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THE EFFECT OF THE PROBLEM BASED LEARNING MODEL ON THE ABILITY TO UNDERSTAND MATHEMATICAL CONCEPTS AMONG JUNIOR HIGH SCHOOL STUDENTS

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ABSTRACT

The process of learning mathematics in schools requires the support of the students in pursuing their learning. Mathematics teaches concepts systematically from simple to complex. The aim of study is to (1) determine the influence of the learning model on student's ability to understand mathematical concepts, (2) determine the difference between students who use the problem based learning model and students using the conventional learning model. This type research is an experimental study with the entire population of students of the 8th grade of La Tansa High School. The sample of the research uses to classes VIII-F as the experimental class and VIII-G as the control class. Data collection techniques using observation and testing. The data analysis technique used were simple linear regression tests and independent sample t-tests. The research results indicate that (1) there is an influence of the Problem Based Learning model the ability of students to understand mathematical concept, (2) there is a difference between students who used the problem based learning model and students who were using the conventional learning model. The test result using a simple linear regression test with a significance level of 0,05 show a Sig. value of 0,004 < 0,05 meaning H_0 is rejected and H_1 is accepted. The result of the testing using the independent sample t-test show a Sig. value of 0,026 < 0,05, which also means H_0 is rejected and H_1 is accepted.

Keywords: Problem Based Learning, Understanding Concept, Students

INTRODUCTION

According to Ki Hajar Dewantara, education is all efforts made by parents towards their children to help their progress in life (Marwah, Syafei, Sumarna, 2018:16). This statement is reinforced by Prof. H. Mahmud Yunus who stated that education is an effort that is deliberately made to invite and help children in improving their knowledge, physical and attitude so that children will slowly achieve their goals and create a happy life (Priantama, 2015:25). In the National Education System Law No. 20 Article 1 of 2003, education is explained as a conscious and planned effort to create an active learning atmosphere and learning process, so that students can develop their potential by having spiritual

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religious strength, self-control, personality, intelligence, noble morals, and skills needed for themselves, society, nation and state (Ristanti, Suri, Choirudin, Dinanti, 2020:156).

Mathematics is an important part of improving the quality of education. This discipline teaches concepts that are systematically structured, from the simplest to the most complex, so that to learn it students need to understand more basic concepts first (Anggraeni, Sunaryo, Fatimah, 2021:136). According to James and James, mathematics is the science of logic about forms, arrangements, and interrelated concepts that are divided into three main points: algebra, analysis and geometry (Rohmah, 2021:6).

The results of the Programmed for International Student Assessment (PISA) in 2022 show that although Indonesia's literacy learning outcomes ranking increased by 5 to 6 positions compared to (PISA) in 2018, scores in several areas decreased. The reading score in 2018 was 371, decreasing to 359 in 2022. The math score also decreased from 379 in 2018 to 366 in 2022 and the science score decreased from 379 in 2018 to 366 in 2022. Although there was an overall increase in ranking, these lower scores indicate that the quality of students' understanding in these areas still needs to be improved.

The abstract nature of mathematics makes it difficult for students to follow the mathematics learning process (Permatasari and Nuraeni, 2021:146). Many students consider mathematics to be a difficult subject. From this point of view, it makes students give up easily before they start learning mathematics (Amalia and Unaenah, 2018:124). One of the reasons why students have difficulty learning mathematics is because they do not understand questions related to conceptual understanding abilities (Fauzi, Irawati and Aeni, 2022:1538).

The ability to understand concepts is the most important foundation in learning mathematics because of the relationship between concepts. By being equipped with the ability to understand a concept, students will easily understand problems, solve problems, and make it easier for students to learn teaching materials (Marliana, Sunaryo and Zamnah, 2023:184). Pranata defines conceptual understanding as a process, treatment, and step to understand learning ideas, students not only know and understand but students are able to express and apply concepts that are easier to understand (Yanda, Jumroh and Octaria, 2019:59). According to Utomo, the indicators of conceptual understanding ability that must be achieved by students are: 1) Restating the concept; 2) Classifying objects according to certain properties according to the concept; 3) Giving examples and non-examples of a concept; 4) Presenting concepts in various forms of mathematical representation; 5) Developing necessary or sufficient conditions for a concept; 6) Using and utilizing and selecting certain procedures or operations; and 7) Applying concepts or algorithms to problem solving. (Septiani and Pujiastuti, 2020:29)

Based on the results of a pre-survey conducted by researchers with one of the mathematics teachers of Class VIII of La Tansa Middle School, Mrs. Senna Segianensys, S.Pd, it was stated that students' mathematical concept understanding ability is relatively low and has not developed optimally.

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The learning process in the classroom tends to use a conventional learning model that is centered on the teacher, with practice questions that are repetitions of examples in the textbook. This makes it difficult for students to apply concepts in different contexts. The average daily test score data also shows that only 21.43% of students reach the "very good" category, while most students are in the "sufficient" or "less" category. One alternative that can be done to overcome this problem is by using a learning strategy that can motivate students and encourage them to be more active in understanding mathematical concepts, namely by using the Problem Based Learning model. *Problem Based Learning* is one of the learning methods that begins with a problem, which will later encourage students to learn and work cooperatively in groups to get solutions, think critically and analytically, be able to determine and use appropriate learning resources. The Problem Based Learning method/problem solving is a way of learning by giving students a problem/issue to be solved or solved conceptually open problems in learning (Hotimah, 2020:5). According to Prof. Howard Barrows and Kelson Problem Based Learning (PBL) is a curriculum and learning process. In the curriculum, problems are designed that require students to gain important knowledge, make them proficient in solving problems, and have their own learning strategies and have the ability to participate in teams (Hartata, 2019:28). According to John Dewey, the steps or stages of the Problem Based Learning model are: 1) Orienting students to the problem; 2) Organizing students to learn; 3) Guide individual or group investigations; 4) Presenting the results of the discussion; and 5) Analyzing and evaluating the problem solving process (Farhana, Yuanita, Kartini and Roza, 2023:127). Based on this background, it is necessary to conduct research to determine the effect of the Problem Based Learning model on students' mathematical concept understanding abilities.

METHODS

This study uses quantitative research type. The method used in this study is the experimental method. The design of this study uses a quasi-experimental design with a non-equivalent control group design that uses two classes as research samples, namely the experimental class and the control class. In the experimental class, students use the Problem Based Learning model while in the control class, students use the Conventional learning model.

Table 1. Research Design

Experiment	O1	X	O2
Control	O3		O4

Source: Sugiyono (2022:75)

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Information :

X : Treatment using the Problem Based Learning model

O_1 : Pre-test for experimental class

O_2 : Post-test for experimental class

O_3 : Pre-test for control class

O_4 : Post-test for control class

In this study, the population used was class VIII of SMP La Tansa in the 2023/2024 academic year consisting of two classes, namely class VIII-F and VIII-G. The sampling technique used purposive sampling technique. The sample in this study consisted of two classes, class VIII-F as an experimental class using the Problem Based Learning model and class VIII-G as a control class using the Conventional learning model.

The instrument used in the study was a test to measure students' mathematical concept understanding ability in the form of seven descriptive questions arranged based on indicators of concept understanding ability. The test instrument has been validated by two experts, namely a grade VIII mathematics teacher and a lecturer of the Mathematics Education Program by assessing the suitability of the indicators. The trial was conducted on grade IX students at La Tansa Middle School. Validity tests using Pearson Correlation and reliability using Cronbach Alpha on seven questions concluded that all questions were valid and reliable, stating that the questions were suitable for use for pre-test and post-test.

Data analysis techniques in this study are prerequisite tests and hypothesis tests. Prerequisite tests consist of normality tests using the Shapiro-Wilk Test, homogeneity tests using the Bartlett Test. Hypothesis tests use Simple Linear Regression tests and Independent Simple t-Test tests.

FINDING

Data analysis of students' mathematical concept understanding ability from the results of the pre-test and post-test that have been carried out in two classes, then calculated using SPSS Version 22 as contained in the following table:

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Table 2. Descriptive Statistics of Mathematical Concept Understanding Ability of Students in Experimental Class and Control Class

Descriptive Statistics						
	N	Range	Minimum	Maximum	Mean	Std. Deviation
Pre-test Experiment	27	57	10	67	38.52	11,775
Post-test Experiment	27	44	48	92	68.89	14.211
Pre-test Control	27	49	10	59	38.33	10,322
Post-test Control	27	49	34	83	60.48	12,705
Valid N (listwise)	27					

Based on the data obtained in table 3, namely the data on the results of students' mathematical concept understanding abilities, it can be seen that the average pre-test to post-test using the Problem Based Learning model in the experimental class shows a difference of 30.37 points. For the average pre-test to post-test using the Problem Based Learning model in the experimental class, it shows a difference of 22.15 points.

1) **Data Concept Understanding Ability Analysis Pre-test**

The results of the pre-test data normality test on the mathematical concept understanding ability of students in the experimental class and control class are shown in the following table:

Table 3. Results of the pre-test data normality test for the experimental class and control class.

Tests of Normality				
		Shapiro Wilk		
	Class	Statistics	df	Sig.
Conceptual Understanding Ability	Experiment Pre-test	.968	27	.549
	Pre-test Control	.969	27	.563

From the calculation above, the Sig. Shapiro Wilk value for the pre-test of the experimental class is 0.549 > 0.05, so H_0 is accepted for the pre-test of the experimental class. While the Sig. Shapiro Wilk value for the pre-test of the control class is 0.563 > 0.05, so H_0 is accepted for the pre-test of the control class. So it can be concluded that the sample comes from a normally distributed population.

The results of the homogeneity test of variance of pre-test data on the mathematical concept understanding ability of students in the experimental class and control class are shown in the following table:

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Table 4. Results of the homogeneity test of variance of pre-test data for the experimental class and control class.

Test Results		
Box's M		.450
F	Approx.	.441
	df1	1
	df2	8112.000
	Sig.	.507

Tests null hypothesis of equal population covariance matrices.

Based on the calculation above, the Sig. value is 0.507 because the significance level used in this study is 0.05, so 0.507 > 0.05, so H0 is accepted. So it can be concluded that the population has a variance **homogeneous.**

The results of the equality test of the two average pre-test scores of the experimental class and the control class. loaded the following table:

Table 5. Results of the equality test of the two average pre-test scores of the experimental class and the control class.

			Sig. (2 tailed)
Conceptual Ability	Understanding	Equal Variances Assumed	0.951
		Equal Variances Not Assumed	0.951

Based on the t-test output table in the "Equal variances assumed" section, the Sig. (2-tailed) value is 0.951 > 0.05 as the basis for decision making in the t-test stating that H_1 is rejected and H_0 is accepted, namely there is no difference in the pre-test values of the experimental and control classes. So it is concluded that the experimental and control classes have the same initial abilities.

2) Analysis of Mathematical Concept Understanding Ability Post-test Data

The results of the post-test data normality test on the mathematical concept understanding ability of students in the experimental class and control class are shown in the following table:

Table 6. Results of the post-test data normality test for the experimental class and control class.

Tests of Normality				
		Shapiro Wilk		
	Class	Statistics	df	Sig.
Conceptual Understanding Ability	Experimental Class Post-test	.968	27	.549
	Control Class Post-test	.981	27	.879

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From the calculation above, the Sig. Shapiro Wilk value for the post-test of the experimental class is 0.549 > 0.05, so H_0 is accepted for the post-test of the experimental class. While the Sig. Shapiro Wilk value for the post-test of the control class is 0.879 > 0.05, so H_0 is accepted for the post-test of the control class. So it can be concluded that the sample comes from a normally distributed population.

The results of the homogeneity test of variance of post-test data on the mathematical concept understanding ability of students in the experimental class and control class are shown in the following table:

Table 7. Results of the homogeneity test of variance of pre-test data for the experimental class and control class.

Test Results		
Box's M		.150
F	Approx.	.147
	df1	1
	df2	8112.000
	Sig.	.701

Based on the calculation above, the Sig. value is 0.701 because the significance level used in this study is 0.05, so 0.701 > 0.05, so H_0 is accepted. So it can be concluded that the population has a variance **homogeneous.**

Test results the similarity of the two average post-test scores of the experimental class and the control class loaded the following table:

Table 8. Results of the equality test of the two average post-test scores of the experimental class and the control class.

			Sig. (2 tailed)
Conceptual Ability	Understanding	Equal Variances Assumed	0,000
		Equal Variances Not Assumed	0,000

Based on the t-test output table in the "Equal variances assumed" section, the Sig. (2-tailed) value is 0.000 > 0.05 as the basis for decision making in the t-test stating that H1 is rejected and H0 is accepted, namely there is a difference in the pre-test values of the experimental class and the control class.

3) Hypothesis Testing

The simple linear regression test was chosen in this study because it can directly conclude whether or not there is an influence in the study. loaded the following table:

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Table 9. Results of simple linear regression test

Coefficients						
		Unstandardized Coefficients		Standardized Coefficients		
Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	43,719	8.161		5.357	.000
	PBL Learning Model	.653	.203	.541	3.220	.004
a. Dependent Variable: Understanding the Concept						

Based on the output results above, the significance value (Sig.) is 0.004 <0.05, so it can be concluded that H0 is rejected and H1 is accepted, which shows that "there is an influence of the Problem Based Learning model on students' mathematical concept understanding ability".

The Independent Sample t-Test is used to determine whether there is a significant difference between two unrelated independent samples listed in the following table:

Table 10. Results of simple linear regression test

			Sig. (2 tailed)
Conceptual Ability	Understanding	Equal Variances Assumed	0.026
		Equal Variances Not Assumed	0.026

Based on the Independent Sample t-Test output table in the "Equal variances assumed" section, the Sig. (2-tailed) value is 0.026 <0.05 as the basis for decision making in the Independent Sample t-Test test stating that H0 is rejected and H1 is accepted, namely there is a difference between students who are taught using the Problem Based Learning model and students who use the Conventional learning model.

The research is an experimental study, with a quasi-experimental design. This research was conducted to determine the students' ability to understand mathematical concept at La Tansa Junior High School. In this study, the sampling technique used is purposive sampling. The population consists of all eighth grade students, totalling 181 students from seven classes. This study uses two classes, namely the experimental class and the control class, with a total of 27 x 2 = 54 students. The experimental class is treated using the Problem Based Learning model, while the control class is treated using the conventional learning model. The research was conducted from May 6 to June 5, 2024.

Before research activities are conducted, the researcher prepares the learning devices and prepares questions for the pre-test and post-test, which consist of 7 descriptive questions. Before the pre-test and post-test questions are administered in to the two classes. The questions will be validated by lecturers and mathematics teachers, and then tested in IX class, which has previously studied the material on

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cubes and cuboids. The results of the question trials will then be tested for validity, reliability, difficulty level, and discrimination power to obtain questions that are suitable for measuring the mathematical concept understanding of eighth-grade students.

DISCUSSION

Based on the analysis of the first hypothesis, it concludes that the Problem Based Learning model has an influence on students' ability to understand mathematical concept. This is in line with Yusri (2018:53) who stated that the Problem Based Learning model has been designed in the form of learning that begins with real problems related to the mathematical concept to be taught. In this case, students do not only receive information from the teacher, but the teacher also plays a role in motivating and guiding students to actively engage in the learning process. And according to Hotimah (2020:6) Problem Based Learning is one of the learning models that helps students improve the skills needed in today's era globalization.

The Problem Based Learning model is made the main focus of the encourage students to be more creative in solving the problems they will face. The problems referred to are certainly related to the students' daily lives. In this case, the teacher, as a facilitator, has the responsibility of identifying learning objectives, providing material, and teaching basic skills. Teachers also help students solve problems in the implementation of the Problem Based Learning model.

Based on the results of the second hypothesis analysis, it concludes that there is a difference between students taught using the Problem Based Learning model and students taught using the Conventional Learning model. This study shows that students taught using the Problem Based Learning model differ from students taught using the Conventional Learning model. It is evident from the results of the Independents Sample t-Test which show a sig value < 0.05.

Through the Problem Based Learning model, students are presented with real problems that can enhance their conceptual understanding and critical thinking skills (Lukitasari, Sudarmiatin, and Zainudin, 2019:1126). Therefore, the Problem Based Learning model is capable of creating activities that spark students' curiosity by providing problems related to their daily lives. This motivates students to engage in the learning process.

The Conventional Learning model is a learning model that is entirely focused on structured learning, consisting of lectures, and evaluations (Lukitasari, Sudarmiatin, and Zainudin, 2019:1126). Therefore, the Conventional Learning model makes students passive and less motivated to engage in the learning process. Student spend more time listening to the learning material and memorizing rather than discovering a concept, so they only take notes on what the teacher delivers during the learning process.

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CONCLUSION

Based on the output results above, the significance value (Sig.) is 0.004 <0.05, so it can be concluded that there is an influence of the Problem Based Learning model on students' mathematical concept understanding abilities, so H0 is rejected and Ha is accepted. The Independent Sample t-Test output table in the "Equal variances assumed" section shows a Sig. (2-tailed) value of 0.026 <0.05, indicating that H_0 is rejected and H_1 is accepted, namely that there is a difference between students who use the Problem Based Learning model and students who use the Conventional learning model.

SUGGESTION

The Problem Based Learning model can be used in mathematics learning on cube and block material in class VIII, provided that obstacles are corrected during the learning process.

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