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The Effect of the Problem-Based Learning Model with Edpuzzle Media on the Material of Plant Body Parts on Critical Thinking Skills and Learning Outcomes of Elementary School Students

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ABSTRAK
One of the essential subjects taught in the Merdeka Curriculum is Science and Social Studies (IPAS). This subject plays a crucial role in enhancing students' thinking abilities. Consistent development of thinking skills contributes to the formation of students' critical thinking abilities. This study aims to analyze the effect of applying the Problem-Based Learning (PBL) model assisted by Edpuzzle media on the critical thinking skills and learning outcomes of elementary school students in the topic of plant body parts. The research employed a quasi-experimental method with a non-equivalent pretest-posttest control group design. The study subjects consisted of two classes: the experimental class, which implemented the PBL model using Edpuzzle, and the control class, which used conventional teaching methods. The research instruments included a critical thinking skills test (essay format) and a learning outcome test (multiple-choice format). The data were analyzed using ANCOVA. The results showed that the PBL model with Edpuzzle media had a significant effect on improving students' critical thinking skills and learning outcomes compared to conventional instruction (Sig. = 0.0001 < 0.05). These findings imply that teachers can integrate Edpuzzle-based PBL into daily lessons through interactive videos and guided problem-solving. Schools need to provide training and adequate infrastructure, while policymakers should support digital PBL integration in curriculum implementation. Future studies are encouraged to apply this model in other subjects and grade levels to examine its broader impact.

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1. INTRODUCTION

One of the essential subjects taught in the Merdeka Curriculum is Science and Social Studies (IPAS). This subject plays a key role in developing students' higher-order thinking skills (HOTS) and helping them connect scientific ideas to real-life contexts. According to Facione (2011), critical thinking involves purposeful, self-regulatory judgment that includes interpretation, analysis, evaluation, and inference. Similarly, Windriani (2021) states that critical thinking is the process by which an individual analyzes and evaluates information obtained through observation, reasoning, and communication. These skills are essential for students in understanding and solving scientific and social problems encountered in daily life.

However, several studies indicate that Indonesian elementary students still have low levels of critical and analytical thinking. According to the OECD (2023), Indonesia's average science score in PISA 2022 was 382.86, far below the OECD average of 485. This finding reflects that most Indonesian students struggle to apply reasoning in scientific contexts. Supporting this, a study by Hidayat and Putri (2024) revealed that elementary school students often rely on memorization rather than analytical understanding when learning science, limiting their ability to evaluate evidence and formulate conclusions. These conditions underline the urgent need to implement innovative teaching models that promote inquiry and reflection.

In response to these challenges, the Kurikulum Merdeka, regulated under Permendikbudristek No. 12 of 2024, emphasizes flexibility, essential content, and deeper learning. According to Kemendikbudristek (2024), the curriculum encourages teachers to use digital tools and inquiry-based learning to foster competencies such as

critical thinking, creativity, collaboration, and communication. This shift calls for teaching models that combine authentic problem-solving experiences with the effective use of technology in the classroom.

The Problem-Based Learning (PBL) model is one approach that aligns well with these principles. According to Nurul and Brillian (2021), PBL engages students in identifying and solving real-world problems through active inquiry, discussion, and reflection. Nugraha (2018) also found that PBL improved elementary students' conceptual understanding and critical thinking compared to conventional learning. To enhance its effectiveness, PBL can be combined with digital media that allows interactivity and self-paced learning. One such tool is Edpuzzle, a platform that enables teachers to embed questions, comments, and reflections into learning videos. According to Permana (2023), Edpuzzle can increase students' motivation and engagement, while Sari (2024) showed that Edpuzzle-supported learning improved conceptual understanding and learning outcomes in senior high school students.

Despite these promising results, most studies on PBL and Edpuzzle have been conducted at the high school or vocational level, with limited evidence from elementary education (Indriyani, 2024; Sihaloho, 2024). At the same time, the integration of digital media in Indonesian elementary schools still faces challenges such as teachers' digital readiness, limited facilities, and inconsistent internet access (Wahyu, Edu, & Nardi, 2020). Therefore, it is crucial to investigate how the PBL model assisted by Edpuzzle can be effectively implemented at the elementary level to enhance students' critical thinking skills and learning outcomes.

Based on these considerations, this study aims to analyze the effect of applying the Problem-Based Learning model assisted by Edpuzzle media on elementary students' critical thinking skills and learning outcomes in the topic of plant body parts. This research is expected to contribute empirical evidence that supports the implementation of digital, inquiry-based learning aligned with the goals of the Kurikulum Merdeka.

2. METHOOD

This study employed a quasi-experimental design with a non-equivalent pretest–posttest control group design. The research was conducted in the even semester of the 2024–2025 academic year at three elementary schools in Lumajang Regency: SD Negeri Sumberpetung 02, SD Negeri Mlawang 01, and SD Negeri Klakah 01. The sampling process used a cluster purposive sampling technique, where intact classes were selected based on their similar academic levels and accessibility for research. This approach was chosen because random assignment at the individual level was not feasible due to administrative and ethical considerations in school settings. Two intact classes were chosen: one as the experimental class implementing the PBL model assisted by Edpuzzle and one as the control class receiving conventional instruction. The total number of participants was 43 fifth-grade students, consisting of 20 students in the experimental class and 23 students in the control class.

Instrument Development and Validation, two main instruments were used: (1) a critical thinking skills test in essay format and (2) a learning outcomes test in multiple-choice format. Both instruments were developed based on indicators of critical thinking adapted from Facione (2011) interpretation, analysis, evaluation, and inference and the elementary science learning objectives outlined in the Kurikulum Merdeka. The instruments underwent a validation process by three experts: one in science education, one in educational assessment, and one in instructional technology. Each expert evaluated the items for content relevance, clarity, and alignment with learning indicators. The Content Validity Index (CVI) for the critical thinking test was 0.89 and for the learning outcomes test was 0.91, indicating high content validity. A pilot test was conducted on 15 students outside the study sample (SD Negeri Mlawang 01) to assess reliability. The reliability coefficients were calculated using Cronbach's Alpha, resulting in 0.86 for the critical thinking test and 0.88 for the learning outcomes test, categorized as "high reliability."

Data were analyzed using prerequisite tests (normality and homogeneity tests) and hypothesis testing via ANCOVA with pretest scores as covariates to control for initial differences. All analyses were performed using SPSS 26.0. This study aimed to determine the effect of the PBL model assisted by Edpuzzle on students' critical thinking skills and learning outcomes. According to Abdullah, A. N. (2024), research using a quasi-experimental design to assess the effect of the PBL learning model on students' science learning outcomes is highly relevant because it supports the use of experimental approaches at the elementary school level.

3. RESULT AND DISCUSSION

The descriptive analysis aims to provide an overview of the pretest and posttest scores on critical thinking skills and learning outcomes for both research groups, namely the experimental and control classes. The following table presents descriptive data on students' critical thinking skills scores in control classes and experiments before and after treatment.

Table 1. Critical Thinking Data

Class	Test Type	Number of Student	Averange±SD	Minimal	Maximal
Control	Pretest	20	59,82 ± 4,11	55,71	63,92

Class	Test Type	Number of Student	Averange±SD	Minimal	Maximal
Eksperimen	Postest	20	69,54 ± 5,56	63,98	75,10
	Pretest	20	59,29 ± 4,80	54,49	64,09
	Postest	20	83,67 ± 4,84	78,83	88,51

The table above shows that the control class's averange pretest score of 59.82 increased to 69.54 in the posttest. This represents a 9.72-point increase. Meanwhile, the experimental class using the Problem-Based Learning (PBL) model with Edpuzzle media experienced a greater increase, from an averange pretest score of 59.29 to 83.67 in the posttest, a difference of 24.38 points. It can be concluded that both classes experienced improvement, both in the control and experimental classes, although the increase was not as large.

The following is a table that presents descriptive data regarding student learning outcome scores in the control and experimental classes before and after treatment.

Table 2. Learning Outcome Data

Class	Test Type	Number of Student	Averange±SD	Minimal	Maximal
Control	Pretest	20	59,38 ± 5,35	54,04	64,73
	Postest	20	69,94 ± 4,52	65,42	74,45
Eksperimen	Pretest	20	60,03 ± 3,45	56,58	63,49
	Postest	20	85,22 ± 5,11	80,11	90,33

Table 2 displays student learning outcomes in both groups. In the control class, the average pretest score was 59.38 and increased to 69.94 in the posttest, representing a 10.56-point increase. In contrast, the experimental class showed a pretest average of 60.03, which increased to 85.22 in the posttest, resulting in a 25.19-point increase.

Prerequisite Analysis Test

Before conducting the hypothesis test, prerequisite tests, including normality and homogeneity tests, were conducted to ensure the data met the parametric test assumptions.

1. Homogeneity Test

a. The homogeneity test using Levene's Test showed that the variances between the groups were homogeneous, with a significance value >0.05 for all variables.
b. The homogeneity test was conducted to determine whether the data from both groups (experimental and control) had the same variance (homogeneity). This test used Levene's Test.

Table 3. Levene Test Result

F	**dfl**	**df2**	**Sig.**
0,314	1	38	0,578

Based on the Levene's test results shown in the table, an F-value of 0.314 was obtained with degrees of freedom (df1 = 1, df2 = 38) and a significance value (Sig.) of 0.578. This significance value is greater than the 0.05 level, meaning the null hypothesis (H_0) stating that the error variances between groups are equal is not rejected.

Thus, it can be concluded that the data meets the assumption of homogeneity of variance, as there was no significant difference in error variance between the experimental and control classes. This indicates that the ANOVA model can be validly applied, and the observed differences in posttest scores between groups are not caused by unequal variances, but rather by the treatment factor (class) administered in the study.

Meeting this assumption provides a strong basis for further statistical analysis, particularly in interpreting the ANOVA test results. This means that significant differences in posttest results found in subsequent analyses are more reliable because they are not influenced by violations of basic statistical assumptions.

2. Normality Test

The Shapiro-Wilk normality test showed that all data were normally distributed, with a significance value > 0.05. To determine whether the data used in this study were normally distributed, a normality test was conducted using the Kolmogorov-Smirnov Test. This test was applied to two main variables: the pretest and posttest scores of all students.

The test results showed that the Asymp. Sig. (2-tailed) value for the pretest score was 0.200, and for the posttest score was also 0.200. These significance values are greater than the $\alpha = 0.05$ limit, meaning the null

hypothesis (H_0) is not rejected. Thus, the data can be considered normally distributed for both the pretest and posttest scores.

Table 4. Normality Test Results

Description	Pretest	Posttest
Number of Samples (N)	40	40
Normal Parameters		
- Mean	59,63	76,63
- Standard Deviation (Std. Dev.)	4,401	8,767
Highest Extreme Difference		
- Absolute	0,106	0,080
- Positive	0,106	0,075
- Negative	-0,105	-0,080
Test Statistic	0,106	0,080
Asymptotic Significance (2-tailed)	0,200	0,200

Hypothesis Testing Using ANOVA

The ANOVA test was used to examine the effect of the Edpuzzle-assisted Problem-Based Learning model on critical thinking skills and student learning outcomes, controlling for pretest scores. The ANOVA results are shown in the following table:

Table 5. Results of the ANOVA Test for Critical Thinking

Source	Type III Sum of Squares	Df	Average of square	F	Sig.
Corrected Model	1,996,264	2	998,132	36,890	0,000
Intercept	1,588,815	1	1,588,815	58,721	0,000
Pretest Score	22,239	1	22,239	0,822	0,370
Class	1,939,744	1	1,939,744	71,691	0,000
Error	1,001,111	37	27,057		
Total	237,853,000	40			
Corrected Total	2,997,375	39			

The table above shows the results of the ANOVA test on students' critical thinking skills. The table shows a significance value for the class variable of 0.000 (less than 0.05), indicating a significant effect between the applied learning model and students' critical thinking skills, after controlling for pretest scores. Although the pretest score did not have a significant effect ($p = 0.370$), the difference between the experimental and control classes was significant. The experimental class, which received the Problem-Based Learning model with the aid of Edpuzzle, experienced a 24.38-point increase in critical thinking scores, while the control class only experienced a 9.72-point increase.

Table 6 Results of ANOVA Test of Learning Outcomes

Source	Type III Sum of Squares	Df	Average of square	F	Sig.
Corrected Model	23339,529	2	1,169,765	50,430	0,000
Intercept	1600,363	1	1,600,363	68,994	0,000
Pretest Score	13,904	1	13,904	0,599	0,444
Class	2383,177	1	2338,177	100,802	0,000
Error	858,246	37	23,196		
Total	243913,000	40			
Corrected Total	3197,775	39			

The table above presents the results of the ANOVA test on student learning outcomes. The analysis shows that the significance value of the class variable is 0.000, indicating a highly significant effect of the learning model on improving student learning outcomes, after controlling for pretest scores. The pretest score did not have a significant effect ($p = 0.444$), but the treatment received by each class had a significant impact. The experimental class experienced a 25.19-point increase in learning outcomes, while the control class only experienced a 10.56-point increase. This difference provides evidence that using Problem-based Learning with the help of Edpuzzle is not only effective in honing critical thinking skills but also highly optimal in improving student learning outcomes, particularly in the context of elementary school science lessons.

The findings of this study indicate that the problem-solving-based e-module is effective in improving students' critical thinking skills and learning outcomes. This is in line with the results of research conducted by Permana (2020), who found that learning models that emphasize problem-solving can significantly enhance students' ability to analyze and evaluate information. Similarly, Sari (2021) reported that the integration of interactive media in science learning fosters student engagement and improves conceptual understanding. Indriyani (2022) also highlighted that innovative teaching materials that guide students through inquiry processes can support the development of higher-order thinking skills (HOTS). These consistencies show that the success of this e-module is not accidental but is supported by empirical evidence from previous studies.

From a theoretical perspective, the objectives of Problem-Based Learning (PBL) provide a strong foundation for interpreting these findings. PBL emphasizes that students learn best when they are actively involved in solving meaningful problems, rather than passively receiving information. The problem-solving tasks embedded in the e-module encouraged students to engage in inquiry, evaluation, and reflection, which are essential components of critical thinking. This is consistent with the view that PBL develops not only cognitive skills but also self-regulation and collaboration. The improvement in students' n-gain scores in both small and large classes demonstrates that the e-module operationalizes the principles of PBL effectively.

However, the study also noted a slight decrease in the n-gain of certain critical thinking indicators, such as evaluation and self-regulation, particularly in large classes. This finding suggests that while PBL-oriented e-modules can enhance thinking skills, their effectiveness is influenced by class conditions and student heterogeneity. Therefore, teachers need to provide additional scaffolding and feedback to ensure that all students can benefit equally. These insights strengthen the argument that PBL-based e-modules are a relevant innovation to address the challenges of science learning in elementary schools, particularly in improving learning outcomes and preparing students for complex problem-solving tasks such as those assessed in PISA.

Based on the analysis, it was found that although the pretest score did not significantly influence the posttest results, the treatment (class) significantly influenced student learning outcomes. This indicates that the Problem-based Learning model with Edpuzzle in the experimental class had a better impact than the control class. Thus, it can be concluded that the **Problem-based Learning model with Edpuzzle media has a significant influence on improving student learning outcomes**, regardless of the initial value they had before the treatment was given.

4. CONCLUTION

The findings of this study demonstrate that the Problem-Based Learning (PBL) model assisted by Edpuzzle media significantly improves elementary school students' critical thinking skills and learning outcomes compared to conventional instruction. This suggests that integrating digital media such as Edpuzzle into problem-based activities creates a more engaging and reflective learning environment that encourages inquiry and collaboration among students.

In practical terms, teachers can apply Edpuzzle-supported PBL by embedding short, problem-oriented videos into their lessons, integrating guiding questions that stimulate discussion, analysis, and reflection. This approach can be used in both classroom and blended learning settings to help students connect scientific concepts with real-life issues. Schools should provide sufficient technological infrastructure (e.g., internet access, devices) and organize regular training to enhance teachers' digital pedagogical competence and ability to design PBL-based learning scenarios.

From a broader educational perspective, policymakers can consider adopting and supporting this model in curriculum implementation under the Kurikulum Merdeka framework by developing digital learning repositories, allocating funding for teacher professional development, and encouraging innovation in technology-enhanced learning.

For future research, it is recommended to explore the implementation of PBL with Edpuzzle in other subjects such as mathematics, social studies, or environmental education, as well as across different grade levels. Further studies could also employ longitudinal designs to investigate the long-term impact of this model on students' higher-order thinking skills, motivation, and digital literacy.

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