and completion, students are allowed to use the skills and experience they have to be applied in the resolution of problems that are not routine because after studying, the students will go into the community that full of social problems.

The same thing also expressed by Sumarmo (1994) states that problem solving is very important that it becomes a general purpose math teaching math even as his heart. The process of thinking in problem solving strategy requires the ability to organize. It will train people to think critically, logically, creatively indispensable in dealing with the development of society.

In fact, when students are exposed to issues that are not routine, for example, related a story about solving problems related to everyday life, the value obtained by the student will usually be lower when compared to the multiple-choice questions. So, it still looks pretty big gap between what is expected in the learning of

mathematics with reality to be achieved. This has become one of the problems for teachers as problem solving is needed to increase the power of reason and can train students to be able to think critically, logically and creatively. From the answers given by the students can be seen that most of the students have difficulty in solving the problem into mathematical form. In the problem-solving is often found that students are only concerned with the final answer without understanding how the process if the answer is correct or not. This often results in the students' incorrect answers. Students also often find it difficult to determine what concepts are used to solve the problem. They tend to solve the problem with arithmetic operations that they think is right without understanding the problem first.

To solve the problems that are not routine that requires problem solving ability of students to be able to through the stages of problem solving as defined by Polya (1985) states in resolving the problem solving, there are four steps that must be done, namely: "(1) to understand the problem, (2) plan for its completion, (3) conduct problems according to plan, and (4) to check back for all the steps done."

In addition to problem-solving ability in a non-routine matters are also needed creativity of the students, because the routine is not necessary to solve the problem are also new ways to solve them. In fact the learning of mathematics in Indonesia tends to be limited to the mastery of the subject matter or rely on low-level cognitive aspects of development that are not able to develop the students' creativity. This is in line with the stated Slameto (2010) that: "The low creativity is not only the SPG graduate teachers but also the students in Higher Education, memorizing system still dominates in PT, in other words the creativity of students is less / no there. "

Though basically needed to answer that question because the students' creativity in problem-solving are necessary components of creativity as expressed by Munandar (1999) that creativity can be defined as the ability of reflecting the smoothness, suppleness (flexibility), and originality in thinking, as well as the ability to elaborate (develop, enrich, itemize) an idea ". The important thing about creativity is not an invention of something new for others (who had never known before) but rather the result of the creativity of a new thing for the students themselves instead of new things for other people or surroundings. Learning process that takes place during the time in the classroom more frequently used algorithms (steps) settlement exemplified by teachers so often happens if matter is changed slightly, the students are confused in the finish. Teachers should know how to teach a more frequent use of algorithms settlement replaced with student-centered learning. According to Saragih (2009), the learning process that doing in the classroom is more often using algorithm (steps) finishing that made the example by the teacher so that it often happens that if the question is a little changed so that the students feel confuse in finishing it. It should be used the model of teaching from the teacher who often use algorithm, the finishing is changed focused on students' centre.

One of the ways that can improve problem-solving abilities and creativity of students is Problem Based Learning (PBL). PBL is one of the innovative learning models that can provide the conditions for students active and creative. According to Arends (2008) Problem Based Learning is learning that prioritizes the filing of a problem or question, focusing on the linkages between disciplines, authentic inquiry, collaboration, and produce work or show results.

PBL (problem based learning) also help students become independent students. In this PBL, the role of the teacher is to ask a matter of asking questions, facilitating student inquiry, and support student learning. In line with that in a study conducted by Nufus (2013) showed that there is an increase in communication and problem solving skills through the application of mathematical problem-based learning in the classroom VII SMP. In addition, Mandasari (2013) in his study also showed an increase in the ability to think creatively and solving mathematical problems students are given a problem based learning model using software autograph better than students who are given the usual learning. Thus, as the results is assumed by Saragih and Afriati (2012) stated that the process of learning that focused on the students can improve the ability high order mathematical thinking students' of junior high school. As the same results shown from Saragih and Rahmiyana (2013) stated that by inventing the learning model of cooperative learning type of STAD can increase the ability of mathematics communication of students' senior high school.

By applying PBL, is expected to be obtained student learning more meaningful, to give a stronger impression on the students, the students can overcome difficulties in learning mathematics and the students themselves can also resolve the problem solving related to everyday life as well as the students themselves are able to develop students' creativity.

Based on the above issues will be examined in this study are: (1) How the differences increase problem solving ability and creativity among students taught mathematics through problem-based learning model with students who are taught through conventional teaching? (2) How the responses of the students who are taught through problem-based learning and conventional learning?

2. The Literature Review

2.1. Problem Solving Ability

Indeed, the core of learning the problem solving is that the students should be accustomed to working on the

problems that not only requires a good memory alone. Therefore, in addition given the challenging problems, during class, a math teacher can only begin the process of learning by asking 'contextual issues' are quite challenging and interesting for the students. Students and teachers are then jointly solving the problem earlier while discussing theories, definitions and mathematical formulas.

Problem solving ability is a process for accepting the challenge of answering the finishing non routine math problem in the contextual form or story questions. To finish the story about the used strategies or measures formulated by Polya (1985) in problem solving, there are four steps that must be done, namely: (1) understand the problem; (2) planning solution; (3) carry out the problem according to plan and (4) to check back for all the measures undertaken.

From the opinions above, it can be concluded that students' mathematical problem solving ability is the activity of students in solving problems non routine contextual or story questions by using the four-step problem solving according to Polya.

2.2. Creativity

Creativity is complex fields of study, which give rise to differences definition of creativity expressed by many experts are complementary definitions. Creativity emphases on ideas or thoughts and discoveries that bring results that are new or relatively new range in creative thinking and creative results. According Munandar (1999) features the ability to think creatively (aptitude), namely: (1) current thinking skills (fluency), (2) flexible thinking skills (flexibility), and (3) original thinking skills (novelty).

Based on the description above definition can be concluded that creativity is essentially a person's ability to give birth to something new, either in the new form of ideas and real work, either in the form of characteristics or non aptitude, both in new work or in combination with things that already exist, all of which are relatively different from that already exist previously. Indicators for creativity are fluency, flexibility, and novelty.

2.3. Problem Based Learning (PBL)

Problem-based learning model focuses on students by directing students to become independent learners actively and directly involved in group learning. According Arends (2008), problem-based learning is a learning approach where students work on authentic problems with a view to construct their own knowledge, develop inquiry and higher level thinking skills, and develop independence and confidence.

According Trianto (2010) there are five stages of PBL: (1) student orientation at issue; (2) organize the students to learn; (3) guiding the investigation of individual and group; (4) develop and present the work and (5) analyze and evaluate the problem-solving process.

So the model of Problem Based Learning is a learning model that focuses more on students who directs students to become independent learners actively and directly involved in the study group that includes five stages of PBL by Trianto as syntax learning models.

2.4. Conventional Learning (CL)

Conventional learning is a learning method teacher center where the teacher will explain the material and students will only listen to it. Correspondingly, according Ruseffendi (1991), the conventional learning generally dominate classroom teachers, pupils are generally passive and just accept. In conventional teaching teachers to teach a number of students in a room with almost the same capabilities, and interests and abilities of students are also assumed to be equal. Thus, conventional learning is learning which is often used by teachers in the classroom the teacher usually only to transfer knowledge to the learners.

3. Methods

This research was a quasi experimental study by control group pre test- post test, for each student conditions could not be controlled entirely as preparation of students prior learning in the classroom, students 'relationships with parents, students' relationships with their environment, additional tutoring in students to get out of school, and so forth. The population in this study was all students of SMP Negeri 2 Siantar years 2013/2014 that consists of 7 classes. The samples were randomly class selected and selected class VII-2 as the experimental class (using PBL) and classes VII-5 as the control class (using the Conventional Learning/CL) which consists of 30 people. The instrument of the research using essay test which consists of a test of mathematical problem solving ability and creativity as many as 4 questions and mathematics creativity as many as 3 questions. Both of test given previously and after doing that, this thing is done to get increase for both of them in the mathematical ability.

Data analysis is begun by determine normalized gain on ability problem solving students' mathematics and creativity for two experiments and control class. To do that is used formula (Hake, 2007).

$$g = \frac{post\,test\,score - pretest\,score}{\max imum\,possible\,scores - pretest\;score}$$

Next step normality and homogeneity test on normalized gain that normalization of each by using Kolmogorov – Smirnov test (K-SZ) and Leneve test. For testing hypothesis is done different test on gain normalized data either problem based ability and students mathematic creativity. All of counting are done by helping software SPSS

16.00. For processing data students answer either on problem solving ability or students creativity mathematics will be analyzed by using qualitative descriptive.

4. Results

The result of description for the calculation of gaining index test results were Problem Solving Ability (KPM) and tests of Mathematical Creativity (KM) students in the class PBL and CL classes were presented in the table below:

Table 1. Mean and Standard Deviation Gain Index Test KPM and KM on PBL class and CL class

Class	Tes KPM		Tes KM	
	Mean	Standard Deviation	Mean	Standard Deviation
Class Experiment	0,7675	0,2659	0,4064	0,2064
Class Control	0,2973	0,1749	0,2311	0,1859

From table 1. Shown that the average gain index tests students' problem-solving abilities were taught by PBL (0.7675) were higher than students taught by CL (0.2973). While the Gain Index mathematical creativity test students were taught by PBL (0.4064) were higher than students taught by CL (0.2311). To determine the significance of the data on the statistical testing with different test, with first tested for normality and homogeneity. The results of homogeneity and normality tests were shown that the two groups of samples have homogeneous variance and normal distribution of data. The results of different tests on the ability of mathematical problem solving and creativity between the experimental group and the control group were shown in table 2 and 3 below.

The null hypothesis (H_0) of this research is the improvement of mathematical problem solving ability of students who are taught by PBL no higher than students taught by conventional learning. Data were analyzed with a different test, with significance = 0.05 using SPSS 16:00. KPM students' data were presented in Table 2.

Table 2. Differential test against the data N_Gain KPM

One-Sample Test

	Test Value = 0					
					95% Confidence Interval of the Difference	
	T	Df	Sig. (2-tailed)	Mean Difference	Lower	Upper
N_Gain	12.653	59	.000	.5318483	.447742	.615954

Based on table 2 above it was obtained that value t = 12.653 with a significance value (sig) is 0.000. Thus H_0 is rejected. It can be concluded that the increase in mathematical problem-solving ability of students who were taught by PBL models higher than students taught with conventional learning.

The null hypothesis (H_0) of this research is the improvement of mathematical creativity of the students taught by PBM no higher than students taught by conventional learning. Data were analyzed with a different test, with significance = 0.05 using SPSS 16.00. KM student data are presented in Table 3.

Table 3. Differential test against the data N_ Gain KM

One-Sample Test

	Test Value = 0					
					95% Confidence Interval of the Difference	
	T	Df	Sig. (2-tailed)	Mean Difference	Lower	Upper
N_Gain	11.545	59	.000	.3186833	.263447	.373920

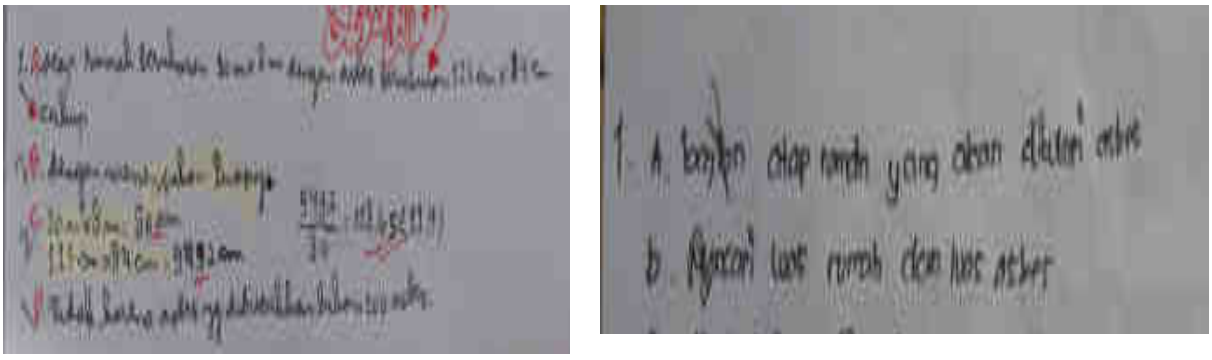
Based on table 3. it was obtained that value of t = 11.545 with significance values (Sig) is 0.000. Thus H_0 is rejected. It can be concluded that the improving in mathematical creativity of students who are taught by PBL models higher than students taught with conventional teaching.

The process of students' answers on each study is analyzed with descriptive analysis with the goal of seeing students' ability to solve problems. Based on student answer sheets, the following process would be presented some students' answers to test the ability of mathematical problem solving and creativity of students.

Problem to Item No. 1

The roof of a house has measuring 10m x 8m will be closed asbestos measuring 113cm x 84 cm. (a) Write down what information you get from the question. It is enough data to determine the amount of asbestos that needed?

(b) Write down how you can determine the amount of asbestos.; (c) Calculate the required asbestos lot by using the steps in section b .; (d) If the answer 100 asbestos Andi justified answer, specify your reasons.



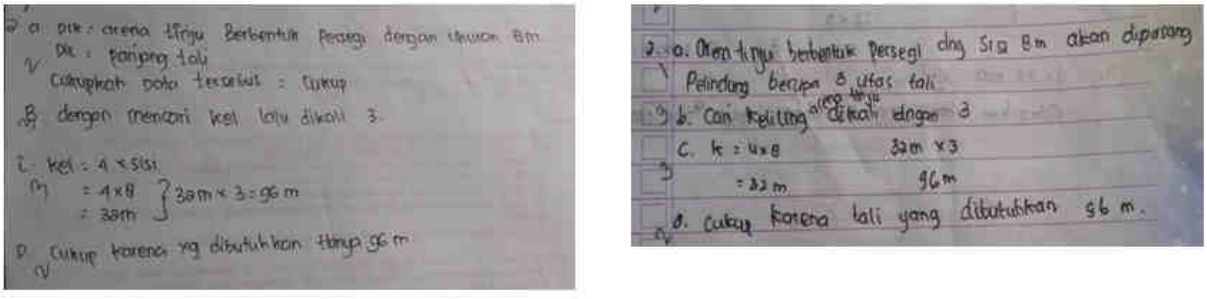
(a) **(b)**

Figure 1 (a) Answer Class PBL, (b) Answer Class CL

From Figure 1 (a). above it can be seen that students are able to write what is known and the adequacy of the data but have not been able to write anything that is asked, then students have also been able to plan for problem solving, but less able to resolve the problem and the steps to re-examine the student is still not true because the steps of problem solving is still wrong. From Figure 1 (b). students are able to write what is known but has not been able to write down what is asked and the adequacy of the data, then the student has not been able to plan for problem solving, as well as students' problem solving and checking back.

Problem to Item No. 2

A square-shaped boxing arena has side length 8m. Boxing arena will be installed around the protective form of 5 pieces of string. (A) Write down what information you get from the question. Enough data to determine the length of rope needed? (B) Write down how you can determine how long a rope is needed.; (C) Calculate the length of rope needed by using the steps in section b .; (D) If available 100m rope the rope that enough? Explain your reasons.



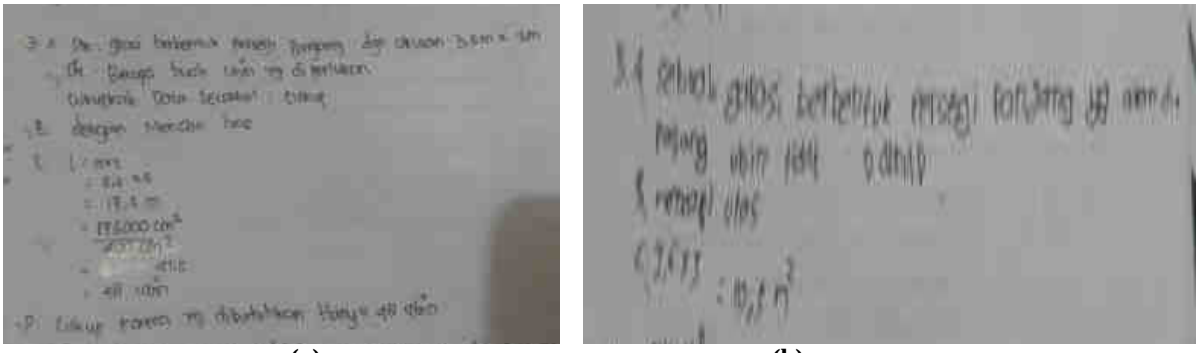
(a) **(b)**

Figure 2.(a) Answer Class PBL, (b) Answer Class CL

From Figure 2(a). Students are able to write down what is known, and asked the adequacy of data, then the student has been able to plan and to implement of problem solving and able to check back for the answer made. From Figure 2(b). Students have been able to write down what is known but has not been able to write down what is asked and the adequacy of the data, and then the students are able to plan and to implement problem solving and be able to check back for the answer made.

Problem to Item No. 3

A rectangular garage space has measuring 3m x 3.5 m. If the floor space garage that will be fitted with tiles measuring 20cm x 20cm. (a) Write down what information do you get from the question? It is enough data to determine how many pieces of tiles needed? (b) Write down how you can determine how many tiles are needed? (c) Calculate the number of tiles needed by using the steps in section b? (d) If there are 50 pieces of tile, the tile it is enough for the garage space, explain your reasons!



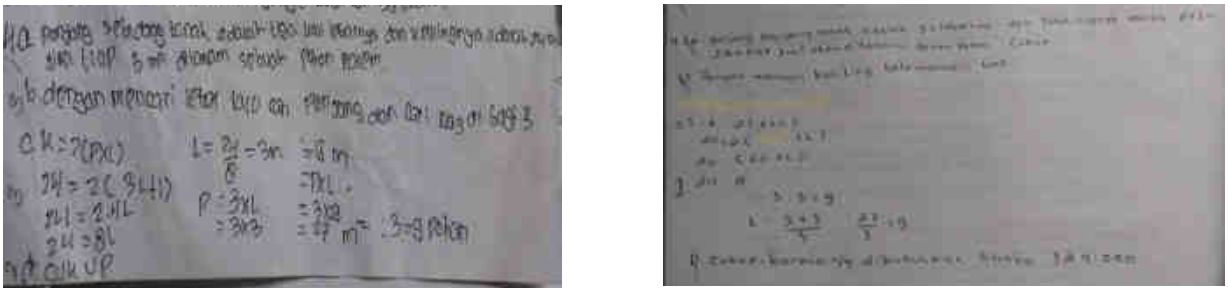
(a) **(b)**

Figure 3 (a) Classroom Answer PBL, (b) Answer Class CL

From Figure 3 (a). students are able to write down what is known, and asked the adequacy of data, then the student has been able to plan completion but are less able to carry out the student problem solving and less able to check back. From Figure 3 (b). students are able to write down what is known but has not been able to write down what is asked and the adequacy of the data, then have not been able to plan for the settlement of the problem and have not been able to resolve the problem and not able to re-examine the problem of existing students.

Problem to Item No. 4

The length of a piece of land is three times its width and the perimeter is 24 m., if there is any $3m^2$ planted a palm tree. (A) Write down what information you get from the question. It is enough data to determine the number of palm trees should be provided?; (B) Write down how do you can determine how many palm trees that needed.; (C) Calculate the required number of palm trees by using the steps in section b.; (D) If the price of a palm tree Rp. 35.000, - and Mr. Doni has money Rp. 1.000.000, - Mr. Doni has enough money? Give your reasons



(a) **(b)**

Figure 4 (a) Answer Class PBL, (b) Answer Class CL

From Figure 4 (a) it can be seen that students are able to write down what is known but has not been able to write down what is asked and the adequacy of the data, then the students have also been able to plan for the settlement of the problem and resolve the problem, and be able to check back for the answer made. From Figure 4 (b). can be seen that the students have been able to write down anything that is known but has not been able to write down the adequacy of the data and what is asked, then students are still less able to plan for the settlement of the problem correctly, less able to complete problems and to check back.

This shows that the mathematical problem-solving ability of students through the process of students' answers were taught by PBL better than students taught with conventional teaching.

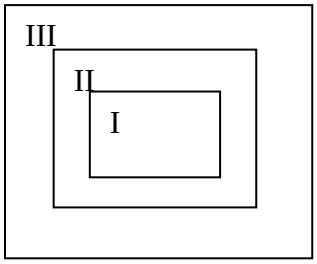
Based on student answer sheets, the following would be presented the mathematical creativity of students test answers.

Problem to Item No. 1

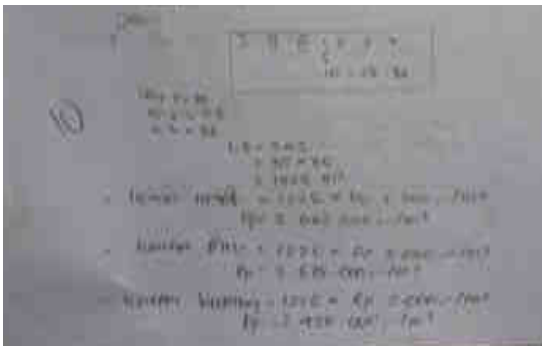
Mr. Blake is a residential builder. He wants to build a square-shaped field in a residential complex with the following sketch:

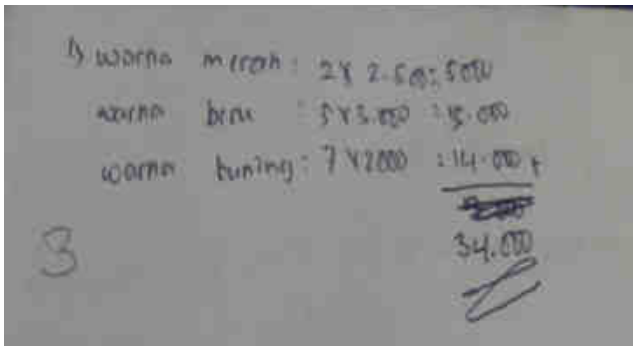
Comparison of I: II: III = 2: 5: 7

The park is about to be installed the ceramic with the following provisions:



Red color: Rp. 2.500, - / m2
Blue color: Rp. 3.000, - / m2
Yellow color: Rp. 2.000, - / m2
To help Mr. Blake calculates how much it will cost to install ceramic in the park.





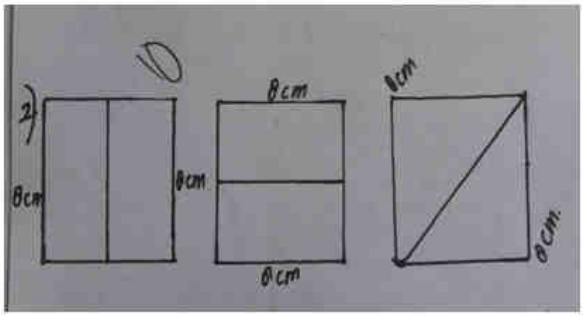
(a) **(b)**

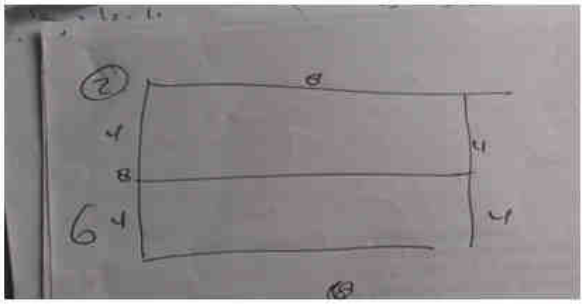
Figure 5 (a) Answer Class PBL, (b) Answer Class CL

From Figure 5. (a). students are able to answer with three kinds of answers correctly and 5. Image (b). Students are still not able to answer these problems with one correct answer.

Problem to Item No. 2

Ani has a piece of manila paper measuring 8 cm x 8 cm. He wants to divide the manila paper of the same size. Help Ani to halve the paper by drawing a sketch and for its size.





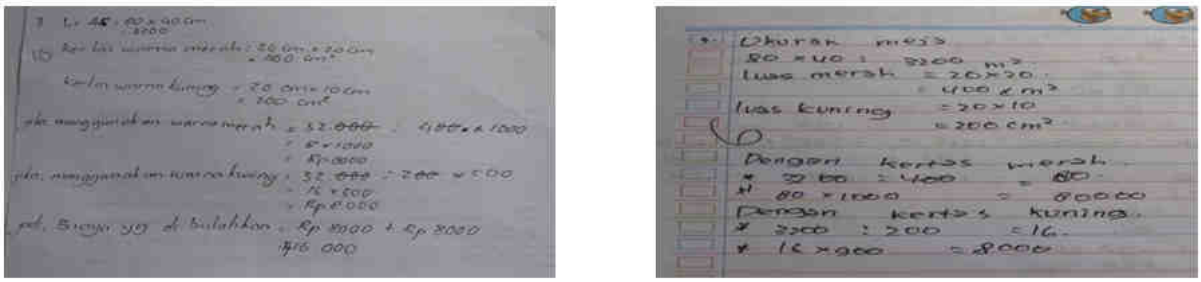
(a) **(b)**

Figure 6 (a) Answer Class PBL, (b) Answers Class CL

From Figure 6 (a). Students are able to answer in three different ways and the true and drawing 6 (b). Students are only able to answer these problems with one correct answer.

Problem to Item No. 3

A table measuring 80 cm x 40 cm outboard wanted in manila paper with the following provisions: (a) manila paper has red square with a size of 20 cm x 20 cm with a unit price of Rp. 1000, -; (b) a yellow manila paper has rectangle with a size of 20cm x 10cm with a unit price of Rp. 500, -. Determine how much money they need to buy all of manila paper



(a) (b)

Figure 7 (a) Answer Class PBL, (b) Answers Class CL

From Figure 7 (a). Students are able to answer in three different ways and the true and the image 7 (b). Students are only able to answer these problems with one correct answer.

This suggests that the ability of mathematical creativity of students through the process of students' answers were taught by PBL better than students taught with conventional teaching.

5. Discussion

The results shown that both problem solving ability and creativity of mathematics students who were taught by Problem Based Learning (PBL) was higher than students taught with conventional learning (CL). Students' mathematical problem solving ability as measured by students' ability in solving a problem solving based indicators, namely: understanding the problem, problem solving plan, implement problem solving and checking back. Based on the results of the study, the average was gained test results of mathematical problem solving ability through learning PBL higher than students taught by CL. This is can be seen from the average of the results of the test scores gain mathematical problem-solving ability of students who were taught by PBL higher than the CL, which is 0.7675> 0.2973. Similarly, the ability of mathematical creativity of students as measured by students' ability to solve a problem based on indicator of creativity, namely: fluency (fluency), flexibility (flexibility), and novelty (novelty). Based on the results of the study, the average gain mathematical creativity test students who were taught by PBL higher than the CL, which is 0.4064> 0.2129.

It is reasonable, if the improve in problem solving skills and creativity of students taught math through the PBL higher than students who were taught with the CL, because PBL using contextual problems so that students were more easily understood and able to develop the knowledge gained from personal experience. While the CL study, given the problems with the students' knowledge is always different because the learning process took place when the teacher explained the material and explained examples of questions and then students were given sample questions similar to those described teachers who ultimately have a negative impact when students were faced with the trouble-non-routine problems, students would be confused because it did not match the sample. Thus, by applying of the PBL provide more advantages when compared with conventional learning more often solve the problems that use a particular settlement.

In addition, PBL required students to make the process of discussion and working together that brought them to a deeper level of understanding of the material was taught. Working together was to provide motivation and able to expand the opportunities to exchange ideas with a group of friends that develops students' creativity. This was supported by Vygotsky's theory (1978) which emphasizes the experience and social skills, where the process of learning would occur if the child worked, handling tasks that have not been studied, but the task was still within their reaching so that children were able to solve problems by developing creativity.

The results of this study are supported by research Nufus (2013) who shown that an improve in communication and problem solving skills through the application of mathematical PBL better than the students who received regular lessons. The results of the study Noer (2011) shown that the average improve in the ability of creative thinking among students who is take an open-ended problem-based learning is higher than the students follow the conventional learning.

Descriptively, the answer to solve problems related to both problem solving ability and creativity of mathematics shown that students who were taught through PBL better than students who were taught with CL, the answer was based on indicators of students seen each capability. Measured ability is the ability of mathematical problem solving and creativity of students. Problem solving ability test contains four indicators, namely: understanding the problem, planning a completion problems, implement solutions and check back. From the results of the students' answers to the 4 questions test the ability to use problem-solving, the students' answers were analyzed viewed by PBL and conventional learning models shown that the responses of the students who were taught by PBL better than that were taught by conventional learning.

While the students' mathematical creativity test was consists of three indicators, namely: fluency, flexibility and novelty. The results of the students' answers to the three questions were used mathematical creativity tests, the

students' answers were analyzed viewed by using PBL and conventional learning models shown that the responses of the students who were taught by using PBL better than that were taught by using conventional learning.

This occurs due to the characteristics of the PBL train the students to solve problems on their own that can improve mathematical problem solving and creativity of students. PBL characteristics are not possessed conventional learning so that there is a difference in the students' answers. In conventional learning, students just do the exercises according to the settlement presented by the teacher. While the PBL, the given problem is a contextual problem that the student should be able to resolve the existing problems and develop their creativity respectively. In the PBL the student given that the LAS contain contextual issues close to students so that students are able to develop creativity and problem-solving abilities. At PBL models are also familiarized students to discuss with their friends in solving the problem so that the problem solving ability and creativity of students can be increased again. While in the conventional classroom students only do the questions are similar to the example problems of teachers.

In addition, this study is also supported by research conducted by Nufus (2013) which indicates that the problem-solving process students are learning answers by using problem-based learning is better than learning ordinary. It can be concluded that the answer to students who are taught with a problem-based learning is better than conventional learning.

6. Conclusion

Based on the research that has been presented in the previous section, some of conclusions can be drawn with regard to the factors of learning, problem solving ability and creativity of mathematics students. These conclusions are:

1. To improve of mathematical problem-solving ability of students who are taught through PBL has average 0.7675 higher than students taught through CL with average 0.2973 at significant rate 0.000.
2. To improve of mathematical creativity of students who are taught through PBL has average 0.4064 higher than students taught through CL with average 0.2311 at significant rate 0.000.
3. Process students' answers taught through PBL better in understanding, planning, finishing the problems and checking the answer than students who are taught by CL.
4. Process students' answer of mathematical creativity ability who are taught through PBL have answer that more varieties and better than students who are taught through CL.

7. Suggestion

Based on the above conclusion, the results of this study are very suitable for use as an alternative to improve the quality of mathematics education in junior high school, then presented some suggestions as follows.

1. Problem-based learning model can be used as an alternative to improve problem-solving abilities and creativity of mathematics students, so it can be used as input for the school to be developed as a model of effective learning, especially in mathematics and in other subjects.
2. To further improve the process of students' answers to the problems of mathematics in particular mathematical problem solving and creativity of the student teacher should use a problem-based learning model with specially designed teaching materials in the form of students activity sheet along with creating a fun learning environment so that students are actively interested and excited for the following study.

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