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# The Difference In Critical Thinking Levels Of Students Using The Problem-Based Learning Method And The Lecture Method In Geometry Courses At Ibrahimy Islamic University In Banyuwangi

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**Abstract**

Classroom learning requires appropriate methods to achieve maximum learning outcomes. One such method is cooperative learning, which can make learning enjoyable. The learning methods used in this study were Problem-Based Learning (PBL) and lecture. The researcher conducted a study comparing PBL with lecture methods. *This was a quasi-experimental* study that measured students' critical thinking levels using 12 critical thinking indicators. Data collection techniques included observation, documentation, and testing. Data analysis was tested using validity tests, reliability tests, data normality tests, paired sample T-tests, and independent sample T-tests. The results obtained from processing the post-test data of the experimental class and the post-test data of the control class show that the mean post-test score of the experimental class is greater than the mean post-test score of the control class, namely 88.000 for the experimental class and 70.5000 for the control class. Meanwhile, the sig (2-tailed) result was 0.000 < 0.05. According to the predetermined hypothesis, if the sig (2-tailed) value is < 0.05, then Ha is accepted and Ho is rejected. From the above results, Ha is accepted and Ho is rejected. This means that there is a significant change between the experimental class using the PBL learning method and the control class using the lecture learning method.

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## INTRODUCTION

Education is the foundation for acquiring knowledge. Both religious and general knowledge must be balanced to prepare individuals to face any challenges in society. The world of education begins with Early Childhood Education, Kindergarten/Raudlatul Athfal, Elementary School/Madrasah Ibtidaiyah, Junior High School/Madrasah Tsanawiyah, Senior High School/Madrasah Aliyah, and College. There is no age limit for pursuing education, meaning that until the end of their lives, humans are allowed to pursue knowledge. The higher a person's knowledge, the higher their way of thinking will be, and they will become wise in solving problems, one of which is the issue of education in schools and higher education.

Learning that is easy to apply for students is learning that can make the classroom atmosphere enjoyable and does not bore students. Whether learning is successful or not depends on how educators determine the learning that is appropriate for their students. In learning today, educators use several methods that can be used as a reference for teaching in the classroom, and do not always use just one method. However, the method varies according to the conditions of the students and the subject/course being taught. In the world of lectures, the learning method that currently poses a challenge for students is problem-based learning, or what can be called the problem-based learning method. This method will encourage students to think critically according to their respective abilities and knowledge. According to (Amidi & Zahid, 2016) Thinking is a state of rational thinking that can be measured and developed through conscious and deliberate practice. In the field of education, critical thinking can help students improve their understanding of the material being studied by critically evaluating arguments in textbooks, journals, discussion partners, including the teacher's arguments in learning activities. So critical thinking in education is a competency to be achieved and a necessary tool in constructing knowledge (Saputra, 2020) . According to Rahmani et al. (2018) , the indicators of critical thinking are as follows: "1) having a

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great sense of curiosity; 2) often asking meaningful questions; 3) providing many ideas and suggestions on an issue; 4) being able to express opinions spontaneously and without shyness; 5) having or appreciating a sense of beauty; 6) having one's own opinion and being able to express it, not easily influenced by others; 7) having a good sense of humor; 8) having a strong imagination; 9) being able to propose ideas and solutions to problems that are different from others (original); 10) being able to work independently; 11) enjoying trying new things; 12) being able to develop or elaborate on an idea (elaboration skills).

Problem-based learning, also known as the problem-based learning method, is a learning method that uses real problems encountered in the environment as a basis for acquiring knowledge and concepts through critical thinking and problem-solving skills. Learning constructs knowledge by building reasoning from all the knowledge one has and from everything one has gained as a result of interacting with other individuals. With PBL, it is hoped that students can solve problems with various alternative solutions and can identify the causes of existing problems (Fakhriyah, 2014) . The characteristics of problem-based learning are (1) dependence on problems, where the problems do not test abilities, but rather help develop those abilities, (2) the problems are truly *ill-structured*, do not agree on a single solution, and when new information emerges in the process, perceptions of the problem and solution may change, (3) students solve problems, teachers act as coaches and facilitators, (4) students are only given clues on how to approach problems and there is no formula for students to approach problems, and (5) authenticity and appearance (Sumartini, 2016) . The hope is that with the PBL method, learning will be more enjoyable, especially in geometry courses.

Referring to existing conditions in the field, many educators still rely on the lecture method in the teaching and learning process. According to Wirabumi (2020), the lecture method is one of the oldest traditional instructional approaches, widely applied from basic education to higher education due to its practicality and efficiency in delivering large amounts of material to large classes. Previous studies have shown that Problem-Based Learning (PBL) has a positive impact on students' critical thinking skills and problem-solving abilities (Hmelo-Silver, 2014; Savery, 2016). However, most existing research tends to examine the effectiveness of PBL in general instructional settings without providing a direct comparison with the lecture method, particularly in geometry courses at the higher education level. In addition, limited studies employ a quasi-experimental nonequivalent control group design combined with structured critical thinking indicators to measure learning outcomes. Therefore, this study seeks to fill this gap by comparing the effectiveness of PBL and the lecture method in improving students' critical thinking skills in a geometry course at Ibrahimy Islamic University in Banyuwangi, with data analysis conducted using SPSS.

Based on the background described above, this study focuses on examining the differences in instructional treatment between classes that apply the Problem-Based Learning (PBL) method as the experimental group and those that apply the lecture method as the control group. Accordingly, the research question of this study is: Is there a significant difference in the level of students' critical thinking between those taught using the PBL method and those taught using the lecture method in the Geometry course at Ibrahimy Islamic University in Banyuwangi? The purpose of this study is to compare the effectiveness of the PBL method and the lecture method in improving students' critical thinking skills in geometry courses at the higher education level.

## METHOD

### Research Design

In this study, an experimental method was used to measure the differences between two learning methods in the experimental class and the control class. (Sugiyono, 2021) defines experimental research methods as research methods used to find the effect of a particular treatment on another under controlled conditions. Experimental research designs can be divided into three types, namely preexperimental design, true experimental design, and quasi-experimental design (Setia, 2014) . In this experimental study, the researcher chose *a Quasi-Experimental Design* because it was difficult to obtain a control group for the study. Therefore, to overcome the difficulty in determining the control group in the study, a Quasi-Experimental Design was developed. The experimental design methods are as follows:

**1. Time Series Design**

In this design, the group used for the research cannot be selected randomly. Before being given treatment, the group is given a pretest up to four times with the aim of determining the stability and clarity of the group's condition before being given treatment. If the results of the four pretests turn out to be different, it means that the group's condition is unstable, uncertain, and inconsistent. Once the stability of the group's condition is clearly known, the treatment is administered. This research design uses only one group, so it does not require a control group.

**2. Nonequivalent Control Group Design**

This design is almost the same as the pretest-posttest control group design, except that in this design, neither the experimental group nor the control group is selected randomly. In this design, both the experimental group and the control group are compared, even though the groups are selected and placed without going through randomization. The two groups are given a pretest, then given treatment, and finally given a posttest.

**3. Conterbalanced Design**

In this design, all groups receive all treatments, only in different treatment sequences, and are conducted randomly.

Of the three types of experimental research above, this study uses a quasi-experimental research method (Quasi Experimental Design), and the research design used in is *a Nonequivalent Control Group Design*. In this design, neither the experimental group nor the control group is selected randomly. The experimental and control groups underwent an initial test. Both groups received different treatments, where the experimental group used the *Problem-Based Learning* method and the control group used the lecture method. According to (Zakiyah, 2020) This design involves an experimental group and a control group that are not selected randomly. The differences between these groups are measured before and after the intervention.

**Table 1.** Research Methods

| | | | |
|---|---|---|---|
| E | $O_1$ | $X_1$ | $O_2$ |
| C | $O_3$ | $X_2$ | $O_4$ |

Explanation:
E : Experimental Class
K: Control Class

O1: Pre-test (before treatment) in the experimental group
O2: Final Test (after treatment) in the experimental group
O3: Pre-test (before treatment) in the control group
O4: Final test (before treatment) in the control group
X1: Application of Problem-Based Learning (PBL)
X2: Application of lecture-based learning
To carry out the *Quasi Experimental Design* method, the following steps can be taken:

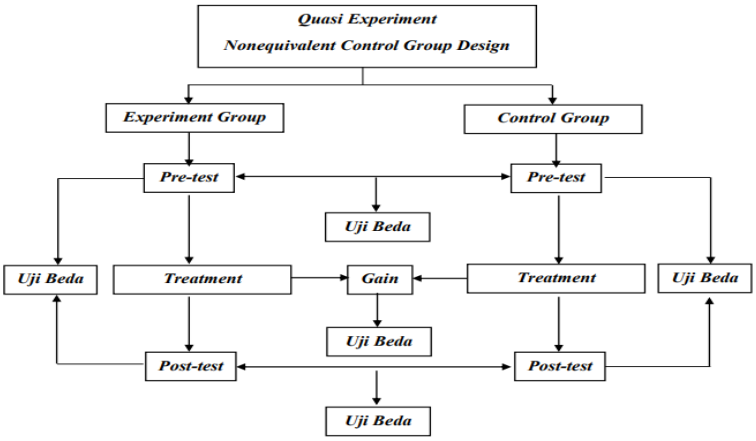



**Figure 1.** Experimental framework

**Population and sample**

The population of this study was students at Ibrahimy Islamic University in Banyuwangi. The sample selected consisted of students majoring in mathematics education in their second semester for the experimental class and fourth semester for the control class. There were 10 students in each class. The reason for selecting samples from different semesters was because both classes had already studied geometry previously.

The variables in this study were students' critical thinking, the PBL method, and the lecture method. From the above variables, it was possible to measure the level of students' thinking both in using the PBL method and in using the lecture method.

**Research instruments**

The test instruments used for the previous study were first tested on other classes that had previously taken geometry courses. This was done to test whether the test instruments were suitable for the experimental and control classes. The instrument given to students was in the form of essay questions which would be given during the pretest and posttest. The pretest and posttest questions were the same, except that the pretest was given before the treatment, while the posttest was given after the treatment. The tests used were validity and reliability tests. If each item is declared valid and reliable, it can be administered to the experimental and control classes. The pretest questions are given to the experimental and control classes at the beginning to determine the initial abilities of the students in each class.

**Data Collection Procedures**

1) Observation.

One of the techniques used in initial data collection is observation, where researchers can collect the data needed for the research. According to (Widiatmika, 2015) Observation is essentially an activity that uses the five senses, such as sight, smell, and hearing, to obtain the information needed to answer research questions. The results of observation include activities, events, incidents, objects, specific conditions or atmospheres, and a person's emotional feelings. Observation is conducted to obtain a real picture of an event or incident to answer research questions. So, when observing, researchers see real events, record what is needed during the research, collect documents if needed, and then reduce them so that the data presented is in accordance with the research needs.

2) Tests.

Tests are a series of questions or exercises used to measure the knowledge, intelligence, abilities, or talents possessed by individuals or groups (Kokotsaki et al., 2016). The tests conducted in this study consisted of four mathematics questions, all of which could be solved by students to measure their critical thinking level using a method different from the critical thinking indicator.

3) Documentation.

Documentation According to (Zakiyah, 2020) Documentation uses available data, such as reports, archives, or institutional records. The documentation referred to by the researcher includes learning RPS, learning materials, essay questions, student learning outcomes, photos of activities, etc.

**RESULTS AND DISCUSSION**

**Data Description**

After conducting a pretest on the experimental class and control class, the researcher observed the results to see if there were any differences between the two. If there were no differences, then treatment was carried out for the experimental and control classes using different learning methods. After the posttest was conducted, the researcher's task was to perform a t-test to see if there were changes in the pretest and posttest results for both the experimental and control classes, then test again between the posttest results of the experimental class and the posttest results of the control class to see the differences. Data analysis began with a description of the subjects, analysis of the subjects' conditions during treatment, and analysis of the comparison as a result of treatment.

**1. Subject Description**

There were 10 students in the experimental class using the PBL learning method and 10 students in the control class using the lecture method. Before the treatment was carried out, the

researcher explained the steps that had to be taken by the students, such as completing the learning process and doing the tasks given by the researcher. The first step taken by the researcher was to give a pretest on the subject that had been taught. Before the pretest was given to the experimental and control classes, essay questions corresponding to the variables were given to other classes to test their validity and reliability. The SPSS results showed that all instruments were valid.

**2. Analysis of the subjects' conditions during treatment**

When the treatment was carried out, the students enthusiastically followed the lessons carefully, both in the experimental class and the control class.

a. Experimental class

The students listened enthusiastically and followed the steps that had to be taken when PBL learning was carried out. Then the students were given an example of a problem that had to be solved. They discussed it in groups of 2- s to solve the problem within a specified time. As a result, they were able to carry it out and solve the problem well. Their critical thinking skills were evident when solving problems, and they often asked the research team to discuss the problem.

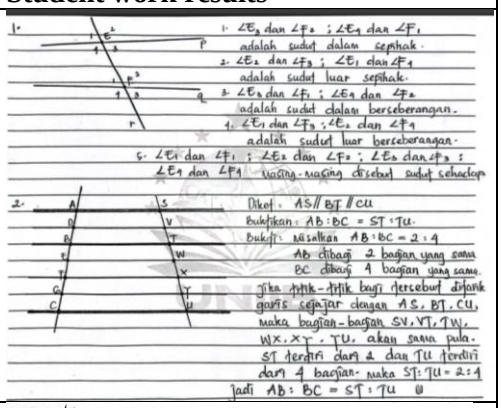
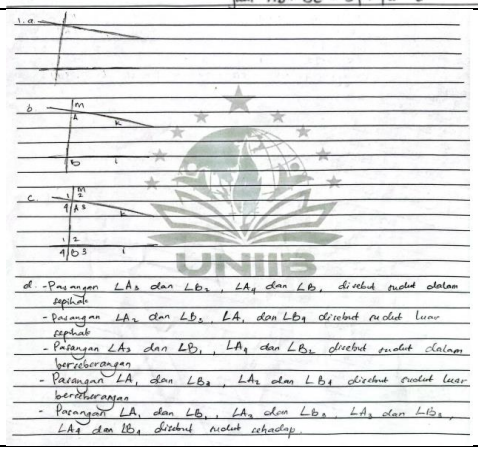
b. Control class

In the control class, learning was conducted using the lecture method. The educator explained and guided the students to solve the problem until it was completed. Then, when the students worked on the correct test, there was confusion while working, which was usually explained while working. When working individually, they were left alone to work on their own.

**3. Comparative analysis as a result of treatment.**

The following is an example of the difference between the experimental class and the control class

**Table 2.** Differences in results between the experimental class and the control class

| Class | Activity photos | Student work results |
|---|---|---|
| **Experimental** |  |  |
| **Control** |  |  |

**Paired sample t-test**

The paired sample t-test is a final test that can be used to determine the results of the study. It can also be used to determine the level of difference or change between the two paired samples. *The paired sample t-test* is a testing method used to assess the effectiveness of treatment, characterized by a difference between the mean before and after treatment (Savery, J. R., & Duffy, 2015) . Meanwhile, according to Abrami et al. (2015), the paired sample t-test is a testing method used to assess the effectiveness of treatment, characterized by a difference in the average before and after treatment. The basic assumption for using this test is that the observations or research for each pair must be under the same conditions. The difference in means must be normally distributed. The variance of each variable can be the same or different. To perform this test, interval or ratio scale data is required. A paired sample means that we use the same sample, but the test is performed on the sample twice at different times or at specific time intervals. The test is conducted using a significance level of 0.05 (α=5%) between the independent variable and the dependent variable (Kokotsaki et al., 2016) .

The basis for accepting or rejecting Ho in this test is as follows.

1. If the significance value is > 0.05, then Ho is accepted or Ha is rejected (the difference in performance is not significant).
2. If the significance value is < 0.05, then Ho is rejected or Ha is accepted (the difference in performance is significant).

This means that if Ha is accepted, there is a significant difference between the *Problem-Based Learning* method and the lecture method, and if Ha is rejected, there is no significant difference between the *Problem-Based Learning* method and the lecture method.

**The following are the results of the Paired Sample T-test**

**1. Paired Sample T-test Pre-test control class pre-test experimental class**

**Paired Samples Statistics**

| | | Mean | N | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| Pair 1 | pretest_eksperimen | 54.90 | 10 | 3.213 | 1.016 |
| | pretest_kontrol | 55.30 | 10 | 3.199 | 1.012 |

**Paired Samples Correlations**

| | | N | Correlation | Sig. |
|---|---|---|---|---|
| Pair 1 | pretest_eksperimen & pretest_kontrol | 10 | .630 | .051 |

**Paired Samples Test**

| | | Paired Differences | | | | | t | df | Sig. (2-tailed) |
|---|---|---|---|---|---|---|---|---|---|
| | | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference Lower | Upper | | | |
| Pair 1 | pretest_eksperimen - pretest_kontrol | -.400 | 2.757 | .872 | -2.372 | 1.572 | -.459 | 9 | .657 |

The results of the above analysis show that there is no significant change, as seen from the sig value (2-tailed) of 0.657 > 0.05. With these results, we can proceed to the next stage to carry out the treatment.

**2. Paired Sample T-test of pretest and posttest control class**

**Paired Samples Statistics**

| | | Mean | N | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| Pair 1 | pretest_kontrol | 55.30 | 10 | 3.199 | 1.012 |
| | postest_kontrol | 70.50 | 10 | 2.953 | .934 |

**Paired Samples Correlations**

| | | N | Correlation | Sig. |
|---|---|---|---|---|
| Pair 1 | pretest_kontrol & postest_kontrol | 10 | .488 | .152 |

**Paired Samples Test**

| | | Paired Differences | | | | | t | df | Sig. (2-tailed) |
|---|---|---|---|---|---|---|---|---|---|
| | | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference Lower | Upper | | | |
| Pair 1 | pretest_kontrol - postest_kontrol | -15.200 | 3.120 | .987 | -17.432 | -12.968 | -15.407 | 9 | .000 |

The results of the above analysis show that there is a significant change, as can be seen from the sig value (2-tailed) of 0.000 < 0.05. Therefore, Ha is accepted, meaning that there is a significant change from the values before and after the treatment.

### 3. Paired Sample T-test for pretest and posttest of the experimental class

**Paired Samples Statistics**

| | | Mean | N | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| Pair 1 | pretest_eksperimen | 54.90 | 10 | 3.213 | 1.016 |
| | postest_eksperimen | 88.00 | 10 | 4.028 | 1.274 |

**Paired Samples Correlations**

| | | N | Correlation | Sig. |
|---|---|---|---|---|
| Pair 1 | pretest_eksperimen & postest_eksperimen | 10 | .060 | .869 |

**Paired Samples Test**

| | | Paired Differences | | | | | t | df | Sig. (2-tailed) |
|---|---|---|---|---|---|---|---|---|---|
| | | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference Lower | Upper | | | |
| Pair 1 | pretest_eksperimen - postest_eksperimen | -33.100 | 4.999 | 1.581 | -36.676 | -29.524 | -20.939 | 9 | .000 |

The results above show that there is a significant change, as can be seen from the sig value (2-tailed) of 0.000 < 0.05. Therefore, Ha is accepted, meaning that there is a significant change from the values before and after treatment.

### 4. Independent sample t-test

The independent sample t-test is used to determine whether there is a difference in the mean of two unpaired samples. The main requirements in the independent sample t-test are that the data is normally distributed and homogeneous (not absolute) (Sumartini, 2016) . The independent sample t-test in this study was used to answer the research question, "Is there a difference in the critical thinking skills of students using the *problem-based learning* method and the lecture method in the Geometry course at Ibrahimy Islamic University in Banyuwangi?" To answer this research question, an independent sample t-test was conducted on the post-test data of the experimental class (PBL method) and the post-test data of the control class (lecture method). The results of the independent sample t-test showed that the sig value (2-tailed) was <0.05, indicating that there was a difference between the data.

The results of the data difference test in this study are presented in the following table.

**Group Statistics**

| | KELAS | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| HASIL BERFIKIR KRITIS | KELAS EKSPERIMEN | 10 | 88.0000 | 4.02768 | 1.27366 |
| | KELAS KONTROL | 10 | 70.5000 | 2.95334 | .93393 |

Based on the results above, the mean values of the two different classes show different results. The experimental class is higher than the control class. Thus, the learning outcomes (critical thinking) of students in the experimental class are much higher than those in the control class.

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 |
| HASIL BERFIKIR KRITIS | Equal variances assumed | .806 | .381 | 11.080 | 18 | .000 | 17.50000 | 1.57938 | 14.18184 | 20.81816 |
| | Equal variances not assumed | | | 11.080 | 16.508 | .000 | 17.50000 | 1.57938 | 14.16021 | 20.83979 |

From the results above, it can be seen that the sig. value (2-tailed) is 0.000, so it can be concluded that there is a difference between the experimental class and the control class.

**HYPOTHESIS TESTING**

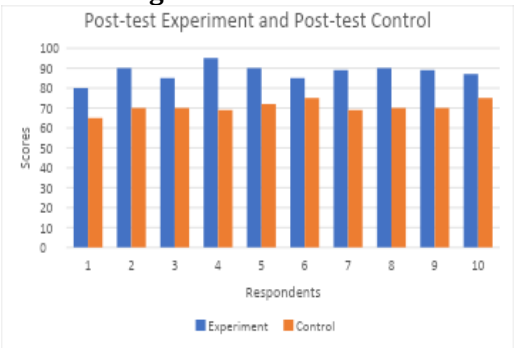
The decision is that:

1. If sig (2-tailed) < 0.05, then Ha is accepted and Ho is rejected.
2. If sig (2-tailed) > 0.05, then Ha is rejected and Ho is accepted.

From the SPSS results above, processing the data from the post-test of the experimental class with the post-test of the control class shows that the Mean Post-test Experimental value is greater than the Mean Post-test Control value, namely 88.000 for the experimental class and 70.5000 for the control class. Meanwhile, the sig (2-tailed) result is 0.000 < 0.05. According to the predetermined hypothesis, if the sig (2-tailed) value is < 0.05, then Ha is accepted and Ho is rejected. From the results above, Ha is accepted and Ho is rejected. This means that there is a significant change between the experimental class using the PBL learning method and the control class using the lecture learning method**.**

**VISUAL PRESENTATION**

**The results above can be seen in the histogram below:**




**DISCUSSION OF FINDINGS**

In this discussion, it can be seen that although the lecture learning method is still applied in classrooms today, PBL is actually a more efficient learning method. This is evident from the learning outcomes of students using critical thinking, which ultimately show that PBL is more effective than the lecture method.

The conclusions from the above research can be seen from the following results:

1. Students are able to think critically, as evidenced by their learning outcomes, with the following measurement indicators: a) analytical skills (student orientation to problems); b) synthesis skills (organizing students for learning); c) problem- s skills (guiding individual and group investigations to solve problems); d) conclusion skills (developing and presenting work results); e) evaluation (analyzing and evaluating the problem-solving process).
2. The results of processing the experimental pretest and control pretest data showed no significant changes, as can be seen from the sig value (2-tailed) of 0.657> 0.05. With the above results, we can proceed to the next stage for treatment; b) The results of the control class pretest and posttest show that there is a significant change, as seen from the sig value (2-tailed) of 0.000 < 0.05. Therefore, Ha is accepted, or there is a significant change from the value before and after treatment; c) The results of processing the pretest and posttest of the experimental class show that there is a significant change, as seen from the sig value (2-tailed) of 0.000 < 0.05. Therefore, Ha is accepted, or there is a significant change from the value before treatment to after treatment; d)

The results of the independent sample T-test show that the Mean Posttest for the Experiment is greater than the Mean Posttest for the Control, namely 88.000 for the experimental class and 70.5000 for the control class. Meanwhile, the sig (2-tailed) result is 0.000 < 0.05. According to the predetermined hypothesis, if the sig (2-tailed) value is < 0.05, then Ha is accepted and Ho is rejected. From the above results, Ha is accepted and Ho is rejected. This means that there is a significant change between the experimental class using the PBL learning method and the control class using the lecture learning method.

## RECOMMENDATIONS

Based on the findings of this study, several recommendations can be proposed for future research. Future researchers are encouraged to explore other learning methods in greater depth to further examine their effects on students' learning outcomes, particularly in relation to critical thinking skills. In addition, similar studies may be conducted using the same instructional methods with different samples or educational contexts to enhance the generalizability of the findings. Furthermore, it is expected that the results of this study can serve as a valuable reference for educators and researchers in designing and implementing effective classroom learning strategies.

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