THE EFFECTIVENESS OF MATHEMATICS LEARNING BASED ON OPEN-ENDED WITH PROBLEM BASED LEARNING METHOD ON CREATIVE THINKING ABILITY

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ABSTRACT

Learning tends to be dominated by teachers, which causes some students to be passive in learning. This is thought to make the level of students' creative thinking skills low. This study aims to determine whether there are differences in the level of creative thinking abilities of students who use Open-ended based learning with Problem Based Learning (PBL) methods with those using Conventional learning methods for students' creative thinking skills of VIII Grande students of State Junior High School (SMP Negeri) 2 Majenang Cilacap Regency At Odd Semester In Academic Year of 2018/2019. The population in this study there are eight classes. The sample was taken by two classes with a random sampling technique for the class and selected VIII-G class as the control class and VIII-H as the experimental class. The design in this study is the Pretest-Posttest Control Group design. Data collection techniques using test techniques (pretest and posttest) and questionnaire techniques. Data collection instruments in the form of tests and test questionnaires. Test data collection instruments using validity, discriminating power, and reliability tests. Data analysis techniques using analysis prerequisite tests include normality test, homogeneity test, and hypothesis testing using the t-test. The study results at a significant level of 5%, and df = 61 indicate that: (1) there is a difference in the value of posttest mathematics using open-ended-based learning with problem-based learning (PBL) method with learning using conventional methods. This is indicated by $t_{table} = t (0,025) (61) = 1,996$ and $t_{count} = 2,988762$ which means $t_{table} < t_{count}$ (2) Learning using Open-ended PBL method is more effective than learning using conventional methods. This is indicated by the value of $t_{count} = 2.988762$ and $t_{table} = t (0.025) (61) = 1.670385$ which means $t_{count} > t_{table}$.

Keywords: Effectiveness, Open-ended, PBL method, Conventional method.

INTRODUCTION

The development of the era of globalization demands high human resources, as stated in the development goals—the right vehicle for developing human resources quality in education. Education is a conscious effort to grow the potential of human resources through learning activities. According to Permendiknas No. 22/2006, National Education aims to develop students' potential to become human beings who believe in and fear God Almighty, have noble, healthy, knowledgeable, capable, creative, independent, become democratic and responsible citizens. Thus it is clear that students must have the ability to think critically and creatively to solve complex daily problems. In this case, the quality of education needs a significant improvement that will not be separated from technology and mathematics development.

Based on the results of observations and interviews with Mathematics Teachers of grade VIII of SMP Negeri 2 Majenang, Cilacap Regency, which was held on May 7, 2018, it can be concluded that mathematics is still considered a boring subject which results in low levels of creative thinking in students. This is because the learning method is still centered on the teacher and students who are rarely given time to discuss, making them passive.

Learning methods that still use conventional methods cause students to only solve problems or problems related to mathematics taught by teachers and students who are rarely given time to discuss. This makes students' assumptions about mathematics is an exact science that there is only one way to get one correct answer from a problem. Learning will be effective when in a pleasant situation, so it is

expected that students will have the ability after receiving their learning experience. In learning mathematics, some students tend to be passive, causing students not to understand the material. When students are given mathematical material problems, they will find it difficult to solve and solve them and hinder students' creative thinking abilities. Therefore, to foster students' creative thinking levels and create an active learning process, a suitable learning method is needed.

Open-Ended learning based on the Problem Based Learning method as a solution to this problem. In Open-Ended-based learning, to solve a problem, students are expected to solve it in several ways and some possible correct answers. Learning with the Problem Based Learning (PBL) method requires students to be more active, more willing to express their ideas, and encourage students to speak out to explain the results of their answers in front of the class. It is hoped that after this learning, the students will be more actively involved in the learning process and the level of students' creative thinking will be better honed to face the problems of daily life that they will encounter in the future.

This study was conducted to know whether there are differences in the level of creative thinking of students who use Open-ended mathematics-based learning with problem-based learning methods rather than learning using conventional methods. Moreover, to find out whether open-ended based learning with Problem Based Learning method is more effective on students' creative thinking abilities than mathematics learning using conventional approaches.

Based on the literature review and frame of mind that has been proposed, this study hypothesizes that there are differences in the level of creative thinking of students who use Open-ended mathematics learning with problem-based learning methods and learning using conventional methods. Open-ended learning based on the Problem Based Learning method is more effective on students' creative thinking abilities than mathematics learning using conventional approaches.

METHODS

This research is a type of experimental research conducted by researchers to determine differences in students' concept understanding ability with open-ended learning based on using problem-based learning (PBL) methods when compared with conventional learning. Moreover, this research design uses the Pretest-Posttest Control Group design. In this design, there are two groups chosen randomly. A pretest is then performed to determine the initial state if there is a difference between the experimental and control groups. A good pretest result if the experimental group's value did not differ significantly from the control group. At the end of the study, learning test results between the two classes were measured. The researcher tested whether there were differences in the test results of the two classes' learning outcomes and which test results were better between the two classes. This study population was all eighth-grade students of SMP Negeri 2 Majenang, Cilacap Regency, Odd Semester, Academic Year 2018/2019. In this study, the researchers took samples using random sampling techniques or using a class draw. Of the eight classes in class VIII of SMP Negeri 2 Majenang, two classes were taken, namely class VIII-H as an experimental class using the Problem Based Learning method based on Open-Ended and VIII-G as a control class using conventional methods. In this study, researchers used two variables, namely Open-ended mathematics learning with the Problem Based Learning method in the experimental class and the conventional approach to the control class and students' creative thinking ability in class VIII SMP Negeri 2 Majenang Cilacap Regency Odd Semester Academic Year 2018/2019. Researchers used instruments in the form of mathematical test questions and questionnaires or questionnaires. Mathematical test questions are used twice, namely to determine the initial ability with a pretest and determine the final ability with posttest after being given open-ended mathematics learning with the Problem Based Learning method. Pretest questions contain ten description questions, and posttest questions contain 15 description items (essays). Before testing the instrument, an instrument test was carried out to determine the different power, reliability, and difficulty index. The results met the criteria of a useful instrument for data collection.

Researchers' data collection technique is the initial capability data documentation technique that is pretest and experimental results data using posttest and questionnaire techniques (questionnaire). Data analysis technique:

1. Test Prerequisite Analysis

   The analysis of prerequisite testing uses a normality test and homogeneity test.

   a. Normality Test

      A normality test is performed to determine whether the sample data taken is normally distributed or not. This test is carried out on the initial ability (pretest). The formula used is the Chi-square formula (χ_0^2), as follows: $\chi_0^2 = \sum_{i=1}^{k} \frac{(O_i - E_i)^2}{E_i}$, the significant level used is 5%. Then reject H_0 if $\chi_0^2 > \chi_\alpha^2 (k-1)$. H_0: the population is normally distributed and H_1: the population is not normally distributed.

   b. Homogeneity Test

      A homogeneity test is used to determine the variance or diversity of samples taken, homogeneous or not. This test carried out the student's initial ability data. To test the data can be used using the Bartlett test with the following formula: $\chi^2 = (\ln 10)\{\beta - \sum_{i=1}^{k}(n_1 - 1)\log S_i^2\}$.

2. Hypothesis test

   Hypothesis testing is a step accepted or rejected by a hypothesis. To test the average difference, the t-test statistic is used.

   a. The first hypothesis test to determine differences in the value of learning outcomes using the Open-ended PBL method based on those using conventional methods in class VIII students of SMPN 2 Majenang, Cilacap Regency, odd semester 2018/2019 Academic Year. The pair H_0 and H_1 that will be tested are:

      $H_0: \mu_1 = \mu_2$

      $H_1: \mu_1 \neq \mu_2$

      Information :

      H_0: There is no difference in the level of creative thinking of students who use open-ended mathematics-based learning with the PBL method with the conventional method in class VIII students of SMP Negeri 2 Majenang, Cilacap Regency, Odd Semester Academic Year 2018/2019.

      H_1: There is a difference in the level of creative thinking of students who use open-ended mathematics learning with the PBL method with the conventional method in grade VIII students of SMP Negeri 2 Majenang, Cilacap Regency, Odd Semester Academic Year 2018/2019.

      Test criteria, if $t_0 > t_{\alpha/2(n1+n2-2)}$ or $t_{count} < t_{table}$ then H_0 is rejected. By using the degree of freedom df = n1 + n2-2 at a significant level α = 5%.

   b. The second hypothesis test was conducted to find out that Open-ended learning based on the PBL method was more effective than learning using conventional methods in grade VIII students of SMPN 2 Majenang, Cilacap Regency, odd semester 2018/2019 Academic Year. The pair H_0 and H_1 that will be tested are:

      $H_0: \mu_1 = \mu_2$

      $H_1: \mu_1 > \mu_2$

      Information :

      H_0: Learning using the Open-ended basis PBL method is no more effective than learning by using conventional methods in grade VIII students of SMPN 2 Majenang Cilacap Regency odd semester 2018/2019 Academic Year.

      H_1: Learning using the Open-ended basis PBL method is more effective than learning by using conventional methods in grade VIII students of SMP Negeri 2 Majenang, Cilacap Regency, odd semester 2018/2019 Academic Year.

Test criteria, if $t_o > t\alpha_{/2(n1+n2-2)}$ or $t_{count} < t_{table}$ then H_0 is rejected. By using the degree of freedom dk = n1 + n2-2 at a significant level α = 5%.

RESULTS AND DISCUSSION

The initial ability scores were obtained from the pretest grades of class VIII and VIII-H of SMP N 2 Majenang, Cilacap Regency, and were obtained as shown in Table 1.

Table 1. Summary of Initial Capability Values

Class	Highest Score	Low Score	Average	Standard Deviation	Variance	Lots of Data
Control VIII-G	90	40	57,645	12,911	167	31
Experiment VIII-H	92	40	56,656	13,496	182,17	32

A normality test is used to find out whether or not the distribution of the initial ability and control class data is normal or not. The researcher performed the normality test calculations twice, namely the normality test for the experimental and control classes. The calculation results show that the experimental class and the control class meet the normality requirements as in Table 2.

Table 2. Summary of Initial Ability Test Results Normality

Class	χ^2_{count}	Significant level (α)	Df (k-1)	χ^2_{table}	Info.
Control VIII-G	2,356	5%	30	7,81	Normal
Experiment VIII-H	4,52	5%	31	7,81	Normal

The homogeneity test is intended to determine whether the two samples have the same variance or not. The Bartlett test is the test because the average and variance are unknown and consist of two samples of the same size. The homogeneity test is done once to test the homogeneity of the experimental class and the control class. The calculation results show that the experimental class and the control class meet the homogeneity requirements, which have the same variance. A summary of the results of the homogeneity test calculation is presented in Table 3.

Table 3. Summary of Initial Homogeneity Test Results

Class	χ^2_{count}	Significant level (α)	Df (k-1)	χ^2_{table}	Info.
Control VIII-G	0,059867	5%	31	3,841	Homogeneous
Experiment VIII-H	0,059867	5%	30	3,841	Homogeneous

A summary of the average similarity test results of the experimental class's initial ability scores and the control class can be seen in Table 4.

Table 4. Summary of Average Similarity Test Results for Initial Ability

t_{count}	t_{table}	Significant level (α)	Df (k-1)	Info.
-0,411	1,996	5%	31	H_0 accepted

So it can be concluded that there is no difference in the value of the control class's initial ability and experimental class VIII students of SMP N 2 Majenang, Cilacapsemester Regency, Odd School Year 2018/2019. A description of the student's final grade data after the experiment is presented in Table 5.

Table 5. Description of Research Results

Class	Highest Score	Low Score	Average	Standard Deviation	Variance	Lots of Data
Control VIII-G	92	70	77,82	4,5	20,03	31
Experiment VIII-H	96	70	81,06	6,4	41,03	32

A normality test is used to find out whether or not the distribution of the initial ability and control class data is normal or not. The researcher performed the normality test calculations twice,

namely the normality test for the experimental and control classes. The calculation results show that the experimental class and the control class meet the normality requirements as in Table 6.

Table 6. Summary of Normality Test Results of Research Results

Class	χ^2_{count}	Significant level (α)	Df (k-1)	χ^2_{table}	Info.
Control VIII-G	1,35	5%	30	7,81	Normal
Experiment VIII-H	2,97	5%	31	7,81	Normal

The homogeneity test is intended to determine whether the two samples have the same variance or not. The Bartlett test is the test because the average and variance are unknown and consist of two samples of the same size. The homogeneity test is done once to test the homogeneity of the experimental class and the control class. The calculation results show that the experimental class and the control class meet the homogeneity requirements, which have the same variance. A summary of the results of the homogeneity test calculation is presented in Table 7.

Table 7. Summary of Test Results for Homogeneity of Research Results

Class	χ^2_{count}	Significant level (α)	Df (k-1)	χ^2_{table}	Info.
Control VIII-G	3,82	5%	31	3,84	Homogeneous
Experiment VIII-H	3,82	5%	30	3,84	Homogeneous

A summary of the first hypothesis test results of the experimental class and the control class can be seen in Table 8.

Table 8. Summary of the First Hypothesis Test Results

t_{count}	t_{table}	Significant level (α)	Df (k-1)	Info.
2,98	2,00	5%	61	H_0 accepted

Based on the Table 8 obtained $t_{(0,0250)\ (61)} = 2,00064$. Based on calculations obtained, $t_0 = 2.988762$, which means $t_0 > t_{\alpha/2}(n_1 + n_2 - 2)$, H_0 is rejected. So it can be concluded that there are differences in the value of learning outcomes using the Open-ended PBL method based on those using conventional methods in grade VIII students of SMPN 2 Majenang Cilacap Regency odd semester 2018/2019 Academic Year.

Table 9. Summary of the Second Hypothesis Test Results

t_{count}	t_{table}	Significant level (α)	Df (k-1)	Info.
2,98	1,67	5%	61	H_0 rejected

Based on Table 9 obtained $t_{(0,0250)\ (61)} = 1,670385$. Based on calculations obtained $t_0 = 2,988762$ which means $t_0 > t_{\alpha/2(n1+n2-2)}$, then H_0 is rejected. So it can be concluded that learning using the Open-ended basis PBL method is more effective than learning by using conventional methods on participant's students of class VIII SMPN 2 Majenang Cilacap Regency odd semester 2018/2019 Academic Year.

Based on the research results, the posttest value data used has a regular and homogeneous distribution. The average value obtained from the posttest experimental class's posttest value was 81.625, and the control class was 77.82258. The first and second hypothesis testing results for the experimental class and the control class obtained $t_0 = 2.988762$. For the first hypothesis test, $t_{table} = 2,00064$ and the second hypothesis test $t_{table} = 1.670385$. So for the two hypothesis tests, it is obtained that $t_0 > t_{\alpha/2(n1=n2-2)}$, then H_0 is rejected, and H_1 is accepted. Based on these data, it can be concluded that:

1. There is a difference in the level of creative thinking of students who use Open-ended mathematics learning with problem-based learning methods than learning that uses conventional methods in class VIII students of SMP N 2 Majenang Cilacap Regency, odd semester 2018/2019 Academic Year.

2. Open-ended learning based on the Problem Based Learning method is more effective on students' creative thinking abilities than mathematics learning, which uses a conventional approach to grade VIII students of SMP N 2 Majenang, Cilacap Regency, odd semester 2018/2019 Academic Year.

Researchers also used a questionnaire technique with an average yield of 83%, and each question item had a range of 75% - 100%. It can be concluded that the experimental class felt that mathematics learning was more active, effective, and pleasant when they got learning using the Problem Based Learning (PBL) method.

CONCLUSION

Based on the results of research and discussion, as described in Chapter IV, the following conclusions can be drawn:

1. There is a difference in the level of creative thinking of students who use Open-ended mathematics learning with problem-based learning methods than learning that uses conventional methods in class VIII students of SMP N 2 Majenang Cilacap Regency, odd semester 2018/2019 Academic Year.
2. Open-ended learning based on the Problem Based Learning method is more effective on students' creative thinking abilities than mathematics learning, which uses a conventional approach to grade VIII students of SMP N 2 Majenang, Cilacap Regency, odd semester 2018/2019 Academic Year.

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