The effect of problem based learning model (PBL) towards creative thinking ability and self-efficacy of junior high school students in Pekanbaru

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Abstract. The research was based on the low ability of students' creative thinking in learning mathematics at SMPN Pekanbaru. An effort to address the students' creative thinking ability is through the learning model of Problem Based Learning (PBL). The model can provide opportunities for students to develop their skills in the new learning process. The purpose of this research is to test the influence of Problem Based Learning Model (PBL) to the Creative Thinking Skills and the Self-Efficacy of Junior High School Students. This study is a quasi experimental research. The design of this research is Randomized Control-Group Posttest Only Design. The population is all students at SMP Negeri Pekanbaru. Data collection techniques in this study is a test of mathematical creative thinking. Data analysis techniques are t-test and ANOVA. The results showed that the ability of students' creative thinking ability taught using Problem Based Learning Model (PBL) is higher than the students' creative thinking ability by conventional learning. Therefore, it can be said that Problem Based Learning (PBL) Model has a good influence on students' creative thinking ability in mathematics.

1. Introduction

Mathematics is a very important basic science in the development of science education and technology. Mathematics is a science that explains concepts ranging from abstract, to well-defined ones [1]. This is because mathematics is not derived from observation, but rather from deductive ideas, processes, and proofs. For that, the need for an active learning process in learning mathematics. Active learning is not only gained in active learning group learning but in a large enough classroom can occur. In learning mathematics students are brought toward observing, guessing, doing, trying, being able to answer the question why, and if possible argue. This principle of active learning is expected to foster the objective of creative and critical mathematics learning [2]. In line with Suherman's opinion, creative thinking is indispensable in learning mathematics. Creative thinking is a habit of thinking that is digging, animating the imagination, intuition, cultivate new potentials, open up views that generate admiration, stimulate unexpected thoughts [3].

Some research results found that students' creative thinking ability is still low. This is evidenced by research conducted by the team Program of International Student Assessment (PISA) in 2015 shows that Indonesia is ranked 69th from 76 countries. In addition to the results of research conducted by PISA, the results of UN (National Exams) 2016/2017 showed that the average score of the Mathematics in each province is still far from the desired expectations, this indicates that mathematics

is still a difficult subject for students. From the Mathematics scores of students in Pekanbaru of academic year 2016/2017, it was obtained that the average scores of Mathematics is still relatively low.

Related to the above phenomenon, it is neededan improvement and renewal in the learning process. Currently there have been many models of mathematics learning that can involve students actively to build the ability of creative thinking in mathematics. One of the learning model that can improve the ability of creative thinking in learning mathematics is Problem Based Learning (PBL) model. Problem Based Learning (PBL) is one of the problem-based learning models that enable the development of students' thinking skills. PBL learning model can stimulate students to learn through various real problems in everyday life. PBL aims to enable students to acquire and form their knowledge in an integrated manner. Problem Based Learning enables students to interact with their environment, classmates, who will guide students to improve their knowledge [4].

In addition to the ability to think creatively mathematically, students' attitudes in learning mathematics also need to be considered, that is about self-efficacy. Psychologist Albert Bandura stated that Self-efficacy is an individual belief that he is capable of doing things in certain situations successfully. From this sense, in simple terms, self-efficacy can be regarded as a person's confidence in his ability in a field or a particular concept [5]. Self-efficacy is a cognitive self-persuasion formed from four main components, personal experience, through observation of other people's experiences, social or verbal media, and physical and emotional conditions. Personal experience is the most influential source, because experience about success or failure can then increase or decrease a person's self-efficacy in the same experience.

When examined, the meaning of self-efficacy is almost the same as the sense of self-confidence, namely the belief in self-ability, but self-efficacy is more specific to the belief in the ability of a particular field or concept. Belief in this ability is needed in order to compete in the era of globalization and the world of work, as well as in the world of education. The fact that happens, often found students who are less confident, not sure of its ability, or resigned to accept fate. This condition if left unchecked, will certainly be bad for the future of the students. In learning activities when they are asked to do a question, they usually turn left and right as if seeking support to the friend next to him. They seem to be unsure that he can answer the given question. As a person involved in education, teachers should look for ways to solve this problem. Mathematics is one of the subjects that should be able to develop students' confidence or belief in their abilities. From various researches that have been done with regard to self-efficacy, there have been found that self-efficacy affects students' success in mathematics [6]. Self-efficacy is not something that was born or something with the permanent quality of an individual, but is the result of cognitive processes. This means that the self-efficacy of a person can be developed., Because many cognitive processes occur during the learning, the development of one's self-efficacy can be driven through learning activities.

PBL according to Vienna Sanjaya is more emphasized is student activity, while the teacher only as a facilitator. PBL model is a learning model that begins with authentic problem-solving. Problem-based learning model can improve students' high-order mathematical thinking [7]. In a learning step involving a group of students is encouraged to communicate with their friends. Similarly, when presenting the results group of students are required to communicate with friends and teachers. While students' creativity is demanded when students complete the student worksheet. As the students discuss, students will use their experience and knowledge previously obtained to present various ways or solutions. Furthermore, the process guides individual and group investigations that allow students to exchange answers and produce a flexible solution of existing problems and the ideas conveyed are originated. Both of these can improve students' creative thinking ability.

By conducting group discussions, each student gained experience with others during the lesson. Students are also trained to convey opinions within the group, so that their verbal skills also increase. It can improve self-efficacy through problem based learning. Then some students presented the results of the discussion in detail and fluent in front of his friends. In addition, the experience during the discussion makes students have a good assessment of the achievement of its performance.

2. Research methodology

This study is a quasi-experimental study. The design used is Non-equivalent Control Group Design. In this design there are two groups, the first group is treated (X) and the other group is not. the treated group is called the experimental group and the untreated group is called the control group. The population in this study is the students of state junior high school in Pekanbaru amounted to 36 and divided into several levels according to the UN results. The sample in this research is SMPN 4 Pekanbaru for high level, SMPN 20 Pekanbaru for middle level, and SMPN 21 Pekanbaru for low level. The instrument used in this research is a test of mathematical creative thinking ability and self-efficacy questionnaire. Data analysis technique to be used in this research is ANOVA.

3. Research findings and discussions

3.1. Creative thinking

Creative thinking scores are analyzed through posttest result data. The postest result score data is presented in the table below. Average score and standard deviation obtained after the data processing of creative thinking test based on learning model.

Table 1. Scores of student creative thinking based on Learning Model and school level

Ability of Creative Thinking based on School Level	Learning Model					
	PBL			Conventional		
	Mean	SD	N	Mean	SD	N
High	88,55	8,48	31	77,83	6,25	30
Middle	83,41	9,65	41	75.49	6,87	41
Low	79,87	7,99	39	74,23	3,35	39
Total	83,94	8,71	111	75,85	5,49	110

From the table above, in the PBL class, high school level students have higher average creative thinking scores compared to middle school level students and low school level students ie 88.55. In Conventional class, high school level students have higher average creative thinking score compared with middle school level students and low school level students is 77,83. The difference in average score of creative thinking between PBL class and Conventional class can be seen in Figure 2 below.

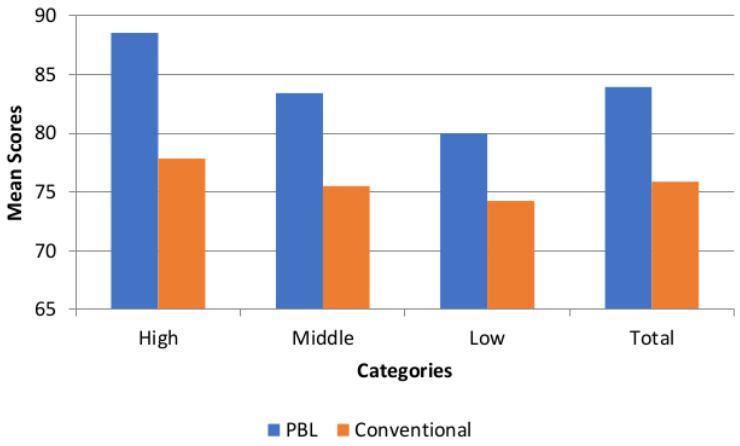

Figure 1. Diagram of creative thinking based on learning model

Based on figure 2 it can be explained that from all three levels of school, high school level students have a significant difference in mean scores between PBL classes than Conventional classes. From the above diagram, creative thinking scores of both high school level students, middle school level students and low school level students of PBL have a higher average than Conventional classes.

Table 2. Creative thinking summary with two-way variance analysis.

Tests of between-subjects effects

Dependent variable: Creative thinking

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	5144,758[a]	5	1028,952	19,063	,000
Intercept	1326446,403	1	1326446,403	24574,852	,000
Model	31,403	1	31,403	,582	,000
School levels	2001,270	2	1000,635	18,539	,000
Model * level sekolah	3400,052	2	1700,026	31,496	,003
Error	11604,789	215	53,976		
Total	1419175,000	221			
Corrected Total	16749,548	220			

a. R Squared = ,307 (Adjusted R Squared = ,291)

From the calculation results, it can be argued that the significant value of creative thinking based on the school level 0.00 <0.05. Thus, for school-level factors reject the null hypothesis. This means that the school level has a significant role in creative thinking so that creative thinking of students in high school is different from creative thinking of students who attend school at a moderate level and low school level students.

Based on the above table, it can be argued that the significant value of the model 0.00 < 0.05, thus there is a difference in the ability of creative thinking between students taught by PBL and Conventional. To see the difference between each learning model is done, test scheffe. The following will be presented scheffe test results with SPSS for 18.

Table 3. Scheffe test of creative thinking. multiple comparisons

Dependent variable:creative thinking

	(I) IQ	(J) IQ	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Scheffe	High	Middle	2,6104	1,30716	,139	-,6116	5,8325
		Low	6,8391*	1,29567	,000	3,6454	10,0328
	Middle	High	-2,6104	1,30716	,139	-5,8325	,6116
		Low	4,2286*	1,12726	,001	1,4500	7,0072
	Low	High	-6,8391*	1,29567	,000	-10,0328	-3,6454
		Middle	-4,2286*	1,12726	,001	-7,0072	-1,4500

Based on observed means.
The error term is Mean Square(Error) = 53,976.
*. The mean difference is significant at the ,05 level.

Table 3 shows that the Scheffe significance value indicates that there is a difference in the ability of creative thinking between students taught by PBL and conventional. This is supported by the graph below:

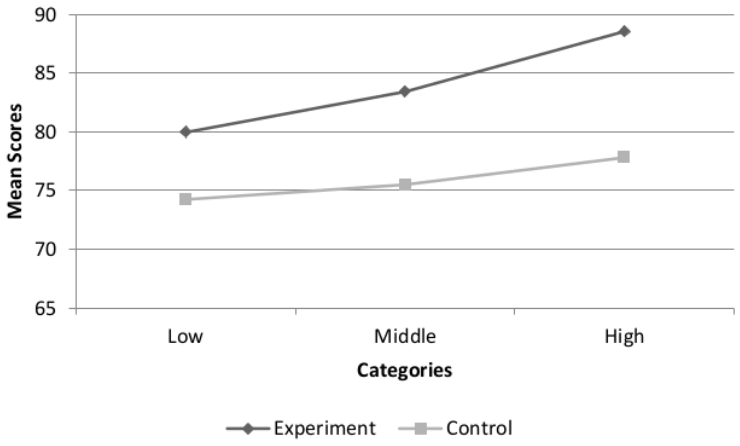

Figure 2. Diagram of School Level with Creative Thinking.

Based on the line diagram, the experimental class has a higher average creative thinking ability than the control class. For the high class experimental class 88,55 and for the control class 77,83, for the experimental class was 83,41 and for the control class 75,49, while for the low group experimental class 79,87 and the control class 74,23. The PBL model is very well applied to the high level group because it has the highest mean that is 10.72 compared to the moderate group is 7.92 and the low group is 5.64. Based on the mean difference, it is concluded that there is a difference of creative thinking ability between students taught by PBL and conventional.

3.2. Self efficacy

Self-efficacy score was obtained through analysis of questionnaire data. Average score, standard deviation and number of students obtained after the data processing of self-efficacy questionnaires of students to mathematics based on the model of learning and school level.

Table 4. Student self-efficacy score based on learning model and school level

Self efficacy based on school level	Learning Model					
	PBL			Conventional		
	Mean	SD	N	Mean	SD	N
High	120	10,61	31	118	9,36	30
Middle	112	11,75	41	111	12,03	41
Low	121	10,38	39	103	8,95	39
Total	117,7	10,91	111	110,67	10,11	110

From the above table, low level students in PBL class have the average score of self efficacy of mathematics students higher than the third level of school that is 121. High students in the conventional class have the average self efficacy score higher than the third level of school that is 118. The difference of mean score of self efficacy of student mathematics between PBL class and Conventional class can be seen in the following diagram.

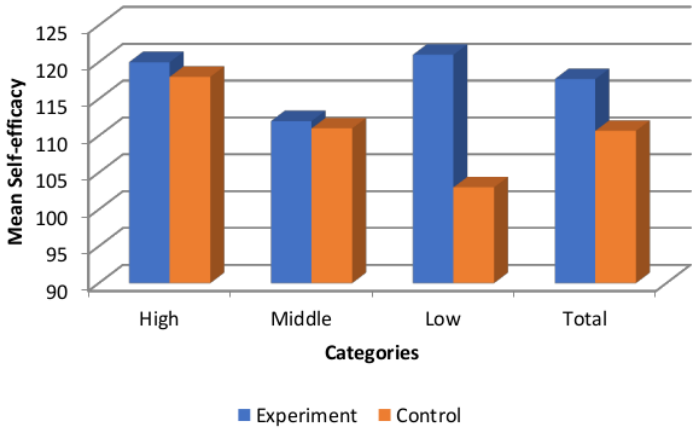

Figure 3. Self efficacy chart Based on Learning Model and school level

Based on the Figure above the low-level students have a greater average score difference between the conventional class PBL class than the middle-level students and the high-level students. Can be explained that the overall self-efficacy score of both high school level students, middle school level students and low school level students, PBL classes have an average self-efficacy outcomes higher than the Conventional class.

Table 5. Summary of results of two-way variance analysis of self-efficacy students in mathematics

Tests of between-subjects effects.

Dependent variable:self efficacy

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	8958,019[a]	5	1791,604	16,013	,000
Intercept	2674375,337	1	2674375,337	23903,380	,000
Model	1914,772	1	1914,772	17,114	,000
School Level	1293,333	2	646,666	5,780	,004
Model * School level	4473,552	2	2236,776	19,992	,000
Error	24054,786	215	111,883		
Total	2892830,000	221			
Corrected Total	33012,805	220			

a. R Squared = ,271 (Adjusted R Squared = ,254)

Based on the above table, it can be argued that the significance level of the school level is 0.004 <0.005. Thus, there is no difference in self-efficacy between high school level students, moderate school level and low school level. This means that the school level has a significant role in self-efficacy so that high school self-efficacy is different from self-efficacy in the middle school level and low-intelligence students.

Based on the Table, it can be argued that the model significance value is 0.000 <0.005. Thus there are differences in self efficacy between students taught by PBL. This means that from both learning models at least one has different effects with others. The following will be presented a scheffe test results with SPSS 18.

Table 6. Scheffe test of self-efficacy. multiple comparisons

Dependent variable: self efficacy

	(I) IQ	(J) IQ	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Scheffe	High	Middle	5,2783*	1,88196	,021	,6395	9,9171
		Low	7,7383*	1,86542	,000	3,1403	12,3364
	Middle	High	-5,2783*	1,88196	,021	-9,9171	-,6395
		Low	2,4600	1,62296	,319	-1,5404	6,4605
	Low	High	-7,7383*	1,86542	,000	-12,3364	-3,1403
		Middle	-2,4600	1,62296	,319	-6,4605	1,5404

Based on observed means.

The error term is Mean Square(Error) = 111,883.

*. The mean difference is significant at the ,05 level.

Based on Scheffe significance value there is a difference of self efficacy between students taught by PBL and conventional. This is supported by the graph below:

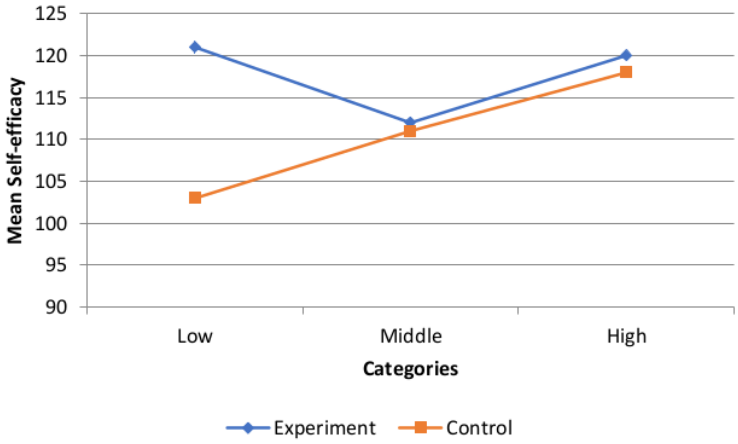

Figure 4. Line diagram between school level and self-efficacy.

Based on the Diagram above, the experimental class has a higher average than the control class. For high class experiment class 120 and for control class 118, for experimental class and experiment class 112 for control class 111, while for low group experiment class 120 and control class 103. Model of PBL is very good applied to low level group for self efficacy because have the highest mean selisish that is 17 compared to medium group 1 and high group 2. Based on the difference of mean value can be concluded that there are differences of self efficacy of low school level students taught by PBL, there is no difference of self efficacy of middle level students taught by PBL and conventional, there is no difference in self-efficacy of low-level students taught by PBL and conventional.

4. Conclusions

Based on the result of the research, it is concluded that the Problem Based Learning model can improve students 'mathematical creative thinking ability in Junior High School of Pekanbaru and improve students' self-efficacy.

Based on the research findings of this study, researchers provide suggestions related to the implementation of problem based learning models in learning mathematics. :

1. Teachers need to develop students' creative thinking skills by choosing the right learning strategies and can facilitate teaching and learning activities in the classroom.
2. Time spent in applying a model that exceeds a predetermined time. It is expected that teachers will be able to better manage how long each model step takes.

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