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The Effect of Problem-Based Learning Model on Mathematics Problem-Solving Ability in Class XI SMAS PPM Rahmatul Asri

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Abstract
This study aims to determine whether there is an effect of the Problem Based Learning Model on students' problem-solving abilities. This type of research is a quasi-experimental involving two groups that are given different treatments. The population of this study was students of class XI SMAS PPM Rahmatul Asri, and two classes were selected by cluster random sampling as the research sample, namely class XI Science 1 and XI Science 2. Class XI Science 1 is an experimental class taught using the Problem Based Learning Model, while XI Science 2 is a control class taught using conventional learning. The research instrument was used in the form of a problem-solving ability test in the form of a test in the form of a description. The data collected using the instrument was analyzed using descriptive and inferential statistical techniques. The results of the descriptive analysis showed that: (1) the problem-solving ability of students after being taught using the Problem Based Learning Model was in the very good category, namely84.56 from the ideal score of 100, (2) the problem-solving ability of students after being taught using conventional learning is in a good category, namely 75.39from the ideal score of 100. The results of inferential statistical analysis show that: (1) with the Wilcoxon test, it can be said that there is a significant difference between the problem-solving ability score parameters of students in class XI science who are taught using the Problem Based Learning Model and the parameter scores of problem-solving abilities of students in class XI science who are taught using conventional learning. From the results of this study, it can be concluded that the problem-Based Learning Model influences students' problem-solving abilities.

Keywords: *Problem Based Learning Model; Problem-solving ability.*

INTRODUCTION

Technology development in modern times cannot be separated from the influence of universal science, including mathematics. The important role of mathematics in various ways will advance the human mindset. So it is important to teach mathematics at every level of education, which is a provision for developing abilities when applying the language of mathematics in explaining a situation. According to (Suherman, 2003: 17), mathematics is the study of relationships and patterns, art, language, tools, paths, and mindsets. The meaning of mathematics used as language is that students are able to have communication skills in conveying their mathematical ideas. Students' skills in how to communicate mathematically are useful as competencies from things to be learned and taught,

Some of the goals in achieving the success of a mathematics lesson are the ability of students in mathematical communication to be able to provide broad opportunities for students to integrate and develop skills in written and oral communication and display and explain what is being taught.

In line with the objectives of mathematics education, NCTM or the National Council of Teachers of Mathematics said that in mathematics learning carried out in schools, teachers are able to pay attention to mathematical abilities, as follows: mathematical representation, mathematical reasoning, mathematical communication, problem-solving skills, and mathematical connections. From

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the description above, students' problem-solving ability is included as a standard based on the NCTM and the Ministry of National Education.

Problem-solving is used for many disciplines, as with other views or meanings. For example, mental processes in psychology and computerized processes in computer science. A problem can be divided into 2 types, namely well-defined and unclear from the solutions made and obtained. Problems with a good definition have clear solutions and specific goals, and clear solutions are obtained. An unclear problem is a problem in which the solution is unclear, the purpose is unclear, and the solution is unclear. A clearly defined problem allows for early planning rather than an unclear problem. Can solve problems sometimes using logic and interpreting the existing problems. The ability to understand the purpose of the problem and the rules that need to be used and applied can be the key to problem-solving. Sometimes problems need abstract thinking and creative solutions.

A. *Problem-Based Learning Model*

According to(Nurfitriyanti, 2016), The Problem Based Learning model is a process used as a guide that is sequentially applied by a teacher, who is usually called a teacher, to determine learning media that support learning activities so that students get the expected targets and the teaching and learning process is carried out smoothly. The concept of the learning process to be. Apart from a mature and correct concept, the teacher must have various forms of learning that will support the success of student learning steps.

In (Siswono, 2005) states that Problem Based Learning is an approach in the learning process that initially determines the problem and then solves the problem. According to (Ha Roh, 2008), students need a new understanding to solve problems (Nugroho, Chotim, & Dwijanto, 2013: 50). A problem can help sharpen the mind with a high level of understanding and ability to perform analysis. Educators and philosophers (John Dewey, 1938; Miller, 2004) state, "a problem is a stimulus to think." PBL or it can be said to be a high level of educational interest (Sherwood, 2004), is related to the approach when the learning process focuses on problem-solving procedures for students to get the necessary understanding.

PBL is a way of student learning with freedom of inspiration. Group was thinking and using pertinent information to try to solve real or suspected problems; students are taught to synthesize understanding and skills before students apply the problem (Kuan-nien, Lin, & Chang, 2011). In (Erik and Annete, 2003) suggest the problem of basic learning, which is an approach used in education whose problems are the basis of teaching and learning procedures. Types of problems based on things exist. Common problems found in everyday life have actually been sorted and edited to meet educational benefits and targets. (Graaff & Kolmos, 2003). There is a learning procedure involved to gain understanding and creativity,

Based on the opinion above, problem-based learning is based on a learning approach that focuses on problem-solving procedures by understanding what is used. Problem-based learning is a form of learning; in this case, students learn through group thinking, inspiration, and utilizing available information. In (Perez and Uline, 2003), Problem-based learning is useful in preparing school leaders by joining the ability to think analytically and structure (Schechter, 2011). Problem-based learning is an approach to curriculum development that involves confronting students with problems from practices that provide a stimulus for learning (Gijbels, Dochy, Bossche, & Segers, 2005). According to (Barrows, 2002; Cleveland, 2006), this model encourages students to use past experiences to solve problems at hand (Werth, 2009). The PBL model has important differences with discovery learning. Discovery learning based on questions based on disciplines and student investigations takes place under the guidance of the teacher and is limited in the scope of the class, While Problem Based Learning (PBL) begins with meaningful real-life problems where students have the opportunity to choose and conduct any investigations both inside and outside the school as far as it is needed to solve the problem. The goal of PBL is long-term learning that results in behavioral change, and mastery is not just conceptual (Brownell & Jameson, 2004) to produce solutions (Wirkala & Kuhn, 2011).

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According to (Gallow, 2001), PBL encourages students to be active in discussion activities and solve given problems (Asyari, Al Muhdhar, & Ibrohim, 2016). Learners, thereby realizing ways to manage the learning as a problem that must be solved and a way that must be passed. In this case, the teacher facilitates learners to work independently or in groups to analyze problems and solve them based on the information they have extracted from various relevant sources. According to (Creedy and Hand, 1995), independence and group learning are two characteristics of PBL, with self-reflection as an important component in the learning process. PBL requires students to adopt a mindset change from teacher dependence to independence (Yeo, 2005)

B. Problem-solving skill

Every problem faced in everyday life cannot be completely said to be a problem. A problem is something that must be solved. A problem is defined as a situation or question faced by someone that cannot be immediately resolved using certain rules or procedures. During the problem-solving process, each student needs to realize that the solution he is looking for is a form of the real learning process.

Problem-solving has become the first title in research and curricula worldwide (Torner, Schoenfeld, & Reiss, 2007), including in Indonesia. The standard content of the Minister of National Education Regulation No. 22, Year 2006, described the ability to solve mathematical problems, which include the ability to understand problems, make mathematical methods, complete methods, and interpret the solutions obtained, namely the objectives of the field of mathematics studies. Therefore, many studies have been carried out related to developing an understanding of mathematical problem-solving through the application of various approaches and learning models, including those carried out by Ahmad (2005) with a problem-based learning model, Marzuki (2006) with cooperative learning, Sugiman (2010) with realistic mathematics learning,

In the steps of teaching and learning mathematics in schools, the questions given to students are usually called questions. The questions given to students can be divided into two types, namely: (1) questions in the form of exercises intended to train students to be skilled in applying the newly acquired mathematical learning experience, (2) questions in the form of problems intended to develop students' ability to apply past mathematical learning experiences to situations. If one examines the definition of the problem stated above, it can be stated that the problem is subjective in nature and depends on time. A problem for an individual is not certain, namely, a problem for others. Likewise, the other time problems.

The important goal of teaching problem-solving in mathematics is not only to procedures but tends to make it possible for learners to think about what he thinks. When initially, there is no standard problem-solving process. The number of ways that can be taken to solve problems is closely related to the level of difficulty and the skills possessed by the individual who solves the problem. However, there are many ways or methods of solving problems that are stated by experts that can be used as guidelines.

Based on this description, the indicators for solving problems using the Polya steps are as follows.

a. Understanding the problem, the subject can determine what is known at this stage and ask about the given problem.
b. When planning a solution, at this stage, the subject can determine the relationship between what is known and what is asked on a given problem to get something needed to solve the problem and determine a settlement plan.

When implementing a settlement plan, the subject can carry out the problem-solving design process correctly and get the correct solution to the problem. Re-evaluating, in this the subject can re-evaluate the problem-solving process that has been carried out and interpret the solution to the problem given

METHOD

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The research method used in this research is quasi-experimental (Quasi Experiment) with a nonequivalent control group type design. In this study, two classes were taken as samples and then given different treatments at the learning time. The class that became the experimental class used learning using the Problem Based Learning (PBL) approach, namely the first class, while the control class used ordinary or conventional learning, namely the second class. Giving a pre-test regarding students' problem-solving abilities in the experimental and control classes before giving treatment during learning. Then after the treatment was completed in both classes, a final test (post-test) was held for students' problem-solving abilities.

Table 1. Research Design

Experiment Class	O1	X	O2
Control Class	O3	-	O4

Source: (Sugiyono, 2018).

Information:
O1 : experimental class pretest
O2 :*post-test*experimental class
X :Treatment using the Problem Based Learning Model

\- : There is no learning treatment at SMA PPM Rahmatul Asri
O3 : pretest control class
O4 :*post-test*control class

Data collection in this study was using student test results, including the pretest and post-test results in both the control and experimental classes. The data analysis used in this study consisted of two parts, namely inferential analysis, and descriptive analysis.

A. Descriptive Statistical Analysis

Descriptive statistics are statistics that describe and provide an overview of the thing being studied through the population or data from the sample without carrying out analysis and drawing conclusions. Descriptive analysis is used to describe students' ability to solve mathematical problems based on post-test results and then describe the characteristics of students' ability to solve problems, namely maximum value, minimum value, mean, median, mode, range, variance, and standard deviation. The analysis of these values is done manually and through the application of the Statistical Package for Social Science or SPSS.

The students' mathematical problem-solving scores obtained are then converted into scores with the following conditions:

$$\text{Value} = \frac{\textit{Skor yang diperoleh siswa}}{\textit{Skor maksimal}} \times 100$$

B. Inferential Statistical Analysis

Inferential statistical analysis is useful in analyzing data from research obtained from samples to apply the results to the population. From the population, a random sample is obtained. In testing the hypothesis in this study, inferential statistical analysis was used. The data analysis technique in this research is the t-test. The T-test is a statistical analysis in testing hypotheses about no or no difference between two or one samples under study. Conducted data analysis prerequisite test before hypothesis testing.

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a. Analysis Prerequisite Test

The analysis prerequisite test was carried out on the data from the research results to find out whether the data was feasible or not; an analysis was carried out for hypothesis testing. In this case, the normality test and homogeneity test are used through the application of Statistical Product and Service Solutions or SPSS.

1) Normality test

A normality test was carried out to be able to determine the shape of the distribution of research data, whether it was not normally distributed or normally distributed. In this case, the Shapiro-Wilk test was carried out using a significant level of 5% or 0.05. The test criteria are if the P-value <0.05, then the data is not normally distributed, and if the P-value is 0.05, then the data is normally distributed.

2) Homogeneity Test

A homogeneity test was carried out to investigate the variance of the two samples being the same or not the same. In this case, the Levene Statistic test was carried out using a significant level of 5% or 0.05. The test criteria are as follows: if the P-value <0.05, then the data variance is not homogeneous; if the P-value < 0.05, then the data variance is homogeneous.

3) Hypothesis testing

Hypothesis testing is a step that is carried out in producing a decision in the form of a decision to reject or accept the null hypothesis that has been proposed. The test carried out, in this case, is the paired sample t-test which is useful to know the significance of the effect of a treatment, namely the application of the Problem Based Learning Model on students' ability to solve problems. However, if any prerequisite test is not met, it is directed to use the Wilcoxon test analysis. The steps that must be taken in testing the hypothesis are as follows:

1) Determining the Hypothesis

The hypothesis that will be tested in this study is

Hypothesis

H0 :$\mu_1 \leq \mu_2$ Oppose H_1:$\mu_1 > \mu_2$

Information:

μ_1= Parameters of problem-solving ability of class XI SMAS PPM Rahmatul Asri students who are taught by applying the Problem Based Learning Model

μ_2= Parameter of problem-solving ability of class XI SMAS PPM Rahmatul Asri students who are taught by applying conventional learning.

2) Determining the Significant Level ()α

The level of significance is a number that refers to the probability of error that occurs when drawing conclusions that apply to the population. The significance level is 5% or 0.05.

3) Wilcoxon test

Wilcoxon test is a non-parametric test used to measure the difference between two groups of paired data or intervals, but the data are not normally distributed. This test is also called a comparison test.

4) Determining Gain

A normalized gain test (N-Gain) was conducted to be able to determine whether or not there was an increase in student learning outcomes after treatment during learning. N-Gain is the ratio of the actual gain score to the maximum gain score. (Richard R. Hake, 1998: 65). The actual gain score is the score obtained by the student, and the maximum score is the highest score the student may get. Calculation of N-Gain has the formula, namely:

$$NGain = \frac{Skor\ Posttest - Skor\ Pretest}{Skor\ Ideal - Skor\ Pretest}$$

5) Making Conclusions

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Making conclusions becomes a determination of deciding the null hypothesis is accepted or rejected according to the test criteria. The criteria for making the hypothesis are that H0 is accepted if the significant value is P-value 0.05, whereas if the significant value is P-value <0.05, then H0 is rejected.

RESULT AND DISCUSSION

a. The normality Tes

The normality test aims to determine whether the population is normally distributed. The test statistic used in the normality test is Shapiro-Wilk. The tested hypotheses are as follows:

H0: data is normally distributed
H1: data is not normally distributed
Testing Criteria:
Accept H0 if > significance level (0.05)

Table 2. Shapiro-Wilk. Normality Test Results

	Class	Statistics	Sig.
Students' Mathematical Problem Solving Ability	Pre-test Experiment	0.800	0.028
	Post-test Experiment	0.935	0.564
	Pre-test Control	0.786	0.014
	Post-test Control	0.973	0.917

The calculated value obtained for the pretest value in the experimental class with the Problem Based Learning model>(level of significance= 0.05) is 0.028 <0.05, and the calculated value obtained for the pretest value in the control class with the direct learning model is 0.014 <0.05. The test criteria are the data are normally distributed if>so it was concluded that the pretest scores of both the experimental and control classes were included in the abnormal category. While the post-test scores in the experimental class with the Problem Based Learning model>(level of significance= 0.05), i.e., 0.564 > 0.05, and the results of the calculation obtained that the post-test value in the control class with the direct learning model was 0.917 > 0.05. The test criteria are normally distributed data if>so it can be concluded that the posttest scores of both the experimental and control classes are included in the normal category.

b. Homogeneity Test

Based on the population normality test, it turns out that the control class is not normally distributed while the experimental class is normally distributed; according to the explanation above, the next test is the homogeneity test. The purpose of the homogeneity test is to determine whether the two populations' variance is homogeneous (same). The homogeneity test can be calculated using Lavene's Test. The hypotheses tested are as follows:

Accept H0 if>

Table 3. Levene's Homogeneity Test Results

	Levene Statistics	df1	df2	Sig.
Students' math	Pretest	4,844	1	15	0.004

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problem-solving ability	Posttest	0.265	1	15	0.614

Based on the results of data analysis using Lavene's Test, the results of calculations for students' math problem-solving ability scores were obtained>(significant level= 0.05), which is 0.614 > 0.05. So it can be concluded that there is no difference in variance between the two groups.

Based on the results above, it is known that the Posttest Significance (Sig.) value is 0.614 > 0.05, so it can be concluded that the variance of the experimental class post-test data and control class post-test data is the same or homogeneous. Thus, one of the requirements (not absolute) of the paired sample t-test is fulfilled.

c. Hypothesis testing

After all prerequisite tests have been carried out, then proceed with hypothesis testing using SPSS (Statistical Package for Social Science)version24 because on the Pretest results Shapiro-Wilk population is not normal, but when the Posttest is normally distributed, therefore the Wilcoxon test is used with a two-sample independent t-test (paired-samples t-test) because the data are not distributed.

Hypothesis 1 (hypothesis test of the comparison of students' problem-solving ability test scores in the experimental class and in the control class)

H0: 1 2 against$\mu \leq \mu$ H1: 1 2$\mu > \mu$

Information:

μ_1= Parameters of problem-solving ability of class XI SMAS PPM Rahmatul Asri students who are taught by applying the Problem Based Learning Model.

μ_2= Parameters of problem-solving ability of class XI SMAS PPM Rahmatul Asri students who are taught by applying conventional learning.

Test Criteria:

1. If the value of sig. (2-tailed) < 0.05 then H0 is rejected
2. If the value of sig. (2-tailed) ≥0.05 then H1 is accepted

Table 4. Wilcoxon Test Results

Test Statistics	
Z	-2521
Asymp.Sig. (2-tailed)	0.012

From the above calculation results, the Asymp value is obtained. Sig. (2-tailed) is 0.012. Asymp Value. Sig. (2-tailed) is smaller than the significance level, namely = 0.05 (0.012 < = 0.05). This means that H0 is rejected and H1 is accepted, so inferentially with the Wilcoxon test, it can be said that there is a significant difference between the problem-solving ability parameters for class XI science taught using Problem Based Learning and problem-solving ability parameters for class XI science being taught using conventional learning.

Table 5. N-Gain Test Results Scores of Students' Problem-Solving Ability between Experiment Class and Control Class

N-Gain Score Test Calculation Results			
	Experiment Class		Control Class
	N-Gain Score (%)		N-Gain Score (%)
Average	84.56	Average	75.39
Minimum	71.01	Minimum	63.77
Maximum	100	Maximum	96.43

Table 6. N-Gain Score Percentage

No	N-Gain Value	Category
1	80≤ X 100	Very good
2	60≤ X 80	Well
3	40≤ X 60	Enough
4	20 X 40	Not enough
5	0 X 20	Very less

The results of the calculation of the N-gain score test show that the average value of the N-gain score for the Experimental class (Problem Based Learning Model) is 84.56%, including very good. With a minimum N-gain value of 71.01% and a maximum of 100%.

Meanwhile, the average N-gain score for the control class (direct learning) is 75.39%, which is included in the Good category. With a minimum N-gain score of 63.77% and a maximum of 96.43%

CONCLUSION

After obtaining the results of the research above, it can be concluded that there is an effect after using a problem-based learning model at SMAS PPM Rahmatul Asri:

1. Students of class XI IPA 1 SMA PPM Rahmatul Asri, in learning with the Problem Based Learning Model, have a very good ability to solve problems obtaining an average score of 91. The maximum score of students is 100, and the minimum score of students is 80.
2. In the direct learning model, students of class XI IPA 1 SMA PPM Rahmatul Asri have the very good problem-solving ability, obtaining an average score of 85. The maximum score of students is 98, and the minimum score of students is 75.

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