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# Educaplay Integration in Post-Disaster Adaptive Learning to Improve Elementary Students' Critical Thinking Skills

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**Abstract**
This study aims to examine the effect of integrating Educaplay as a digital learning medium with the deep learning approach on elementary school students' critical thinking skills in the context of post-flood learning. The study employed a quantitative approach with a non-equivalent control group quasi-experimental design. The study was conducted at MIN 2 in Langsa City, involving 64 fifth-grade students, comprising 32 students in the experimental group and 32 students in the control group. Data were collected through critical thinking skill tests in the form of pre-tests and post-tests. Data analysis was performed using Analysis of Covariance (ANCOVA) with pre-test scores as a covariate. The results showed that after controlling for pre-test scores, there was a significant difference in post-test scores between the experimental and control groups, with $F(1, 61) = 278.139$ and $p < 0.001$. The analytical model explained 87.8% of the variation in post-test scores, with an $R^2$ value of 0.878 and an Adjusted $R^2$ of 0.874. These findings indicate that, under the conditions of this study, students who participated in learning that integrated Educaplay and the deep learning approach achieved higher critical thinking skill scores compared to the control group. These results suggest that the integration of interactive digital media and deep learning has the potential to support IPAS learning in the context of post-flood recovery, although the interpretation must take into account the quasi-experimental design, the use of a single class in each condition, the short duration of the intervention, and the limitations of the study location.

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## Introduction

The phenomenon of flooding in recent years can no longer be viewed merely as a natural cycle; rather, it has evolved into a complex environmental crisis resulting from the declining ability of ecosystems to respond to extreme rainfall (Nufutomo, 2022; Pratama et al., 2022; Sasti & Putra, 2025). One event that illustrates the magnitude of this disaster's impact was the flash flood that struck the Sumatra region on November 25, 2025. This disaster affected 17 villages across five subdistricts, with a total of 2,376 people directly impacted (Chairul, 2025). The impact of this disaster was not limited to ecological aspects but also extended to the education sector (BNPB, 2025). Damage to school facilities forced students to study in makeshift classrooms with all their limitations. Efforts to catch up on the curriculum amid these difficult conditions have become a major challenge that indirectly hinders students' cognitive development (Dahlia & Fadiarman, 2020). These conditions indicate that post-disaster situations can pose challenges to the learning process and have the potential to affect the development of students' thinking skills, particularly in understanding the relationship between human activities and the occurrence of environmental disasters.


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Therefore, adaptive and contextual learning is needed to continue supporting the development of students' critical thinking skills in post-disaster conditions.

In this context, critical thinking skills are among the essential competencies that must be developed in elementary school students. Watson and Glaser (as cited in Fatmarani & Setianingsih, 2022) define critical thinking as an integrated ability that involves a deep-thinking mindset, knowledge of logical reasoning, and the skills to apply it to problem-solving. In this study, critical thinking skills were measured using the Watson-Glaser indicators, which include recognizing assumptions, evaluating arguments, deduction, interpretation, and inference. These skills enable students to analyze information, evaluate various alternative solutions, and make appropriate decisions when facing various problems (Safitri et al., 2025). It is important to begin developing critical thinking skills as early as elementary school because at this stage, students begin to think logically about concrete problems, which requires learning experiences that gradually train their ability to analyze, evaluate, and solve problems (Tambunan et al., 2025). Various studies also indicate that critical thinking skills are one of the 21st-century competencies that need to be developed through active and contextual learning tailored to the developmental characteristics of elementary school students (Bahtiar & Desiningrum, 2024). However, teaching practices in elementary schools are still dominated by conventional, teacher-centered methods, which do not provide students with sufficient opportunities to develop higher-order thinking skills (Chaparro-Banegas et al., 2024).

The post-disaster situation further worsened learning conditions at the school. Based on observations at MIN 2 in Langsa City, the flood that occurred on November 25, 2025, led to a temporary suspension of learning activities until the school resumed operations on January 5, 2026. Based on the researcher's observations on December 20, 2025, muddy water reaching approximately knee-level for an adult meant that classrooms and the school grounds had to be cleaned before they could be used again, thereby disrupting the learning process. Limited facilities, a lack of learning materials, and an unproductive learning environment made it difficult for students to fully grasp the material (Adrian et al., 2025). These conditions can disrupt the learning process and potentially affect students' conceptual understanding and the development of their critical thinking skills. Research shows that an unsupportive learning environment has a significant impact on students' cognitive development (Gold et al., 2025). Therefore, teaching innovations are needed that can address the challenges of learning under emergency conditions while also fostering the development of students' critical thinking skills.

One potential solution to this problem is the use of interactive digital learning media. Digital learning media have the potential to create learning experiences that are more engaging, flexible, and adaptable to various constraints (Ayu & Sari, 2025; Permana, 2024). Among the various digital learning media, Educaplay is an educational game-based platform that offers 19 interactive activities—such as crossword puzzles, quizzes, and interactive maps—that can support the learning process (Sari et al., 2025). In this study, Educaplay was utilized through its "Presentation" feature as a medium for delivering learning materials and the "Froggy Jumps" activity as an interactive assessment. In the "Froggy Jumps" activity, students are asked to select the correct answer to help the frog character reach its destination, thereby encouraging them to think carefully before making a decision. This activity not only increases student engagement in learning but also trains their ability to analyze information, evaluate alternative answers, and draw conclusions in line with critical thinking skill indicators. Educaplay's interactive nature, ease of use, and ability to provide immediate feedback make this platform suitable for elementary school students because it offers game-based learning that can boost


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students' motivation, attention, and active participation in learning (Nadilah et al., 2025). Additionally, Educaplay can be accessed via a computer or smartphone with relatively low internet connection requirements. In this study, Educaplay was used in face-to-face learning after teaching and learning activities resumed following a disaster, thereby serving as a learning medium responsive to the post-disaster context that continued to support the learning process even though school facilities had not yet fully recovered.

In addition to the use of instructional media, teaching approaches also play a crucial role in improving the quality of learning outcomes (Khotimah & Abdan, 2025). In this study, the term "deep learning" refers to a pedagogical approach—that is, deep learning in the context of education, not deep learning in the field of artificial intelligence. The deep learning approach emphasizes a learner-centered learning process through meaningful conceptual understanding, connections between concepts, reflection on learning experiences, and the application of knowledge in real-life contexts (Marsam et al., 2026; Ratri et al., 2026). Conceptually, deep learning is realized through three principles: mindful, meaningful, and joyful learning, which encourage students to understand, apply, and reflect on knowledge (Suyanto, 2025). This approach also has the potential to support the development of critical thinking and problem-solving skills through activities involving the analysis, evaluation, and construction of knowledge based on learning experiences (Yulita et al., 2025). In this study, the principle of mindful learning was applied through activities such as carefully observing images of the environment, reading the worksheets thoroughly, recording observation results, verifying answers based on discussion outcomes, and drawing conclusions. The principle of meaningful learning was realized by connecting the concept of natural resources to the environment and daily life, including environmental conditions, community occupations, and economic activities. Meanwhile, the principle of joyful learning was applied through group discussions, presentations, recognition, reflection, and interactive activities using Educaplay. Thus, the implementation of deep learning in this study was not merely conceptual but was realized through observable learning activities integrated with the stages of Problem-Based Learning and the use of Educaplay.

The integration of the Educaplay platform and the deep learning approach has the potential to create a more effective and innovative learning experience that fosters students' critical thinking skills. In this study, this integration was implemented through a series of learning stages that began with the exploration of a contextual problem related to flooding, followed by the presentation of material using the Presentation feature on Educaplay, and then students completed the "Froggy Jumps" activity to test their conceptual understanding through an educational game. Next, students engaged in discussions and reflections on the results of the learning activities before collaborating with the teacher to draw conclusions based on the concepts they had learned. This series of activities allows students not only to gain an interactive learning experience but also to build a deep conceptual understanding through the processes of analysis, evaluation, and reflection. As research has shown, the use of game-based digital learning media with elementary school students can enhance learning engagement and critical thinking skills because it encourages active participation and problem-solving in the learning process (Gold et al., 2025).

Various previous studies have shown that digital learning media and deep learning approaches have the potential to enhance the quality of the learning process and outcomes. The use of Educaplay, for example, has been reported to increase student engagement and support conceptual understanding through interactive learning activities (Nurhayati et al.,


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2025), while technology-based learning media also show potential in developing critical thinking skills among elementary school students (Elisabeth, 2024). On the other hand, the deep learning approach is known to promote student-centered learning through conceptual understanding, reflection, and the development of higher-order thinking skills, including in IPAS learning (Seviardini et al., 2026). These findings indicate that digital media can provide interactive learning experiences, whereas the deep learning approach offers a pedagogical framework that fosters deeper student understanding and engagement. However, previous studies have tended to examine the use of digital media and the deep learning approach separately, thus offering little insight into how the two can be integrated into a single learning process, particularly in post-disaster contexts. Conceptually, the integration of Educaplay with the deep learning approach could be a relevant strategy because Educaplay's interactive activities can be combined with mindful, meaningful, and enjoyable learning to help students remain engaged in the learning process while developing critical thinking skills in the context of disaster-affected learning environments.

Although various studies have demonstrated the potential of Educaplay as a digital learning medium and the deep learning approach in supporting the quality of learning, previous research has generally examined the use of these digital media and pedagogical approaches separately. Thus, there remains a need for a study that explains how Educaplay and the deep learning approach can be integrated into a single instructional design to support the development of students' critical thinking skills. This need becomes increasingly relevant in IPAS instruction within the context of post-disaster recovery, when the learning process must continue adaptively while providing students with opportunities to understand the relationships between human activities, environmental changes, and disaster mitigation efforts. Therefore, the contribution of this study lies in testing the integration of Educaplay as a digital learning medium with the deep learning approach in IPAS instruction to enhance the critical thinking skills of elementary school students in a post-disaster context. This integration combines Educaplay's interactive activities with mindful, meaningful, and enjoyable learning within a single learning process that is adaptive to post-disaster conditions.

Based on the research gap identified in this study, the uniqueness of this research lies in the integration of the Educaplay platform with a deep learning approach in teaching IPAS within the context of post-flood recovery to strengthen the critical thinking skills of elementary school students. Unlike previous studies, which generally tested the effectiveness of digital learning media or learning approaches separately, this study examined the integration of both through a quasi-experimental design involving fifth-grade students at MIN 2 in Langsa City. Thus, this study is expected to provide empirical evidence regarding the effectiveness of integrating digital learning media and the deep learning approach in improving students' critical thinking skills, while also serving as an adaptive learning alternative for elementary schools in post-disaster situations.

Based on the discussion above, this study aims to analyze the effect of integrating the Educaplay platform with a deep learning approach on elementary school students' critical thinking skills in science learning within the context of post-flood recovery.

## Research Method

### *Research Design*

This study employs a quantitative approach with a quasi-experimental design. This approach was chosen to examine the effect of integrating the Educaplay media with the deep


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learning approach on elementary school students' critical thinking skills in IPAS learning within the context of post-flood recovery. The study used a non-equivalent control group design, in which an experimental group and a control group are compared without random assignment (Capili & Anastasi, 2025). In addition to testing the effect of the treatment in the research context, the instructional design that integrates Educaplay's interactive activities with the principles of deep learning provides a pedagogical framework that can serve as a reference for teachers and schools in designing adaptive, contextual, and critical-thinking-oriented instruction, particularly in learning environments facing limitations due to disasters. Schematically, the research design is presented in Table 1.

**Table 1.** Non-Equivalent Control Group Design

| Grup | Pre-test | Treatment | Post-test |
|---|---|---|---|
| Experimental | $O_1$ | X | $O_2$ |
| Control | $O_3$ | - | $O_4$ |

***Notes:***
$O_1$ = Pre-test for the experimental class
$O_2$ = Post-test for the experimental class
$O_3$ = Pre-test for the control class
$O_4$ = Post-test for the control class
X = Instruction using the Educaplay medium integrated with the deep learning approach
– = Conventional instruction

***Research Subjects and Location***

This study was conducted at MIN 2 Langsa City with the population consisting of all fifth-grade students. The sample was selected using purposive sampling, taking into account the similarity in initial ability characteristics across classes based on the pre-test results. Two classes were selected as the study sample: Class V-A and Class V-B, each consisting of 32 students. Based on the pre-test results, Class V-A, as the control group, scored an average of 58.125 (SD = 18.128), while Class V-B, as the experimental group, scored an average of 58.125 (SD = 17.309), indicating that the two classes had relatively comparable initial abilities. The results of the test for differences in initial ability also showed no significant difference between the two groups ($p = 0.909$). Class V-A was designated as the control group and Class V-B as the experimental group based on the similarity of their initial scores. Throughout the study, the same researcher taught both groups to ensure consistency in the implementation of instruction. Since the study involved only one complete class in each condition, the influence of class characteristics cannot be completely separated from the influence of the treatment. Therefore, the study's findings should be interpreted with caution and should not be broadly generalized beyond the characteristics of the study sample.

The study was conducted after obtaining official permission from MIN 2 Langsa City. Before the learning activities and data collection began, the students were briefed on the research activities and gave their consent to participate. The participants' identities were kept confidential by not including students' names in the data presentation or research report. Since the research took place in a post-disaster context, the learning activities utilized general environmental and disaster contexts without asking students to recount personal experiences related to the flood. This measure was taken to minimize the possibility of psychological distress during the learning process.


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***Action Procedure***

The intervention in the experimental class was conducted in two sessions, each lasting 2 × 35 minutes, integrating the Educaplay platform and the deep learning approach through the Problem-Based Learning (PBL) model. The intervention followed the learning steps designed in the module and was conducted by the same researcher in both sessions. In the first session, learning focused on the introduction to and analysis of natural resources through observation, identification, group discussions, and interactive activities using Educaplay. In the second session, students analyzed issues related to the utilization of natural resources, discussed their impacts on daily life and economic activities, formulated solutions, and participated in interactive Educaplay activities and learning reflections. The principles of deep learning were applied through mindful, meaningful, and joyful activities, manifested in observation, discussion, analysis, problem-solving, interactive activities, and reflection. The control class was also taught by the same researcher with the same allocation of instructional time but used conventional instruction without the integration of Educaplay and the deep learning approach. Thus, both groups utilized the same time and instructors, while the primary difference in treatment lay in the integration of Educaplay and deep learning in the experimental class. Since the study did not use specific observation sheets to measure the implementation of the intervention, consistency in implementation was based on the use of pre-designed learning modules and learning steps.

***1) First Session***

In the first session, the lesson focused on the diversity of natural resources in the surrounding environment, relating it to environmental conditions following heavy rain or flooding as the problem context. The lesson began with an introductory activity and the presentation of images or scenarios depicting changes in environmental conditions after heavy rain or minor flooding. This context was used to help students identify environmental issues and connect them to the presence and use of natural resources in their surroundings. Next, students were divided into groups of 4–5 and worked on Worksheet 1 to identify natural resources, explain the rationale for their categorization, and describe their benefits in daily life. During the discussion, students are guided to consider environmental conditions and the importance of conserving natural resources so they can continue to be used sustainably—even when the environment undergoes changes due to heavy rain or flooding. The results of the discussion are then presented and reviewed by other groups, while the teacher facilitates analysis and evaluation through probing questions. Thus, the post-disaster context is not merely used as an initial stimulus but serves as a framework that guides students to connect the topic of natural resources with environmental conditions and the importance of ensuring the sustainability of these resources. Following this activity, students participate in an Educaplay "Quiz" to reinforce their understanding of the types, classification, and benefits of natural resources.

***2) Second Session***

In the second session, the lesson focused on the relationship between natural resources and economic activities. The teacher presented a contextual problem regarding differences in community economic activities based on the natural resource conditions in a specific region. Students worked in groups to complete Worksheet 2 by analyzing the relationship between natural resources and economic activities, identifying the impacts of dwindling natural resources, and formulating solutions for the wise use of natural resources. The results of these


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discussions were presented and reviewed by other groups. Following the analysis and evaluation process, students participated in the "Froggy Jumps" Educaplay activity to reinforce their understanding of the relationship between natural resources and economic activities. The lesson then concluded with review questions, reflection, and drawing conclusions.

### *3) Deep Learning Integration*

The deep learning approach was implemented through the principles of mindful, meaningful, and joyful learning. Mindful learning was supported through focused observation, problem identification, and information processing; meaningful learning through connections between natural resource content, the environment, and daily life; and joyful learning through group discussions, presentations, interactive activities, and reflection. In the experimental class, learning activities were conducted over two sessions with the same time allocation as the control class and used the same learning materials and test instruments. However, the experimental class incorporated Educaplay and the deep learning approach through the Problem-Based Learning (PBL) model, which involved observation, problem identification, group discussions, completing worksheets, presentations, analysis, problem-solving, interactive Educaplay activities, and reflection. In contrast, the control class received the same material through conventional instruction using the lecture method, with a blackboard as the teaching medium, without the use of Educaplay, deep learning, PBL, worksheets, group discussions, or presentations. Both groups were allocated the same amount of instructional time, were taught by the same researcher, and took pre-tests and post-tests using the same instruments. Thus, the main difference between the two conditions lies in the instructional design applied to the experimental class, namely the integration of Educaplay and the deep learning approach through PBL. Since these three components were applied simultaneously in the experimental group, the research results are interpreted as the effect of the integrated intervention package, rather than the separate effects of Educaplay or deep learning.

### *Research Instruments*

The research instrument consisted of a critical thinking skills test in the form of essay questions, comprising 10 items. The test was designed based on the five indicators of critical thinking skills used in the Watson–Glaser framework: identification of assumptions, analysis of arguments, deduction, interpretation, and inference. Each indicator is represented by two items, ensuring that all indicators are equally represented in the instrument. Each item is scored on a scale of 0 to 10, with the following scoring criteria: a score of 10 for a complete and accurate answer, a score of 5 for an answer that is partially correct or incomplete, and a score of 0 for an answer that is incorrect or does not demonstrate relevant understanding. Thus, the maximum score a student can achieve is 100. The pre-test and post-test instruments use the same indicators but are designed with different questions and contexts to measure critical thinking skills before and after the intervention without directly reusing the same items. Each indicator is operationalized through cognitive demands aligned with the fifth-grade IPAS curriculum. The identification of assumptions is measured by students' ability to identify the underlying assumptions or reasons behind a statement or problem. Argument analysis is measured by students' ability to determine reasons that support or weaken an opinion. Deduction is measured by students' ability to draw logical consequences based on available information. Interpretation is measured by students' ability to understand information, connect it to given conditions, and determine relevant meanings. Inference is measured by students' ability to draw conclusions based on available information and evidence.


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The context of the questions is aligned with the fifth-grade IPAS curriculum, specifically natural resources, the environment, economic activities, and issues related to environmental conditions. This alignment ensures that the demands of critical thinking are understandable to elementary school students and remain relevant to their learning experiences. Before use, the instrument underwent an expert validation process covering content, construction, and language. All student responses on the pre-test and post-test were scored by the same researcher using a predetermined scoring rubric. Scoring was conducted by matching student responses to the criteria on the rubric for each test item, ensuring that the assessment procedure was applied consistently across both groups and at both measurement time points. This study did not use a second rater or an inter-rater reliability procedure. The test was administered twice: a pre-test before instruction to measure initial critical thinking skills and a post-test after the entire intervention was completed to measure post-intervention skills. The instrument blueprint is presented in Table 2.

**Table 2.** Test Blueprint for Assessing Critical Thinking Skills

| Critical Thinking Indicators | Question Number | Measurement Focus |
|---|---|---|
| Introduction to Assumptions | 1-2 | Identify the assumptions or premises underlying a statement or issue |
| Argument Analysis | 3-4 | Analyze the reasons that support or weaken an opinion |
| Deduction | 5-6 | Draw logical conclusions based on the available information |
| Interpretation | 7-8 | Understand and connect information to determine its relevant meaning |
| Inference | 9-10 | Draw conclusions based on information and evidence |

In addition to the test instruments, this study utilized student worksheets (LKPDs) developed using Canva, instructional presentation media, and interactive assessment activities via Educaplay as supplementary materials for the learning process. The test instruments were validated through expert judgment by a subject-matter expert using a validation sheet that covered three aspects: content/substance, item construction/technical aspects, and language. Each aspect consists of three indicators, resulting in nine assessment indicators on a 1–5 scale. The pre-test instrument scored 39 out of a maximum of 45 (86.67%), while the post-test instrument scored 35 out of a maximum of 45 (77.78%). These validation results indicate that both instruments received favorable ratings based on the content, construction, and language aspects. Feedback from the validator was used to refine the test items before the instruments were used in the study. Since the validation was conducted by a single expert, these results are treated as preliminary evidence of content validity rather than as evidence of inter-rater agreement. Furthermore, since the study used essay-type questions, all student responses were evaluated by the researcher using scoring guidelines based on the Watson–Glaser critical-thinking indicators. Data collection was conducted through tests and documentation. Tests were used to obtain data on students' critical thinking skills through pre-tests and post-tests, while documentation was used to


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support the research data in the form of photographs of learning activities, teaching materials, and other documents related to the study's implementation.

***Data Analysis Technique***

The research data were analyzed using IBM SPSS Statistics version 30. The analysis began with a presentation of descriptive statistics in the form of mean values and standard deviations of the pre-test and post-test scores for the experimental and control groups. The Shapiro–Wilk test was used to assess the normality of the data because the number of students in each group was less than 50. The Mann–Whitney U test on the pre-test scores was used to determine whether there was a difference in initial ability between the experimental and control groups. Next, a test for homogeneity of variances was conducted using Levene's test. The main analysis was conducted using Analysis of Covariance (ANCOVA), with post-test scores as the dependent variable, the learning method as the independent variable, and pre-test scores as the covariate. ANCOVA was used to control variations in students' initial ability and to compare the adjusted post-test scores between the experimental and control groups. All tests were conducted at a significance level of $\alpha = 0.05$.

## Research Findings and Discussion

Before being used for data collection, the critical thinking skills test instrument first underwent content validation through expert evaluation. The validation was conducted by an expert faculty member using a scoring sheet that covered three aspects: content, item construction/technical aspects, and language. Each aspect was rated on a five-point scale. The validation sheet consisted of nine validation criteria for each test form. The results of the expert evaluation of the pre-test and post-test instruments are presented in Table 3.

**Table 3.** Results of the Validation of the Critical Thinking Skills Test Instrument

| Instrument | Number of Validation Criteria | Score Obtained | Maximum Score | Percentage |
|---|---|---|---|---|
| Pre-test | 9 | 39 | 45 | 86.67% |
| Post-test | 9 | 35 | 45 | 77.78% |

Based on Table 3, the pre-test instrument scored 39 out of a maximum of 45 (86.67%), while the post-test instrument scored 35 out of a maximum of 45 (77.78%). These differences in validation scores indicate variations in expert ratings on several criteria between the two test versions and do not indicate differences in the number of critical thinking skill indicators measured. Both test versions consist of 10 essay questions that measure five critical thinking skill indicators, with each indicator represented by two questions. The same indicator structure and proportion of questions were used to maintain equivalence in construct coverage between the two test versions, while the wording of the questions and the contexts used were made different. Both test versions were also scored using the same scoring guidelines. However, equivalence in difficulty level between the pre-test and post-test was not assumed because no specific statistical analysis was conducted to compare the difficulty levels of the two test versions. Input from experts was used as the basis for making editorial revisions to several test items before the instrument was used in the study.

Before testing the hypothesis, the analysis began with a presentation of descriptive statistics and an examination of the assumptions regarding the change in scores between the


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pre-test and post-test results in the experimental and control groups. The normality test was conducted using the Shapiro–Wilk test because the number of students in each group was less than 50 (N = 32 per group). The results of the normality analysis are presented in Table 4.

**Table 4.** Normality Test of Critical Thinking Ability Data

| Data | Sig. (Shapiro-Wilk) | Notes |
|---|---|---|
| Experimental Class Pre-test | 0.422 | Normal |
| Experimental Class Post-test | 0.074 | Normal |
| Control Class Pre-test | 0.039 | Non-Normal |
| Control Class Post-test | 0.109 | Normal |

Based on Table 4, the pre-test data for the experimental group were normally distributed (p = 0.422), whereas the pre-test data for the control group were not normally distributed (p = 0.039). Meanwhile, the post-test data for the experimental group (p = 0.074) and the control group (p = 0.109) were normally distributed. Since the pre-test data for the control group did not meet the assumption of normality, the comparison of initial ability between the experimental and control groups was subsequently analyzed using the Mann–Whitney U test. The results of this test are presented in Table 5.

**Table 5.** Mann–Whitney U Test of Initial Ability Based on Pre-Test Scores

| Data | Mann-Whitney U | Z | Sig. (2-tailed) | Notes |
|---|---|---|---|---|
| Experimental and Control Pre-test | 503.500 | -0.115 | 0.909 | No significant difference |

Based on Table 5, the Mann–Whitney U test of the pre-test scores yielded a U value of 503.500, a Z value of −0.115, and p = 0.909 (p > 0.05). These results indicate that there was no statistically significant difference between the experimental and control groups in terms of initial ability. However, these results cannot be used to conclude that the two groups are completely equivalent. Therefore, the subsequent main analysis treated the pre-test scores as a covariate to control for variations in initial ability. Next, a test of homogeneity of variances was conducted on the post-test scores to examine the equality of variances between the experimental and control groups. The results of the homogeneity test are presented in Table 6.

**Table 6.** Test of Homogeneity of Variances for Post-Test Scores

| Data | Levene Statistic | df1 | df2 | Sig. | Notes |
|---|---|---|---|---|---|
| Based on Mean | 2.176 | 1 | 62 | 0.145 | No significant difference in variances |

Based on Table 6, there was no evidence of a significant difference in variance between the experimental and control groups in the post-test scores (Levene = 2.176; p = 0.145). Next, to account for possible differences in initial ability and to obtain an estimate of the difference in post-test scores adjusted for pre-test scores, the analysis continued using Analysis of Covariance (ANCOVA) with pre-test scores as a covariate. The results of the ANCOVA analysis are presented in Table 7.


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**Table 7.** Results of the ANCOVA Analysis of Post-Test Scores

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Pre-test | 5637.541 | 1 | 5637.541 | 162.852 | <0.001 |
| Teaching Methods | 9628.516 | 1 | 9628.516 | 278.139 | <0.001 |
| Error | 2111.678 | 61 | 34.618 | - | - |

Based on Table 7, the pre-test score, as a covariate, had a significant effect on the post-test score, $F(1,61) = 162.852$, $p < 0.001$. After controlling for the effect of pre-test scores, the learning method also showed a significant effect on post-test scores, $F(1,61) = 278.139$, $p < 0.001$. These results indicate that there was a significant difference in post-test scores between the experimental and control groups after controlling for students' initial ability. The ANCOVA model explained 87.8% of the variation in post-test scores ($R^2 = 0.878$; Adjusted $R^2 = 0.874$).

The results of this study indicate that the integration of Educaplay and a deep learning approach was associated with higher critical thinking skills in the experimental group compared to the control group under the conditions of this study. These findings must be interpreted with consideration of the study design, which used a non-equivalent control group without random assignment and involved only one class in each condition. Although the results of the Mann–Whitney U test on the pre-test data did not show a statistically significant difference between the two groups ($p = 0.909$), these results cannot be used to conclude that the two groups were entirely equivalent at baseline. Therefore, the differences in outcomes after instruction should be interpreted as an association between the implementation of the intervention and changes in critical thinking skills, rather than as evidence of a causal relationship that is entirely isolated from the possible influence of class characteristics, teachers, or other factors. Under the conditions of this study, the group that received instruction integrating Educaplay and the deep learning approach demonstrated a greater improvement in critical thinking skills compared to the control group, indicating that this instructional design has the potential to support more active, meaningful, and contextual learning.

The improvement in critical thinking skills observed in this study may be related to features of the Educaplay platform, which enables the delivery of interactive learning activities through educational games. In this study, the "Froggy Jumps" activity was used as an interactive assessment tool that required students to answer questions correctly in order to proceed in the game. The characteristics of this activity have the potential to support student engagement in the learning process and encourage them to think actively when faced with questions related to IPAS material. Through this activity, students have the opportunity to apply thinking processes related to identifying assumptions, analyzing arguments, making deductions, interpreting information, and drawing conclusions based on available information. This process aligns with the critical-thinking indicators attributed to Watson and Glaser, which served as the basis for developing the research instrument. However, since student engagement was not specifically measured in this study, the increase in engagement cannot be treated as an empirical finding of the research but rather as a mechanism that may support the development of critical thinking skills.

In addition to the use of instructional media, the learning process in this study was also supported by the implementation of a deep learning approach. This approach was applied through activities that linked natural resource material to environmental conditions and students' daily lives. During instruction, students were guided to observe environmental


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conditions used as the context for problems, identify and categorize natural resources, explain their benefits, and analyze the impacts of mismanaging natural resources. Discussion activities, the sharing of ideas, probing questions from the teacher, and reflection provided students with opportunities to connect the concepts they learned to situations relevant to their daily lives. Thus, the application of the deep learning approach in this study did not merely focus on the delivery of content but also provided students with opportunities to understand concepts, connect information, and apply knowledge in relevant contexts. This interpretation is consistent with Pinilih and Suswandari (2026), who report that the deep learning approach can support meaningful learning through students' active engagement in understanding, connecting, and reflecting on the concepts they have learned.

The results of this study also reinforce the findings of previous research indicating that the use of Educaplay can enhance students' motivation to learn, academic achievement, and engagement in the learning process (Nurhayati et al., 2025). Another study reported that the use of digital learning media based on educational games has a positive impact on the critical thinking skills of elementary school students (Latifatunnisa & Purwanti, 2026). The results of this study are consistent with those findings and indicate that the use of interactive digital media has the potential to support the development of higher-order thinking skills in elementary school students.

Nevertheless, the contribution of this study lies not only in the integration of Educaplay and the deep learning approach, but also in how both are used within a single IPAS learning sequence linked to environmental contexts relevant to students' daily lives. Pedagogically, this integration can help connect interactive activities with the processes of understanding concepts, discussing, analyzing information, and reflecting on learning outcomes. Educaplay serves as an interactive medium to provide students with opportunities to respond to questions and gain a more varied learning experience, while the deep learning approach gives students space to connect the material to real-life contexts through observation, discussion, analysis, and reflection. However, the success of implementing this instructional design can be influenced by implementation conditions, including teacher readiness, device availability, internet access, and the learning environment. In a post-disaster context, these aspects are particularly important because damage to educational facilities and infrastructure limitations can restrict the use of digital learning media. Therefore, the implementation of Educaplay-based learning must be adapted to the availability of facilities and school conditions to ensure optimal implementation. Furthermore, the increase in critical thinking skill scores observed in this study cannot be entirely attributed to the integration of Educaplay and the deep learning approach, as other factors—such as differences in class characteristics, students' prior learning experiences, teacher support, and the novelty effect of using digital media—may also have influenced the results. Given these conditions, the contribution of this study is best understood as providing an overview of the potential for implementing an instructional design that integrates interactive digital media and deep learning in IPAS instruction under specific research conditions, rather than as evidence that this integration alone leads to improved critical thinking skills.

The post-disaster context is one of the factors that reinforces the relevance of this study's findings. Following the flood that occurred on November 25, 2025, learning activities at MIN 2 in Langsa City were temporarily suspended until the school resumed operations on January 5, 2026. These conditions highlight the importance of learning that is responsive to the post-disaster context—that is, learning that takes into account environmental conditions


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and the needs of the recovery process without neglecting learning objectives. In this study, responsiveness to the post-disaster context was achieved through the use of environmental contexts closely related to students' lives in IPAS instruction, as well as the implementation of interactive digital media and a deep learning approach. However, given that this study was conducted at only one school with an intervention lasting two sessions, these findings cannot yet be generalized as a strategy applicable to all post-disaster situations. The findings of this study are more appropriately viewed as an initial insight into the potential for implementing post-disaster-responsive learning through the integration of Educaplay and a deep learning approach in IPAS instruction under the specific conditions of this study.

## Conclusion

This study shows that the experimental group achieved higher critical thinking skill scores on the post-test compared to the control group under the conditions of this study. The experimental group's average post-test score was 78.13, while the control group's was 53.59, with an average difference of 24.531 points. However, these findings must be interpreted with the understanding that the study employed a quasi-experimental design without random assignment and involved only one class in each condition. Furthermore, the intervention was conducted in two sessions at a single school; thus, the potential influence of class characteristics, prior learning experiences, and other factors cannot be entirely ruled out. Therefore, the results of this study are best understood as evidence that the group receiving the integration of Educaplay and the deep learning approach achieved higher post-test scores under the conditions of this study, rather than as evidence of effectiveness that can be broadly generalized. The implementation of this instructional design can be considered an alternative for contextual and interactive IPAS instruction; however, its application in schools or other post-disaster contexts requires further research with a longer intervention duration, a larger number of schools and classes, and a stronger research design.

## Recommendations

Nevertheless, this study has several limitations that must be considered when interpreting the results. First, the study involved only 64 students from a single school, with one class in each condition, so the sample size and geographical scope of the study remain limited. Second, group assignments were not randomized, so the influence of the classes' initial characteristics on the results cannot be entirely ruled out. Third, the intervention was conducted in only two sessions, so this duration was insufficient to assess the long-term development of critical thinking skills. Fourth, because the same researcher taught both groups and only one class represented each condition, the potential influence of teacher and class characteristics cannot be completely separated from the effect of the treatment. Furthermore, the use of new learning media in the experimental group may have caused a novelty effect or the Hawthorne effect, which might have influenced students' responses during the learning process. Fifth, evidence regarding the validity and reliability of the instruments remains limited because content validation was conducted by a single expert, and the scoring of all essay responses was performed by the researcher; thus, scoring consistency has not been tested through inter-rater reliability. Sixth, the study lacks follow-up data; therefore, it remains unknown whether improvements in critical thinking skills can be sustained after the intervention ends. Consequently, the recommendation to integrate


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Educaplay with the deep learning approach should be viewed as a potential learning alternative under the conditions of this study, rather than as evidence of effectiveness that can be broadly generalized. Future research is recommended to involve more classes and schools, use a stronger group-assignment procedure or research design, extend the duration of the intervention, involve more than one instrument rater, and conduct follow-up measurements to assess the sustainability of learning outcomes.

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