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# Problem solving ability: The impact of student worksheets based on problem-based learning models on set material in junior high school

Thitra Padma Rani<sup>1</sup>, Sugeng Sutiarto<sup>2,\*</sup>

<sup>1</sup> Universitas Lampung, Indonesia

<sup>2</sup> Universitas Lampung, Indonesia

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\*Correspondence: E-mail:  
[sugengsutiarto7@gmail.com](mailto:sugengsutiarto7@gmail.com)

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## ABSTRACT

*The problem in this study is related to the less optimal ability to solve students' mathematical problems. Therefore, the purpose of this study was to find out and analyze the average difference in the ability to solve mathematical problems between students who apply the PBL model assisted by worksheets and those who apply the conventional learning model at one of the junior high schools in Tulang Bawang district. This study uses a quasi-experimental method. Samples were taken using the Cluster Random Sampling technique with a lottery procedure. The instrument in this study was an essay test. Hypothesis testing using t-test: prior to testing the hypothesis, prerequisite tests were first carried out, namely the normality test and homogeneity test. From the results of the hypothesis testing, it can be concluded that the application of the PBL model with the help of student worksheets can improve students' mathematical problem-solving abilities. Worksheets made with PBL syntax can facilitate and improve students' problem-solving abilities. This can be seen in the increase in the average value of the class that applies the PBL model.*

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## INTRODUCTION

Mathematics is considered the queen of knowledge. Mathematics is one of the most important parts of science. Mathematics is a science that is very necessary in life because mathematics is a basic science that is also used in other sciences (Susanti & Nusantara, 2020). Students acquire mathematical

knowledge both formally and through incidental learning. Learning mathematics is one of the tools used by teachers to facilitate existing talents in students so that they gain knowledge, reason, and develop behavior and self-confidence. Basically, learning mathematics is continuous learning because the material studied at the advanced level is the

development of concepts from the basic material that has been studied previously. In addition, in learning mathematics, it is not only the cultivation of concepts that must be emphasized, but the application of the concepts learned is very much needed in social life and character formation so as to give birth to quality human resources (Salahudin, Akos, & Hermawan, 2018).

Mathematical problem-solving ability is a student's skill in using and constructing the mathematics he has learned to solve problems within the scope of mathematics itself, problems in other sciences, or problems in everyday life. Polya believes problem solving is an activity to find a way out of a problem that is not easy to solve (Hendriana, Johanto, & Sumarmo, 2018; Munifah, Septiyani, Rahayu, Ramadhani, & Tortop, 2020). In solving problems, students do not immediately find solutions; instead, they need to go through a series of procedures before finally obtaining conclusions or solutions to the problems given. According to Polya (Netriwati, 2016), the indicators that need to be done in solving the problem are several steps, including first understanding the problem. Before solving it, the first step is to understand in advance what the problem is. Things that need to be done at this stage include problem analysis. The second step is to develop a method or strategy to solve the problem. In this stage, students will analyze which path will be taken to solve the problem. After finding the right steps or procedures to solve the given problem, the next step is to solve the problem according to the predetermined procedure. Until finally finding a solution or result to the problem. After finding a solution, the final step that needs to be done is to check again whether there is a wrong procedure, whether there are other steps that are more appropriate to solve it, and finally, whether the steps used can be generalized or not (Dung & Bao, 2017; Simamora, Saragih, & Hasratuddin, 2018).

In everyday life, almost all the problems presented require students to use advanced thinking skills to solve them. In several schools that are still implementing the revised 2013 curriculum, the importance of mathematical problem-solving abilities is explicitly regulated in order to integrate mathematical problem-solving abilities in other fields (Hirza, Muchtar, Sutiani, Dibyantini, & Sinaga, 2023). The ability to solve mathematical problems is one of the basic abilities that needs to be developed and honed in the process of learning mathematics. The learning approach uses mathematical problem-solving abilities, namely process measures and outcome measures. This is in accordance with the opinion of Sumarmo, who stated that the ability to solve mathematical problems is a learning activity to obtain strategies and do mathematics as an activity (Nguyen, Do, Nguyen, Tran, & Nguyen, 2023).

But in reality, there is a discrepancy between expectations and reality when it comes to teaching students how to solve mathematical problems. The findings of a preliminary study carried out by researchers at one of the junior high schools in Tulang Bawang Regency demonstrate this. Of the 58 samples given regarding problem-solving abilities, only 29% of students were able to pass the standards given.

From the results of the 2018 PISA in mathematics, which was attended by 73 countries, Indonesia obtained a score of 379, ranking seventh from the bottom (Astuti, Hamdani, & Pranata, 2021). less learning, a lack of learning literacy, and the learning model used is still centered on it, so that students feel bored while learning, and as a result, the learning process in class has not activated students as a whole. Not to mention the added stigma from students who state that learning mathematics is a difficult subject, which has an impact on reducing student interest and motivation in learning.

It turns out that students' ability to solve math puzzles is a problem not only in Indonesia but also in developing countries like Vietnam. According to a previous study by Dung & Bao (2017) Most of the solutions offered during the first phase, "Identify solutions to the problem," were either wrong (115 students, recorded at 57% incorrect) or somewhat inaccurate (69 students, counted at 33% correct). This shows that Vietnamese students still have low problem-solving abilities in terms of recognizing data deficiencies using statistical tools.

To overcome these problems, innovation is needed that can provide opportunities for students to actively participate in the learning process. One of the solutions offered is to use the problem-based learning (PBL) model. PBL is a learning model related to the real world. PBL is learning that focuses on problem-solving activities in the form of unstructured problems so that it can invite students to think deeply and engage in group discussions. This is in line with the research of Phungsuk, Viriyavejakul, & Ratanaolarn (2017), which states that PBL is a learner-centered learning model in which students learn about a subject by trying to find solutions to open problems. PBL learning syntax includes a) problem orientation, b) forming heterogeneous study groups, c) students make observations to find solutions to the problems given, d) the teacher guides students in preparing findings, e) the teacher guides students to make presentations, and f) teachers and students carry out evaluations (Anazifa & Djukri, 2017; Yustianingsih, Syarifuddin, & Yerizon, 2017).

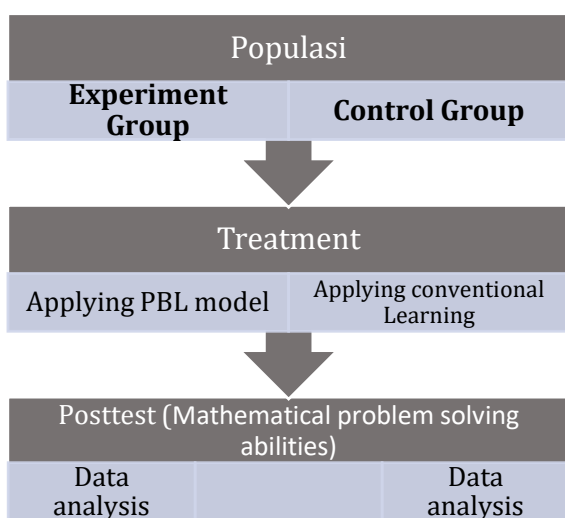
There are several advantages to PBL learning, including that it can increase students' soft skills, increase learning motivation, and build students' social skills. By solving their own problems, students will apply the knowledge they

already have to the new knowledge they are learning. Through PBL learning, students become responsible for the decisions taken and are encouraged to evaluate both the results obtained and the learning process carried out (Rerung, Sinon, & Widyaningsih, 2017). Besides the advantages, there are also disadvantages to the PBL model. The weaknesses of the PBL model include the fact that if students do not have self-confidence and think the problems given are difficult, they will feel reluctant to try them. Furthermore, learning using the PBL model requires clear supporting books for conducting learning. The implementation of the PBL model takes quite a while. Not all material for learning mathematics is suitable to be taught using the PBL model (Agung Widayat, 2023). Based on some of these opinions, it can be concluded that PBL is a learning model that starts learning activities by presenting students' problems and involving students in solving these problems, so that this model is felt to have an influence on increasing students' mathematical problem-solving abilities (Khairani, Suyanti, & Saragi, 2020).

In previous research, research has been carried out that discusses increasing mathematical problem-solving abilities with PBL (Khikmiyah, 2021; Simarmata & Sirait, 2019). From the research conducted, it can be concluded that the application of the PBL model can improve students' problem-solving skills in statistical material and social arithmetic. However, several studies have not found the application of the PBL model, which focuses on the ability to solve students' problems in set material. Therefore, this research was conducted to see the effect of applying the PBL model assisted by worksheets on students' problem-solving skills in junior high schools.

## **METHOD**

The type of research used in this study is quantitative research with experimental methods. The design of this study is Quasi-Experimental Design. In this study, two samples were randomly selected. The experimental class will be treated using the PBL model, assisted by student worksheets. While in the control class, it will be given treatment using the conventional model. In this study, a posttest-only control group design was implemented. In Figure 1, the experimental design is shown.



**Figure 1.** Experimental Design

All odd-semester junior high school students in the 2022–2023 academic year became the study population. In this study, a sample of 58 students was distributed, with 29 students from the experimental class and 29 students from the control class. To test problem-solving skills, students are given five questions in the form of descriptions that have been validated beforehand. The validation of the questions can be seen in Table 1.

**Table 1.** Test Validity

No.	$r_{xy}$	$t_{count}$	$t_{table}$	Information
1	0.75	6.00	1.70	Valid
2	0.87	9.34	1.70	Valid
3	0.87	9.34	1.70	Valid
4	0.88	9.80	1.70	Valid

5	0.88	9.0	1.70	Valid
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Based on the data, it can be seen that the test instrument used is valid with a coefficient value of 0.98, so the test instrument can be used as a measuring tool in this study. From the results of the problem-solving ability test given, the data is obtained. The data is then processed and tested for normality using the Kolmogorov-Smirnov test and homogeneity test, before finally testing the hypothesis.

## RESULTS AND DISCUSSION

The outcomes and evaluations for this study came from several stages of the research process. The viability of the research instrument is examined during the initial testing phase. The research tool was a question test designed to gauge pupils' knowledge. The findings of the descriptive test will be reported for the score data to be tested for problem-solving ability in Table 2 based on the research design.

**Table 2.** Distribution of Data on Mathematical Problem-Solving Abilities

Distribution of Data	Group Experiment	Group Control
Min. value	50	34
Max. value	98	88
Mean	74.55	55.52
Median	72	50

Data on the worth of students' problem-solving skills from classes with various teaching methods are shown in Table 2. The PBL model is more effective at enhancing problem-solving skills when centralized rules are used, as shown by the table's higher average and median values for the PBL model than for the conventional method. As a prerequisite for assessing the hypothesis, normality and homogeneity tests must be performed before the t test. The purpose of the normality test is to establish whether or not the data obtained are normally distributed. Table 3 includes both the

results of the homogeneity test and the normalcy test.

**Table 3.** Normality Test of Students' Mathematical Problem-Solving Abilities

	Kolmogorov-Smirnov <sup>a</sup>		
	Statistic	df	Sig.
Group Experiment	.091	29	.200*
Group Control	.158	29	.064

If a data point's significance value is greater than 0.05, it is considered normal. Table 3 shows that the application of the traditional and PBL models is normally

distributed with a significant level of 0.05, allowing for continuation to the stage of the variant homogeneity test.

**Table 4.** Homogeneity Test of Mathematical Problem-Solving Ability

		Levene Statistic	df1	df2	Sig.
Mathematical problem solving abilites	Based on Mean	.992	1	56	.323
	Based on Median	.420	1	56	.519
	Based on Median and with adjusted df	.420	1	51.246	.520
	Based on trimmed mean	.845	1	56	.362

With a significance level of 0.05, the homogeneity test calculation yielded a sig value of 0.323. Because  $H_0$  is accepted when the sig value is greater than 0.05, the variances of the two distributions are

homogeneous. A t-test hypothesis will be evaluated because the data are normally distributed and the variance is homogeneous, as shown in Table 5.

**Table 5.** T-Test of Mathematical Problem-Solving Ability

t-test for Equality of Means										
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error	95% Confidence Interval of the Difference	
									Lower	Upper
Mathematical problem solving abilites		.992	.323	4.789	56	.000	19.03448	3.974	11.07213	26.99684
				4.789	54.346	.000	19.03448	3.974	11.06677	27.00219

The hypotheses given in this study is as follows:  $H_0$  = the average value of the problem-solving ability of students who apply PBL, which is the same as that of those who apply the conventional model.  $H_1$  = the average value of the problem-solving ability of students who apply PBL, which is higher using the conventional model. Based on Table 5, it is known that the t test obtained a t count of 4.789.

Meanwhile, to draw conclusions from the hypothesis, if  $t_{count} \geq t_{table}$  then  $H_0$  will be rejected.

Because  $4.789 \geq 2.04227$ ,  $H_0$  is rejected, which means that the PBL model has a significant effect on students' mathematical problem-solving abilities compared to conventional models. This is in line with previous research, which states that the PBL model has an influence

on increasing students' mathematical problem-solving abilities. This is consistent with earlier research showing that the PBL approach influences students' ability to improve their mathematical problem-solving skills (Andesma & Anggraini, 2019; Darma, 2018; Suparman, Yohannes, & Arifin, 2021).

The difference in the average value of students' mathematical problem-solving abilities in the experimental and control classes was caused by the difference in the treatment given. From the pre-research results, it can be seen that students' problem-solving abilities are still not optimal. Therefore, the application of the PBL model with the help of student worksheets is made in such a way that it is a tool that can train students to increase their mathematical problem-solving abilities. PBL is a learning model that encourages people to be more active in maximizing their critical thinking skills to find solutions. By providing student worksheets based on PBL syntax, students are directed to find their own information and relate it to other knowledge they already have, which is then conveyed to their other friends and validated by the teacher. By discovering their own knowledge, students will better understand the concepts being studied and remember them longer. So that if faced with everyday problems related to the set material taught by students, they can solve these problems according to their abilities. Apart from that, in applying the PBL model, students are also trained to work together and respect different opinions from other groups. Whereas in conventional group learning, learning is more centered on the teacher, so that learning has not been able to facilitate students' problem-solving abilities.

In the experimental class, students learn using the PBL model, assisted by worksheets with specified materials. Where the first step in learning using the

PBL model is to analyze the problems given by the teacher, students then collect information from various sources. After gathering information, students will be directed by the teacher to hold discussions in small groups formed by counting 1 to 5. Students who have the same number will be joined in one group. This method is carried out so that the groups formed are heterogeneous and train students' communication and collaboration skills. After completing the discussion within the allotted time, the teacher will help students develop a conclusion framework from the facts and information that have been collected and discussed together. This stage provides an opportunity for students to analyze their findings so that they can relate the knowledge they already have with the new knowledge they have learned. The next step in implementing the PBL model is for students to present the results of their discussions in front of the class. At the end of the lesson, the teacher will help students draw conclusions from what is learned and carry out joint evaluations of both the results and the learning process. The steps in PBL learning can facilitate the development of students' mathematical problem-solving abilities in experimental classes. The steps in PBL learning can facilitate the development of students' mathematical problem-solving abilities in experimental classes. These steps in PBL learning can facilitate the development of students' mathematical problem-solving abilities in the experimental class (Temel, 2014; Ulger, 2018).

While learning in the control class, students are taught as teachers teach or use conventional models. In the control class, the medium used was textbooks, in which the language used was too complicated so that students did not understand some of the procedures or the meaning of the problems given. So from this study, it can be concluded that the application of the PBL model has a

significant effect on increasing students' mathematical problem-solving abilities.

### CONCLUSIONS AND SUGGESTIONS

The results of the study refer to the fact that the increase in the average value of the experimental class's mathematical problem-solving ability is higher when compared to the average value of the control class's problem-solving ability, which means that the application of the PBL model with the help of student worksheets on set material has a significant effect on increasing students' ability to solve mathematical problems.

Suggestions for further research, namely the use of worksheets for PBL students, should provide clear implementation instructions so that they do not cause many perceptions from students that make them confused in solving the problems given. The next suggestion is that when giving problems, the teacher should pay attention to the level of difficulty of the problems so that students can find appropriate solutions to them. Apart from that, teachers too should apply problem-based learning to learning mathematics in the long term and implement it consistently by providing student activity facilities that support the development of indicators of students' problem-solving abilities.

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