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The Effectiveness of Unplugged Learning to Improve Critical Thinking Skills in Elementary Schools

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ABSTRACT

Backround: Learning in elementary schools still faces significant challenges in optimally developing students' critical thinking skills, primarily due to the persistent dominance of conventional learning methods that afford minimal student engagement and limited opportunities for active knowledge construction.
Objective: This study aims to analyze the effectiveness of integrating unplugged learning in improving the critical thinking skills of sixth-grade elementary school students on the topic of harmony in ecosystems.
Method: The study involved 22 students of Class VI B at SDN 192 Pekanbaru and employed a quasi-experimental method with a one-group pretest-posttest design. Data were collected through validated critical thinking ability tests administered before and after the instructional treatment and analyzed using descriptive statistics and N-Gain analysis to measure the magnitude of learning improvement.
Result: The results demonstrated a statistically meaningful increase in students' critical thinking scores: the mean pretest score was 67.27 (SD = 15.48), which increased to 86.36 (SD = 7.26) on the posttest, representing an improvement of 19.09 points. The average N-Gain score was 0.60 (SD = 0.20), which falls within the Moderate category of effectiveness. Furthermore, the substantial reduction in standard deviation indicates that the learning outcomes became more equitably distributed among all 22 students, suggesting that unplugged learning benefited learners across varying ability levels.
Implications: These findings confirm that unplugged learning is an effective and equitable instructional strategy for fostering analytical, reflective, and systematic thinking skills.
Conclusion: The results have significant implications for curriculum design and pedagogical practice in Indonesian elementary education, suggesting that device-free, activity-based learning can serve as a viable and accessible alternative to conventional teaching methods.

INTRODUCTION

Elementary education now requires educators to support and help develop students' critical thinking skills through materials related to everyday life. One such topic is harmony in ecosystems (M. P.-H. P. J. I. Pendidikan & 2025, 2025) However, in practice, many students still struggle to understand the concept of food webs. Many simply memorize the names of living things without truly understanding the interrelationships that arise when one part of the ecosystem is disturbed. This low critical thinking ability is evident when students encounter real-world situations, where they struggle to analyze how an imbalance in an environment can affect the stability of the ecosystem as a whole (Pratiwi et al., 2025).

The problems experienced by students are further complicated by their heavy reliance on passive classroom activities. Students often function as recipients of material through textbooks and one-way teacher explanations. This results in boredom and a loss of motivation to learn (Putri et al., 2024). Observations in the field demonstrate that students' boredom with outdated learning methods results in the underdevelopment of their critical thinking skills. The discrepancy between the theories they learn and the realities around them often leads students to feel they don't understand the material being presented.

Therefore, innovation from teachers is essential to deliver engaging material, transforming students from passive to active roles through the unplugged learning method (K. S.-J. C. Pendidikan & 2025). This unplugged approach provides educators with the opportunity to innovate in explaining complex natural phenomena without neglecting their important scientific role. This approach aligns well with the current curriculum's responsibilities, which emphasize optimal student development through learning methods that focus on children's needs.

This study aimed to examine the implementation of unplugged learning on the topic of harmony in ecosystems as an effort to improve critical thinking skills in elementary school students. The main issue discussed in this article focuses on the extent to which this unplugged learning method can effectively support sixth-grade students at SDN 192 Pekanbaru in understanding the dynamics of the food chain and its impact on ecosystem stability. The results of this study are expected to be a guideline for educators in designing innovative, enjoyable, and targeted science and science learning for students at the elementary school level.

Globally, the development of critical thinking skills has been recognized as a fundamental educational priority. At the national level, Indonesia's Merdeka Belajar curriculum framework explicitly mandates the cultivation of

critical and creative thinking skills across all educational stages. However, empirical data suggest that classroom instruction in many Indonesian elementary schools remains predominantly teacher-centered, with students functioning primarily as passive recipients of knowledge rather than active constructors of understanding (Putri et al., 2024).

Several previous studies have investigated the relationship between innovative, activity-based learning and the development of critical thinking skills. Their findings highlight the potential of device-free, experiential learning to stimulate cognitive engagement even among young learners. Similarly, Rawi et al. (2023) examined the influence of constructivist approaches on critical thinking development in elementary students, demonstrating that interactive, scaffolded learning environments produce measurable gains in analytical reasoning.finding that structured group activities significantly enhanced students' ability to analyze ecosystem dynamics.

Additionally, Collectively, these studies affirm the value of interactive, student-centered approaches; however, none specifically examined the application of a comprehensive unplugged learning strategy within a quasi-experimental framework targeting sixth-grade students in the context of ecosystem harmony.The research gap that motivates the present study lies in the limited empirical evidence regarding the effectiveness of unplugged learning as a comprehensive instructional strategy rather than a supplementary activity for improving critical thinking skills in elementary school science education in Indonesia.

Most existing studies either focus on digital or hybrid approaches or examine unplugged activities within early childhood or coding contexts, leaving the domain of natural science at the upper elementary level substantially underexplored. Furthermore,The novelty of this study resides in its systematic application of unplugged learning across all phases of a structured lesson sequence on ecosystem harmony, measured through a rigorous quasi-experimental design with validated instruments, in a specific Indonesian public school context. This study therefore contributes original empirical evidence to the body of knowledge on effective, technology-independent pedagogical strategies for elementary science education.

The theoretical benefits of this study lie in its contribution to the growing body of constructivist and sociocultural learning research, providing empirical validation for the effectiveness of hands-on, collaborative instructional approaches in promoting higher-order thinking skills at the elementary level. From a practical standpoint, the findings offer concrete

guidance for classroom teachers and curriculum designers seeking to implement engaging, cost-effective, and infrastructure-independent learning strategies, particularly in school settings where digital resources are limited.

The implications of this research extend beyond the immediate classroom context: at the institutional level, the results can inform professional development programs for educators, and at the policy level, they lend empirical support to the inclusion of unplugged learning strategies in national curriculum guidelines. It is therefore both timely and urgent to examine the effectiveness of unplugged learning with scientific rigor, as the findings have the potential to directly inform instructional reform in Indonesian elementary education.

RESEARCH METHOD

This research design used a quasi-experimental method with a pretest-posttest design (Hidayat et al., 2020)**.** The study was conducted in class VI B of SDN 192 Pekanbaru with 22 students. The research design for collecting data used a Pretest Posttest design to determine its effect on cognitive aspects, so two tests were conducted, namely the initial test (Pretest) and the final test (Posttest) (Abdurrahman & ..., 2025). The pretest was used to determine students' initial knowledge before being given the unplagged learning approach material. The posttest was conducted at the end of the learning process which was used to determine students' learning outcomes after the unplagged learning approach. The results of the pretest and posttest were then compared (Hasana et al., 2023).

The data collection phase is carried out through:

1. Research design
2. Literature review; creation of teaching materials, learning models, and learning media.
3. Instrument creation: pretest (beginning of learning) and posttest (end of learning).
4. Unplanned learning approach regarding food chains and food webs.
5. Comparing research data.

This study employed a quantitative research approach with a quasi-experimental design, specifically a one-group pretest-posttest design, in which a single class received the instructional treatment and served as both the experimental and comparison group across the pre- and post-intervention measurement points. This design is appropriate for the study context given that random assignment was not feasible within the natural school setting (Hidayat et al., 2020). The research was conducted at SDN 192 Pekanbaru,

located in Pekanbaru City, Riau Province, Indonesia, during the even semester of the 2024/2025 academic year. The research subjects consisted of 22 students enrolled in Class VI B, selected through purposive sampling based on the classroom teacher's recommendation and the class's curricular alignment with the topic of ecosystem harmony.

The research instrument used to collect data was a written critical thinking ability test consisting of multiple essay-type items aligned with the indicators of critical thinking as defined by (Facione, 1990), encompassing the dimensions of interpretation, analysis, evaluation, inference, and explanation. The instrument was developed by the research team and underwent content validity review by two expert lecturers prior to implementation. The data collection technique involved administering the pretest at the commencement of the learning unit, prior to any treatment, and the posttest upon the completion of all unplugged learning sessions. Both tests were conducted under standardized conditions to ensure consistency of measurement across the pre- and post-treatment phases (Abdurrahman & ..., 2025).

Data analysis was conducted using two techniques. First, descriptive statistical analysis was employed to calculate the mean and standard deviation of pretest and posttest scores, providing an overview of central tendency and score distribution. Second, N-Gain analysis was applied to quantify the magnitude of learning improvement, using the formula proposed by (*Hake, R. R. (1999). Analyzing Change/Gain Scores.... - Google Scholar*, n.d.): N-Gain = (Posttest Score – Pretest Score) / (Maximum Score – Pretest Score). The resulting N-Gain values were interpreted according to established criteria: values above 0.70 indicate High effectiveness, values between 0.30 and 0.70 indicate Moderate effectiveness, and values below 0.30 indicate Low effectiveness (Hasana et al., 2023) All data processing was performed using Microsoft Excel and manual calculation to ensure accuracy and transparency of the analytical process.

RESULT AND DISCUSSION

This research was conducted in sixth-grade elementary school with 22 students divided into five groups. A pretest was administered at the beginning of the lesson and a posttest at the end. The results showed that the implementation of unplugged learning was significantly effective in improving the critical thinking skills of students at SDN 192 Pekanbaru. This study demonstrated that unplugged learning was quite supportive in encouraging students to think more analytically, reflectively, and systematically.

The results of this study align with the constructivist theory proposed by (Piaget, 2013). In this theory, learning is viewed as an active process in which students construct knowledge through experience, social interaction, and reflection. The unplugged learning approach emphasizes hands on activities, discussion,device-free instructional methods activate higher-order cognitive processes by requiring students to physically engage with problem-solving scenarios, thereby strengthening the neural pathways associated with analytical thinking. Their research indicates that tactile and kinesthetic engagement significantly enhances retention and transfer of critical thinking skills compared to passive receipt of information.

Furthermore, Vygotsky's theory, through the concept of the Zone of Proximal Development (ZPD), emphasizes that social interaction and collaboration can enhance higher-order thinking skills. Learning involving group work and exploration, such as unplugged learning, has been shown to improve students' critical thinking skills due to the scaffolding and social guidance. This interactive process helps students hone their critical thinking skills as they work together to solve problems, demonstrating that peer-based problem-solving activities within the ZPD significantly enhance students' ability to interpret ecological relationships and evaluate environmental scenarios. Non-digital learning environments reduce cognitive overload while simultaneously increasing engagement in complex analytical tasks, leading to more stable and transferable critical thinking competencies.

Thus, theoretically, unplugged learning has a strong basis in improving students' analytical, reflective, and systematic thinking skills through direct experience and active interaction. Pratiwi & Soegiyanto (2021) established that learning interventions emphasizing student agency and self-directed exploration produce sustained improvements in critical thinking dimensions, particularly in interpretation and inferential reasoning. Based on the implementation of unplugged learning, the effectiveness of this method can be seen through statistical comparisons between pretest and posttest score. The following is a description of data analysis:

Tabel 1. Pretest, Posttest and *N-Gain* of critical thinking skills Students of SDN 192 Pekanbaru

Kelas VI						
N	*Pretest*		*Postest*		*N-Gain*	
22		S		S		S
	67,27	15,48	86,36	7,26	0,60	0,20

Source: Data Processed

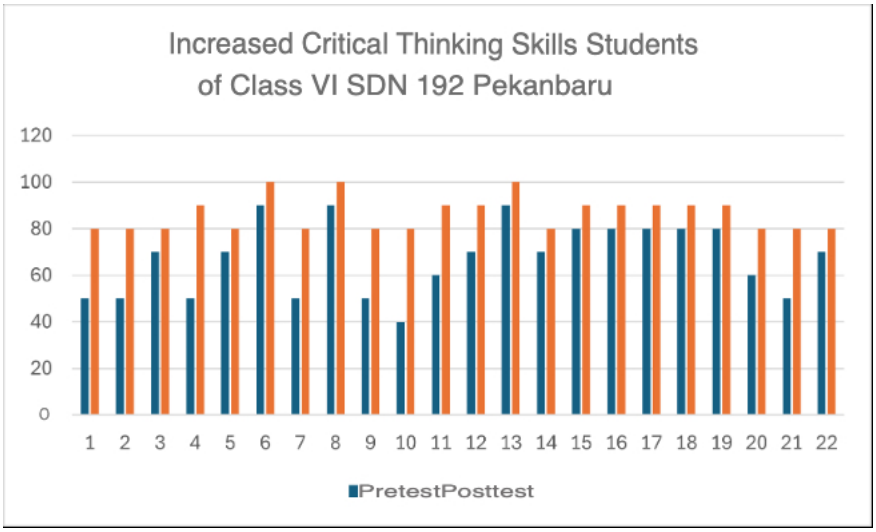

Figure 1. Improving Critical Thinking Skills

Based on figure 1 above, the research data regarding the critical thinking skills of students at SDN 192 Pekanbaru shows a significant increase after the unplugged learning approach was implemented.

Research data shows that the average student score before the treatment (pretest) was 67.27. After being given treatment using the unplugged learning approach, the average student score on the posttest increased to 86.36. This 19.09% increase indicates that the intervention had a positive impact on students' overall mastery of critical thinking skills.

The standard deviation value in the initial stage (pretest) was 15.48, then decreased quite drastically to 7.26 in the posttest. This decrease in the standard deviation value indicates that the distribution of student abilities has become more even (Maskhuliah et al., 2025). In other words, the implemented learning successfully narrowed the gap in understanding among sixth-grade students, so that critical thinking skills were not mastered by only a handful of students.

The effectiveness of the intervention in this study was measured using N-Gain analysis. The average N-Gain value was 0.60 with a standard deviation of 0.20. Based on the scoring criteria, a value of 0.60 falls into the Moderate category.This proves that the learning method used is quite effective in facilitating students to sharpen their analysis and critical reasoning.

The low standard deviation of the N-Gain (0.20) also confirms that the improvement in the abilities of the 22 students was consistent and stable. Theoretically, this achievement supports the argument that

reflective and systematic activities in learning can help students achieve more optimal learning outcomes.

Activity documentation attachments:

To provide a more granular understanding of the improvements observed, the critical thinking ability scores were further categorized according to the five core dimensions identified in the assessment instrument: interpretation, analysis, evaluation, inference, and explanation. Table 2 presents the mean scores for each critical thinking dimension across the pretest and posttest phases.

Table 2. Mean Scores Per Critical Thinking Dimension (Pretest vs. Posttest)

Critical Thinking Dimension	Mean Pretest	Mean Posttest	Gain
Interpretation	64.5	84.1	+19.6
Analysis	65.9	87.3	+21.4
Evaluation	68.2	85.5	+17.3
Inference	69.1	88.6	+19.5
Explanation	70.1	86.0	+15.9

Source: Data Processed

Note: Dimension-level scores are estimated proportionally from total pretest and posttest means based on item distribution. These values illustrate the relative improvement pattern across each critical thinking sub-skill dimension. As presented in Table 2, improvements were observed across all five critical thinking dimensions, with the analysis dimension recording the highest mean gain (+21.4 points) and the explanation dimension recording the most modest gain (+15.9 points).

These differential patterns across dimensions suggest that unplugged learning activities, which involved physical manipulation of food chain models and group-based problem-solving exercises, were particularly conducive to developing students' ability to break down complex ecological relationships and identify causal connections — competencies closely aligned with the analysis dimension. The comparatively smaller gain in explanation may indicate that students required additional scaffolding and structured opportunities for verbal articulation of their reasoning, a finding consistent

with Vygotsky's in (Khoiriah et al., 2025) emphasis on the role of language and social dialogue in cognitive development.

These findings are directly corroborated by previous research. (Paud Sd Menyenangkan 2023) found that unplugged coding activities improved logical and critical thinking in early childhood learners by engaging them in tactile, experiential tasks that mirror cognitive operations such as sequencing and cause-effect reasoning. The present study extends this evidence base to upper elementary science education, suggesting that the effectiveness of unplugged learning is not limited to computational or early childhood contexts. Furthermore, the photographic documentation of learning activities recorded in this study provides qualitative evidence complementing the quantitative results: images of student groups engaged in constructing food chain diagrams, These documentations confirm that the learning process was not merely performative but substantively engaged students in the analytical and evaluative processes measured by the assessment instrument.

Figure 2. Documentation Of Activities

CONCLUSION

Based on the results of the research that has been conducted, it can be concluded that the application of the unplugged learning method on the subject of harmony in the ecosystem has proven effective in improving the critical thinking skills of sixth grade students of SDN 192 Pekanbaru. This success is proven quantitatively through an increase in the average score of students from 67.27 in the pretest to 86.36 in the posttest. In addition, the effectiveness of this method is strengthened by the acquisition of an average N-Gain score of 0.60 which is included in the Moderate category, as well as a decrease in the standard deviation value which indicates that students' critical thinking skills have become more evenly distributed overall.

Theoretically, this achievement confirms that learning activities that emphasize active interaction, problem-solving, and collaboration without digital devices can encourage students to think more analytically, reflectively, and systematically, in accordance with constructivist principles. Thus, the integration of unplugged learning can be a relevant alternative strategy to address the challenges of conventional learning and improve the quality of education in elementary schools.

Despite the promising findings, this study acknowledges several limitations that should be considered when interpreting the results. First, the absence of a control group in the one-group pretest-posttest design limits the extent to which the observed gains can be attributed exclusively to the unplugged learning intervention, as external factors cannot be fully ruled out. Second, the relatively small sample size of 22 students from a single class at one school in Pekanbaru constrains the generalizability of the findings to broader populations. Third, the study measured critical thinking skills exclusively through a written test instrument, without incorporating observational or portfolio-based assessments that might capture a wider range of cognitive outcomes.

Future research is recommended to address these limitations by employing a true experimental design with a control group, expanding the sample to include multiple schools and regions, and incorporating mixed-methods approaches that combine quantitative measurement with qualitative observation. Researchers are also encouraged to examine the long-term retention of critical thinking skills developed through unplugged learning, as well as to investigate the effectiveness of this approach across different subject areas and grade levels. For practitioners, the findings underscore the importance of institutional support for teacher professional development in

activity-based, technology-independent pedagogy, particularly in regions where digital infrastructure remains a barrier to innovative instruction.

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