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APPLICATION OF PROBLEM-BASED LEARNING TO IMPROVE THE MATHEMATICAL UNDERSTANDING OF SEVENTH GRADE JUNIOR HIGH SCHOOL STUDENTS

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ABSTRACT

The background of the problem with students' mathematical understanding, which prompted this research. The sample of this study consisted of two classes, SMPN 2 Batujajar VII-C and VII-F. The instrument used was six questions that measured mathematical understanding abilities. The purpose of this study was to determine whether the learning of mathematical understanding abilities and the improvement of mathematical understanding abilities of students who used the Problem Based Learning (PBL) model developed. The results of the study were processed using two independent samples with normality tests and Mann Whitney tests. The results showed that seventh grade junior high school students who learned using the Problem Based Learning (PBL) model had better learning outcomes and better mathematical understanding abilities than students who learned using conventional learning.

Latar belakang masalah dengan pemahaman matematis siswa, yang mendorong penelitian ini. Sample penelitian ini terdiri dari dua kelas, SMPN 2 Batujajar VII-C dan VII-F. Instrumen yang digunakan adalah enam soal yang mengukur kemampuan pemahaman matematis. Tujuan dari penelitian ini adalah untuk mengetahui apakah pembelajaran kemampuan pemahaman matematis dan peningkatan kemampuan pemahaman matematis peserta didik yang menggunakan model pembelajaran berbasis masalah (PBL) berkembang. Hasil penelitian diproses menggunakan dua sampel independen dengan uji normalitas dan uji Mann Whitney. Hasil menunjukkan bahwa siswa kelas VII SMP yang belajar menggunakan model Problem Based Learning (PBL) memiliki hasil belajar yang lebih baik dan kemampuan pemahaman matematis yang lebih baik daripada siswa yang belajar menggunakan pembelajaran konvensional.

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INTRODUCTION

The current situation is an era of rapid technological development in various aspects of life, but mathematical ability remains the foundation and driving force behind modern technological development. Many students believe that the purpose of mathematical ability is simply to be able to calculate, but its purpose is actually much more noble than that. Basically, mathematics is taught so that students can become accustomed to solving abstract and concrete problems in

life. Mathematics learning also requires deep understanding, so that when students master the basic concepts, they can apply them in the daily life of a modern person (Marlina et al., 2018).. Therefore, learning mathematics is very important at various ages and formal levels.

The process of learning mathematics in schools generally only reaches a basic level of proficiency in accordance with educational regulations, but it can encourage higher-level thinking skills in students. Therefore, teachers need to be innovative in developing mathematics teaching methods in formal institutions. The definition of mathematics learning is very narrow if we interpret it as only arithmetic; far from that, mathematical learning is a specific condition for achieving the goals of mathematical philosophy itself. In this process, students learn concepts, conceptual structures, and seek connections between concepts and their structures.

However, in schools, mathematics learning is often hampered by several factors such as a lack of creativity on the part of teachers, haphazard methods, an intimidating and unpleasant atmosphere, and other negative factors. One common cause of students' poor understanding of mathematical concepts is misconceptions. A deep understanding of mathematics and creativity in line with curriculum requirements can be used as guidelines in the learning process to achieve the desired results. In addition, another factor contributing to low mathematical understanding is the boredom experienced by students during mathematics learning. Mathematical understanding is one of the urgent skills and the basis for applying mathematics to students as much as possible so that they can solve problems better.

Mathematical understanding among students is not something trivial and cannot be ignored. A lack of understanding can result in poor problem-solving skills, communication skills, logical thinking, and mathematical connections. (Sarwoedi et al., 2018).. Even in everyday life, they may avoid anything related to mathematics. Therefore, one can imagine how much better their quality of life would be if they had a good understanding of mathematics.

In line with this, the mathematical understanding expressed by Sariningsih (2014) It is crucial for students to have this skill, as it is the basis for moral individuals to develop their mathematical problem-solving abilities. When people learn mathematics and begin to understand its concepts, they also begin to develop other ways of thinking, including the ability to analyze mathematical problems.Freeman-Green (Sari et al., 2021) states that mathematical understanding is very ready to be improved by using appropriate and targeted learning models. Therefore, mathematical understanding can be developed by applying problem-based learning. The learning process that involves problem solving can improve students' mathematical comprehension skills (Minarni et al., 2016). Therefore, mathematical comprehension can be developed through the application of problem-based learning.

One alternative innovation that teachers can choose is the problem-based learning (PBL) approach. According to Nur (Respati et al., 2016) Pembelajaran berbasis masalah (PBL) adalah metode mengajar yang memperbolehkan siswa untuk mengeksplorasi dan belajar mengenai berbagai situasi masalah yang nyata dan bermakna. Dengan menerapkan PBL, proses belajar dapat lebih optimal dengan menggunakan lembar kerja siswa, media pembelajaran yang tepat, serta pengelolaan kelas yang baik.

Problem-Based Learning (PBL), first introduced by John Dewey in 1859, promotes the concept of “learning through experience” or problem-based learning. In this model, students are divided into small groups of 3 to 5 people. Each group is assigned to find a problem related to the material or concept being studied. They then explore the problem by formulating questions,

making hypotheses, collecting data, and testing the hypotheses. Next, students report their work, fill out worksheets, and develop plans for the next task. (Rahmadani & Acesta, 2017). Each group also presented their findings related to the project topic they studied. Meanwhile, according to the PBL model Cahyaningsih & Ghufron (2016) is a learning model that begins by presenting problems to students, who are then asked to solve the problems to discover new knowledge. In this model, students are required to be more active in the teaching and learning process.

This study is based on previous research that questioned the relationship between the PBL model and students' mathematical comprehension abilities. The aim is to analyze how the use of the PBL model affects the improvement of students' mathematical comprehension abilities, as well as how successful students are in learning using this model. For this reason, an in-depth analysis of the PBL model itself is required.

METHOD

In this study, the cause and effect of the PBL model, independent variables, on dependent variables, were examined through a quasi-experimental method. This study involved 28 students from class VII-F and 28 students from class VII-C from a junior high school in West Bandung. The data collected in this study came from test results covering four essay questions used to analyze students' ability to understand mathematics. Furthermore, the data was processed using SPSS 26. A normality test was conducted after initial data processing to determine whether the data distribution was normal. Next, a homogeneity test was conducted on the normal data to determine whether the data was homogeneous or not, and a t-test was used to determine whether the data was not homogeneous. For data with a normal and homogeneous distribution, a t-test was used, and a Mann Whitney nonparametric statistical test was used to identify whether one or both did not have a normal distribution. The stages of the PBL model used in this study according to Haeruman et al, (2023);

Table 1. Stages of Problem-Based Learning Models

No	Steps
1	Adjusting students to problems
2	processing students for learning
3	directing individual and group investigations
4	developing and presenting work, and
5	analyzing and evaluating a problem-solving process

The indicators of mathematical comprehension used in this study, according to Oktavianda et al., are as follows: (2019);

Table 2. Mathematical Comprehension Ability Indicators

No	Indicators
1	Reinterpreting an idea
2	Classifying various objects based on whether they
3	meet the requirements that form the idea
4	Applying the idea with an algorithm

In addition, there is a preliminary assumption or hypothesis used in this study to determine whether students can improve their mathematical understanding. The hypothesis used in this study is as follows:
$H_0 : \mu_1 \leq \mu_2$ Problem-based learning (PBL) does not improve students' mathematical comprehension skills..
$Ha : \mu_1 > \mu_2$ Problem-based learning (PBL) improves students' mathematical comprehension skills..

Normalized gain scores, or N-Gain, as interpreted by Meltzer, can be used to see whether students' mathematical comprehension skills have improved. (Hanim, 2017);:

Table 3. Interpretation of N-Gain

Indeks Gain	Kriteria
(N-gain) $\geq 0{,}7$	Tinggi
$0{,}3 \leq$ (N-gain) $< 0{,}7$	Sedang
(N-gain) $< 0{,}3$	Rendah

In addition to improving students' mathematical abilities, students' classical proficiency is measured to determine how well they have succeeded in their learning. The formula is as follows: Pertianti et al., (2024);

$$\textit{Percentage of Classical Completion} = \frac{\textit{Number of students who have completed their studiesumlah siswa tuntas belajar}}{\textit{Number of students}} \text{ x } 100\ \%$$

The percentage of classical completion according to Tampubolon (Pertianti et al., 2024):

Table 4. Classical Mastery Criteria Period

Percentage Interval	Category	Interpretation
81% – 100%	A	High Quality
61% – 80%	B	Good Quality
41% – 60%	C	Fair Quality
21% – 40%	D	Poor Quality
0% - 20%	E	Very Poor Quality

RESULTS AND DISCUSSION

Result

At one of the secondary schools in West Bandung, this study was conducted over five meetings. The students' mathematical comprehension scores after the treatment were obtained from tests administered during the first meeting (pre-test) and the last meeting (post-test). These scores were collected from the control class and the experimental class. The following are the students' mathematical comprehension scores from the pre-test and post-test:

Table 5. Pre-test and Post-test Results of Mathematical Comprehension Skills

Value	Pretes		Postes	
	Eksperimental	Control	Eksperimental	Control
0 - 25	9	7	0	0

26 - 50	13	17	0	11
51 - 75	6	4	15	15
76 - 100	0	0	13	2
Total	28	28	28	28

The table above shows the pretest and posttest scores for students' mathematical comprehension skills. The analysis results show that 30 students in the experimental and control classes had fairly low scores on the pretest. However, after the treatment using the PBL model, the posttest results for the experimental class were better. The following table shows this improvement:

Table 6. N-Gain Mathematical Comprehension Score

N-Gain Score Criteria	Indeks Gain	Number of Students	
		Eksperimental	Control
High	(N-gain) $\geq 0,7$	19	0
Medium	$0,3 \leq$ (N-gain) $< 0,7$	8	15
Low	(N-gain) $< 0,3$	1	13
Average		0,6	0,3
Interpretation		Medium	Medium

The table above shows the average N-Gain scores for students in the experimental class, who were at a moderate level and obtained an average N-Gain score of 0.6. These results indicate that students in the experimental class experienced greater improvement than students in the control class. However, these findings are not sufficient to answer the research hypothesis, so a statistical test will be conducted using SPSS 26.

Table 7. Normality Test

Shapiro-Wilk	Statistic	df	Sig.
Experimental Class	0,896	28	0,009
Control Class	0,940	28	0,111

Normality tests are used to determine whether the data distribution in the experimental class and control class is normal. A t-test is performed if the data has a normal distribution, and a nonparametric test is performed if the data does not have a normal distribution. According to the table above, the significance value of the experimental class is 0.009, which is greater than 0.05, and the significance value of the control class is 0.111, which is greater than 0.05. Therefore, it can be concluded that the data from both classes do not have a normal distribution. Therefore, the Mann-Whitney test must be performed.

Table 8. *Mann-Whitney Test*

	N-Gain Score
Mann-Whitney U	41,500
Wilcoxon W	447,500
Z	-5,749
Asymp. Sig. (2 tailed)	0,000

The output table from the Mann-Whitney test shows that the significance value for Asymp. Sig. (2 tailed) is 0.000, which is less than 0.05, so H0 is rejected. In other words, the results of the test of junior high school students' mathematical ability using the Problem Based Learning

(PBL) model are better than those of junior high school students using conventional learning. The results show that 21 students are in the mastery category, while 7 students are in the enrichment category and need more assignments. According to Pertianti et al. (2024), the formula for the percentage of mastery of classical learning outcomes used in this study is as follows:

$$\textit{Percentage of Classical Completion} = \frac{\textit{Number of students who have completed their studiesumlah siswa tuntas belajar}}{\textit{Number of students}} \text{ x } 100\ \%$$

$$\textit{Percentage of Classical Completion} = \frac{21}{28} \text{ x } 100\%$$

$$= 75\%$$

Based on the percentage of learning outcomes achieved in the experimental class, it can be seen that 75% of the percentage is in the "B" category and falls under the interpretation of "Quality". Students who learn using the Problem Based Learning (PBL) model achieve quality learning outcomes.

Discussion

The purpose of this study was to determine whether seventh-grade junior high school students who learned using the Problem-Based Learning (PBL) model improved their mathematical comprehension skills compared to students who learned using conventional learning methods. Conventional learning is a learning model commonly used by teachers and consists of techniques such as question and answer sessions, assignments, and lectures. (Peranginangin et al., 2020). In experimental classes, problem-based learning (PBL) models are considered effective because students are active and do not get bored.

In the problem-based learning (PBL) model, students are required to talk with their groupmates. In LKPD, students help each other analyze and answer questions. The PBL model makes students concentrate on challenges so that they can discover concepts in unique ways. Thus, students will become high-quality learners.

The use of problems in the Problem-Based Learning (PBL) model is used to stimulate students' thinking skills. (Indriani, Haryanto & Gularso, 2022). Meanwhile, media assistance is a technique used to make communication between teachers and students more effective in the process of school education and teaching. (Yanti, Yusran & Ino, 2019). The results of the gain normality test (N-Gain), which was calculated by comparing the differences between the pretest and posttest scores, showed an increase in students' mathematical comprehension abilities in the experimental class before and after the treatment using the problem-based learning (PBL) model.

The N-Gain results show that the experimental class that was given the Problem Based Learning (PBL) model treatment had an average N-Gain interpretation of "moderate," while the control class that was given conventional learning treatment had a better N-Gain interpretation. This is in line with Rerung's belief. (2017) which states that problem-based learning (PBL) can improve student learning outcomes by enhancing their mathematical comprehension skills. The learning outcomes of students using the PBL model are measured by classical mastery, which is defined as the ability that students must demonstrate as evidence that they have achieved the learning objectives. According to Juhairiah (2023) stated that educators are not advised to assess student mastery based on absolute scores or minimum scores that students must achieve in a

subject. It is best to use descriptions; however, teachers can use score intervals, such as score ranges. It is said that the experimental class that used the problem-based learning (PBL) model achieved classical learning mastery. This can be seen from the fact that the percentage of classical mastery scores fell into the "Quality" category.

CONCLUSION

The results of data processing and analysis can be simplified as follows: According to the N-gain and Mann-Whitney test results, which show that H0 is rejected and Ha is accepted, it can be concluded that seventh-grade junior high school students have better mathematical comprehension skills than students who learn using the PBL model than those who learn using the conventional learning model. According to the classical mastery percentage score, students who learn using the PBL model achieve classical mastery in learning. This is demonstrated by the fact that they are in the "Quality" category. The recommendation for further research is to use interactive and engaging ICT media to increase junior high school students' desire to learn mathematics.

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