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The Effect of Project Based-Learning Model Assisted by ESD-Based Student Worksheets on Critical Thinking Skills

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ABSTRACT

Critical thinking is an essential skill in the 21st century, so that students are able to adapt and compete in the era of the global economic community, unfortunately students' critical thinking skills are still relatively low due to the lack of habituation activities in the learning process in the classroom. Therefore, this study aims to examine the influence of the Project Based Learning model assisted by LKPD based on Education for Sustainable Development on students' critical thinking skills in learning science science in grade 5 elementary school. The research method used was an experiment with a posttest-only control group design. The research sample consisted of 64 students from SDN Cipayung 04 Pagi consisting of 32 students in both control and experimental classes, and 64 students from SDN Cipayung 05 Pagi consisting of 32 students both in control and experimental classes selected using convenience sampling techniques. The data analysis in this study uses descriptive and inferential statistics, with the t-test as a tool to test the hypothesis. The results showed that the average score of the experimental group was 83.81, while the control group obtained an average score of 72.42. The hypothesis test showed a Sig. (2-tailed) value of 0.000, which was smaller than 0.05 (a=0.05), so that there was a significant difference in students' critical thinking skills between the experimental group and the control group. Based on these results, it can be concluded that the Project Based Learning model assisted by LKPD based on Education for Sustainable Development significantly affects the ability of students' critical thinking skills in learning science science in grade 5 of elementary school. The results of this study are expected to encourage teachers to integrate the Project Based Learning model and LKPD based on Education for Sustainable Development in learning to improve students' critical thinking skills.

Keywords: *critical thinking skills; project based learning; student worksheets based on ESD*

ABSTRAK

Berpikir kritis merupakan keterampilan esensial pada abad ke-21, agar peserta didik mampu beradaptasi dan bersaing di era masyarakat ekonomi global, sayangnya keterampilan berpikir kritis peserta didik masih tergolong rendah karena kurangnya kegiatan pembiasaan dalam proses pembelajaran di kelas. Maka dari itu, penelitian ini bertujuan untuk mengkaji pengaruh model Project Based Learning berbantuan LKPD berbasis Education for Sustainable Development terhadap

keterampilan berpikir kritis peserta didik pada pembelajaran IPAS di kelas 5 sekolah dasar. Metode penelitian yang digunakan adalah eksperimen dengan desain posttest-only control group. Sampel penelitian berjumlah 64 orang peserta didik dari SDN Cipayung 04 Pagi yang terdiri dari 32 orang peserta didik baik di kelas kontrol maupun eksperimen, dan 64 orang peserta didik dari SDN Cipayung 05 Pagi yang terdiri dari 32 orang peserta didik baik di kelas kontrol maupun eksperimen yang dipilih menggunakan teknik convenience sampling. Analisis data dalam penelitian ini menggunakan statistik deskriptif dan inferensial, dengan uji t sebagai alat untuk menguji hipotesis. Hasil penelitian menunjukkan bahwa skor rata-rata kelompok eksperimen adalah 83.81, sedangkan kelompok kontrol memperoleh rata-rata skor sebesar 72.42. Uji hipotesis menunjukkan nilai Sig. (2-tailed) sebesar 0,000, yang lebih kecil dari 0,05 (α=0,05), sehingga terdapat perbedaan signifikan dalam keterampilan berpikir kritis peserta didik antara kelompok eksperimen dan kelompok kontrol. Berdasarkan hasil tersebut, dapat disimpulkan bahwa model Project Based Learning berbantuan LKPD berbasis Education for Sustainable Development secara signifikan memengaruhi kemampuan keterampilan berpikir kritis peserta didik pada pembelajaran IPAS di kelas 5 sekolah dasar. Hasil penelitian ini diharapkan dapat mendorong guru untuk mengintegrasikan model Project Based Learning dan LKPD berbasis Education for Sustainable Development dalam pembelajaran untuk meningkatkan keterampilan berpikir kritis peserta didik.
Kata Kunci: keterampilan berpikir kritis; *project based learning*; LKPD berbasis ESD

INTRODUCTION

Critical thinking is an essential 21st century skill that is essential for education and the world of work and this skill needs to be taught early so that students are able to adapt and compete in the era of a global economic society (Cahyaningsih & Nahdi, 2020). The development of critical thinking skills in elementary school has significant implications in the formation of learners' mindsets and learning skills. Critical thinking helps students explore their potential to achieve personal, social, academic, and career actualization, and becomes an important skill at all levels of education (Kurniawan et al., 2020). In addition, critical thinking is also an important skill for understanding, analyzing, and evaluating information rationally, helping learners solve problems and make decisions in daily life (Triansyah et al., 2023). Therefore, critical thinking is an important skill to be taught from an early age to help students adapt and compete in the global era and support the formation of mindsets, development of self-potential, and rational decision-making in daily life.

Learning that leads to critical thinking skills is very important because it can help learners in thinking logically, handling problems effectively, and making rational decisions regarding the beliefs or actions they choose (Susilawati et al., 2020; Cynthia & Sihotang, 2023). Critical thinking is often described as a metacognitive process that involves several sub-skills of critical thinking such as analysis, evaluation, and inference (Dwyer et al., 2014). According to him, if the use of these sub-skills is used appropriately, it can increase the likelihood of reaching a logical conclusion to an argument or finding a solution to a problem. This can certainly help students develop the ability to formulate relevant questions, identify the assumptions underlying an argument, and draw conclusions based on strong evidence. Thus, critical thinking skills provide a solid foundation for learners in solving problems, making the right decisions, and facing challenges with more confidence.

However, the reality is that students' critical thinking skills are still relatively low, due to the lack of knowledge that affects their way of thinking, which tends to focus only on the aspect of remembering and understanding (Ariyani & Prasetyo, 2021). In addition, research

findings conducted by Sipahutar (2022) show that students' critical thinking skills in one of the elementary schools in Jakarta are still relatively low, especially as seen from students' participation in classroom discussions. This is also in line with the results of observations made by researchers at one of the public elementary schools located in East Jakarta, where the findings informed that the critical thinking skills of grade 5 students are relatively low. This can be seen from the results of the critical thinking test which shows that the average score of students is only 46, which is included in the low category. In addition, the researcher's observations show that the lack of habituation activities in the learning process in the classroom is one of the main factors in the low critical thinking skills of students. This skill requires continuous practice so that learners get used to thinking critically. Therefore, a learning process is needed that can support and facilitate students in improving their critical thinking skills.

The right learning model to facilitate students in critical thinking is to use *the Project Based Learning* (PjBL) model, because the PjBL model is an innovative learning model that encourages students to think creatively, critically, and interactively through the creation of products from projects carried out at the end of learning (Sulastri & Cahyani, 2021). The PjBL model can encourage creativity, questioning skills, independence, a sense of responsibility, confidence, and thinking skills (Winarti et al., 2022). This is strengthened from the results of research conducted by Astri et al. (2022) which results that the PjBL model has a positive influence on students' critical thinking skills, as this model provides opportunities for learners to build knowledge and develop their skills and help learners find solutions to problems in daily life. So, it can be concluded that the PjBL model is effective in improving students' critical thinking skills by encouraging creativity and interaction through the creation of products from projects.

The advantages of the PjBL model lie in its ability to increase students' creativity, strengthen critical thinking, and improve their problem-solving skills (Rehani & Mustofa, 2023). The PjBL model is closely related to the critical mindset of learners, as it includes the ability to apply, analyze, synthesize, and evaluate information as well as process the results of observation, experience, reflection, discussion, or communication. In more detail, the advantages of the PjBL model are as follows (Haerullah & Hasan, 2017; Prihatin, 2019) : (1) expanding students' mindset in solving problems in daily life, (2) applying knowledge, attitudes and skills in daily life, (3) improving problem solving skills from simple to more complex, (4) improving collaboration and communication skills through the project completion process, (5) training students' skills in managing resources in completing tasks, and (6) provide opportunities for learners to gather information, infer and implement it into the real world.

ESD is a type of education that involves all aspects and is transformational, including content and learning outcomes, pedagogy, and learning environment (UNESCO, 2017). In line with Leicht et al. (2018) which defines ESD as a form of education that allows each individual to acquire the knowledge, skills, attitudes, and values necessary to create a sustainable future. ESD plays an important role in equipping primary school students to face global challenges and support the achievement of sustainable development from an early age (Vioreza et al., 2023).

Project Based Learning (PjBL) and Education for Sustainable Development (ESD) support each other in creating meaningful learning. ESD plays a role in equipping elementary school students to face global challenges and support sustainable development from an early age. Meanwhile, PjBL, as an innovative learning model, encourages students to think creatively, critically, and interactively through projects that demand real problem-solving (Anwar et al., 2021). By integrating PjBL in ESD, students not only understand the concept of sustainable development, but also develop high-level thinking skills and awareness of environmental and social issues through applicable learning experiences.

To facilitate students in improving critical thinking skills, in addition to using the PjBL model, teaching materials are also needed that are able to help students develop these skills, especially in the form of Student Worksheets (Yuzan & Jahro, 2022). The Student Worksheet (LKPD) in question is an *Education for Sustainable Development* (ESD) based LKPD. ESD-based LKPD is a learning tool that is prepared by paying attention to the principles of sustainable learning designed to guide students in understanding learning concepts that emphasize sustainability, both in terms of environment, social, and economic. In the context of IPAS learning, ESD-based LKPD is very relevant because IPAS integrates natural and social sciences, which are in line with *the principles of Education for Sustainable Development* (ESD). The use of this LKPD can increase students' understanding of sustainability issues and develop critical thinking skills. The results of the research conducted by Ain & Gunansyah (2022) informing that the Sustainability-based LKPD developed has proven to be quite effective in improving students' critical thinking skills. This can be seen from the increase in average scores between *the pretest* and *posttest* which reflects students' skills in understanding problems related to *Sustainability* and also encourages students to be more aware of the importance of the environment, its function, and its preservation efforts in daily life.

Research on the influence of the ESD-based LKPD-assisted PjBL model on critical thinking skills has not been widely carried out by previous researchers, while several previous studies on the influence of the PjBL model on critical thinking skills have been carried out a lot, namely research conducted by Agustin & Fanani (2024) which examined the influence of the STEM-based PjBL model assisted by PhET media on critical thinking skills in science learning the results of his research showed a positive influence on the critical thinking skills of students in learning science on the topic of electrical energy, especially simple electrical circuit material, in grade V of SDN in the Surabaya area in the 2023/2024 school year. Furthermore, the research conducted by Alni et al. (2024) It was found that there is a significant influence of the PjBL model on the critical thinking ability of social studies students in class V at SDN 31 Ampenan.

Departing from the research that has been done before, the difference between the research that has been done before and the research that will be conducted lies in the use of the PjBL model supported by ESD-based LKPD which is used to help students improve critical thinking skills. In addition, this ESD-based LKPD raises the theme "Bumiku Sayang, Bumiku Malang" in IPAS learning which is filled with several topics that are local and global issues that must be solved together and sustainably. So, research on the influence of the PjBL model on the critical thinking skills of elementary school students has indeed been carried out. However, there has been no research on the influence of the ESD-based LKPD-assisted PjBL model on social studies learning in elementary schools, so this is the novelty of this study. Therefore, the

researcher felt the need to conduct further research on the influence of the ESD-based LKPD-assisted PjBL model on critical thinking skills in elementary schools. Based on this background, this study aims to examine the influence of the *LKPD-assisted* Project Based Learning model based *on Education for Sustainable Development* (ESD) on students' critical thinking skills in social studies learning in grade 5 of elementary school.

METHODS

Type and Design

This study uses an experimental method with a quantitative approach designed to determine the cause-effect relationship clearly and definitively between causal factors and problems (Maulidiyah et al., 2022). The research design used is *Posttest-Only Control Design*. This study did not use *pretests* to avoid repeating the same questions. This design flaw was overcome by testing the group's equivalence before the experiment, ensuring that the difference in posttest results was caused by the stimulus. This study used a design with two randomly selected groups, namely the experimental group that received the treatment and the control group that was not given the previous treatment. The two groups were then given *a posttest* to see if there was a significant difference between the two. The experimental group used the ESD-based LKPD-assisted PjBL model, while the control group used the conventional LKPD-assisted PjBL model. The ESD-based LKPD-assisted PjBL model acts as an independent variable that provides influence, while the bound variable is the critical thinking skills of students. The following research design can be seen in the table below.

Table 1. Research Design *Posttest-Only Control Design*

Experimental Group	R	X	O_1
Control Group	R	-	O_2

Description :

R : Random picking

X : Treatment of ESD-based LKPD-assisted PjBL model

O_1 : The final test given to the experimental class in the form of *a posttest*

O_2 : The final test given to the control class in the form of *a posttest*

Data and Data Sources

This research was conducted at SDN Cipayung 04 Pagi and SDN Cipayung 05 Pagi, Cipayung District, East Jakarta City with the research population consisting of all 5th grade elementary school students in Cipayung District, East Jakarta City. This study uses several populations that are considered to be representative of the entire population as a sample. Sample selection was carried out using the Convenience Sampling technique, as the researcher selected participants based on their availability and willingness to study (Creswell, 2015). Based on this technique, the research sample was determined on grade 5 students at SDN Cipayung 04 Pagi and SDN Cipayung 05 Pagi, each consisting of two classes, namely an experimental class with a total of 32 students and a control class with a total of 32 students so that a total of 128 students. The reason why the researcher chose grade 5 students is that grade 5 students already have a higher level of understanding than the class below, this is in line

with Piaget's theory of cognitive development, grade V elementary school students are at a concrete operational stage, where children begin to think logically and organized.

The data collected in this study is the data on the results of the students' critical thinking skills test in the form of description questions in the science and science subjects totaling 10 items. The preparation of test instruments to measure critical thinking skills is based on the indicators that have been formulated by the researcher contained in the following table:

Table 2. Critical Thinking Skills Indicators

Aspects of Critical Thinking Skills	Critical Thinking Skills Indicators
Interpretation	Understand or explain information clearly and accurately.
Analysis	Detect facts and strategies to use to solve problems.
Evaluation	Providing assessments and providing appropriate solutions to problems.
Inference	Draw conclusions based on information appropriately.

Data collection technique

This study uses a type of instrument in the form of a series of written questions in the form of tests given to respondents to measure students' critical thinking skills. This test instrument was designed by the researcher and was used to assess the critical thinking skills of students after being given treatment.

Data analysis

The data analysis in this study was carried out through several systematic stages. First, the instrument validity test includes the validity of the content and the validity of the construct. The validity of the content is evaluated by experts in the relevant field without using statistical analysis. Meanwhile, the validity of the construct is assessed by experts and can be strengthened through field trials to ensure the extent to which the question item can accurately measure the concept or construct in question according to the conceptual definition. Before use, the instrument is tested by experts, then tested on a predetermined sample. The data from the instrument test results were analyzed using the validity of Pearson Product Moment and the reliability of Cronbach Alpha. The test results showed that all question items were declared valid and reliable.

The data analysis in this study uses descriptive and inferential statistics, with the t-test as a tool to test the hypothesis. Before hypothesis testing is carried out, a classical assumption test is carried out to ensure that the data meets the requirements of statistical analysis. Classical assumption tests include normality tests, which aim to check whether the data is normally distributed, and homogeneity tests, which ensure that the variance between data groups is homogeneous. This stage is very important because the t-test requires data that is normally distributed and has variance homogeneity so that the analysis results are valid and reliable. Thus, classical assumption testing ensures that statistical analysis is performed precisely and provides accurate results.

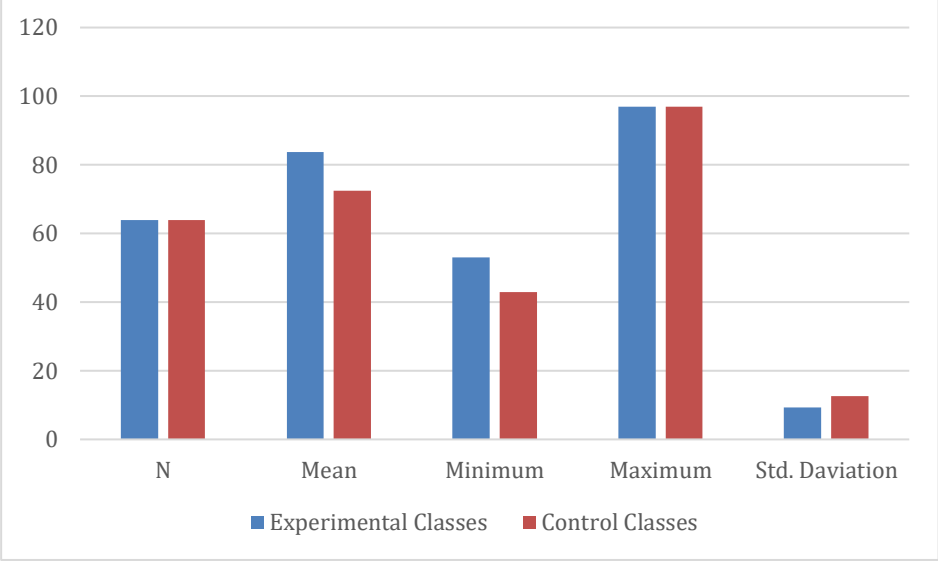
RESULTS AND DISCUSSION

The research conducted in both schools, namely SDN Cipayung 04 Pagi and SDN Cipayung 05 Pagi in the East Jakarta City area, involved the provision of *a posttest* at the end of the meeting. The test used was in the form of 10 questions or essays, which were given to the control class (Class 5A SDN Cipayung 04 AM and SDN Cipayung 05 AM) and the experimental class (Class 5B SDN Cipayung 04 AM and SDN Cipayung 05 AM). The assessment was carried out based on the critical thinking skills indicator, and the data analysis was carried out with the help of SPSS software. The results of the data obtained included statistical data of descriptive analysis, inferential analysis data (normality test and homogeneity test), and hypothesis test (t test).

The results of the descriptive analysis are used to describe and summarize the data clearly (Salim et al., 2024). The goal is to provide a comprehensive picture of students' critical thinking skills without drawing in-depth conclusions or generalizations. The posttest result data, which includes the average score, standard deviation, maximum score, and minimum score of the learner's critical thinking skills, is presented in the following table.

Table 3. Results of Descriptive Analysis

Statistics	Experimental Classes	Control Classes
N	64	64
Mean	83.81	72.42
Minimum	53	43
Maximum	97	97
Std. Deviation	9.314	12.533



Picture 1. Descriptive Analysis Results Graph

Based on Table 3 and Figure 1, the total population of the two classes studied is 64 students. The minimum score in the control class was recorded at 43, while in the experimental class it was 53. The maximum score in the control class reached a score of 97, which was similar to the maximum score in the experimental class which reached a score of 97. The average score of the experimental class using the ESD-based LKPD-assisted PjBL model was 83.81, higher

than the average of the control class using the conventional LKPD-assisted PjBL model, which was 72.42. This shows that the experimental class has better results than the control class.

Based on Table 3 and Figure 1, it shows the distribution of the scores of the two classes studied with a total population of 64 students. From the data, there was a significant difference between the experimental class and the control class in terms of learning outcomes. The minimum value in the control class was 43, lower than the experimental class which had a minimum value of 53. This indicates that students in the experimental class have a better understanding overall, even at their lowest achievements. The maximum score in both classes was the same, at 97, which indicates that both the experimental class and the control class had students with the highest equivalent academic achievement. However, what makes the difference is the overall distribution of value.

The average score in the experimental class, which applied ESD-based LKPD-assisted PjBL, reached 83.81, higher than the control class that used conventional LKPD-assisted PjBL, with an average of 72.42. This difference is 11.39 points, which is significant enough to show that the integration of ESD-based LKPD in the PjBL model is able to improve students' understanding and skills better than conventional methods. Thus, these results confirm that a project-based learning approach that adopts the principles of Education for Sustainable Development (ESD) can increase learning effectiveness, especially in supporting the development of critical thinking skills and deeper understanding of concepts.

Before conducting a hypothesis test, the first step taken by the researcher is an assumption test or an analysis prerequisite test. This test includes a data normality test and a variance homogeneity test, which aims to ensure that the data to be analyzed has a homogeneous normal distribution and variance. The normality test was carried out using the Kolmogorov-Smirnov method by paying attention to the significance values obtained. If the significance value is greater than alpha ($\alpha = 0.05$), the data is considered to be normally distributed. Conversely, if the significance value is less than $\alpha = 0.05$, the data distribution is considered abnormal. The results of the normality test for the experimental group and the control group are presented in Table 4 below.

Table 4. Normality Test Results

Statistics		Kolmogorov-Smirnov			Shapiro-Wilk		
		Statistics	**Df**	**Sig.**	**Statistics**	**df**	**Sig.**
Critical Thinking Skills	Experimental Classes	0.237	17	0.12	0.895	17	0.056
	Control Classes	0.189	17	0.107	0.917	17	0.131

In Table 4 above, significance values (Sig.) are obtained for experimental classes and control classes greater than 0.05. The experimental class had a significance value of 0.12 > 0.05, while the control class had a significance value of 0.107 > 0.05. This shows that the data from both classes are normally distributed. After the normality test is met, the next step is to perform a variance homogeneity test to determine whether the variance of the two groups is homogeneous. The significance level used is $\alpha = 0.05$. If the significance value of the variance homogeneity test is greater than 0.05, then the variance of the data is considered homogeneous. Conversely, if the significance value is less than 0.05, then the data is declared inhomogeneous.

Information regarding the results of the variance homogeneity test will be described in more detail in Table 5.

Table 5. Homogeneity Test Results

Statistics		Levene Statistic	df1	df2	Sig.
Critical Thinking Skills	Based on Mean	1.585	3	124	0.196
	Based on Median	1.593	3	124	0.195
	Based on Median and with adjusted df	1.593	3	122.429	0.195
	Based on trimmed mean	1.600	3	124	0.193

Based on the data in Table 5, the significance value (Sig.) in the "Based on Mean" column was recorded at 0.196, which is greater than the alpha value (α) of 0.05. This shows that the data meet the homogeneity of variance assumptions. After the two prerequisite tests, namely the normality test and the variance homogeneity test, the next step is to conduct a hypothesis test using a t-test. This test is performed with the help of SPSS statistical software as presented in the following Table 6.

Table 6. T-test Results

Statistics Parameters		T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
							Lower	Upper
Critical Thinking Skills	Equal variances assumed	1.093	41	0.000	3.398	3.110	-2.882	9.678
	Equal variances not assumed	1.12	36.279	0.000	3.398	3.057	-2.801	9.597

Based on Table 6 above, the results of the t-test show that the decision is taken if the value of sig. (2-tailed) is smaller than alpha (α = 0.05), then H_0 is rejected and H_1 is accepted. Independent sample tests were conducted to test the hypothesis and determine the average difference between the experimental class using the ESD-based LKPD-assisted PjBL model and the control class using the conventional LKPD-assisted PjBL model. The results of the analysis showed a significance value of 0.000 < 0.05, which means that there was a significant average difference in critical thinking skills between students in the experimental class and the control class.

The results showed that the critical thinking skills of students who learned social studies by applying the Education *for Sustainable Development (ESD-based)* LKPD-assisted Project Based Learning (PjBL) *model* were higher than those of students who used the

conventional LKPD-assisted PjBL model. This is supported by the results of previous research, which states that the integration of ESD in the PjBL model is able to improve students' critical thinking skills more effectively compared to the conventional learning model or PjBL without ESD integration (Dayanti et al., 2022; Kholid et al., 2020; Straková & Cimermanová, 2018). This is because the application of the ESD-based LKPD-assisted PjBL model in the experimental classroom presents contextual problems that are relevant to the real world, so that it can help students learn authentically when facing representations of daily life problems, especially in the context of sustainability (ÖZTÜRK et al., 2019). Experiences that are directly related to the real world help learners develop their thinking skills, especially in critical thinking skills (Khoirunnisa & Malasari, 2021).

The critical thinking process in sustainability learning can be a means for students to understand the environment, recognize things that support or dissupport sustainability, and are environmentally friendly or vice versa. This process encourages students' awareness of the environment that influences their knowledge, skills, and attitudes in decision-making (Hasslöf & Malmberg, 2015; (Ekamilasari et al., 2021). Therefore, through the use of ESD-based LKPD in science learning, it is hoped that students will be able to internalize and apply the concept of sustainability, so that real actions emerge to realize sustainable life on earth. With this habituation, the awareness of the Indonesian people towards sustainability is also expected to increase, thus contributing to joint efforts to solve global issues for survival.

The use of ESD-based LKPD helps students consider sustainability aspects in solving the problems they face. The LKPD is specifically designed to increase understanding and awareness of sustainability issues, such as environmental conservation, social responsibility, and economic sustainability. With a focus on sustainability, students are invited to look at problems from a broader and more complex perspective, thus encouraging them to think critically as they need to consider various interconnected factors in the problem-solving process (Taimur & Sattar, 2020). This approach corresponds to the view UNESCO (2017) that ESD is able to train critical thinking skills. This is also supported by the results of research which show that ESD-based LKPD products have proven to be quite effective in training and developing students' critical thinking skills. This can be seen from the analysis of statistical tests and graphs that show that the average student score increases after using the ESD-based LKPD (Ain & Gunansyah, 2022). The use of LKPD also has a positive impact on students' learning activities, both independently and in groups, such as conducting experiments, completing exercises, and compiling ideas independently (Rifzal et al., 2015; Astuti et al., 2016).

On the other hand, the PjBL model that uses conventional LKPD tends to override the sustainability aspect in the problem-solving process. This model focuses more on achieving academic outcomes and technical skills without considering social, environmental, and economic impacts. In addition, the limitations of conventional LKPD are that there are still teaching materials with the quality of questions that are still in-depth and are not able to provide broader insight and knowledge to students (Faiqoh et al., 2019). This can certainly limit students' ability to think critically and reduce their awareness of sustainability issues. In fact, the implementation of education needs to be complemented by ESD integration to equip students with knowledge, skills, and attitudes that support responsible action taking environmental, economic, and social aspects (Purnamasari & Hanifah, 2021; Vioreza et al.,

2023). The integration of ESD in learning enriches the learning experience by encouraging learners to evaluate problems holistically and consider long-term impacts, thereby improving their critical thinking skills. Based on this, the PjBL model supported by ESD-based LKPD has various benefits, especially in improving critical thinking skills in science subjects.

Although the results of this study show the advantages of implementing ESD-based LKPD-assisted PjBL, there are several limitations that need to be considered. First, there is the possibility of sampling bias, as the study was conducted in only two classrooms in one particular school setting, so the results may not be fully representative of the broader population. Second, the limited duration of the experiment can affect the effectiveness of the implementation of the learning model, where the long-term impact cannot be optimally measured. Third, external factors such as differences in student motivation, support from teachers, and learning environment conditions also have the potential to affect research results. Therefore, follow-up research with a wider scope and longer duration of experiments is needed to ensure the validity and generalization of these findings.

CONCLUSION

Based on the results of the study, it can be concluded that 1) The results of the study show a significant difference in students' critical thinking skills in science learning between the experimental class using the ESD-based LKPD-assisted PjBL model and the control class using the conventional LKPD-assisted PjBL model. 2) The ESD-based LKPD-assisted PjBL model has a significant influence on improving the critical thinking skills of grade 5 elementary school students. Therefore, teachers can use the ESD-based LKPD-assisted PjBL model which can improve students' critical thinking skills in science learning.

Practically, teachers are advised to adapt the ESD-based PjBL model by adjusting the learning materials and characteristics of students to be more effective. The development of ESD-based LKPD needs to be carried out systematically by paying attention to environmental, social, and economic aspects so that it is more contextual in supporting critical thinking skills. In addition, training or workshops for teachers on the implementation of ESD-based PjBL can help improve understanding and skills in implementing this model in the classroom.

Further research can be carried out by expanding the scope of the sample so that the research findings can be more generalized. In addition, other factors such as learning motivation, parental involvement, and the school environment can also be further researched to understand more comprehensively how these models affect students' critical thinking skills..

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