Problem Based Learning and Their Effect on Learning Outcomes Estimation of Calculation Operations Number in Elementary School

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Addition, subtraction, multiplication, division, and other operations on numbers are referred to as arithmetic operations. The purpose of this study is to ascertain the impact of problem-based learning (PBL) on primary school students' learning outcomes related to guessing the outcomes of mathematical operations. A quasi-experimental design was used for this study. Class IVC was acquired as the experimental class and class IVB as the control class thanks to the sample selection's usage of a straightforward random sampling technique. Additionally, SPSS 26 was used to aid in data analysis for this investigation. The data analysis produced the results tcount>ttable, which are 2.423>1.669. If H0 is rejected and H1 is true, then learning through utilizing the model has a large impact. The suggestion of this study put forward to improve learning outcomes in mathematics learning process in elementary schools, specifically on the topic of estimating the results of arithmetics operations.

Keywords: learning outcomes, problem based learning, learning model

INTRODUCTION

Every human has the right to education (Hardinata, Ahwan, et al., 2023) . Where Education is an institution that provides an environment for students that aims to develop the abilities and talents of students so that these abilities and talents can be used by students in their lives. (Utari & Mustikawati, 2017) Education in Indonesia is currently experiencing a decline; this can be seen from the results of the PISA assessment in 2018, which shows that Indonesia in one of the fields of study, namely mathematics, is ranked 7th from the bottom out of 73 countries with an average score of 379 with an average OECD score of 487 (Kemendikbud, 2019). One reason is that the PISA exam questions use the criteria for Higher Order

Thinking Skills (HOTS) questions, while in Indonesia, teachers still apply Lower-Medium Order Thinking type questions, so students cannot solve them when they are faced with HOTS questions.

This increase in higher-order thinking skills is student-centered and influenced by the teacher's understanding and strategies during learning (Hasan & Pardjono, 2019). Higher-order thinking skills can be achieved by students actively understanding their knowledge and incorporating it into their own experiences. Teachers can do this by guiding students through observation, concept building, answering, analysis, comparison, and consideration needed. One learning model that can be used by teachers and is very suitable for increasing the activity and learning outcomes of students is to apply the problem-based learning model (Suryadi et al., 2023) (Hardinata, Yosika, et al., 2023).

In addition, Problem-Based Learning (PBL) is a learning model that provides students with problems related to everyday life that can increase students' understanding of learning material. A study says that problem-based learning is a learning model used to stimulate students' thinking by being oriented toward real problems that exist in students' daily lives (Rusman, 2012). In line with the opinion (Amanda et al., 2022) Problem-Based Learning is "is an active learning model using contextual and authentic problems to train thinking skills, acquire knowledge and concepts, and generate relevant solutions to solve a problem". Therefore, PBL is one of the learning models used to stimulate students' thinking by being oriented toward real problems that exist in students' daily lives.

Furthermore (Stefani & Abidin, 2019) also explained that learning activities using Problem-Based Learning are seen as learning concepts that are following the demands of 21st-century learning. Of course, this requires students to always develop thinking skills, problem-solving skills, and the ability to carry out research as a skills needed in the context of a rapidly changing world. In line with the opinion (Butar Butar et al., 2022) in his research, said one learning model that can improve student understanding and learning outcomes is the Problem-Based Learning model. This statement is also contained in research (Posing, 2020), stating that applying learning using the Problem-Based Learning model can improve students' critical thinking skills in problem-solving. In 2013 the Ministry of Education and Culture stated that problem-based learning is a learning approach that presents contextual problems to stimulate students to learn.

Thus, the application of problem-based learning is one of the efforts that can be made to develop various abilities of students needed in the world of education today and in the future. This statement is reinforced by the opinion (Risda Amini et al., 2019) that Education that can support future development is education that can develop the potential of students so that they can solve their problems. Education that can support future development is education that can develop students' abilities so that they can solve their problems. Furthermore, the advantage of problem-based learning is that students can better understand the concepts being taught because they discover these concepts themselves (Hardinata, Yosika, et al., 2023). Utilizing students discovering their concepts, students will understand more about what is learned; it is hoped that these concepts will make a long-lasting impression on students' memories. In line with the opinion (Polyiem & Nuangchalerm, 2022) says that problem-based learning Problem-Based Learning is a learning model that is centered on students and the teacher is only a facilitator so that the learning done by students will be more meaningful and stored longer in students' memories. Furthermore, students become active in solving problems so that students will get used to using their thinking skills. By creating these good habits, because the problems solved have a direct connection to real life, students can immediately feel the benefits of learning.

Problem-based learning is suitable for use in teaching mathematics. This statement is also reinforced by previous research that learning mathematics is learning that can enable students to develop thinking skills and communicate a problem and solve the problem (Nasution et al., 2021). In line with (Agustyaningrum et al., 2022), mathematics is important to learn because it has many useful applications for solving problems in life. This statement was also expressed by , which is expected that students can develop their abilities in solving problems in everyday life through learning mathematics. By implementing this PBL, students can use their thinking skills in solving the problems given. Furthermore, by (Masniladevi, 2017) that students feel bored and unenthusiastic due to the ineffectiveness of the learning being carried out, so it is necessary to use a learning model to overcome these problems. In line with the opinion (Masriah et al., 2021) states that in attending lessons, students tend not to listen to information from the teacher. Many students do activities outside of math lessons, such as scribbling on books, disturbing friends, and so on. One reason is the lack of variety of learning models carried out by the teacher so that students feel bored and less interested in the learning material presented by the teacher.

One of the mathematics learning materials in grade IV elementary schools that can apply problem-based learning in the learning process is the estimation (estimation) of the results of arithmetic operations. The material for estimating the results of arithmetic operations is a learning material often applied in everyday life. An article says that the benefits of studying the results of arithmetic operations estimate that students can quickly produce close results for a calculation that is sufficient for the situation concerned. In everyday life, estimating skills are a valuable time saver because many situations do not require exact calculation results. Thus, to teach the estimation of the results of arithmetic operations, learning should be linked to students' daily lives (Nasution et al., 2021). Therefore, with this natural context, it provides something that students can do, not something that must be learned so this naturally requires students to think and get natural learning outcomes as well.

Based on the results of observations on July 22, 2019, in class IVC SDN 27 Anak Air, it can be seen that learning mathematics in fractional material does not involve students actively (O'Brien et al., 2011). Students only listen to the teacher's explanation. Furthermore, the results of observations on July 25, 2019, in class IVC and July 26, 2019, in class IVB SDN 27 Anak Air on equivalent fraction material, students experienced problems understanding story problems regarding equivalent fractions, which required certain procedures for solving them. This is because students are not used to using their thinking skills to solve these non-routine questions. With learning like this, students only rely on memorizing the material they have learned before, and cause the concepts given will not make a sharp impression on their memory so students easily forget and are often confused in solving a problem that is different from what was exemplified by the teacher. Low student learning results are a result of this type of learning process. This is demonstrated by the average daily assessment I on fractional content assigned to class IV students at SDN 27 Anak Air who have not met the KBM's (Knowledge Base Minimum) requirement of 75. For more information, see Table 1 below:

TABLE 1
LEARNING OUTCOMES

No	Class	Average
1.	IVA class	70,16
2.	IVB class	71.52
3.	IVC class	71,13

Source: Class IV teacher at SDN 27 Anak Air

Based on the description above, learning by applying Problem-Based Learning is a learning model that is considered appropriate to improve student learning outcomes. Based on research findings (Mastika Yasa & Bhoke, 2019), the learning outcomes obtained by the experimental group that applied the Problem-Based Learning learning model were higher than the learning outcomes in the control class (0.53 > 0.37), and based on the t-test results obtained tcount (5.673) and ttable (2.052) with degrees of freedom (db) = n1 + n2 – 2 = 27 and a significance level of 5%, then $t_{count} > t_{table}$. This means that H0 is rejected and H1 is accepted. There is a significant difference in mathematics learning outcomes between students who study using the Problem-Based Learning model and students who learn using conventional learning models. Learning outcomes on material estimation (assessment) results of arithmetic operations in class IV elementary school.

RESEARCH METHODS

Participant

This research was conducted in the schedule of learning mathematics in class IVC and IVB SDN 27 Anak Air as a research sample. The research was conducted on August 22 - September 2, 2019. For one meeting in mathematics learning it was held for 3 x 35 minutes. The population in this study were all fourth grade students at SDN 27 Anak Air Padang city who had three parallel classes, namely class IVA, IVB and IVC. Sampling was carried out by a simple random sampling technique. According to Sugiyono (2010) simple random sampling is a sampling technique carried out randomly without regard to the existing strata in a population that is considered homogeneous. The sample frame includes every person in the population. If the population is homogeneous, simple random sampling is frequently utilized. It is possible to utilize a random sampling method, which involves choosing specific samples and places at random to reflect the population and area as a whole.

Research Instruments

This type of research is quantitative research using experimental research methods. The research design used is Quasi-Experimental Design. This experimental method is used to answer the research hypothesis regarding learning outcomes in estimating the results of arithmetic operations. Researchers use Quasi-Experimental Design, according to Sugiyono (2010) this design has an experimental group and a control group. The experimental class was treated using the Problem Based Learning model, while the control class used conventional learning. Before being given treatment, both classes were given a pretest first to determine the student's initial abilities. After being given treatment, a posttest was given to both samples to see whether the Problem Based Learning model influenced student learning outcomes.

Based on the existing population, selecting the sample required normality and homogeneity tests. After the data is homogeneous, the class is chosen randomly to be taken as the sample class. Then the researcher determines which class will be the experimental and control classes. The researcher took a random sample, and what was taken was class IVC as the experimental class and class IVB as the control class. The data collection technique used in this study is the test technique. The instrument used in this study was a written test in the form of multiple choice with alternative answers A, B, C, and D. Before the test was given to the class that was the research sample, the test questions were tried out first in the VA class of SDN 56 Anak Air where the school accreditation was the same. With research samples. The questions given are 30 multiple-choice questions. This question was given to 25 students. Next, a question feasibility test was carried out, which consisted of validity, discriminating power, difficulty index, and reliability tests. From the results of the analysis of the test instruments, 20 questions were obtained that met the test criteria for questions consisting of validity, discriminating power, difficulty index, and reliability tests.

Analysis of Data

The t-test is used in this study, and it is manually tested using Microsoft Excel. The data analysis requirements test is run first, followed by the t test. The normalcy test and homogeneity test are employed as analysis prerequisite tests. The Liliefors test was used to check for normality, while the Bartlett test was used to check for homogeneity.

RESULTS AND DISCUSSION

Test data on student learning outcomes in the material for evaluating the outcomes of mathematical operations in class IV of elementary school are acquired from the study results. The two example classes first took a pretest before receiving treatment. The recapitulation in Table 2 shows the pretest value of student learning outcomes in the subject matter for estimating the outcomes of arithmetic operations for experimental and control classes.

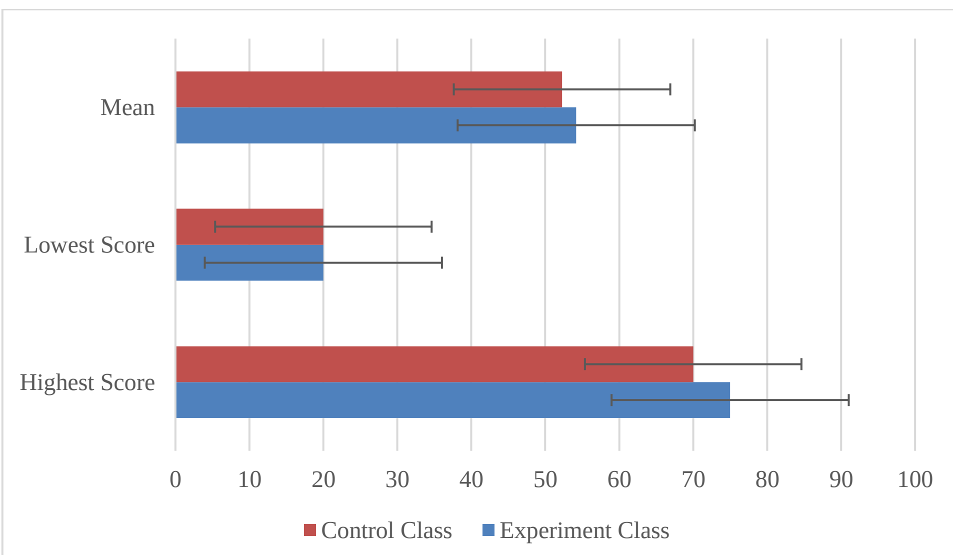
TABLE 2
DATA RECAPITULATION OF EXPERIMENTAL CLASS AND CONTROL CLASS PRETEST RESULTS

Variable	Pretest	
	Experiment Class	Control Class
N	31	33
The highest score	75	70
Lowest Value	20	20
Means	54,19	52,27
SD	13.57	14,15
SD²	181,14	200,22

According to Table 2 above, the experimental class of 31 students received a score of 75, which was the highest, and a score of 20, which was the lowest. The average value was 54.19, the standard deviation was 13.57, and the variance was 181.14 based on the experimental class scores. The 33-child control class received the highest score of 70 and the lowest score of 20, all at the same time. The results for the control class yielded an average of 52.27, a standard deviation of 14.15, and a variance of 200.22.

The learning outcomes for estimating the outcomes of arithmetic operations are higher in the experimental class than the control class, as can be seen from the description of the data from the pretest results in the table above. Refer to Figure 1 below for more information.

FIGURE 1
BAR CHART OF DATA COMPARISON OF EXPERIMENT CLASS AND CONTROL CLASS PRETEST RESULTS



Knowing the consequences after being given treatment, both sample classes were given a posttest. The posttest value of learning outcomes for estimating the results of arithmetic operations in the experimental class and control class can be seen in the recapitulation in Table 3.

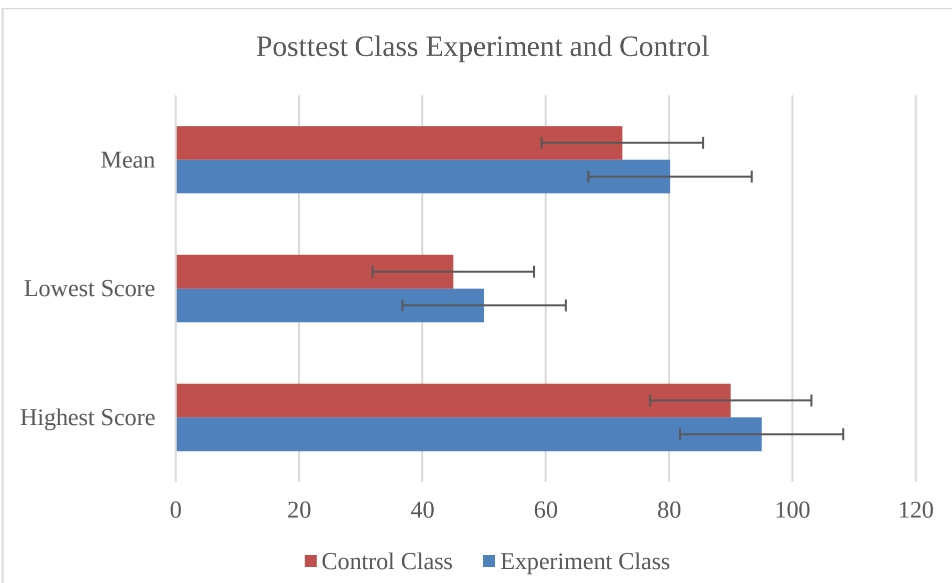
TABLE 3
POSTTEST RESULT DATA SUMMARY FOR EXPERIMENT CLASS AND CONTROL CLASS

Variable	Posttest	
	Experiment Class	Control Class
N	31	33
The highest score	95	90
Lowest Value	50	45
Means	80,16	72,42
SD	13,26	12,32
SD^2	175.83	151.78

According to table 3 above, the experimental class of 31 pupils received a score of 95, which was the highest, and a score of 50, which was the lowest. According to the experimental class scores, the standard deviation was 13.26, the variance was 175.83, and the average was 80.16. The control class, which consisted of 33 kids, received a 45 out of 100, the lowest score, and the maximum score of 90. The average score for the control class was 72.42, with a standard deviation of 12.32 and a variance of 151.78.

The learning outcomes for estimating the outcomes of arithmetic operations are higher in the experimental class than the control class, as can be observed from the description of the post-test data results in the table above. Figure 2 below shows more information.

FIGURE 2
BAR CHART COMPARISON OF POSTTEST RESULTS DATA FROM EXPERIMENTAL CLASS AND CONTROL CLASS



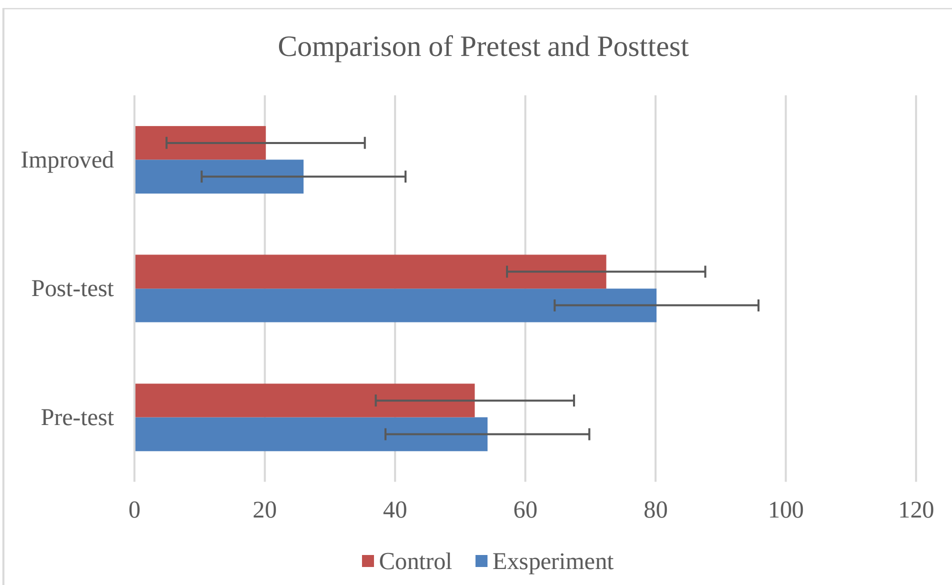
There are disparities in the acquisition of learning outcomes between the two classes, according to the pretest and posttest data analysis on the learning outcomes of the experimental and control classes. The experimental class pretest had an average value of 54.19, while the control class pretest had an average value of 52.27. While the control class's average posttest score was 72.42 and the experimental class's average posttest score was 80.16. Table 4 below shows a comparison of the experimental and control classes' pretest and posttest scores.

TABLE 4
COMPARISON OF THE PRETEST AND POSTTEST VALUES OF THE EXPERIMENTAL CLASS AND THE CONTROL CLASS

No	Class	Average value		Enhancement
		Pre-test	Post-test	
1.	Experiment	54,19	80,16	25.97
2.	Control	52,27	72,42	20,15

Based on table 4 above, a comparison of the pretest and posttest values between the experimental and control classes can be presented in Figure 3 below.

FIGURE 3
COMPARISON OF BAR CHART OF PRETEST AND POSTTEST VALUES FOR EXPERIMENTAL CLASS AND CONTROL CLASS



To find out the effect of the Problem-Based Learning model on learning outcomes in the estimation of the results of arithmetic operations, a hypothesis test was carried out. Before the hypothesis testing is carried out, the normality and homogeneity tests are first carried out on the data from the pretest and posttest results.

The results of the pretest data normality test for the experimental and control classes can be seen in Table 5 below.

TABLE 5
SAMPLE CLASS NORMALITY TEST RESULTS BASED ON PRETEST VALUES

Sample Class	N	L0	Lt	Conclusion
Experiment	31	0.0733	0.1591	Lo <Lt , means the data is normal.
Control	33	0.1056	0.1542	Lo <Lt , means the data is normal.

The cost of Lo and Lt for the two sample classes is shown in Table 5 above. This indicates that the data are evenly distributed. When the homogeneity test was calculated using the Chi Square table (2) and a significant level of 0.05, it was discovered that the results were 2count 2table, or 0.054 3.841. It is evident that the data from the two sample classes' pretest results show uniform variance.

Table 6 below shows the findings of the posttest data normality test for the experimental class and the control class.

TABLE 6
SAMPLE CLASS NORMALITY TEST RESULTS BASED ON POSTTEST VALUES

Sample Class	N	L0	Lt	Conclusion
Experiment	31	0.1314	0.1591	Lo <Lt , means the data is normal.
Control	33	0.0853	0.1542	Lo <Lt , means the data is normal.

Table 6 above shows that for the two sample classes the price of Lo <Lt. This means the data is normally distributed. Calculation of the homogeneity test with a significant level of $\alpha = 0.05$ from the Chi Square table ($\chi 2$), it was found that $\chi 2$count < $\chi 2$table, namely 0.167 <3.841. It can be concluded that the posttest results of the two sample classes have a homogeneous variance.

This study aims to determine the effect of problem based learning on learning outcomes in the material estimation (assessment) of the results of arithmetic operations on students. Based on the calculation of the t test that has been carried out, it is obtained tcount = 2.423 from the t distribution list with a significant level of 0.05 and dk = n1 + n2 - 2 = 31 + 33 – 2 = 62, obtained ttable = 1.669 so that tcount > ttable is 2.423 > 1.669 means that Ha is accepted and Ho is rejected. This shows a significant influence on learning outcomes in estimating the results of arithmetic operations in grade IV elementary schools that use the Problem-Based Learning model. Based on the results of the research above, it can be concluded that the use of the Problem-Based Learning model has a significant influence on learning outcomes in the material for estimating the results of arithmetic operations compared to using conventional models. The results of previous research have provided evidence that the PBL model approach will be able to produce creative and unique solutions to the problem cases they encounter and can experience possible cases that they might face mathematically in real life (Atahan & Mert Uyangör, 2021).

Learning in the experimental class that applies the Problem-Based Learning model in the learning process provides many advantages, including active students, improving thinking skills, and solving problems (Hardinata, Yosika, et al., 2023). This is consistent with the advantages of the Problem-Based Learning model (Ngalimun, 2012), that is, with Problem-Based Learning, students better understand the concepts being taught because they discover these concepts themselves. Utilizing students to discover their concepts, students will understand more about what is learned; it is hoped that these concepts will make a sharp impression on students' memories. Furthermore, students become active in solving problems so that students will get used to using their thinking skills. By creating these good habits, students can experience the benefits of learning because the problems solved are directly related to real life (Dahlia, 2022). With some of the advantages of this model it will affect students' learning outcomes.

Learning in the control class using conventional learning creates a learning atmosphere for students who are classified as passive. This can be seen when the teacher's learning is more active because students only listen to the material explained by the teacher. During learning, there is a lack of interaction between the teacher and students so that many students pay less attention to the teacher because they are busy with themselves and their peers. Several studies support the results of the above research; among others, research (Zulva et al., 2022) found that there was a significant influence in the use of the Problem-Based Learning (PBL) model with the Si Bull media (Integer Stick) on mathematics learning outcomes class IV students, it is proven from the results of hypothesis testing that the tcount is 2.070 and ttable is 2.014 at a significance level of 0.05 or 5%, so that it can be seen that tcount > ttable. Per the test criteria, Ha is declared accepted and H0 is declared rejected.

Research (Girimarto, 2022) also stated that there was an increase in learning by applying the PBL model from meeting 1 to meeting 3. The average meeting was 40%, increased to 51% and increased again to 80%, and students in learning were more effective. this is evidenced by the increase in enthusiastic, active and cooperative students from the less good category to the good one. These results provide evidence that the PBL model has a positive effect on student learning outcomes. So that these results can be considered in the learning process in schools and tertiary institutions.

CONCLUSION

The debate results have taken into account the fact that the research findings have a solid foundation in problem-based learning. The results of the examination of the research data show that the experimental class's average pretest score was 54.19 and the control class's was 52.27. The average posttest score for the experimental class was 80.16 while the result for the control group was 72.42 after treatment in the experimental class using the Problem-Based Learning learning model and the control class using traditional learning. The examination of the data from the performed hypothesis testing yielded the following results: t count = 2.423; t table = 1.669. In other words, if t count > t table, then H0 is rejected and Ha is approved. Therefore, it can be said that the Problem Based Learning learning model has a good and significant impact on learning outcomes in the material estimation (evaluation) of the outputs of mathematical operations in Grade IV Elementary School. The findings of this study add to the body of knowledge in learning, increasing the likelihood that teachers and other professionals in the field of education will take these findings into account.

Based on the conclusions above, several suggestions can be put forward to improve learning outcomes, including (1) For teachers to be able to use the Problem-Based Learning learning model in the Mathematics learning process in elementary schools, specifically on the topic of estimating the results of arithmetic operations, due to the application of the learning model Problem-Based Learning can improve student learning outcomes, and (2) This research only examines student learning outcomes using Problem-Based Learning and conventional learning models. For this reason, it is recommended for future researchers to examine other aspects.

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