



# Measuring Students' Problem-Solving Ability with Problem Based Learning (PBL) in Madrasah Aliyah Schools

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## Abstract

**Background:** In the learning process, the teacher has not brought up the phenomena related to the material to find a solution. Such a learning process has not accompanied students to a problem that requires students to be able to formulate problems, formulate hypotheses, draw conclusions, and recommend problem-solving. This has an impact on the low problem-solving ability of students. This study aims to determine the effect of the Problem Based Learning (PBL) model on the problem-solving ability of Biology students in class X IPA-1 Madrasah Aliyah Swasta Miftahul Fallah Diski. **Methods:** The research method used is a quasi-experimental research design with One-Group-Pretest-Posttest. The data analyzed were in the form of pretest and post-test with data requirements test in the form of normality test and homogeneity test. **Results:** The results of the hypothesis test obtained the value of Sig. (2-tailed) in the "Equal variances assumed" section of  $0.000 < 0.05$ , it can be. **Conclusions:**  $H_0$  is rejected, and  $H_a$  is accepted, which means that there is a positive and significant effect on students' problem-solving abilities in biology material. protists in class X IPA-1 SMA Madrasah Aliyah Private Miftahul Fallah Diski in the 2021/2022 academic year. PBL can increase the students' average pretest and post-test scores, where the average pretest score is 52.62 with a standard deviation of 7.352 and the post-test average value is 82.86 with a standard deviation of 6.036.

**Keywords:** Problem Based Learning (PBL); Problem Solving; Protists

## Introduction

Education is one of the main components to develop human resources to build a nation's life (Asiyah et al., 2021). If education is of high quality, it impacts good student learning. Biology is a lesson related to the events that often occur in the life of pl and even our environment. If a study does not help students to think, then students will be weak in thinking and less competent. The theory of constructivism that the creation of knowledge through the ability to think (Yuliani et al., 2019).

Having scientific thinking is needed to form a critical thinking perspective. "Regulation of the Minister of National Education Number 21 of 2016 concerning content standards for Primary and Secondary Education for biology content at SMA-MA, is required to have competence, including students being able to apply principles, concepts, and laws in the field of biology to solve real problems and the environment." Thus leading to the formation of the end learning goals that can improve problem-solving skills (Hariatik et al., 2017).

Based on (Asih et al., 2017), problem-based learning (problem solving) is important because it helps students think critically. Educators should see if there are students who apply the concept of problem-solving and connecting with life (Gultep et al., 2013). A



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teacher is expected to be creative when developing learning activities that can increase student knowledge and become a facility for students to understand the concepts that are the basis for problem-solving (Lopez, 2017). Students must also contribute to changes in every education component (Lestari et al., 2019).

Some things that need to be seen in applying the PBL learning model: 1) being able to ask, conduct investigations, make suggestions, and argue during the problem-solving process (Maudsley, 1999). 2) it is also necessary to respect every opinion, explained clearly and quickly understood (Kassab, 2006). 3) the language must be easy to understand to improve students' knowledge (Schmidt, 1995). 4) and can stimulate the increase in critical thinking of students (Chng E, 2011). 5) it must also provide feedback of a sustained nature so that it can affect the student's learning progress (McLean, 2003).

From the results, it was found that problem-solving skills were ineffective after the implementation of observations at the Miftahul Fallah Diski Private Aliyah Madrasah. Judging during the learning process, teachers tell many students to take notes. The teacher also does not give the phenomena associated with the material. Such learning does not help students formulate problems, formulate hypotheses, draw conclusions, or recommend troubleshooting. So teachers need to understand the characteristics of student material and suitable learning methods during the learning process that are adjusted to the application of the learning model. Therefore, researchers apply the PBL learning model to see how it affects students' problem-solving abilities.

Because the level of student problem solving is still low, it impacts learning outcomes. Therefore, a suitable learning model is needed and able to improve students' problem-solving abilities (Ionita et al, 2020). PBL is a learning method of discussing real problems so students can think critically and get the appropriate subject matter. The PBL model is applied to spur higher-order thinking skills (Utami, 2013). (Irawati, 2021) said that PBL is a learning model that is a means for students to develop skills, solve problems, and critical thinking. By using protist material that is considered close or identical to the problems that exist in the current environment, for example, the problem of the disease is caused by protists and their classification based on general characteristics.

Based on (Iyus, 2016), biology lessons using PBL can improve the problem-solving process and cognitive learning outcomes in students. According to (Magsiono, 2014), the results of other studies where PBL can stimulate HOTS thinking ability in students. Thus, based on the explanation above, the author chose to research "The Influence of Problem Based Learning (PBL) Models on the Problem Solving Ability of Biology Students in Class X Science at the Miftahul Fallah Diski Private Aliyah Madrasah". One of the goals is to find out the influence of PBL on students' problem-solving levels in the Miftahul Fallah Diski Private Aliyah Madrasah.

## Methods

The method used, namely Quasi-Experiment, involves students in the learning process, including fellow students and educators. The learning model applied is PBL. They are using the Saturated Sampling technique. Students of the science program at the Miftahul Fallah Diski Private Aliyah Madrasah were given the PBL model treatment in learning to discover students' problem-solving abilities.

Based on the research design, first discussing the protist material, students were given a pretest of 20 validated questions in the form of multiple choices (Multiple Choice), which were intended to understand the basic campus of the students from the material. The application of the PBL model on the Protist material, after the learning material was completed, students were given a post-test of 20 questions that had been validated to see its effect with the PBL model in solving student problems. Then the pretest and post-test values are compared so that the difference in the pretest and post-test values obtained is known. With the application of the One Group Pretest Posttest according to the table below:

**Table 1.** Research Design

Class	Pre Test	Experiment	Post Test
X IPA	T <sub>1</sub>	X <sub>1</sub>	T <sub>2</sub>

Information:

- T<sub>1</sub> : Initial test before the PBL model is carried out
- X<sub>1</sub> : PBL model learning
- T<sub>2</sub> : Giving the final test after the PBL model is carried out

**Sample or Participant**

According to (Gunawan, 2013), the entirety of the study object is called population. The total population of students in the science program at the Miftahul Fallah Diski Private Aliyah Madrasah is 21 students. (Sugiyono, 2010) defines a sample as some of the numbers found in the population. Sample selection was obtained using the Saturated Sampling technique, where all population members were research samples..

**Instrument**

The instrument applied is in the form of a test, namely pretest & post-test. The Multiple Choice test (multiple choice) test used in obtaining data on students' problem-solving ability (as many as 20 questions about the Protista material and a score of 5 if it is correct and 0 if it is wrong. The data were subsequently analyzed using the SPSS version 21 program.

**Data collection**

Using the method of collecting data in the form of observation, interviews; tests; and documentation. (Rubiyanto, 2009) says, "Observation is the systematic observation and recording of symptoms that appear in the object of study"—used to obtain student activity to assess student behavior during the learning process. Observations are carried out directly by looking at problems in the class.

Rubiyanto (2009), "Interviews are a way of collecting data by asking questions and answers face to face, researchers asking verbally and respondents answering verbally as well". Interviews are applied to educators and students to determine the data produced under several aspects of learning, actions, and responses. In-depth interviews are conducted with educators to assess the level of difficulty of Biology lessons. In addition, structured interviews were conducted with students to obtain data related to Biology lessons that have been applied and the obstacles felt by students in Biology lessons.

Arikunto (2006) "A test technique is a spate of questions or exercises or other tools used to know the skills, knowledge, intelligence, abilities or aptitudes an individual or group has". It uses pretest and post-test as tests in these observations. The test is carried out to produce quantitative data from student learning outcomes that will later be analyzed descriptively. The test is carried out at the end of the learning process so that students' mastery in learning Biology in the Protist sub-material is known.

Arikunto (2006), "Documentation is a way used to find data on things or variables in the form of notes, transcript, books, newspapers, magazines, inscriptions, minutes, meetings, agendas, and so on." The data source from these observations is obtained through documents and photographs.

**Procedure**

The study consisted of several stages; stages of preparation, execution and completion.

**Preparatory Stage**

In the preparation stage, things are done: determining the research population, Making RPP, Making a grid of test questions, Making research instruments in the form of multiple choice questions, and conducting test instrument trials for biologist lecturers.

### Implementation Phase

In the implementation stage, what is done is to distribute the pretest first before the learning process consists of 20 multiple choice questions, carry out the protist material learning process with the PBL learning model by giving questions to several students before the material is taught then signaling the student to ask the questions that have been given, then the teacher explains the answers to the students, after that, post-test questions were distributed as at the end of the learning process as many as 20 multiple choice questions.

### Completion stage

It processed the data obtained based on the class that was given treatment, analyzed, made conclusions, and prepared reports and related attachments.

### Data Analysis

Data analysis includes pretest & posttest data then continue with the data requirements test.

### Analysis of pretest and posttest data

Based on the data table, the pretest scores of students totaling 21 students, the maximum value (65.00), the minimal value (40.00,) then the average value (52.62), in addition to the middle value (55.00), mode (45.00), and standard deviation (7.352).

**Table 2.** Pre Test statistical data

Statistical Data	N	Max Score	Min. Score	Mean	Mode	Median	Range	Std. Deviation
Pretest	21	65,00	40,00	52,62	45,00	55,00	25,00	7,352

Based on the data above, the pretest score of 21 students obtained data in the form of a maximum score of 65.00, a minimum value of 40.00, an average of 52.62, a middle value of 55.00, a mode of 45.00 & a standard deviation of 7.352.

After completion of the pretest, students are then treated with a post-test. Then the pretest and post-test values are compared. Furthermore, the data obtained were used to determine the PBL model's influence on students' problem-solving ability with SPSS version 21. The following are the results of processing class post-test data:

**Table 3.** Post Test Statistical Data

Statistical Data	N	Max Score	Min. Score	Mean	Mode	Median	Range	Std. Deviation
Posttest	21	95,00	75,00	82,86	80,00	80,00	20,00	6,036

In the data above, a student pretest score of 21 students was obtained, with a maximum score of 95.00, a minimum value of 75.00, an average of 82.86, median sera (middle value) of 80.00, a mode of 80.00, and a standard deviation of 6,036.

### Test Data Requirements

Furthermore, the data is collected into one, and then the score calculation is carried out. The data is in the form of student pretest and post-test results. Quantitative data from the test results were processed using the IBM statistics program SPSS version 21. Statistically processed data in the form of:

### Normality test

Done to see the data distribution based on pretest & post-test normal or not. Based on SPSS version 21, we look at the normality test obtained from the sig value. "One Sample Shapiro Wilk Test" is used to determine the normality of the data. The data is said to be Normal if it produces a signification value higher than the alpha level of 5% (significance > 0.05).

**Table 4.** Normality Test Statistical Data

Student Learning Outcomes	Kolmogorov-Smirnov <sup>a</sup>			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pretest	0,183	21	0,064	0,923	21	0,101
Posttest	0,206	21	0,020	0,900	21	0,035

**Homogeneity Test**

This test was carried out to see if there was a variance in a homogeneous population. This is done as a condition of being carried out before other tests, such as t-tests. The data formula is Sig > 0.05 at the significance level ( $\alpha = 0.05$ ).

**Table 5.** Homogeneity Test Value

Student Learning Outcomes	Levene Statistic	df1	df2	Sig.
Based on Mean	1,762	1	40	0,192
Based on Median	1,047	1	40	0,312
Based on Median and with adjusted df	1,047	1	39,951	0,312
Based on trimmed mean	1,777	1	40	,190

Judging from student learning outcomes based on the mean obtained significant value of 0.192 > 0.05 means that the data is homogeneous.

**Test the Hypothesis**

After the previous test, the pretest-posttest value was obtained homogeneously (having the same large variance). After that, it is calculated with SPSS version 21, which aims to see the influence of the PBL learning model of students' problem-solving ability. Requirement:

- a. If the probability of > 0.05, so Ho is accepted, thus stating the absence of the influence of the PBL model on the learner's problem-solving ability
- b. If the probability of < 0.05 so that Ho is rejected, it states that the PBL model influences the student's problem-solving ability.

Based on the data obtained from the hypothesis test, it can be seen that the signification value is 0.000. Because " $0.000 < \alpha = 0.05$ ", so Ho Is Rejected. So that it states the influence of the PBL model on students' problem-solving ability.

**Table 6.** Hypothesis Value

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Dev	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Pre test - Post test	-30,238	11,122	2,427	-35,301	-25,176	-12,459	20	0,000

**Result**

Based on the data that has been processed from observations, the learning outcomes of students of the science program at the Miftahul Fallah Diski Private Aliyah Madrasah on protist material have increased. At the pretest time, as many as 21 students (100%) were declared incomplete with a KKM score of 75.00 with an average score of 52.62 and a standard deviation of 7.352. After the use of the PBL model protist submaterials are given a posttest to see student learning outcomes. The calculation of the data obtained, where students completed as many as 21 students (100%) with a KKM score of 75.00 average score of 82.86 and a standard deviation of 6,036.

That can be drawn there is the influence of a problem-based learning model with the increase in student scores in solving problems through protist material at the Miftahul Fallah Diski Private Aliyah Madrasah, in the science class where the post-test is high. The pretest is low because this learning model can improve the problem-solving ability of science class students (Halim et al., 2010). Students are guided in improving their critical thinking (Edelson, Gordin, & Pea 1999). Underlying this is constructivist theory. In (Amalia, 2020), the problem-based learning process is more meaningful because the learning process begins with a real problem, making students interested in knowing how to solve the problem. This learning can improve student problem-solving learning.

According to Oviyanti (2017) learning process of the PBL model, students are required to solve problems by looking for information and then analyzing and finding solutions to these problems. Students are also required to have broad insights. Students' pretest and post-test scores change problem-solving ability, meaning that the PBL model on protist material has a significant influence. Through the PBL model, students are expected to be able to investigate problems based on thinking skills with data analysis. (Klangmanee. R. & Sumranwanich., 2013).

Just like research (Saputri et al., 2017) there is an increase in the results of problem-solving tests with the PBL learning model where students are easy to remember because protist material is still covered with daily life. The increased ability to solve problems in the science class is due to the design of issues and learning objectives. (Ruchaedi, 2016) stated in his research that learning with the PBL model is carried out in groups of students playing an active role in solving problems. From the results of these observations, using the PBL model improves students' problem-solving abilities.

Based on observations adjusted based on these objectives, it was also seen that there were different learning outcomes in students, during and before using the PBL learning model. Where based on the average score obtained increased after using the PBL learning model. So from the study results, it is stated that the PBL learning model affects the learning outcomes of science class students at the Miftahul Fallah Diski Private Aliyah Madrasah on protist material. This is motivated because students get more in-depth concept knowledge from the subject matter, which makes students more creative in developing knowledge ideas. One of the advantages of the PBL learning model is that students are guided to conduct experiments/experiments to make it easier for students to remember lessons, in contrast to conventional models where students fully expect explanations and learning resources from the teacher (Asiyah et al., 2020).

The results in the experimental class were an increase in learning outcomes because the learning process carried out was able to improve the ability to think based on existing problems. And the material used fits into the PBL model, and the material still covers life. Wahyudi (2011) stated that implementing learning through the PBL model positively impacts student learning outcomes (Wahyudi, 2011).

The PBL learning model in the experimental class can improve learning outcomes (Utomo et al., 2014). This is because the syntactic of the PBL model stimulates students to improve problem-solving skills. The syntax of the PBL model includes: "expressing ideas/opinions, working in groups, seeking information, asking questions/opinions, answering questions, and communicating the results of discussions". The study's results (Irawati, 2021) concluded that the PBL model makes it easier for students to understand environmental pollution material. It is known that there is an increase in thinking and problem-solving skills after using the PBL model (Cooke & Moyle, 2002). Because when the learning process takes place, educators identify, look for alternatives, find new ideas and hypotheses, make revisions, and present. (Zhou et al., 2013).

The learning process has been applied to see that in the science class at the Miftahul Fallah Diski Private Aliyah Madrasah School in the learning process, it is known that there is an excellent student problem-solving. They were judged on: "students' ability to identify problems, students' ability to formulate (analyze) problems, ability to choose alternative solutions (best), students' fluency in solving problems, and the quality of problem-solving

results". Based on observations that have been carried out where learning activity in students increases after the application of the PBL learning model. It is known from the discussion process carried out by small groups where students are always actively responding to answers or answering questions asked. Group discussions are held to answer discussion questions.

## Discussion

The results stated that students who use the PBL learning model can solve problems in biology learning. This is the hypothesis of the researcher in the study. However, it cannot be said that PBL plays a role in improving learning outcomes and problem-solving skills. Due to differences in learning outcomes and problem-solving skills in students, for example, time constraints because the application of PBL takes a long time, and often students are still hesitant to express their opinions in discussions. However, the PBL model can be an alternative in delivering lessons. Although it can be concluded that the PBL model influences students' problem-solving ability, it must go through strict control considerations.

In the results of students' pretest and post-test scores, there was a difference where the average student pretest was 52.62, and there was an increase in students' post-test scores with an average post-test score of 82.86. After that, a hypothesis test was obtained by the value of probability (significance) (0.000.). The sig value ( $0.000 < \alpha = 0.05$ ), so  $H_0$  is rejected. So there is an influence of the PBL model on students' problem-solving ability. Like his research (Meilasari, 2020), the PBL learning model can increase interest in learning, improve problem-solving abilities, increase learning motivation and critical thinking, and improve learner learning outcomes. (Aidoo et al., 2016) The PBL model greatly develops student process skills, critical thinking, and science process capabilities. And also, the PBL model provides an opportunity for students to determine the level of strengths or weaknesses in learning. So it can be concluded that the PBL model plays a role in the ability to solve students' problems.

As a result, there are factors related to suggestions for further observations to be perfect where the limitations include; the lack of readiness of students to receive learning, the lack of a number of students, only 21 students, and the lack of time allocation because at the time of the study the learning time was very minimal.

The author suggests that later, teachers can use the PBL model better during the learning process, in addition to paying more attention to student conditions, learning materials and time allocation. Further research is also needed to be related to the PBL model with other materials and the need for development to compare the application of the PBL model and other bound variables.

## Conclusions

Based on the value data obtained, it shows that problem-based learning has a positive and significant effect on students' biology problem-solving ability on protist material in the science program class at the Miftahul Fallah Diski Private Aliyah Madrasah for the 2021/2022 Learning Year.

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## Declaration statement

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