

COMPARING EFFECT OF PROBLEM BASED LEARNING AND DISCOVERY LEARNING TO IMPROVE MATHEMATICS LEARNING OUTCOMES

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ABSTRACT

Students often consider mathematics as a complicated subject, because they only follow the problem-solving methods taught by the teacher, which results in reduced engagement and increased boredom during learning. The main objective of this study is to determine whether the Problem Based Learning model has a significant influence than the Discovery Learning model on mathematics learning outcomes. In order to do so, the research method that we used is Quasi Experimental with a Pretest-Posttest Control Group Design. The results shows that mathematics learning outcomes of eighth-grade students of SMP Negeri 2 Batudaa Pantai are significantly influenced by the Problem Based Learning (PBL) model, which is clearly seen from the results of the t-test and effect size test. The results of the hypothesis test conducted using the t-test can be concluded that problem based learning model more effective than discovery learning model to improve mathematics learning outcomes. In addition, the effect size test produced a result of 0.813, which indicates that this figure is included in the large or high category.

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INTRODUCTION

Education plays a crucial role in equipping future generations with the skills to address emerging issues and challenges using today's resources. A country's high level of educational quality is a sign of ongoing change (Marisa, 2021). The Ministry of Education, Culture, Research, and Technology of the Republic of Indonesia (Kemendikbud Ristek RI) has specifically initiated the implementation of the "Merdeka Belajar" curriculum. Nadiem Makarim emphasized that thinking skills are crucial for autonomous learning (Education et al., 2022). Dewi dan Septa (2019) in (Anderha & Maskar, 2021) states that education is actually a system designed to equip individuals so that they can adapt to the environment around them (survival skills).

According to Dompas et al., (2019) in (Heri et al., 2024) mathematics is often considered by many students as a scary subject, full of challenges, and difficult to understand, so that some of them dislike it and are reluctant to ask questions even though they do not fully understand. Mathematics is considered similar to other subjects that require memorization, many students today see it as one of the materials that is difficult to understand (Muhayana, 2021). This statement supports the statement (Zulva et al., 2022) this means that students today still consider mathematics a difficult subject. Students often view mathematics as a complicated subject because they simply follow the problem-solving methods taught by teachers, which results in reduced engagement and increased boredom during learning.

Success in learning is largely determined by teaching skills in implementing an approach that focuses on student participation. Based on research by Rahmawati (2020) in (Wijayanti & Widodo, 2021), Learning outcomes are the achievements that students attain after being involved in learning activities in a field of study during a specified period of time.

Based on interviews with math teachers at SMP Negeri 2 Batudaa Pantai, many students appeared less enthusiastic about participating in lessons, as they focused more on games and discussing other topics during class. This situation arose because the teacher's teaching methods were considered uninteresting and tended to be boring, resulting in learning outcomes that did not meet the teacher's expectations.

Table 1. Student Learning Outcomes

Class	Number Of Student	Class Average	KKM	Students' Achieved KKM
VIII A	21	68	70	8
VIII B	21	65	70	5

This is based on the learning outcomes of students who did not meet the minimum passing grade (KKM) in mathematics for eighth grade. Of the 42 students in both classes, only a small percentage achieved scores above the standard set by the KKM for mathematics, which is 70. Students tend to struggle with mathematics because they struggle to understand the material being taught. Teachers' learning models typically focus on collaborative and teacher-oriented learning, which leads to students' lack of enthusiasm for the material.

The impact of this problem on students' learning abilities in mathematics is noteworthy, as when eighth grade students face exams, their learning achievement can impact their final exam results. Furthermore, concerns have arisen that students' interest in mathematics will decline, even though this subject is one of the topics tested in the national exams. Students' lack of ability to face mathematical challenges has an impact on their learning outcomes which can result in suboptimal achievement of learning objectives. Referring to existing problems, it is very important to maximize the ongoing mathematics teaching process in order to support students in improving their skills, which will then have a positive effect on their learning outcomes (Santoso et al., 2023)

Achieving learning objectives will be very challenging if appropriate learning models are not implemented throughout the learning process. Using appropriate learning models can improve academic outcomes, increase student engagement, encourage them to complete assignments, and aid their understanding of the material being taught (Abidin, n.d.). Teachers are expected to be able to encourage student participation by using various teaching methods that focus on their active involvement in the learning process, especially in mathematics lessons (Selfiani et al., 2022). One very effective model for achieving this goal is to implement a model called Problem Based Learning (PBL). Problem Based Learning (PBL) is a teaching method aimed at

helping students develop the skills needed in the global era, as stated by (Jember, n.d.). Meanwhile, (Kurniawati et al., 2023) emphasizes that the problem-oriented learning model is a way in which educators provide instructions to students by presenting real issues during the learning process. This method encourages students to find solutions to the issues presented by the teacher. Problem Based Learning is a tactic that utilizes real-life challenges as a foundation, in order to improve analytical abilities and skills in solving challenges faced by students in mastering the ideas and fundamentals of a field of study (Rahmadani & Anugraheni, 2017) in (Aprina et al., 2024). According to Darmadi, (2017) in (Ristyaningsih et al., 2021) the PBL model provides opportunities for students to hone their critical thinking skills and problem-solving abilities by engaging in various real-world situations. This relates to (Hermansyah, 2020) in (Zulkarnain, 2023) Problem Based Learning provides a number of benefits, including: 1) Assessing the extent to which students have mastered the material and providing meaningful learning experiences, 2) Increasing student motivation during the learning process and encouraging their active involvement, 3) Deepening students' understanding of the challenges faced in everyday life, 4) Encouraging students to develop learning skills through methods that involve participation, 5) Training students to think critically and adapt to developments in science, 6) Providing opportunities to apply the knowledge they have, 7) Inspiring students to continue trying to learn, and 8) Helping students gain the conceptual understanding needed to face various challenges in the real world.

Meanwhile, the second learning model implemented is the Discovery Learning model. Discovery Learning is a learning model that requires students to actively participate in the learning process, a key element in empowering young women to resist social and family pressures (Marisyah & Sukma, 2020). Furthermore, according to (Pendidikan et al., 2019) the Discovery Learning model is a learning model that requires students to actively participate, a key element in empowering adolescents to resist social and family pressures. Meanwhile, according to (Suwiti, 2022) the Discovery Learning model is an approach to education that trains students to actively discover, search for, and discuss matters related to the teaching and learning process.

According to Irwan et al. (2019) in (Salsabila et al., 2020) He said that one of the interesting learning tools, which has an interactive character that emphasizes cooperation, communication, and can encourage interaction among students, is games, which have characteristics that can increase motivation in the learning process, namely imagination, challenge, and curiosity. Furthermore, Quizizz is an educational platform that provides a learning experience through play, offering interactive and fun activities (Mulyati & Evendi, 2020). Based on the explanation from (Rahmawati et al., 2022), Quizizz is an educational game app with story elements and is customizable. Besides being a tool for providing information, Quizizz also serves as an engaging and fun medium for evaluating the learning process. In this study, the Quizizz app was used to measure how far students had achieved their learning objectives, both in the initial and final exams.

To evaluate the effect of Problem-Based Learning and Discovery Learning models on mathematics learning outcomes, this study selected two groups. One group used the Discovery Learning model as a control group, and the other group implemented the Problem-Based Learning (PBL) model in the experiment. The main objective of this study was to determine which of the Problem-Based Learning (PBL) and Discovery Learning models had a more significant effect on mathematics learning outcomes. To assess academic achievement, the researcher will utilize the Quizizz application to analyze student learning outcomes through pre-tests and post-tests.

METHOD

Based on the research conducted, the research method used in this study is Quasi Experiment with a research design namely Pre-test Post-test Control Group Design as shown in the following table.

Table 2. Research Design Pretest-Posttest Control Group Design

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

Information :

X_1 : Learning that uses models Problem Based Learning (PBL)

X_2 : Learning that uses models Discovery Learning

O_1 : Pretest for the experimental group

O_2 : Post-test for the experimental group

O_3 : Pretest for the control group

O_4 : Post-test for the control group

Based on Sugiyono's (2020:130) opinion in (Penjualan et al., 2024), population can be interpreted as a general scope that includes: entities or objects that have certain characteristics and numbers determined by the researcher for further analysis and then conclusions are drawn. In this case, the population used includes all eighth-grade students at SMP Negeri 2 Batudaa Pantai with a sample size of 42 students.

The research instruments used were teaching modules, student worksheets (LKPD), and pre-test and post-test questions. This study involved two groups serving as subjects: the experimental group receiving the application of the Problem Based Learning (PBL) model and the control group using the Discovery Learning model. For this research step, a pre-test was administered using Quizizz to assess students' initial abilities. After the results of the pre-test were known, the learning process continued using the predetermined treatment. Next, after the learning process, a post-test was administered, also using Quizizz.

In this study, the data analysis used was to compare student scores from the pretest-posttest results in the control group and the experimental group, descriptive analysis, prerequisite tests (normality test and homogeneity test), hypothesis testing was carried out using the independent sample t-test and finally the Cohen effect size test was carried out.

RESULTS AND DISCUSSION

Results

Pre-Test Results For The Control Group (Discovery Learning) And The Experimental Group (Problem-Based Learning)

The pre-tests administered to the control and experimental groups aimed to evaluate the basic skills of students in both groups. The pre-tests were administered before the learning process began or before the treatment was applied to the two groups being observed. After administering the pre-tests to both classes, the students' initial abilities were determined. The following table shows the pre-test results for the control and experimental classes.

Table 3. Pre-Test Results in The Control Group and Experiment Group

Control Class : VIII A			Experiment Class: VIII B	
No	Student Name	Pre-Test	Student Name	Pre-Test
1	AAFR	37	ATM	33
2	ARY	43	ARPG	40
3	FRP	30	JA	33
4	GAH	37	KPA	30
5	MRH	27	MW	27
6	MRAN	27	MFMH	37
7	MAK	33	MAMG	33
8	MFP	37	NA	33
9	RRT	50	RRB	33
10	RRA	23	RSS	27
11	SRD	33	SRS	20
12	TYR	20	TPH	23
13	TK	23	VAN	17
14	AYY	40	AS	37
15	ARD	33	ARS	43
16	AAD	50	NHU	40
17	FM	30	RU	47
18	MSGM	47	RFAM	30
19	NYY	37	SMA	50
20	NGM	43	SSJA	40
21	SMA	43	SI	43
Total		743	Total	716
Maximum		50	Maksimum	50
Minimum		20	Minimum	17
Average		35,4	Average	34

Based on the information in the table, it can be seen that the average scores achieved by students in the pre-test in the two classes are not the same, with the control class getting 35.4 and the experimental class getting 34. Furthermore, if we look at the maximum scores of the two classes, the control class shows the number 50 while the experimental class also gets 50. For the minimum score of the two groups, namely the control class 20 and for the experimental class 17. If seen from the Minimum Completion Criteria (KKM) that has been determined by the school is 70, then both classes are said to be incomplete.

Posttest Results for Control Class (Discovery Learning) and Experimental Class (Problem Basic Learning)

During learning activities in the control class, students recorded data presented by the researcher. The teaching method used in the control class presented problems for students to overcome, but during the learning session, students appeared less active in participating and more inclined to play, so no one asked questions about things they didn't understand. In contrast, in the experimental class, students appeared more enthusiastic and active during the learning process. From the learning activities that took place, the final exam results for both classes were as follows:

Table 4. Posttest Results of The Control Group and The Experiment Group

Control Class : VIII A			Experiment Class: VIII B	
No	Student Name	Posttest	Student Name	Posttest
1	AAFR	87	ATM	93
2	ARY	90	ARPG	93
3	FRP	83	JA	87
4	GAH	80	KPA	93
5	MRH	83	MW	83
6	MRAN	70	MFMH	77
7	MAK	100	MAMG	87
8	MFP	80	NA	97
9	RRT	87	RRB	80
10	RRA	80	RSS	90
11	SRD	70	SRS	90
12	TYR	63	TPH	93
13	TK	80	VAN	87
14	AYY	87	AS	97
15	ARD	93	ARS	90
16	AAD	90	NHU	100
17	FM	87	RU	90
18	MSGM	93	RFAM	87
19	NYY	83	SMA	93
20	NGM	93	SSJA	90
21	SMA	93	SI	93
Total		1772	Total	1890
Maksimum		100	Maksimum	100

Minimum	63	Minimum	77
Average	84,4	Average	90

Based on the information presented in the table above, it shows a striking difference between the average scores of the two groups after implementing various learning methods. The average score of the experimental group was significantly higher than that of the control group, which received no treatment, namely $90 \geq 84,4$. Furthermore, if we look at the highest and lowest scores, the experimental group achieved the same maximum score as the control group, which was 100. However, the control group recorded the lowest score, which was 63, which was clearly lower than the experimental group which obtained a score of 77. Based on the Minimum Completion Criteria (KKM) determined by the educational institution, it is 70, and there is one student in the control group who still does not meet this criteria.

Descriptive Analysis

The purpose of descriptive statistical analysis is to provide a clear illustration of the data, making the information more easily understood by the reader. Descriptive statistics explain various characteristics of the data, and the results of this descriptive analysis are displayed in the table below:

Table 5. Descriptive Analysis Results

Descriptive Statistics					
	N	Minimu m	Maximu m	Mean	Std. Deviation
Pre-Test Kelas Eksperimen	21	17	50	34.10	8.526
Post-Test Kelas Eksperimen	21	77	100	90.00	5.505
Pre-Test Kelas Kontrol	21	20	50	35.38	8.738
Post-Test Kelas Kontrol	21	63	100	84.38	8.902
Valid N (listwise)	21				

According to the information obtained from the descriptive analysis, the highest pre-test score in the experimental group was recorded at 50, while the lowest score was 17, with an average score of 34.10, equivalent to 34.1. Meanwhile, in the post-test in the experimental group, the average final score was 90, with the highest recorded score being 100 and the lowest being 77. The table presented above shows that the pre-test score in the control group also showed a highest score of 50, but the lowest score was 20, resulting in an average of 35.38. On the other hand, in the post-test in the control group, the maximum score obtained was 100, while the lowest score was 63, with an average of 84.38.

Normality Test

The normality test is an important action that needs to be taken before starting a parametric statistical study. Software called SPSS 25 is used to evaluate parametric normality. According to the test standard, if the significance value is greater than the predefined threshold $\geq \alpha = 0,05$, the data can be considered regularly distributed. If, on the other hand, the significance value is $\leq \alpha = 0,05$ the data is not regularly distributed. The findings of the normalcy test study are shown in the following table.

Table 6. Data Normality Test Results

Kelas		Tests of Normality					
		Kolmogorov-Smirnov ^a			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Mathematics Learning Outcomes	Pre-Test Kelas Eksperimen (PBL)	.123	21	.200*	.980	21	.927
	Post-Test Kelas Eksperimen (PBL)	.167	21	.131	.944	21	.264
	Pre-Test Kelas Kontrol (Discovery Learning)	.097	21	.200*	.966	21	.649
	Post-Test Kelas Kontrol (Discovery Learning)	.168	21	.123	.939	21	.207

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Significance of the value, as determined by the test setup. It can be said that the data are routinely distributed. The significance value of the pre-test of the experimental group in the Shapiro-Wilk test is sig $0,927 \geq \alpha = 0,05$, Based on this statement, the data can be considered normally distributed. In the Shapiro-Wilk test analysis, the pre-test significance value for the experimental group was determined sig $0,649 \geq \alpha = 0,05$, indicates that the initial or pre-test data has a normal distribution. Furthermore, by following identical testing criteria, if the significance value $\geq \alpha = 0,05$ or also considered to have a normal distribution. In the Shapiro-Wilk test, The post-test significance value for the experimental group was $0,264 \geq \alpha = 0,05$, while the post-test significance value for the control group was sig $0,207 \geq \alpha = 0,05$. This indicates that the final data, or post-test data, had a normal distribution. The homogeneity test was performed by following the normal distribution of both data sets.

Homogeneity Test

Finding similarities or differences between the experimental and control groups is the aim of the homogeneity test. SPSS 25 software is used to conduct the testing process, and the test results are considered valid if they show no similarity $P \geq \alpha = 5\%$ or probability $\geq \alpha = 0,05$. Therefore, the data can be considered uniform. The calculation results for the initial data homogeneity test (pre-test) can be seen in the following table:

Table 7. Pre-Test Homogeneity Test Results

		Test of Homogeneity of Variance			
		Levene Statistic	df1	df2	Sig.
Mathematics Learning Outcomes	Based on Mean	.085	1	40	.772
	Based on Median	.103	1	40	.751
	Based on Median and with adjusted df	.103	1	39.932	.751
	Based on trimmed mean	.081	1	40	.778

Analysis to test the uniformity of the initial data (pre-test) showed a recorded 0.772 is the significance value. This shows that $\text{sig } 0,772 \geq \alpha = 0,05$ or the value obtained, is greater than 0.05. This indicates that the pre-test data is homogeneous. Stated differently, it can be said that the experimental and control groups' starting data (pre-test) are equal. The resulting data will then undergo a homogeneity test (post-test), as indicated in the table that follows.

Table 8. Post-Test Homogeneity Test Results

		Test of Homogeneity of Variance			
		Levene Statistic	df1	df2	Sig.
Hasil Belajar Siswa	Based on Mean	.023	1	40	.881
	Based on Median	.002	1	40	.962
	Based on Median and with adjusted df	.002	1	29.942	.962
	Based on trimmed mean	.001	1	40	.974

Based on the evaluation of homogeneity testing on the final data (post-test), a significant figure of 0.881 was recorded. This indicates that the significant value is higher than 0.05 or If $\text{sig } 0,881 \geq \alpha = 0,05$ then This suggests that homogeneity is also present in the final data (post-test). As a result, it may be said that the experimental group's and the control group's post-test results are similar.

Independent Sample T-Test

After undergoing normality and homogeneity tests as initial requirements in both class groups, then a difference test was carried out using an independent sample t-test with the following stages. Hypothesis on this research as follow bellow:

H_0 :There is no significant difference in student learning outcomes between students taught using the Problem-Based Learning (PBL) model and those taught using the Discovery Learning model..

H_a :There is a significant difference in student learning outcomes between students taught using the Problem-Based Learning (PBL) model and those taught using the Discovery Learning model.

To find the t_{tabel} value, find the df with a significance level of 0.05. Therefore, $df = n_1 + n_2 - 2 = 21 + 21 - 2 = 40$, for t_{tabel} if we use a significance level of 0.05, we obtain $t_{tabel} = 1,684$. The results of data analysis using the t-test can be displayed in the following table.

Table 9. Results of T-Test Analysis

		Independent Samples Test								
		Levene's Test for Equality of Variances		t-test for Equality of Means					95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Mathematics Learning Outcomes	Equal variances assumed	3.879	.056	2.460	40	.018	5.619	2.284	1.003	10.235
	Equal variances not assumed			2.460	33.343	.019	5.619	2.284	.974	10.264

According on the analysis of data gathered for the student learning outcomes t-test, it can be concluded from the previous table that the value $t_{count} = 2.460$, higher than $t_{table} = 1.684$ or in other words $2,460 \geq 1,684$. In the decision-making process, if $t_{count} \geq t_{table}$ then H_0 will be rejected and H_a will be accepted. Using a t-test analysis, the researchers concluded that there was a difference in learning outcomes of students who use the Discovery Learning model and students who use the Problem-Based Learning (PBL) model. We can determine the average learning achievement of each class group to understand the variance that influences learning outcomes.

Effect Size Test

To evaluate the influence of the Problem Based Learning (PBL) model on student learning outcomes, a specially created formula was used. The value of the influence can be seen in the table below.

Table 10. Effect Size Test Results

Class	Average Gain	Standard Deviation	Effect Size	Ket
Experiment	84,82	8,29	0,8	Big
Control	76,44	11,43		

Table 7 shows that the effect size was 0.8, which is considered large. This indicates that the Problem-Based Learning (PBL) model had a significant impact on the mathematics learning outcomes of eighth-grade students at SMP Negeri 2 Batudaa Pantai.

Based on the data analysis, it can be concluded that the implementation of the Problem-Based Learning (PBL) model had a more significant impact than the Discovery Learning model. This is evident in student learning outcomes, where the results from the Problem-Based Learning model were higher than those from the Discovery Learning model..

Discussions

The findings of this study align with research conducted by Nurlia Sagita (2023) which examined differences in learning outcomes in mathematics, where the group implementing the PBL learning model achieved a score of 81.52, while the control group using the traditional model achieved a score of 81.14. These findings indicate that the Problem Based Learning (PBL) learning approach has the potential to improve the learning outcomes of eighth-grade students at SMP Negeri 6 METRO during the 2022/2023 academic year. This research is also in line with research (Usman et al., 2022) The use of the Problem Based Learning model produces a beneficial effect, where students show great enthusiasm in the learning process, participate more actively when facing various challenges, and their ability to solve mathematical problems is much better compared to traditional teaching methods. Therefore, it can be concluded that the application of the Problem Based Learning method is more effective in improving students' skills in solving mathematical problems on social arithmetic material in class VII of SMP Negeri 2 Limboto.

This research also received support from Hasnah (2018) who involved 26 students as subjects through the application of the Problem Based Learning (PBL) model, the average score obtained was 77.73. From this study, it is clear that the Problem Based Learning (PBL) Model has a significant positive influence when applied in the mathematics learning process in class VII 2 SMP Negeri 26 Makassar. The research was also conducted by (Kumaralo et al., 2025) which states that the use of the Problem-Based Learning model has a positive effect on students' ability to solve mathematical problems. Students demonstrate a higher level of participation during learning activities and when completing assigned assignments compared to traditional teaching methods.

Research was also conducted by (Wahyuni, 2025) Based on the analysis and discussion above, it can be concluded as follows: There is a positive and significant impact of the application of problem-based learning models on the mathematics learning achievement of class VIII students at SMPN 11 Mataram for the 2024/2025 academic year. This can be seen from the results of the t-test which shows that $t_{count} > t_{table}$ atau $4.275 > 2.006$, which means that the null hypothesis is rejected and the alternative hypothesis is accepted, and the average learning achievement in the experimental class exceeds the control class ($79.11 > 61.26$). The magnitude of the impact is classified as large with a significance value of 1.16.

Further research was conducted by (Kinaseh et al., 2015) The average score of students in class VB of State Elementary School 30 South Pontianak (as a control class) on the topic of surface area of cubes and cuboids using the expository method was recorded at 66, with a total score reaching 1320 and having a standard deviation of 15.65. On the other hand, the average score of students in class VA of State Elementary School 30 South Pontianak (experimental class) who learned the surface area of cubes and cuboids using the Problem Based Learning approach was 78.5, from a total score of 1570 and a standard deviation of 16.22. The results of the post-test in the control class and the experimental class showed a difference in the average post-test score of students of 12.5. Based on hypothesis testing through a t-test with a separate variant formula, the t-count value was 2.48 and the t-table (with $\alpha = 5\%$ and $df = 38$) was 1.6866. Considering that $t_{count} > t_{table}$ or $2,48 > 1.6866$, it can be concluded that H_a is accepted. Therefore, it is concluded that there is a difference in student learning achievement on the material of surface area of cubes and cuboids between those who use the Problem Based

Learning model (experimental class) and those who learn with the expository model (control class) in class V of State Elementary School 30 South Pontianak. The application of the Problem Based Learning model shows a significant influence (with an effect size of 0.79) on the material of surface area of cubes and cuboids on student learning achievement in class V of State Elementary School 30 South Pontianak.

Further research conducted by (Kinaseh et al., 2015) the results of data analysis showed the influence of the application of the Problem Based Learning model assisted by fractional clocks on student learning achievement. This proof can be seen from the results of the hypothesis test which shows a sig. value of $0.000 < 0.05$, with $t_{count} > t_{table}$ or $8.043 > 2.051$, which allows us to make a decision by rejecting H_0 and accepting H_a , meaning there is an influence of the Problem Based Learning (PBL) learning model that uses fractional clock media on student learning outcomes. From here, we can conclude that learning using the Problem Based Learning model with the help of fractional clocks has a fairly effective impact on student learning outcomes.

From the results of observations conducted at SMP Negeri 2 Batudaa Pantai, it can be stated that the learning findings of the two groups in each test showed different variations. This difference was caused by an increase in student understanding after the teaching. From the results of the study, it was seen that before the learning activities began, the researcher conducted an initial test (pre-test) on the experimental group and the control group aimed to evaluate the initial abilities of each group. The findings from the initial test carried out by the researcher showed a difference in the average score between the two groups, where the experimental group obtained an average score of 34, while the control group recorded an average of 35.5. After the pre-test in both classes was completed, the next step was to implement teaching with different models. In the control group, the researcher applied the Discovery Learning model, while in the experimental group, the researcher used the Problem Based Learning (PBL) model. After the learning process with different treatments was carried out, there was a significant difference in the post-test, where the control group obtained an average score of 84.4, while the experimental group managed to achieve an average of 90.

The results of the pre- and post-evaluation in both classes showed a significant effect due to the implementation of the Problem Based Learning (PBL) learning model. To assess the extent of the effect of the Problem Based Learning (PBL) learning model, this study applied the t-test. In the hypothesis analysis, the t-test technique was applied along with an effect size analysis that utilized the final evaluation data of students from the experimental and control groups who followed the learning process with different interventions. Based on the findings of the independent sample t-test analyzed using SPSS 25 software, the value obtained was $t_{count} = 2.460$ while at a significance level of 0.05, it was obtained $t_{table} = 1.684$ which shows that $t_{count} \geq t_{table}$ or $2.460 \geq 1.684$. Next, an effect size analysis was conducted to assess how big the influence of the implementation of the Problem Based Learning (PBL) model was, with the results obtained being 0.813, which is included in the large category.

Based on the findings of this analysis, if $t_{count} \geq t_{table}$ then H_0 is rejected and H_a is accepted. From the research conducted using the t-test, the researcher was able to determine that there were differences in student learning outcomes between those using the Problem Based Learning (PBL) model and those applying the Discovery Learning model. In addition, testing was also conducted using effect size which showed that the Problem Based Learning (PBL) model had a significant influence on the mathematics learning outcomes of eighth-grade students at SMP Negeri 2 Batudaa Pantai.

CONCLUSION

From the results of observations conducted at SMP Negeri 2 Batudaa Pantai, it can be stated that the learning model of the two groups in each test showed different variations. This difference was caused by an increase in student understanding after the teaching. From the results of the study, it was seen that before the learning activities began, the researcher conducted an initial test (pre-test) on the experimental group and the control group aimed to evaluate the initial abilities of each group. The results of the initial test carried out by the researcher showed a difference in the average score between the two groups, where the experimental group obtained an average score of 34, while the control group recorded an average of 35.5. After the pre-test in both classes was completed, the next step was to implement teaching with different models. In the control group, the researcher applied the Discovery Learning learning model, while in the experimental group, the researcher used the Problem Based Learning (PBL) model. After the learning process with different treatments was held, there was a significant difference in the post-test, where the control group obtained an average score of 84.4, while the experimental group managed to achieve an average of 90.

Based on the evaluation of the information that has been conducted, it can be concluded that the implementation of the Problem Based Learning (PBL) model has a positive influence on student learning outcomes. This can be seen from the results of the hypothesis testing using the t-test at a significance level of 0.05, which shows a value of $t_{count} = 2.460$ greater than $t_{table} = 1.684$. In addition, an effect size analysis was also conducted to understand the extent of the impact of the PBL learning model, which produced a value of 0.813, indicating a significant level of influence from this model. The average final test score of the experimental group that implemented the PBL learning model was recorded at 90, indicating that the experimental group's performance was superior to the control group, which only obtained an average of 84.4. By using this model, researchers can conclude that this study shows a significant influence of the Problem Based Learning (PBL) learning model on the mathematics learning outcomes of eighth-grade students at SMP Negeri 2 Batudaa Pantai.

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