

The Effectiveness of PBL-Based LKPD for Empowering the Senior High School Student's Critical and Creative Thinking Skills



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ABSTRACT: This study aims to determine the effectiveness of PBL-based LKPD. The method used was a quasi experimental with a *posttest only control design*. The population in this study were the students of grade XI MIPA SMAN 6 Merangin for the 2020/2021 academic year. The sample in this study was the students from class XI MIPA 3 as the experimental class and XI MIPA 4 as the control class chosen by using the purposive sampling technique. The research instruments were observation questionnaires, product validation sheets, practicality sheets for teachers and students, and evaluation questions based on critical and creative thinking indicators. Results of the analysis of evaluation questions showed that the mean scores of the critical and creative thinking skills of the experimental class students were higher than the control class. The mean scores of critical and creative thinking skills in the experimental class were 73.21 and 73.79. Meanwhile the mean score in the control class were 54.06 and 58.94. The results of the t-test of students' critical thinking were $(0.000) < t (0.05)$ and creative thinking skills were $(0.001) < t (0.05)$. Thus, it indicates that PBL-based LKPD is effective for empowering students' critical and creative thinking skills.

KEYWORDS: Critical Thinking, Creative Thinking, LKPD, PBL.

I. INTRODUCTION

Critical and creative thinking are key competencies that must be possessed by students to face the challenges of the present and the future. Critical thinking is one part of higher order thinking skills (Agnafia D. N., 2019). Creative thinking skills are also needed in the 21st century to create new innovations in human life (Putra, 2016). Critical and creative thinking is important to develop because it can improve the quality of human resources and develop the mindset of students in solving problems and providing solutions to existing problems, especially in everyday life. These two skills support each other and must be applied to learning, especially learning Biology.

Biology is a discipline that requires high-level thinking skills for students to analyze, understand, and apply them in everyday life. Higher-order thinking skills are the ability to connect, manipulate, and transform knowledge and experience already possessed to think critically and creatively in solving learning problems (Syarifah, 2018). Therefore, critical and creative thinking is needed in biology learning so that it can become a habit and be applied to everyday life.

Based on the problem analysis conducted to Biology teachers, it is stated that critical and creative thinking skills in schools are still rarely trained. Previous research stated that low critical and creative thinking skills from elementary school to university levels in Indonesia are still often complained of (Reta, 2012).

The limitations of learning tools are also one of the factors that determine the quality of learning. Teaching materials are a set of materials that are systematically arranged, written or unwritten, so as to create an environment that allows students to learn and train students' thinking skills (Prastowo, 2012). The required teaching materials must contain activity based which contains the activities of students, and teaching materials that are made to emphasize the activities of students so that they can train students' thinking skills.

Based on the needs analysis, students need teaching materials that provide detailed material, activities on teaching materials can help students to be active, and help understand learning where 93% of students want the development of teaching materials, namely LKPD. The use of LKPD in learning can provide opportunities to develop students' thinking processes (Wati, 2017). LKPD can train students' critical thinking skills, because each student can provide ideas and opinions in critiquing problems through activities and exercises on LKPD. LKPD is developed based on a model to improve students' critical and creative thinking skills (Zikri, 2020).

The LKPD developed is a PBL-based LKPD and is made by taking into account the PBL syntax and adapted to the indicators of critical and creative thinking. PBL is one of the learning models that is carried out to improve students' thinking skills, help

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develop problem solving abilities. PBL requires students to identify the problems presented by digging up as much information as possible, then analyzing and finding solutions to existing problems (Asyhari, 2018). Students are expected to be individuals who are broad-minded and able to see the relationship between learning and the environment.

LKPD developed contains material on the digestive and respiratory systems in humans. Based on the observations to 60 students, 71.7% of them said that the material for the digestive system in humans is difficult to understand and for the respiratory system in humans is 73.3%. Furthermore, 70% of students stated that the material had not been presented in detail and 60% stated that LKPD had not helped students understand the concept of learning.

Moreover, based on the observations with five Biology teachers, 80% of them said that the students' critical and creative thinking skills had not been facilitated and had never been measured. This was evidenced by the mean results of the analysis of students' thinking skills which were 32.1 in the very low category. The teaching materials used also did not meet the indicators of the critical and creative thinking assessment of the students. This was proved when the teacher shows that the LKPD used is only taken from the package book.

Based on the above background, it is deemed necessary to develop an LKPD teaching material as a way to solve the problem of learning biology. The PBL-based LKPD developed is expected to be able and effective in empowering the students' critical and creative thinking skills.

II. RESEARCH METHOD

This study was a quasi-experimental (quasi-experimental). This study aims to test the effectiveness of PBL-based LKPD developed to empower the students' critical and creative thinking skills. The design of this study used *Post test Only Control Group Design*. The research design of *Posttest Only Control Group Design* is shown in Table I.

Table I. Research Design Post-test Only Control Design.

| Class | Treatment | Posttest |
|----------------|-----------|----------|
| Experimental X | | T2 |
| Control | | T2 |

Source:(Lufri,2015)

Note:

- X : Learning using PBL-based LKPD.
 - : Learning using LKPD which is commonly used in schools.
 T2 : The final test is both given at the end of the lesson.

The population in this study was the students of grade XI IPA SMAN 6 Merangin for the 2020/2021 academic year. The sample of this study was the students from XI MIPA 3 as the experimental class and XI MIPA 4 as the control class chosen by using purposive sampling technique. The independent variable in this study was the use of PBL-based LKPD. The dependent variable in this study was critical and creative thinking skills. This type of research data was primary data because it is obtained directly based on the student assessments related to LKPD responses and scores from essay tests. The research instruments used were (1) analytical questionnaire, product validation sheet, teacher and student practicality sheet. (2) data collection instruments were essay test instruments based on critical and creative thinking indicators. The data analysis technique was to see the effectiveness of students on PBL-based LKPD based on post-test scores. Posttest assessment was assessed based on critical and creative thinking assessment indicators. Then, the critical thinking assessment indicators were based on the following rubrics:

Table II. Critical Thinking Scoring Rubric

| Score | Description |
|-------|---|
| 5 | <ul style="list-style-type: none"> All concepts are correct, clear and specific. The flow of thinking is good, all concepts are interrelated and integrated. All descriptions of answers concluded are correct, clear, and specific, supported by strong reasons, true, clear arguments. All aspects are clear, the evidence is good and balanced. Grammar is good and correct by paying attention to the correct terms. |
| 4 | <ul style="list-style-type: none"> Most of the concepts are correct, clear but not specific. The flow of thinking is good, most of the concepts are interrelated and integrated. Most of the descriptions of answers concluded are correct, clear, and specific, supported by strong reasons, true, clear arguments. |

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- All aspects are visible, but not yet balanced.
- Grammar is good and correct, there are minor errors.

| | |
|---|---|
| 3 | <ul style="list-style-type: none"> • Some of the concepts are correct and clear. • The flow of thinking is quite good, some are interrelated. • A small part of the answer description is concluded correctly and clearly but the reasons and arguments are not clear. • Most of the aspects seem correct. • Grammar is quite good, but there are spelling errors. |
| 2 | <ul style="list-style-type: none"> • Unfocused or exaggerated or dubious concepts. • The flow of thinking is bad, the concepts are not related to each other. • Descriptions of answers are not concluded correctly, clearly, and specifically, and are not supported by strong, true and clear reasons. • Few aspects seem correct. • Good grammar, incomplete sentences. |
| 1 | <ul style="list-style-type: none"> • All concepts are incorrect or insufficient. • The flow of thinking is bad. • The description of the conclusion of the answer is incorrect. • Overall aspects are not sufficient. • Poor Grammar. |
| 0 | No answer or the answers are incorrect |

Source: (Zubaidah S. , 2015)

The creative thinking assessment indicators were based on the following rubrics:

Table III. Creative Thinking Assessment Rubric.

| Category | Description | Score |
|---------------------|--|-------|
| <i>Fleksibility</i> | Writing several alternative answers that are logical and relevant to the problems given from several different points of view. | 4 |
| | Writing several alternative answers that are quite logical and relevant to the problems given from several different points of view. | 3 |
| | Writing several alternative answers that are logical but less relevant to the problems given from several different points of view. | 2 |
| | Writing an answer that is quite logical and relevant to the problems given from one point of view. | 1 |
| <i>Originality</i> | Providing some interesting unique ideas that are logical, relatively new and relevant to the given problems. | 4 |
| | Giving some interesting unique ideas logically, relatively new but less relevant to the given problems. | 3 |
| | Providing some quite unique ideas that are logically interesting and relevant to the given problems. | 2 |
| | Providing some ideas that are commonplace, logical and relevant to the given problems. | 1 |
| <i>Elaboration</i> | Explaining some logical details on existing ideas so that the formulation of ideas becomes easier to apply clearly. | 4 |
| | Explaining one logical detail on an existing idea so that the formulation of the idea becomes easier to apply and clear. | 3 |
| | Explaining some logical details on existing ideas but does not fit the main concept, so it cannot be used to clarify ideas. | 2 |
| | Not adding details to the existing ideas so that the formulation of the concept is less applicable. | 1 |
| <i>Fluency</i> | Providing more than 5 different ideas, suggestions, or alternative answers. | 4 |
| | Giving 3 different ideas, suggestions or alternative answers. | 3 |
| | Providing several ideas or alternative answers that are not always different. | 2 |
| | Mentioning ideas, suggestions or alternative answers. | 1 |

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| | | |
|------------------------------|---|---|
| <i>Metaphorical Thinking</i> | Combining several ideas, modifying, and explaining the formulation of ideas with logical and coherent analogies. | 4 |
| (Berpikir Metafora) | Combining several ideas, modifying, but unable to explain the formulation of ideas with logical and coherent analogies. | 3 |
| | Combining several relevant ideas but does not explain the formulation of ideas with logical analogies. | 2 |
| | Less able to combine relevant ideas so that they become a coherent whole. | 1 |

Source: (Treffinger, 2002)

Posttest results were analyzed using the formula according to (Ermayanti, 2016)

$$\text{Result} = \frac{\text{Total Score}}{\text{Maximum Score}} \times 100\%$$

The results of students' answers were calculated based on the students' completeness and class mean obtained from critical and creative thinking skills. The critical thinking indicator used in this study was according to Ennis (1995) modification (Zubaidah S., 2016). The achievement of critical thinking skills was categorized into critical thinking criteria. The criteria for the percentage of critical thinking skills are as follows:

| | |
|------------|-----------------|
| 81% - 100% | :Very Critical |
| 61% - 80% | :Critical |
| 41% - 60% | :Quite Critical |
| 21% - 40% | :Less Critical |
| 1% - 20% | :Not Critical |

(Setianingih, 2019)

The criteria for the percentage of creative thinking skills are as follows:

| | |
|------------|------------------|
| 81% - 100% | :Very Creative |
| 61% - 80% | : Creative |
| 41% - 60% | : Quite Creative |
| 21% - 40% | : Less Creative |
| 0% - 20% | : Not Creative |

(Ekawati, 2011)

Hypothesis testing criteria H0 is accepted (H1 is rejected) if the significance value is >0.05 H0 is rejected (H1 is accepted) if the significance value is <0.05. Before the t-test was carried out, the normality and homogeneity tests were first carried out. The data is normal if the significance is > 0.05 and the data is homogeneous if the significance is > 0.05.

III. RESULTS AND DISCUSSION

Learning outcomes data were obtained through learning outcomes tests conducted at the last meeting. The test is given in the form of essay questions. The data on the assessment of the students' critical and creative thinking skills are presented in the table below.

Table IV. Assessment of Students' Critical and Creative Thinking Skills

| Thinking Skills | Class | N | Post-test Average | SD |
|-----------------|--------------|----|-------------------|--------|
| Critical | Experimental | 33 | 73,21 | 17,073 |
| | Control | 33 | 54,06 | 14,496 |
| Creative | Experimental | 33 | 73,79 | 14,632 |
| | Control | 33 | 58,94 | 18,276 |

Based on the table above, it shows that there is a difference between the mean of the students' critical and creative thinking skills. The treatment in the experimental class used PBL-based LKPD while the control class used the LKPD which is commonly used by teachers. This is because the LKPD developed contains the stages of the PBL model that can improve the students' critical thinking skills. PBL that uses problems in the real world has an effect on students' critical thinking (Gorghiu, 2015). This is in accordance with the opinion by Hosnan (2014) which states that the main purpose of PBL is to develop students' critical thinking

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skills, problem solving abilities, and build their own knowledge. The PBL syntax that is integrated with LKPD is also integrated with aspects of critical thinking skills. Critical thinking is a problem-solving ability that requires students to connect previously studied ideas to problem solving (Yamin, 2012). The good results of students' critical thinking skills are closely related to the learning process carried out. In addition, creative thinking is also integrated where students are directed to be able to express ideas or ideas in more detail, clearly, and differently than in general. Students' creative thinking ability is very important. Thinking can affect ability, speed and effectiveness student learning. One of them is in demanding biology learning scientific and conceptual learning, in which students must have creative thinking skills (Elmanazifa, 2018). The activities of students during the PBL-based LKPD work are orienting students to problems, organizing students to learn, assisting independent and group investigations, developing and presenting the results of their work, and exhibiting them and analyzing and evaluating the problem solving process.

However, the assessment of critical and creative thinking skills was also assessed based on indicators. The assessment of critical thinking skills was based on the rubric of critical thinking indicators based on modifications (Zubaidah S., 2015). The assessment of creative thinking is based on the rubric of creative thinking indicators based on modifications (Zubaidah S., 2016). The results of the critical thinking assessment of the experimental class were analyzed based on the indicators that can be seen in Figure 1.

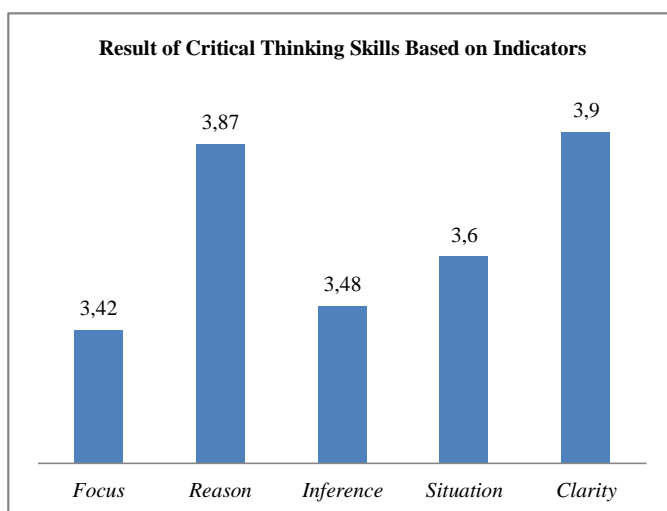


Figure I. Results of Critical Thinking Skills Based on Indicators

Based on Figure I above, it means that the average students from the experimental class have a critical thinking skill in the very good category after learning using PBL-based LKPD. Based on the post-test score, the mean result of the *focus* aspect was 3.42 with a very good category. The students are able to focus the questions and make decisions with good thinking. Critical thinking skills in the problem-oriented syntax that is developed is the *focus* aspect. The students are able to focus on existing questions or issues to make decisions about what is believed from the discourse that has been presented in the LKPD (Ennis R. H., 1996). The posttest assessment of the inference aspect requires students to think about making assumptions that are in accordance with the phenomena presented in the discourse. An important part of this inference step is identifying assumptions and seeking solutions, considering interpretations of the situation and evidence. The data shows that the mean of the students' *inference* aspect was 3.48 in the very good category. The *inference* aspect is contained in the syntax of organizing students to learn. This stage is carried out so that the students are required to identify problems and make problem formulations. Furthermore, the *reason* aspect is an aspect that trains students in identifying the relationship of several statements, concepts and descriptions (Ennis, 1993). The mean of posttest for the *reason* aspect was 3.87 in the very good category. At this stage, the students think in groups to relate the problem to the LKPD by conducting a literature study so that the problems can be solved optimally. The mean *clarity* aspect obtained was 3.9 in the very good category. The students are very good at explaining the meaning or terms used. Furthermore, the mean situation aspect was 3.6 in the good category. This means that the students are able to understand the situation and keep the situation in mind to help clarify questions and know the meaning of supporting the decisions taken (Affandy, 2019).

The results of the experimental class's creative thinking assessment were analyzed based on indicators that can be seen in Figure II.

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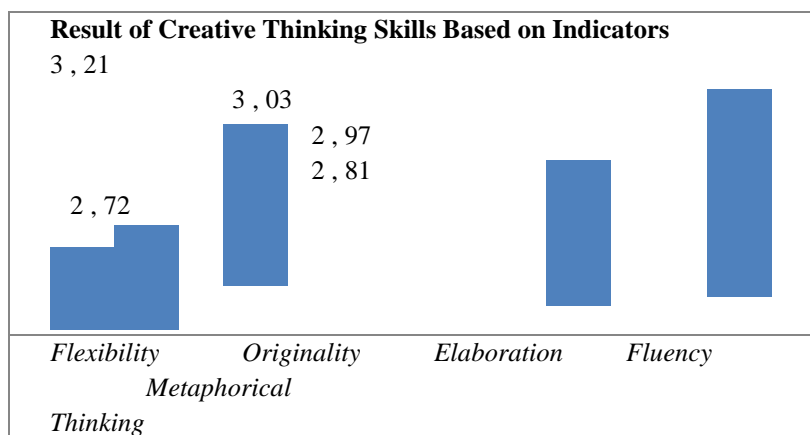


Figure II. Result of Creative Thinking Skills Based on Indicators

Based on Figure II above, it can be interpreted that the mean students from the experimental class has good creative thinking skills after learning using PBL-based LKPD. The *flexibility* aspect trains students to discuss the formulation of questions that have been formulated (Ennis R. H., 1996). The mean score of the *flexibility* aspect was 2.72 in good category. The originality aspect was 3.03 in the good category.

The next aspect is *elaboration* which this skill aims to enrich or develop ideas, detailing the details of an idea (Treffinger, 2002). The mean result of the elaboration aspect was 2.81 in the good category. This means that the students are able to process the information that has been obtained from the reference study developed so as to form an idea to answer the problem formulation that has been formulated previously. The fluency aspect of the students was 2.97 in the good category. To train the *fluency* aspect of creative thinking skills, one of which is by looking at the fluency of students in answering or providing new ideas, namely in the form of open questions (Treffinger, 2002). The *metaphorical thinking* aspect of the students was 3.21 in the good category. This means that the students are able to make an analogy of something into a concept that is easy to be understood (Treffinger, 2002).

The next stage is *hypothesis testing*, but first the normality test and homogeneity test were carried out as prerequisites for data analysis. The prerequisite tests carried out were normality test and homogeneity test. The researcher conducted a normality test using the Kolmogorov-Smirnov test. The results of the post-test normality test for the critical values of the control and experimental classes can be seen in the table below.

Table V. Normality Test Posttest Critical and Creative Values for Control and Experiment Class

| Class | Thinking Skills | Significance | Description |
|--------------|-----------------|--------------|-------------|
| Experimental | Critical | 0,253 | Normally |
| Control | | 0,754 | Normally |
| Experimental | Creative | 0,202 | Normally |
| Control | | 0,947 | Normally |

Based on the table, it can be seen that all critical and creative values of the control class, experimental significance > 0.05 , meaning that the data has been normally distributed. Furthermore, the homogeneity of the data was tested by using *Levene's test*. The results of the post-test homogeneity test of the critical and creative values of the control and experimental classes can be seen in the table below.

Table VI. Test of Posttest Homogeneity Critical and Creative Values for Control and Experiment Class

| Thinking Skills | Significance | Description |
|-----------------|--------------|-------------|
| Critical | 0,272 | Homogeneous |
| Creative | 0,263 | Homogeneous |

Based on the test results, it indicates that the critical and creative thinking skills data significance > 0.05 which means all data are homogeneous. The data that have been normal and homogeneous, then tested the hypothesis by using the Independent Samples T Test. The results of the hypothesis test of critical and creative thinking skills in the experimental and control classes can be seen in the table.

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Table VII. Calculation Results of Critical and Creative Thinking Skills T-Test.

| Thinking Skills | Class | Average | SD | Significance | Description |
|-----------------|--------------|---------|--------|--------------|-------------|
| Critical | Experimental | 73,21 | 17,073 | 0.000 | H1 accepted |
| | Control | 54,06 | 14,496 | | |
| Creative | Experimental | 73,79 | 14,632 | 0.001 | H1 accepted |
| | Control | 58,94 | 18,276 | | |

Based on the table above, it is known that the significance value of students' critical thinking skills is 0.000 and creative thinking skills is 0.001. This indicates that the value of sig. < 0.05, which means that H0 is rejected and H1 is accepted. Thus, it is known that the use of PBL-based LKPD has an effect on empowering the students' critical and creative thinking skills of grade XI of SMAN 6 Merangin.

The effectiveness of the developed PBL-based LKPD can be seen from the students' critical and creative thinking skills obtained after they used the LKPD in the learning process. The product effectiveness is a product quality criterion developed based on the influence on users (Nieveen, 2007). The results of the effectiveness assessment showed that the developed LKPD were effectively used as teaching materials in the learning process. The students' critical and creative thinking skills were assessed through daily tests of the human respiratory system. The instrument used in the form of essay questions was 5 items. Testing the effectiveness of LKPD was carried out by using the t-test because the data were normally distributed and homogeneous. Based on the t-test, the results obtained that the hypothesis was accepted. Therefore, it shows that the use of PBL-based worksheets on the digestive and respiratory system materials in humans is effectively used for learning.

The first PBL syntax is an activity to orient students to problems. The problems presented in the PBL-based LKPD in the form of discourse were sourced from news and journals related to digestive and respiratory materials in humans. The PBL learning model has the characteristics of authentic inquiry. PBL requires students to carry out authentic investigations which include analyzing and solving problems, making hypotheses, collecting and analyzing information, conducting experiments, and formulating conclusions (Utami, 2019). PBL-based learning presents real problems in life that require students to actively think and cooperate in identifying and solving problems so that students can find concepts (Fariroh, 2015). Thinking skills are needed in solving learning problems. Creative thinking is closely related to problem solving (Widiawati, 2019). The problems given to LKPD aim to arouse students' curiosity by way of connecting theory with everyday life. When students learn something by being given a problem, it provides a challenge to think more deeply. Thus, the PBL model is expected to be suitable to be applied in 2013 Curriculum learning in an effort to achieve the expected competencies.

Then, the next stage is to organize students to learn. This stage is carried out so that students are required to identify problems and formulate problems at this stage. The third PBL stage is an activity to help independent and group investigations. The students conduct a literature study to answer the formulation of the problem that has been made. They think in groups to relate the problem to the LKPD by conducting a literature study so that the problem can be solved optimally.

The next stage is to develop and present the results of scientific works and exhibit them. Due to the Covid-19 pandemic, students present the results of discussions by making presentations using online meeting applications such as Google Meet. Researchers continue to strive for an effective learning process using PBL-based worksheets, even in the conditions of the Covid-19 pandemic. Current conditions require teachers to be able and skilled in determining good teaching materials or learning tools. This is in line with the opinion of Zuriah (2016) that the skills that must be possessed by a professional teacher in carrying out their duties are that their creativity is required to be able to develop innovative, varied, interesting, contextual teaching materials, and in accordance with the needs of students.

The last stage is to analyze and evaluate the problem solving process. The students assess the strengths and weaknesses of other groups and then make conclusions. The presenter group looks for answers from the responses that have been given by other groups. Then, the teacher evaluates the results of the discussion and together concludes the learning materials contained in the LKPD. At this stage, it emphasizes the activity of checking or re-checking thoroughly from the beginning to the end of the investigation (Setiana, 2020). This step is important to check whether the results of the investigation are in accordance with the provisions and can become new knowledge that is applied to everyday life.

Based on the explanation above, PBL syntax can improve students' critical and creative thinking skills. This is supported by the mean of the posttest obtained in each aspect of the critical and creative thinking skills of experimental class students (figures 1 and 2).

Based on the mean of the post test obtained by the students and based on the results of research, PBL-based LKPD is able to improve the students' critical and creative thinking skills. In line with a research, Ulfah (2020) said that the use of PBL based LKPD on human reproductive system materials is effectively used for learning. Another research by Purnamaningrum (2012) also shows that creative thinking skills can be improved through PBL. Therefore, it can be concluded that the PBL-based LKPD based on the research results are able to improve the students' critical and creative thinking skills.

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IV. CONCLUSION

Learning using PBL-based LKPD is effective to empower the students' critical and creative thinking skills. The mean score critical and creative thinking skills of the experimental class students was higher than the control class. The mean scores of the critical and creative thinking skills in the experimental class were 73.21 and 73.79. On the other hand, the mean scores of the critical and creative thinking skills in the control class were 54.06 and 58.94. The results of the t-test of students' critical thinking are $(0.000) < t(0.05)$ and creative thinking skills are $(0.001) < t(0.05)$. This explains that PBL-based LKPD is effective for empowering students' critical and creative thinking skills.

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