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The Effectiveness of E-LKPD on Environmental Pollution Material Based on PBL (Problem Based Learning) to Improve Students' Critical Thinking Skills

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Abstract

Global challenges and competition require quality human resources to compete in society with 21st century skills. Critical thinking skills are competencies to be able to solve problems needed to answer challenges in the present and the future. The use of E-LKPD based on problem based learning (PBL) on environmental pollution material is very influential in triggering critical thinking. The purpose of this study was to analyze the effectiveness of the use of E-LKPD based on problem based learning (PBL) for students' critical thinking skills with biology learning activities on environmental pollution material. This study is a quantitative study using a quasi-experimental method. The results of the effectiveness of E-LKPD on students' critical thinking skills were obtained from the results of the N-gain analysis, it is known that the N-gain value in the experimental class is much higher with an N-gain value of 0.69 with moderate criteria, while the N-gain value in the control class is 0.37 with moderate criteria. The N-Gain test shows that the N-Gain value of the experimental class is greater than the control class. Therefore, E-LKPD based on problem based learning (PBL) on environmental pollution material is effective in improving students' critical thinking skills in learning.

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INTRODUCTION

Independent learning is a policy breakthrough initiated by the Minister of Education Nadiem Makarim (Hutabarat et al., 2022). In grade X, the phase used is phase E with learning outcomes in biology subjects, students are required to have the ability to create problem solving based on local issues related to understanding the diversity of living things, ecosystem components, and interactions between components and environmental pollution (Head of the Agency for Standards, Curriculum, and Education Assessment, Ministry of Education and Culture Research and Technology, 2022).

Education is currently required to be able to create a generation that is skilled in the use of technology, can survive by using life skills, in the form of hard skills and soft skills (Saltan, 2017). Based on these demands, P21 (Partnership for 21st Century Learning) formulates a paradigm that must be possessed by every student in the 21st century, including life and career skills, learning and innovation skills and technology and information skills (Wijaya et al., 2020). One of the skills contained in learning and innovation skills is critical thinking skills (Trilling & Fadel, 2019).

Critical thinking skills are self-regulation and the ability to decide something that results in interpretation, analysis, evaluation, inference and presentation using evidence, concepts, methodologies, criteria or contextual considerations that form the basis for making a decision (Ennis, 2011). The best effort to develop critical thinking skills that can be done is to link learning materials with students' real experiences in everyday environments (Susilawati et al., 2020).

With critical thinking skills, students are expected to be able to analyze and synthesize an idea or idea in a more specific direction, solve problems and draw conclusions (Fitriyani et al., 2019).

Critical thinking is also in line with the level of student understanding. Understanding concepts is very necessary for students who have experienced the learning process, with mastery of concepts it will make it easier for students to learn something (Corey et al, 2020).

For students, environmental pollution material is material that is quite difficult to learn and understand, this is in line with the statement (Sukmawati et al., 2023) that environmental pollution material is material with a broad scope so that it is quite difficult to understand. In the learning process, it is not enough to just have a theoretical explanation, so there needs to be good and appropriate teaching materials (Sukmawati et al., 2023).

The use of teaching materials can contribute to the potential utilized in learning. According to Toharudin & Iwan (2017), teachers are expected to be able to develop factual learning innovations to build student knowledge and improve learning outcomes. Teaching materials can help explain the main topics related to environmental pollution material which are equipped with brief and systematic explanations and images as basic illustrations that make it easier for students to understand a concept or fact.

indirectly requires teachers as facilitators in learning to be able to prepare teaching materials that can further activate students, one example of which is the Student Worksheet (LKPD). This statement is supported by (Suyitno & Angga, 2016; Sunardi et al., 2017) that teachers must be able to develop effective teaching materials in order to support the achievement of student competencies optimally. In fact, the LKPD used in the current learning process still focuses on answering practice questions which tend not to be able to improve critical thinking skills and are less innovative or interesting (Nurhalimah et al., 2020).

This is supported by the statement (Lathifah et al., 2021) that printed LKPD used in schools today are mostly still less effective and practical because they use practice questions that are not in accordance with the indicators and materials presented, language and images that are not interesting and difficult to understand so that the expected learning objectives are not achieved. Teaching materials must be well designed and follow the times, this is intended to make it easier for teachers to carry out the teaching and learning process, while the results obtained will have an impact on improving the quality of learning itself (Zaini & Jumirah, 2016).

Electronic LKPD (e-LKPD) is one of the teaching materials that is integrated with current technology which contains images, videos, animations and others that are effective in attracting students' attention. The development of e-LKPD based on PBL can help knowledge and understanding of in-depth learning concepts so that students can solve environmental problems that occur in society (Lawrence et al., 2022). This is part of an effort to improve students' skills in line with 21st century technology-based developments (Lessy, 2021).

According to Setyaningsih (2019), the results of the study showed that e-LKPD received a positive response which showed that e-LKPD

media can make students understand better. Teaching materials that are contextual and can help explain the main material related to environmental pollution material are equipped with brief, systematic explanations and images according to the actual situation.

Observations by researchers together with Biology subject teachers and students in senior high school (MAN) 01 Jepara found that in Biology learning, especially on environmental pollution material, they still use printed LKPD which only contains material and assignments in the form of multiple choice questions, fill-in questions and essay questions which researchers feel are still not able to train or improve students' critical thinking skills optimally.

The use of E-LKPD teaching materials in the learning process, especially in Biology subjects on environmental pollution material, is a cutting-edge idea that is expected to help students improve their critical thinking skills and can be one of the teaching materials integrated with current technology.

Based on the background description above, this study aims to see the effectiveness of PBL-based e-LKPD to improve the understanding and critical thinking skills of class X students of MAN 01 Jepara.

METHOD

This research is a quantitative research using the quasi-experimental method (Klassen et al., 2012), stating that quantitative research is a method to test certain theories by examining the relationship between variables. These variables are measured so that data consisting of numbers can be analyzed based on statistical procedures (Sugiyono, 2013).

The population in this study was 114 students. The sample was selected using sampling purpose technique, namely determining the sample technique based on certain considerations from the research subjects. The sample in was selected 2 classes consisting of 2 experimental classes, namely class A with 76 students and 1 control class, namely class B two with 38 students.

This study used a pretest posttest control group design, namely the experimental class is given learning treatment using PBL-based E-LKPD (X1) while the control class is given treatment with conventional LKPD which is still in printed form which is commonly used in MAN 01 Jepara (X2), then a pretest (Q1) and posttest (Q2) are carried out. The following is a table of research designs.

Table 1. Research Design

Group	Pretest	Treatment	Posttest
A	Q1	X1	Q2
B	Q1	X2	Q2

The experimental group was given treatment in the form of learning assisted by E-LKPD media. While the control group was given treatment in the form of learning using conventional LKPD. The critical thinking skills test instrument given to the experimental group and the control group was the same. The critical thinking skills test instrument for students was in the form of an essay test. The test used in this study was based on aspects of students' critical thinking skills indicators, Elementary Clarification, Basic Support, Inference, Advanced Clarification, Strategies and Tactics (Ennis, 2011) that have been designed by researchers can be seen in Table 2.

Table 2. Profile of The Instrument

Critical Thinking Skills Indicators	Amount of Question
Elementary Clarification	1
Building Basic Skill	1
Inference	1
Advanced Clarification	1
Strategies and Tactics	1
Total	5

The use of this data collection instrument is to determine the effect after the use of E-LKPD on students' critical thinking skills. The research instrument has been validated by 2 validators by looking at the curriculum, material, suitability with indicators of conceptual understanding, level of difficulty of questions and suitability of instrument answers so that the instrument can be said to be suitable for use. There are several improvements to several test questions. After improvements have been made, it can be stated that the critical thinking skills test instrument for students can be used in research.

The data analysis technique was carried out using statistical tests. Data analysis was carried out through several statistical tests, namely essay test data processing, including question validity tests, reliability tests and difficulty level tests. The prerequisite test is tested with a normality test and a homogeneity test. While the hypothesis test is carried out with a normalized gain test (N-Gain) to determine the increase in students'

cognitive learning outcomes after being given treatment. The increase is taken from the pretest and posttest scores obtained by students. Normalization Gain or abbreviated as N-Gain is a comparison of the actual gain score with the maximum gain score (Hake, 1998). N-gain is used to assess the effectiveness of learning by comparing pretest and posttest scores. The N-gain score categories can be seen in Table 3.

Table 3. N-gain Category

N-gain Category	N-gain Value
High	$g > 0.7$
Medium	$0.3 \leq g \leq 0.7$
Low	$g < 0.3$

If the N-Gain calculation result of the experimental class is higher than the control class, it can be interpreted that the experimental class has a higher change than the control class. This shows that there is an influence of the use of E-LKPD on students' critical thinking results.

RESULT AND DISCUSSION

The developed e-LKPD was declared very valid and was then implemented in the learning process on environmental pollution material for class X at MAN 01 Jepara. The implementation stage was carried out to test the effectiveness of e-LKPD in learning by providing questions with syntax critical thinking skills.

This study has successfully shown that the use of E-LKPD is able to improve students' critical thinking skills through syntax and teaching and learning activities in it so that the results show a significant difference when compared to the control group.

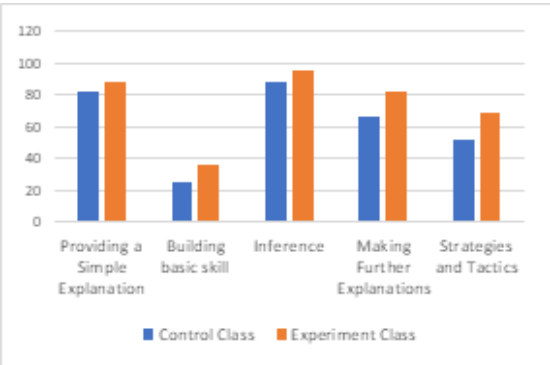

Figure 1. Achievement of Each Critical Thinking Indicator

Based on Figure 1, it shows a difference in the achievement of indicators between the control class and the experimental class. The control class showed an average ability to answer questions on the level of understanding for the five indicators of 61.4%. While the experimental class had an average ability to answer critical thinking questions for the six indicators of 72.6%. The experimental class showed success in increasing understanding because it had exceeded the minimum target of 70% of students successfully achieving learning outcomes.

The first indicator in critical thinking skills is basic clarification, students are required to Focus questions, Analyze problem topics regarding types of environmental pollution and state the reasons and characteristics of environmental pollution. This indicator obtained a fairly high average value of 87.8% in the experimental class and 82.6% in the control class which is included in the good category in both sample classes. However, there is a difference in the average value in the two classes. The experimental class obtained a higher score than the control class. This is due to the difference in treatment in the two classes.

Building basic skills is the second indicator of critical thinking skills. Students' success in being able to Observe and consider the results of observations that are appropriate and relevant to the problem topic through literacy activities. This indicator obtained an average value with a sufficient category of 25% for the control class and 36.1% for the experimental class. This shows that students have not been able to master building basic skills well.

The assessment of the inference indicator is observed through student activities in identifying information that is appropriate to be described in the test answers. Based on the average value obtained, students' skills on this indicator are included in the good category, with an average value of 87.8% in the control class and 95.8 in the experimental class. This shows that students are able to master inference skills well. The difference in treatment in the two classes is due to the two different class treatments.

Indicator Able to explain a situation/condition, states that the assessment of this indicator is observed through student activities applying previously obtained ideas. Students explain the effects and characteristics of an environmental pollution case. This indicator obtained an average score of 65.7% in the control class and 82.6% in the experimental class.

Assessment of the indicator of arranging Strategies and Techniques is observed through student activities in presenting previously processed information in narrative form, students provi-

de suggestions and input regarding prevention of environmental pollution (Facione, 2011). This indicator obtained an average score of 52.1% in the control class and 68.5% in the experimental class.

Based on the overall average score obtained for each indicator, the average score of the experimental class is higher than the average score of the control class. This shows that E-LKPD is more appropriate for use in learning activities to improve critical thinking skills.

Essay tests are used to measure students' critical thinking skills in the control class and experimental class. the method used is pretest and posttest with quiz features. The use of this method aims to determine the differences in students' critical thinking skills in two sample classes before and after learning using E-LKPD.

The results of the comparison of the completeness of critical thinking skills of students in the Control and Experimental Classes of E-LKPD based on Problem Based Learning on Environmental Pollution material at MAN 01 Jepara are shown in Figure 2.

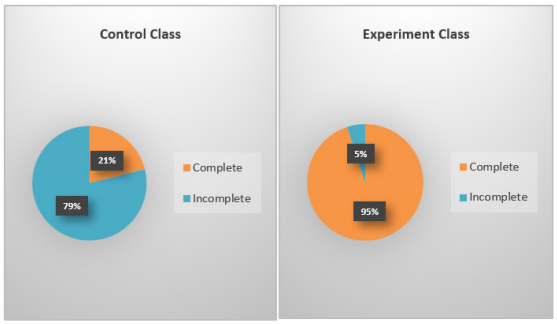

Figure 2. Comparison of Control and Experimental Class Completion on students' critical thinking skills

Based on Figure 2, it shows a comparison of completion between the control class and the experimental class. In the control class, 21% of students completed the test and 95% in the experimental class. The comparison shows a significant difference, because it has exceeded the minimum target of 70% of students successfully achieving the completion of learning outcomes. Based on the completion results, E-LKPD has been effectively implemented.

Based on the data processing that has been done, there is a significant difference in critical thinking ability between before and after being given treatment and there is a significant difference between the values obtained by the control class and the experimental class.

The N-Gain test was conducted to determine the increase in students' critical thinking ability in the control class and the experimental class. The n-gain category used in this study is the category created by (Hake, 1998). The results of the N-Gain calculation in the experimental class and the control class can be seen in Table 4.

Table 4. Result score N-Gain of critical thinking skills

Class	Pre-test	Post-test	N-gain	Category
Experiment	49,9	66,7	0,69	Medium
Control	45,8	85,1	0,37	Medium

Based on the results of the N-gain analysis, it is known that the N-gain value in the experimental class is much higher with an N-gain value of 0.698 with moderate criteria, while the N-gain value in the control class is 0.379 with moderate criteria. This shows that learning using e-LKPD based on PBL on environmental pollution material in the experimental class is better in improving critical thinking skills compared to conventional teaching materials used by teachers.

The effectiveness of PBL-based e-LKPD is confirmed by the results where most of the experimental class students were able to answer correctly on each indicator of critical thinking skills. Critical thinking skills are the abilities possessed by a person to solve problems appropriately. A person who has critical thinking skills will have a good impact on the surrounding environment. This impact can be seen from changes in a person's behavior when solving problems (Kraiter, 2017; Stellmacher et al., 2020).

The implementation of learning using PBL-based E-LKPD on environmental pollution material in this study went well. E-LKPD plays an important role as a means or container for student and teacher learning in this study. The function of E-LKPD here is as a container that will be explored by students. The image and video features make this E-LKPD feature interactive, E-LKPD is also easy to access anywhere and anytime. The use of PBL-based E-LKPD can stimulate students' critical thinking skills well.

This study has successfully shown that the use of E-LKPD is effective in improving students' critical thinking skills through syntax and teaching and learning activities in it so that the results show significant differences when compared to the control group and each critical thinking indicator can be achieved well so that the experimental class is in the category of critical thinking skills. This shows that students' critical thinking skills are increasing

Based on these findings, it can be seen

that the implementation of E-LKPD can help students understand a material. E-LKPD has a syntax that encourages discussion and question and answer activities that stimulate students to be able to think critically so that students also have a high curiosity, have the ability to argue and draw conclusions (Prihatni et al., 2023).

CONCLUSION

The implementation of the use of E-LKPD based on PBL on environmental pollution material is effective in improving students' critical thinking skills according to the indicators. The values and completeness obtained by students in the experimental class are higher compared to the control class with an average N-Gain value of the experimental class having a percentage of 0.69%, which is greater than the control class which is only 0.37%.

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