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THE INFLUENCE OF THE PROBLEM-BASED LEARNING MODEL ON CRITICAL THINKING ABILITY AND MATHEMATICS LEARNING OUTCOMES AT SMPS PGRI 19 LOHSARI BARAT

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Abstract:
The background to this research is the low level of mathematics learning outcomes and critical thinking abilities. The need for influential learning to support critical thinking skills and student learning outcomes through the problem-based learning model. This research aims to determine the effect of the problem-based learning model on students' critical thinking abilities and mathematics learning outcomes. The research was carried out at PGRI 19 West Lohsari Private Junior High School. This research is a quasi-experimental type with a Non-Equivalent Control Group Pretest-Posttest Design. The subjects in this research consisted of two classes, namely class VIII-1 with a total of 26 students as an experimental class treated using a problem-based learning model and class VIII-2 with a total of 26 students as a control class using a conventional learning model. The data analysis technique used is the t-test or paired sample t-test. The instrument used is a test in the form of an essay to measure critical thinking abilities and mathematics learning outcomes. The results of hypothesis testing using the t-test obtained a value of t-count 8.33431 > t-table = 0.388, which means that there is a significant influence of the application of the problem-based learning model on critical thinking skills and mathematics learning outcomes for class VIII at PGRI 19 West Lohsari Private Junior High School. The Problem-Based Learning model has been associated with several advantages, such as improving critical thinking skills, improving problem-solving abilities, and improving mathematics learning outcomes. Thus, the problem-based learning model can be effective in improving students' critical thinking skills and mathematics learning outcomes.

Keywords: Problem-Based Learning, Critical Thinking, Mathematics Learning Results

PENGARUH MODEL PROBLEM-BASED LEARNING TERHADAP KEMAMPUAN BERPIKIR KRITIS DAN HASIL BELAJAR MATEMATIKA DI SMPS PGRI 19 LOHSARI BARAT

Abstrak:
Latar belakang penelitian ini adalah masih rendahnya hasil belajar matematika dan kemampuan berpikir kritis siswa. Perlunya pembelajaran yang berpengaruh untuk

mendukung kemampuan berpikir kritis dan hasil belajar siswa, yaitu melalui model pembelajaran problem-based learning. Tujuan penelitian ini yaitu untuk mengetahui pengaruh model problem-based learning terhadap kemampuan berpikir kritis dan hasil belajar matematika siswa. Penelitian ini dilaksanakan di SMP Swasta PGRI 19 Lohsari Barat. Penelitian ini berjenis quasi eksperimen dengan desain Non-Equivalent Control Group Pretest-Posttes Design. Subjek pada penelitian ini yaitu terdiri dari dua kelas yaitu kelas VIII-1 dengan jumlah 26 siswa sebagai kelas eksperimen yang diberi perlakuan menggunakan model pembelajaran problem-based learning dan kelas VIII-2 dengan jumlah 26 siswa sebagai kelas kontrol menggunakan model pembelajaran konvensional. Teknik analisis data yang digunakan adalah uji t atau paired sample t-test. Instrumen yang digunakan adalah tes berupa essay untuk mengukur kemampuan berpikir kritis dan hasil belajar matematika. Hasil Pengujian hipotesis dengan uji-t diperoleh nilai t_{hitung} 8,33431 > t_{tabel} = 0,388, yang berarti terdapat pengaruh yang signifikan dengan penerapan model pembelajaran problem based learning terhadap kemampuan berpikir kritis dan hasil belajar matematika kelas VIII di SMP Swasta PGRI 19 Lohsari Barat. Model Problem-Based Learning telah dikaitkan dengan beberapa kelebihan, seperti meningkatkan kemampuan berpikir kritis, meningkatkan kemampuan memecahkan masalah, dan meningkatkan hasil belajar matematika. Dengan demikian, model problem-based learning dapat menjadi model pembelajaran yang efektif dalam meningkatkan kemampuan berpikir kritis dan hasil belajar matematika siswa.

Kata Kunci : Problem-Based Learning, Berpikir Kritis, Hasil Belajar Matematika

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INTRODUCTION

Mathematics is a very important subject for education because it can help students solve everyday problems (Sianturi, Sipayung, & Simorangkir, 2018) Mathematics is a very necessary science and is taught at all levels of education. One of the important math skills that children must have is the ability to think critically about mathematics. Higher-order thinking abilities include critical thinking skills as well (Helmon, 2018). This is because mathematics is one of the fundamental knowledge that can build students' critical thinking abilities (Tobing & Sinaga, 2022). Oktaviana and Prihatin (2018) argue that mathematics is a subject that applies logic in its thinking process.

In mathematics lessons, you must be clever in choosing the strategies used to foster students' interest in learning and improve students' mathematics learning outcomes in accordance with the new paradigm in the world of education, namely student-centered education, so that students become more active and think critically. Syahbana (2012) argues that students can be taught mathematics very well and that the field itself depends on mental processes. Stated differently, the goal of studying mathematics is to improve students' critical thinking skills and teach them how to think methodically, logically, critically, and creatively.

Through the study of abstract concepts and the patterns they contain, mathematics teaches students how to solve problems and develop their critical thinking skills. In Rahmadani and Anugraheni (2017) one of the subjects that can help students develop their critical thinking and debate skills to help solve difficulties that arise in everyday life is mathematics. To understand mathematics topics properly, mathematics students must be able to think critically.

According to Dinar (2013), the process of applying more advanced and critical thinking skills to help someone become more accurate in their judgments and decisions is known as critical thinking. Children who lack this ability find it difficult to investigate themselves and find solutions to their difficulties. In addition, having the ability to think critically helps them be (Crismasanti & Yunianta, 2017), more careful when evaluating statements logically. Meanwhile, according to Crismasanti and Yunianta (2017) critical thinking is the process of using thinking skills effectively to make, evaluate, and implement decisions based on one's beliefs or actions.

The level of success of students in learning subject matter at school is called learning outcomes (Susanto, 2013). Student learning outcomes are one measure of success in the world of education during learning (Saihu, 2020), including changes in behavior that cover the cognitive, affective, and psychomotor domains (Yukentin, Munawaroh, & Winarso, 2018). Students' low mathematics learning outcomes can be assumed to be a lack of mastery of the material (Sari, Hidayat, & Yuliani, 2019), because the accuracy of students' mathematics learning outcomes is closely related to the cognitive domain, activities that involve brain activity and are oriented towards students' thinking abilities.

Based on Bloom's taxonomy, the cognitive domain consists of knowledge, understanding, application, analysis, synthesis, and evaluation

(Oktaviana & Prihatin, 2018). Students' cognitive mathematics learning outcomes are results that have been achieved through a test to measure their ability, understanding, and mastery of the material after following the mathematics learning process for a certain period of time (Nuriati, 2021). Apart from a lack of mastery of the material, students' achievement of learning outcomes can also be influenced by several other factors, namely, internal factors and external factors. To achieve these results, students must be given stimulation and exercises to improve their ability to think critically (Marisa, 2020).

The results of interviews and observations conducted with class VIII mathematics teachers at PGRI 19 West Lohsari Private Middle School showed that students' mathematical critical thinking abilities were still low. This is caused by the fact that students do not show interest in mathematics lessons, do not show a response to the material provided by the teacher, and only accept the material provided by the teacher without studying or reconsidering what has been given. Students usually only listen to the teacher's explanation and have no desire to ask questions. As a result, when teachers ask questions, students answer them but don't know how to solve them. This problem causes students' critical mathematical thinking abilities to be hampered, which results in a decrease in their learning achievement. Apart from that, judging from the daily grades and exams of students in class VIII, student learning outcomes are still relatively low.

According to Azizah, Sugiyanti, and Happy (2019) the use of teacher learning methods that prioritize knowledge of concepts over the development of critical thinking skills students can be one of the causes that contribute to students' inadequate critical mathematical thinking ability. The traditional methods of teaching mathematics in schools are another element that could be the cause of this problem. Appropriate learning models are needed to address the student's mathematical learning challenges and improve learning outcomes. The learning process in the classroom will be influenced by the use of appropriate learning models, which will improve the learning outcome. To improve students' critical thinking skills and learning outputs in mathematics, teachers should choose the best learning approach. The problem-based learning model helps improve students' ability to think critically and their learning outcomes, especially in mathematical studies (Phasa, 2020).

Problem-based learning (PBL) is the kind of instruction that can teach students how to think critically about mathematics (Azizah, Sugiyanti, &

Happy, 2019). Students' ability to think critically can be enhanced with appropriate learning models. One of the best learning models is a problem-based learning approach (Phasa, 2020). A constructivist theoretical framework serves as the basis for a problem-based learning methodology. Selective problems serve as problem-based learning focal points, ensuring that students acquire more than just relevant concepts (Bharata, 2015). According to (AN Asriningtyas, F Kristin, 2018) a challenge is presented in a problem-based learning approach for students to solve using critical thinking.

Duch explains that the problem-based learning paradigm (PBL) is an instructional strategy that uses real-world situations to help students develop their critical thinking and problem-solving skills, as well as to absorb knowledge and better learning outcomes. Students are taught to solve problems and collaborate in groups through problem-driven learning, which encourages students to take an active role in their education. The problem based learning model offers a variety of benefits to students, such as improving their learning outcomes and simplifying the materials taught (Sari, 2017).

Many students have difficulty solving math problems. One resource on Pythagoras's theorem has this problem. The instruction that makes students commit the formula to memory, makes it impossible for them to approach the problem methodically. To overcome the challenge of answering Pythagoras's theorem questions, students need enough training and direction to be able to combine skills using their formulas and calculations.

Students are taught to think critically, and analytically, and to use a variety of resources to discover through problem-based learning (PBL). This method is suitable for creating an ideal learning environment (Sumarmi, 2012). A problem-based learning model is a type of learning model where challenges require advanced cognitive skills to be overcome (AN Asriningtyas, F Kristin, 2018). This explanation led to the conclusion that problem-based learning improves students' ability to think critically while studying mathematics. Therefore, the researchers are very excited to undertake a study entitled "The Impact of Problem-Based Learning (PBL) Learning Models on Critical Thinking Ability and Mathematical Learning Outcomes".

METHODS

This research was carried out at the SMP Swasta PGRI 19 Lohsari Barat in the full semester of the academic year 2023/2024. The research approach used

is quantitative. This type of research is quasi-experiment with the research design used as a non-equivalent Control Group Pretest-Posttes Design. In this study, there is no superior class in this research because the population is homogeneous. The study sample used a random approach called random sampling, the sample was taken from two classes; class VIII-1 was the chosen class. Class VIII-2 consisted of 30 students in a control group and 26 students in an experimental group. The research design can be seen more clearly in table 1:

Table 1. Non-Equivalent Control Group Pretest-Posttes Design

Group	Pre-test	Treatment	Post-test
Experiment	O_1	X_1	O_2
Control	O_3	X_2	O_4

Description:

X_1 : Treatment in the experimental class using the Problem based learning model

X_2 : Treatment in the control class using conventional models

O_1 : Pre-test score on experiment class

O_2 : Post-test score on experiment class

O_3 : Pre-test score on control class

O_4 : Post-test score on control class

The population in this study is all the students of the eighth grade in the di SMP Swasta PGRI 19 Lohsari Barat. The sample in this study consists of two classes, namely class VIII-1 with 26 students and class VIII-2 with 30 students. According to Sugiyono (2017), simple random sampling is taking a sample member from a population randomly without paying attention to the population layer. Where class VIII-1 is the experimental class, while class VIII-2 is the control class. Experimental classes are treated using a problem-based learning model and control classes are dealt with with conventional learning models.

There are two variables in this study, i.e. the independent variable is the variable that affects the other variable while the dependent variable is the variable that is affected by the free variable. Therefore, the problem-based learning approach (PBL) is independent in this research, whereas the mathematical learning results and the ability to think critically are the bound variables dependent. The learning evaluation instrument used in this study is an essay test based on learning indicators. The reason for using the essay exam

in this study is that the essay question allows the measurement of students' critical thinking skills. The essay question, especially those related to Pythagoras's theorem, is used to assess abilities.

The data collection techniques used in this study are essay and lift tests. The ability to solve mathematical problems is measured through the assessment of the essay, which will be given at the end of the study. These questions take the form of essays or descriptions that refer to the mathematical problem-solving skill markers tested. Students' learning outcomes are measured through the use of lifts. Besides being collected, 28 lifting statements were also given to students in the experimental class. However, before the data is analyzed, the data requirement test is normality test and homogeneity test.

RESULTS AND DISCUSSION

Descriptive statistics, a type of data analysis technique, is used to test students' critical thinking abilities and learning outcomes. However, data must first pass the necessary tests of homogeneity and normality tests, before being submitted to the procedures of statistical analysis of descriptive data. SPSS version 25 is used to test the normality of research. Table 2 shows the results of the normality test of the data.

Table 2. Results of Normality Test Critical Thinking Ability
Experimental Classes and Control Classes

Class	Statistic	df	Sig
Experimental Pre-Test	0,183	26	0,026
Experimental Post-Test	0,180	26	0,030
Pre-Test Control	0,202	26	0,08
Post-Test Control	0,180	26	0,029

Table 3. Results of Normality Tests Angket Mathematics Learning Results
Experimental Classes and Control Classes

Statistics	Results
Sig (2-tailed)	0,200
Kolmogorov-Smirnov test	Sig > 0,05

Tables 2 and 3 show how the Kolmogorov-Smirnov formula is used to apply the results of the normality test to the experimental class and the data of

the control class through the SPSS version 25 program to obtain the normality test, if the sig value > the level of significance (α = 0,05), then the data is normally distributed. The homogeneity test aims to demonstrate the equality of variance between the groups that make up the sample, on the condition that the sample is representative and can represent the population accurately. Test the homogeneity of this study using analysis of variance (ANOVA). Table 4 shows the data homogeneity test results.

Table 4. Results of Test Homogeneity Critical Thinking Ability Experimental Classes and Control Classes

Statistic	Results
Sig	0,064
Based on Mean	Sig > 0,05

Table 5. Test Homogenity Results in Mathematical Learning Experimental Classes and Control Classes

Statistic	Results
Sig	0,011
Based on Mean	Sig > 0,05

Tables 4 and 5 show that significant values are greater than 0.05, indicating that the variation in data between the two samples is homogeneous. Data in the test using SPSS and test paired sample t-test after meeting normal and homogeneous conditions. If the significance level ($\alpha = 0{,}05$) exceeds the sig value, H_0 is rejected while H_a approves is possible to argue that students' critical thinking skills and learning outcomes in mathematics are affected by problem-based learning methodologies. Table 6 shows the results of the pre-test and post-test hypothesis tests.

Table 6. Test Results of Paired Sample Hypothesis T-Test Critical Thinking Ability Experimental Classes and Control Classes

Class	Mean	Std Error mean	t	df	Sig
Experimental Pre-Test	-24,154	1,332	-18,132	26	0,000
Experimental Post-Test	-24,154	1,332	-18,132	26	0,000
Pre-Test Control	-12,385	3,388	-3,655	26	0,001
Post-Test Control	-12,385	3,388	-3,655	26	0,001

Table 7. Paired Sample Hypothesis Test Results in t-test Mathematics Learning Results Experimental Classes and Control Classes

Class	Mean	Std Error mean	t	df	Sig
Experimental Pre-Test	7.23077	0,53582	8,33431	26	0,000
Experimental Pre-Test	7,23077	0,53582	8,33431	26	0,000

The results of the hypothesis test with the help of SPSS application with data analysis techniques paired sample t-test were obtained significant in the Experiment class and the control class it was seen that significant values of both classes were < 0,05 so that H_0 was rejected and H_1 was received that there was an influence of problem-based learning on critical thinking ability and mathematical learning outcomes of the eighth grade in the SMP Swasta PGRI 19 Lohsari Barat.

Critical thinking skills and the mathematics learning outcome of the students taught using the problem-based learning model in the experimental class and control class were analyzed using the conventional learning model, based on the final results obtained from experiments conducted in the two classes. Table 8 shows the results of the analysis of descriptive statistical data.

Table 8. Descriptive Analysis of Critical Thinking Abilities of Students

Class	N	Min	Max	Mean	Std. Deviation
Experimental Pre-Test	26	28	83	59,38	16,030
Experimental Post-Test	26	56	100	83,54	15,082
Pre-test Control	26	22	77	58,81	13,002
Post-test Control	26	54	88	71,19	10,477

Table 8 shows a significant difference between the average after treatment of the experimental and control classes. The experimental classes that used the problem-based learning model reached an average score of 83.54 while the control classes that applied the conventional learning model achieved an average of 71.19. These differences confirm the superior critical thinking abilities demonstrated by students in experimental classes when studying mathematics, in the context of the Pythagorean theorem. The differences observed can be attributed to different learning approaches, where the experimental class benefits from problem-based learning strategies that are not used in conventional learning methods in control classes.

High critical thinking ability because students are more active during classroom learning using the PBL model. Students are active in constructing their knowledge through real-life problem-based issues. This can encourage the ability to think critically to be maximized. Based on relevant research conducted Tomi (2014) stated that the problem-based learning model as an alternative to classroom learning so that students are not easily bored and motivated to follow lessons.

The same goes for research conducted by Nafiah and Suyanto (2014) which concluded that the application of problem-based learning can improve students' critical thinking skills in learning. Ardianti, Sujarwanto, and Surahman (2021) improving students' ability to think critically Problem-based learning is a student-centered learning approach in which students are asked to solve real-world problems after being presented to them throughout the learning process.

Students participate more actively in learning activities which can have an impact on students' critical thinking skills when a problem-based learning paradigm is used.

Table 9. Results by Students Based on Students' Intensity

Value	**Category**	**Control Class**		**Experiment class**	
		fk	Percentage	fk	Percentage
≥ 75	Pass	14	53,6%	18	69,2%
≤ 75	No Pass	12	45,9%	8	30,7%
Amount		26	100%	26	100%

The results above show that there is a significant difference between the percentage of the experimental class and the percentage of the control class. Specifically, it can be concluded that the student increase applied with the PBL model is higher than the conventional model. Based on data analysis, the percentage of the control class of the category passes is 53.6% while the percentage of the experiment class category passes is 69.2%. This shows the number of students in the Control class of 14 students and the experimental class of 18 students. Thus, the learning model of PBL has a significant influence on the improvement of student learning outcomes (Nurlia & Anggo, 2023) concluded that the use of the PBL learning model had a significant impact on student learning outcomes.

The application of the PBL learning model in this study can influence student learning outcomes. Students become more accustomed to solving the problem given, so the learning outcome is higher than students who only listen to the teacher's explanation. The PBL Learning Paradigm can improve students' ability to think critically while also improving the activity and learning output by concentrating the learning process around the needs of each student, giving them first-hand experience (Farisi & Hamid, 2017).

CONCLUSION

Based on the research carried out, the conclusion of the influence of the problem-based learning model (PBL) on students' critical thinking ability and learning outcomes is that PBL can improve students' critical thinking skills as well as their learning results. By using the PBL approach, students are invited to be active in solving complex problems, encouraging them to think critically, developing problem-solving, and improving their understanding of concepts.

Studies have shown that students who learn through the PBL approach tend to have better critical thinking than students who study through the conventional approach. Moreover, students' learning outcomes also tend to increase because they are more involved in the learning process and can associate the concepts they learn with real-world situations.

Thus, it can be concluded that the problem-based learning model has a positive influence on students' ability to think critically and learning outcomes.

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