



## Comparison of Problem Based Learning and Guided Discovery Learning in Terms of Students' Mathematical Problem-Solving Ability

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### abstract

Indonesian students' problem solving abilities are currently still low. One of the reasons is because the learning model applied by the teacher is not student-centered. Several learning models that can be used include the Problem Based Learning (PBL) and Guided Discovery Learning (GDL) models. This study is quasi-experimental research. This study was conducted in the eight grade at SMPN 4 Bengkulu City for the 2021–2022 academic year. Two experimental groups were selected randomly from eight classes. After performing normality and homogeneity tests, a sample of class A was made up of 31 students who received Problem Based Learning (PBL) model treatment and class C was made up of 30 students who received Guided Discovery Learning (GDL) model treatment. In this study, two types of data analyses—descriptive data analysis and inferential analysis—were used. The data on the students' problem-solving ability before and after treatment were described using descriptive analysis. The t-test of two independent sample means, which compares the means of two separate samples, was used to compare differences in the efficacy of learning models with PBL and GDL on students' ability to solve mathematical problems. The result shows that the ability to solve mathematical problems on average using the PBL model and the GDL approach is equivalent.

### Keywords:

Guided Discovery Learning; Problem Based Learning; Problem solving Ability



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## INTRODUCTION

Problem solving ability is an important thing that students have in learning mathematics. This is in accordance with what is stated by the National Council of Teacher Mathematics which stipulates that there are 5 (five) process skills that must be mastered by students through learning mathematics, namely: (1) problem solving; (2) reasoning and proof; (3) connection; (4) communication; and (5) representation (Mauliyda, 2020). Based on this, one of the focuses in learning mathematics is problem solving ability. In addition, the importance of problem solving is a means for a person to use previously acquired knowledge, skills, and understanding to meet the demands of unusual circumstances. So solving math problems is important in learning mathematics (Carson, 2007; R. Pratiwi & Musdi, 2021).

The importance of problem solving abilities to be improved is also due to the low problem solving abilities of students in Indonesia at this time. The low ability of Indonesian students to solve mathematical problems can be seen from the results of a 2011 Trends in International Mathematics and Science Study (TIMSS) survey placing Indonesia in 38th place out of 44 countries with a score of 386, below the standard score set at 500 (Mullis et al., 2016). This shows that there was a decrease in the previous score in 2007, which was 411 (Mullis et al., 2016). In addition, the low ability of students' mathematical problem solving can be seen based on the results of the Program for International Student Assessment (PISA), Indonesia in 2012 was ranked 64 out of 65 countries participating in the competition. (Organization for Economic Co-operation and Development [OECD], 2013). In the 2018 PISA results for the mathematics category, Indonesia is at level 1 with a rating of 7 from the bottom (73) and an average score of 379 (Stiadi et al., 2022).

In addition, the low problem-solving abilities of students, especially at the junior high school level, can be seen based on the results of research related to the TIMSS level reasoning questions, students' ability at low criteria is 58.33%, medium is 33.33% and high is only 8.33% (Susanto et al., 2021). In addition, other studies also state that the problem-solving ability of students at the SMP/MTs level is relatively low (Nugraha & Basuki, 2021).

One alternative solution to improve students' mathematical problem solving abilities is through the application of learning models that can involve students' activeness and provide opportunities to improve this. It is also explained in the Minister of Education and Culture Number 22 of 2016 concerning Process Standards for Elementary and Secondary Education which states that "To encourage students' abilities to produce contextual work, both individually and in groups, it is highly recommended to use a learning approach that produces work based on problem solving." Some of the recommended learning is problem-based learning (PBL) and discovery learning.

PBL is a set of teaching models that use problems as a focus to develop problem-solving, material, and self-regulation skills (Eggen & Kauchak, 2012). This is in line with what is stated by Akinoglu & Tandoğan (2007), argues that the PBL model can change students from passive to active to obtain information, students can be free to learn and solve problems on their own and PBL also changes an educational program from teaching to learning. According to Samford University (in Fani & Indarini, 2023; Tan, 2004) PBL is a learning strategy that can encourage students to develop critical thinking skills, and solve problems that can be used and beneficial throughout students' lives.

The selection of the Discovery Learning model pair is used because Discovery-Learning also focuses on problem solving. This is in line with opinion Abdisa & Getiner (2012) which states that Discovery Learning is a learning through problem solving under the supervision of the teacher and the teacher provides material illustrations for students to learn by themselves/independently.

But not all students can make discoveries independently. This is in line with opinion Onikarini, Suardana, & Selamat (2019) states that pure Discovery Learning is not appropriate to be applied in learning, this is because not all students are able to make discoveries, this means that there are students who still need guidance to be able to find other concepts. In addition, the limited time in learning also affects, because the time needed by students to find a concept is not fast. So it takes help or guidance from the teacher to be able to find a concept. Therefore, in this study the Guided Discovery Learning model will be used.

According to Eggen & Kauchak (2012); Wibowo (2019) Guided Discovery Learning is a teaching approach in which the teacher gives students examples of specific topics and guides students to understand the concept. Eggen and Kauchak's opinion explains that Guided Discovery Learning emphasizes providing examples of concepts for students to learn later with the help of the teacher as needed. Meanwhile Guided Discovery Learning according Onikarini et al. (2019) is a student-centred approach, which combines didactic instruction with an assignment-based approach to students. From Lavine's opinion it shows that the special feature of guided discovery learning is the existence of guidance from the teacher to students in the form of instructions. According to Astuti, Prasiwi, & Yusuf (2018) *guided discovery learning* can stimulate curiosity, as well as improve students' problem-solving skills and creative thinking.

In connection with that, both PBL and GDL aim to improve problem-solving skills, PBL focuses more on problem solving, while GDL places more emphasis on student discovery of concepts. By understanding these differences, educators can choose the approach that best suits their learning goals. Besides that, both emphasize student involvement in the learning process, but in different ways. PBL encourages students to be active in solving problems, while GDL emphasizes the teacher's role as a facilitator in guiding students towards concept discovery. This comparison helps in understanding how both models can promote student engagement effectively. In connection with that, the researcher wants to examine "Comparison of the Effectiveness of Guided Discovery Learning and Problem-Based Learning in terms of Student's Mathematical Problem Solving Ability".

## METHODS

This study is quasi-experimental research. This study was conducted in the eight grade at SMPN 4 Bengkulu city for the 2021/2022 academic year. Two experimental groups were selected randomly from eight classes, then tested for normality and homogeneity. So, a sample of class A consisted of 31 students who received the PBL model treatment and class C consisted of 30 students who received the GDL model treatment. The research instrument was a problem solving ability test consisting of 5 questions with the topic about Three-Dimensional Shapes for the pretest and posttest which had been validated by experts and with a high level of reliability, which was equal to 0.72. In addition, another instrument is the observation sheet of the learning implementation.

There are two data analyses used in this study, namely descriptive data analysis and inferential analysis. Descriptive analysis was used to describe data on students' problem-solving abilities before and after the treatment. The completeness criterion for the problem-solving ability variable is at least 75 based on the Minimum Mastery Criteria (*KKM*). The problem-solving ability data are then categorized based on the criteria used. The categorization is presented in Table 1.

Table 1

Criteria for Completeness of Problem-Solving Ability

Learning outcomes	Category
Score $\geq$ 75	Pass
Score $<$ 75	Not pass

Inferential data analysis is used to statistically prove the proposed hypothesis and answer the formulated problems. To find the differences in the effectiveness of the learning model with PBL and GDL on students' mathematical problem-solving abilities, the t-test of two independent sample means is used to compare the means of two different samples.

The hypothesis is:

$$H_0: \mu_1 = \mu_2$$

$$H_1: \mu_1 \neq \mu_2$$

Note:

$\mu_1$  : the average problem-solving ability of classes taught using PBL

$\mu_2$  : the average problem-solving ability of classes taught using GDL

The basis for making a decision to measure whether there is a difference in the average of the two groups is to compare t count with t table. If the value of t count > t table, then  $H_0$  is rejected. On the other hand, if the value of t count < t table, then  $H_0$  is accepted. This study uses SPSS with criteria if significance value (2-tailed) > .05, then  $H_0$  is accepted.

## RESULT AND DISCUSSION

### Descriptive Analysis

The results of the descriptive analysis included the pretest and posttest data for both classes which were used to find a comparison between the PBL and GDL models on students' mathematical problem-solving abilities. The data on problem-solving ability test results for the experimental classes with the PBL and GDL models can be seen in Table 2.

Table 2

Descriptive Analysis on Students' Mathematical Problem-Solving Ability Test Results

Descriptive statistics	PBL		GDL	
	Pretest	Posttest	Pretest	Posttest
Means	11.83	64.50	10.67	64.83
Variance	58.51	145.43	52.99	193.94
Standard Deviation	7.65	12.06	7.28	13.93
Minimum	0	40	0	40
Maximum	25	90	25	90
Number of Completed Students	0	11	0	11
Completeness percentage	0 %	35.48%	0%	36.67%

Based on Table 2, the average value of the pretest on students' mathematical problem-solving abilities with the PBL model is 11.83 which then increased as 64.50 during the posttest. For the class with the GDL model, the average value of the pretest is 10.67 and increased as 64.83 during the posttest. The completeness percentage of the pretest at the class with the PBL model is only 0% or no students reached *KKM*. During the posttest, the completeness percentage at the class with the PBL model increased to 35.48% or 11 out of 31 students fulfilled *KKM*. In addition, the completeness percentage of the pretest at the class with the GDL model is only 0% or no students reached *KKM*. During the posttest, the completeness percentage increased to 36.67% or 11 out of 30 students fulfilled *KKM*.

## Inferential Data Analysis

### Assumption test

#### Pretest data

The pretest data are first tested for normality and homogeneity tests. The normality test uses the Kolmogorof-Smirnov test with SPSS. The normality test results can be seen in Table 3.

Table 3  
Pretest Normality Test Results on Mathematical Problem-Solving Ability

<i>Mark Pretest</i>	<i>Sig.</i>	<i>Information</i>
<i>PBL</i>	<i>.080</i>	<i>Normal</i>
<i>GDL</i>	<i>.056</i>	<i>Normal</i>

Table 3 shows that the significance values of the pretest at the PBL and GDL classes respectively are .080 and .056. Both values are more than .05 so that it can be concluded that both classes are normally distributed.

The homogeneity test uses the Levene's test with SPSS. The results of the homogeneity test can be seen in Table 4.

Table 4  
Pretest Homogeneity Test Results on Mathematical Problem-Solving Ability

		Levene Statistic	df1	df2	Sig.
Value_Pretest_Ability	Based on Mean	.076	1	56	<b>.784</b>
_Solving_Problem	Based on Median	.051	1	56	.823
	Based on Median and with adjusted df	.051	1	55.4 79	.823
	Based on trimmed mean	.069	1	56	.793

Based on Table 4, the significance value of 'based on the mean' is  $.784 > .05$  so that the pretest data for both classes are homogeneous.

#### Posttest data

The posttest data are first tested for normality and homogeneity test. The normality test uses the Kolmogorof-Smirnov test with SPSS. The normality test results can be seen in Table 5.

Table 5  
Posttest Normality Test Results on Mathematical Problem-Solving Ability

<i>Mark Posttest</i>	<i>Sig.</i>	<i>Information</i>
<i>PBL</i>	<i>.130</i>	<i>Normal</i>
<i>GDL</i>	<i>.179</i>	<i>Normal</i>

Table 5 reveals that the significance values of the posttest at the PBL and GDL classes respectively are .130 and .179. Both values are more than .05 so that it can be concluded that both classes are normally distributed.

The homogeneity test uses the Levene's test with SPSS. The results of the homogeneity test can be seen in Table 6.

Table 6  
 Posttest Homogeneity Test Results on Mathematical Problem-Solving Ability

		Levene Statistic	df1	df2	Sig.
Value_Posttest_A	Based on Mean	.860	1	59	<b>.357</b>
bility_Solving_Pr	Based on	.833	1	59	.365
oblem	Median				
	Based on	.833	1	58.	.365
	Median and			038	
	with adjusted df				
	Based on	.863	1	59	.357
	trimmed mean				

Based on Table 6, the significance value of ‘based on the mean’ is  $.357 > .05$  so that the posttest data for both classes are homogeneous.

After carrying out the normality and homogeneity tests, a hypothesis test using the t-test of two independent sample means was conducted. The t-test of two independent sample means is an assumption test used in this study to find the effectiveness of the learning approaches. The results of this hypothesis test can be seen in Table 7.

Table 7  
 T-Test Results of Two Free Sample Means

		t-test for Equality of Means		
		t	df	Sig. (2- tailed)
Value_Posttest_A	Equal variances assumed	.031	59	<b>.976</b>
bility_Solving_Pr	Equal variances not	.031	58.857	.976
oblem	assumed			

Table 7 shows that the significance (2-tailed) value is  $.976 > .05$  so that  $H_0$  is accepted. This can be concluded that the average ability to solve mathematical problems using the PBL model is the same as the average ability to solve mathematical problems using the GDL model in solving problems on the topic of Three-Dimensional Shapes.

In terms of the results of students' mathematical problem-solving abilities, the PBL and GDL models have the same effectiveness. This happens because both models make students active at the class and learning becomes more meaningful. This is in line with the results of the study by (Nahdi, 2018) which states that there is no difference in students' mathematical problem-solving ability using PBL and GDL.

The PBL model relates learning to problems in daily life (Achsin et al., 2020; Asmara & Zachriwan, 2021). This certainly makes students familiar with problem-solving questions that relate to the problems in daily life that can improve their problem-solving abilities. This is in line with opinion Andesma & Anggraini (2019) who said that in the Problem Based Learning (PBL) model, students are usually given complex and realistic mathematical problems that require in-depth solving. Students are expected to use the knowledge and skills they have to identify problems, formulate problem-solving strategies, and find appropriate solutions. This process encourages students to understand mathematical concepts in real and relevant contexts. They can also work together with fellow students to solve problems, promoting teamwork and collaboration.

The GDL model makes students active in finding concepts independently and comprehend them in the learning process (Tarsiyah, 2021). On the other hand, in the Guided Discovery

Learning (GDL) model, the teacher provides instructions or questions designed to help students discover mathematical concepts on their own (A. N. Pratiwi et al., 2023). The teacher acts as a facilitator who provides guidance and direction when students explore. This process provides students with the opportunity to strengthen connections between the mathematical concepts learned and their application in various contexts. Students experience an active discovery process, which can increase their understanding of the concept. This results in the students' ability to solve complex or non-routine problem-solving questions. Furthermore, a group discussion is provided in the PBL and GDL models. Students can be actively involved in the group discussion by exchanging opinions to solve the given problems. This activity can make students more active in answering, asking questions and comprehending the answers (Graciella & Suwangsih, 2016).

The main difference between these two models lies in the level of student autonomy in the learning process. In PBL, students are more independent in solving problems, while in GDL, they receive direction from the teacher in discovering concepts. However, both models have the same focus on understanding in-depth mathematical concepts through direct and active experience. So, we can say that the problem-based learning and guided discovery learning models are both effective in improving the problem-solving abilities of class 8 students at SMP Negeri 4 Bengkulu City.

## CONCLUSION

Based on the results of the hypothesis test, independent sample t test, the significance (2-tailed) value is  $.976 > .05$  so that  $H_0$  is accepted. This can be concluded that the average ability to solve mathematical problems using the PBL model is the same as the average ability to solve mathematical problems using the GDL model in solving problems on the topic of Three-Dimensional Shapes. In the Problem Based Learning (PBL) model, students are usually given complex and realistic mathematical problems that require in-depth solving. Students are expected to use the knowledge and skills they have to identify problems, formulate problem-solving strategies, and find appropriate solutions. This process encourages students to understand mathematical concepts in real and relevant contexts. They can also work together with fellow students to solve problems, promoting teamwork and collaboration. On the other hand, in the Guided Discovery Learning (GDL) model, the teacher provides instructions or questions designed to help students discover mathematical concepts on their own. The teacher acts as a facilitator who provides guidance and direction when students explore. This process provides students with the opportunity to strengthen connections between the mathematical concepts learned and their application in various contexts. Students experience an active discovery process, which can increase their understanding of the concept. The main difference between these two models lies in the level of student autonomy in the learning process. In PBL, students are more independent in solving problems, while in GDL, they receive direction from the teacher in discovering concepts. However, both models have the same focus on understanding in-depth mathematical concepts through direct and active experience. All of that increased student's problem solving skills. So, we can say that the problem-based learning and guided discovery learning models are both effective in improving the problem-solving abilities of class 8 students at SMP Negeri 4 Bengkulu City.

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