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Enhancing Critical Thinking Skills in Graduates: An Experiential Learning Approach

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ENHANCING CRITICAL THINKING SKILLS IN GRADUATES: AN EXPERIENTIAL LEARNING APPROACH

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Abstract

Critical thinking is a vital 21st-century graduate attribute that significantly enhances employability and adaptability. This study investigated the effectiveness of experiential learning in fostering students' critical thinking skills within the context of Indonesian higher education. Using a quantitative pretest-posttest design, data were collected from 117 university students enrolled in a science course at Universitas Riau. A structured questionnaire assessing five levels of critical thinking was used to measure students' skills before and after the intervention. The findings revealed a statistically significant improvement in students' critical thinking after the intervention (p < .001), with an average increase of 6.78 points and a 13.9% gain. Cohen's d value of 0.84 indicated a large effect size. Post-intervention results showed a substantial shift in the distribution of critical thinking levels, with more students reaching the 'superior' and 'exceptional' categories. These results underscored the value of active, reflective, and real-world learning experiences in enhancing students' cognitive skills. This study contributes to the growing body of evidence on pedagogical innovations in science education and offers practical implications for curriculum reform in developing countries.

Keywords: *Critical Thinking; Experiential Learning; Graduate Attributes; Science Education.*

A. Introduction

In today's dynamic educational and professional landscapes, critical thinking is acknowledged as a fundamental graduate attribute (Brits, 2018; Chhinzer & Russo, 2017; Hénard & Roseveare, 2012). As societies become increasingly technologically advanced and economically interconnected, the global demand for graduates equipped with higher-order thinking skills—particularly analytical reasoning, evaluation, and problem-solving abilities—has intensified (Archer & Davison, 2008; Schreck et al., 2020). Higher education institutions are therefore expected not only to cultivate technical competencies but also to nurture cognitive and metacognitive skills that ensure graduates' adaptability and employability in the twenty-first century (Howard, 2019; Woya, 2019).

Among these essential competencies, critical thinking stands out as a core skill that enables individuals to address complex problems, make sound decisions, and adapt effectively to rapidly changing environments (Carter, 2019; Pherson & Pherson, 2020). This skill is particularly vital in science education, where students must go beyond memorization to engage in observation, inquiry, analysis, and reasoning. Affandy et al., (2019) emphasize that critical thinking is crucial for scientific literacy, while Santos (2017) stresses its role in promoting reflective engagement with scientific concepts. According to Murawski (2014), students trained in critical thinking are better equipped to question assumptions, construct meaningful knowledge, and support scientific reasoning—making this competency essential for future educators and professionals (Dellantonio & Pastore, 2021).

However, in the Indonesian educational context, science instruction often remains dominated by lecture-based delivery and rote memorization. As reported by Suprapto et al., (2021), there is a persistent reliance on traditional pedagogies that limit students' opportunities to engage with real-world problems and apply theoretical knowledge critically. Although global trends are moving towards student-centered and inquiry-based learning models, the adoption of experiential learning in Indonesia's higher education institutions—particularly in science education—remains limited and underexplored. This pedagogical gap has significant implications, as it restricts students' development of essential cognitive skills such as critical thinking, reasoning, and reflective inquiry (Coetzee et al., 2011; Murawski, 2014).

Experiential learning, which involves active engagement in real-world tasks, discussions, and reflection, has gained recognition as an effective strategy to promote higher-order thinking. Prince (2004) defines it as a process whereby students learn through structured activities and reflection. Hurd et al. (2014) and Fisher et al., (2017) highlight that experiential learning enables students to develop competencies by applying concepts in authentic contexts and constructing knowledge through direct engagement. Grounded in Kolb's Experiential Learning Theory (1984), this approach emphasizes a cyclical process involving concrete experience, reflective observation, abstract conceptualization, and active experimentation. Similarly, Schön's (2017) theory of reflective practice underscores the role of metacognition and self-awareness in fostering critical inquiry. When effectively implemented, experiential learning not only makes learning more meaningful and lasting (Morris, 2020), but also cultivates independence, accountability, and deeper understanding as students take ownership of their learning (Schwartz, 2012).

Despite substantial international evidence supporting the role of experiential learning in enhancing critical thinking across disciplines such as engineering (Mertayasa et al., 2024), medicine (Coker, 2010), and interdisciplinary education (Espey, 2018; Kolb & Kolb, 2017), there remains a paucity of empirical research investigating its application in the context of Indonesian science education. Most studies conducted to date have focused on general pedagogical practices or have not examined experiential learning strategies in depth. As a result, there is limited understanding of how this approach can be effectively adapted to local educational settings and how it influences specific graduate attributes such as critical thinking.

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This study seeks to address that gap by providing context-specific insights into the implementation of experiential learning within the Indonesian higher education landscape. Situated in a primary science course at Universitas Riau, the research aims to evaluate the extent to which experiential learning can enhance critical thinking among university students. Drawing on Kolb's Experiential Learning Theory (1984) and Schön's Reflective Practice (2017), this study utilizes classroom-based interventions to observe how students engage in reflective, collaborative, and problem-oriented tasks that foster cognitive development. By integrating theoretical frameworks with empirical classroom practices, the study contributes to a growing discourse on pedagogical innovation and curriculum reform in science education.

Moreover, this research responds to the broader educational imperative of aligning local curricula with global competencies. As Indonesia seeks to strengthen its higher education system and enhance graduate readiness for the global workforce, understanding how to cultivate essential soft skills like critical thinking becomes increasingly urgent. The findings of this study are expected to inform educators, curriculum developers, and policymakers about effective strategies for embedding experiential learning within science education. In doing so, this research not only addresses a national pedagogical challenge but also contributes to international scholarship on experiential and student-centered learning.

B. Method

This research employed a quantitative method using a pretest-posttest design without a control group. The study was conducted among 117 fifth-semester students from the Primary School Teacher Education (PSTE) program at Universitas Riau, all of whom were enrolled in a primary science course. The sample predominantly consisted of female students (approximately 75%) aged between 21 and 23 years.

A control group was not included due to both ethical and instructional constraints. To begin with, all participants were part of a single course cohort with no parallel class available, making random assignment unfeasible since everyone was enrolled in the same learning environment and schedule. Moreover, experiential learning was embedded in the course design; thus, dividing students would have disrupted instructional consistency. Ethically, it was also inappropriate to withhold a potentially beneficial approach from any participants.

The research data were collected using a seven-point Likert scale questionnaire designed to assess levels of critical thinking, based on the framework developed by Chettaoui et al., (2021). The levels of critical thinking are presented in Table 1.

Table 1. Critical thinking level

Emergent	Tries to solve problems or answer questions that have no single correct answer
Basic	Compares information from different sources before completing a task
Adequate	Draws on own ideas based on analysis of relevant information
Superior	Summarizes or creates own interpretation of what has been read or taught
Exceptional	Uses evidence to develop arguments, perspectives, or solutions to a problem

Before data analysis, instrument validity and reliability were examined. The results indicated a high level of internal consistency, with a Cronbach's Alpha of 0.963. Data were then analyzed using both descriptive and inferential statistics using SPSS 25. A paired sample t-test was applied to determine significant differences between pretest and posttest scores. The research hypotheses were as follows:

1. Null hypothesis (Ho): There is no significant enhancement of students' critical thinking skills after an experiential learning approach.
2. Alternative hypothesis (Ha): There is a significant enhancement of students' critical thinking skills after an experiential learning approach.

C. Results and Discussion

The following section presents the empirical findings of the study based on the data collected through pretest and posttest assessments. Descriptive statistics, inferential analysis, and effect size interpretations are discussed to evaluate the extent to which experiential learning contributed to students' improvement in critical thinking.

1. Results

This study aimed to examine the impact of experiential learning on the critical thinking skills of university students enrolled in a science course. A pretest–posttest design was employed to measure changes in students' critical thinking performance before and after the implementation of the intervention. The results are presented in two main parts: the analysis of score differences and the changes in students' critical thinking levels.

The descriptive statistical analysis of the data of graduate attribute, critical thinking, which includes minimum value, maximum value, average value, and range, is shown in Table 2 below.

Table 2. Descriptive analysis of students' critical thinking

	N	Minimum	Maximum	Average Score	Std. Deviation
Pre-Test	117	30	67	48.9145	8.15853
Post-Test	117	23	70	55.6923	7.97027
Valid N	117				

The provided table displays the pre-test and post-test data, showing the lowest score of 30 and the highest score of 67 for the pre-test, with an average (mean) score of 48.91. On the other hand, the post-test data reveals a minimum score of 23, a maximum score of 70, and an average score of 55.69. This indicates that there was an increase in the average scores of students in the post-test. Table 3 presents the results of the paired sample t-test:

Table 3. The paired t-test of students' critical thinking

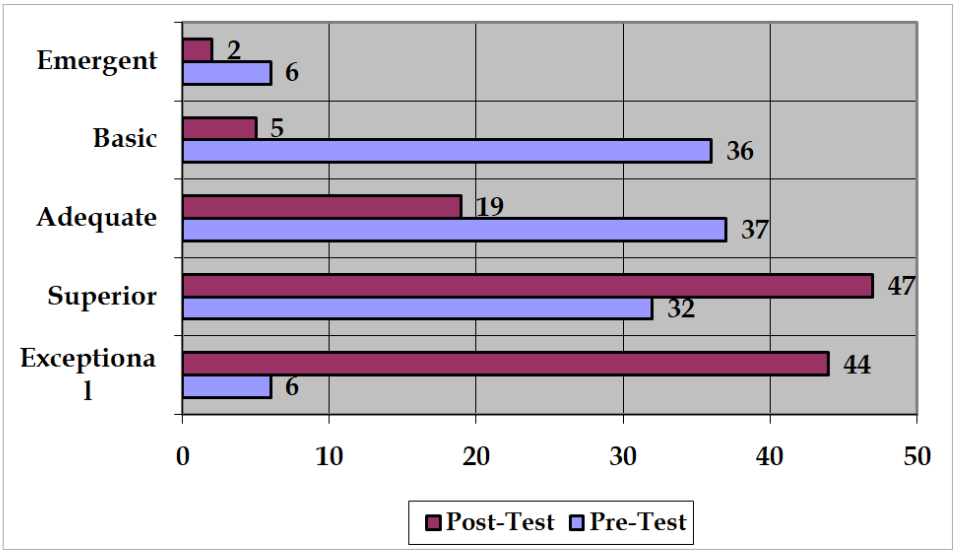
Mean	Std. Deviation	95% Confidence Interval of the Difference		Sig. (2-tailed)
		Lower	Upper	
-6.778	10.818	-8.759	-4.797	.000

Based on the presented table, the obtained p-value is 0.000, which is below the significance level of 0.05. This indicates a significant difference between the pre-test and post-test data. Furthermore, the mean difference between the two sets of data is -6.778, confirming a statistically significant improvement in students' critical thinking skills following experiential learning. Thus, the Ha is accepted.

To enhance the understanding of practical significance beyond statistical significance (p-value), the effect size (such as Cohen's d) is also calculated, particularly using the website https://www.socscistatistics.com/, and gained a result as follows.

Cohen's d = (55.6923 - 48.91453)/8.064949 = 0.840398

The result shows that Cohen's d value is 0.84, which indicates *a large effect size*. This means that the improvement in students' critical thinking skills from the pre-test to the post-test is not only statistically significant but also substantively meaningful. Graph 1 provides a detailed overview of the changes in students' levels of critical thinking to further illustrate this enhancement.



Graph 1. The graph of students' critical thinking enhancement

As depicted in Graph 1, the distribution of students' critical thinking levels underwent a marked transformation following the experiential learning intervention. Before the implementation, only 6 students (5.13%) demonstrated 'emergent' critical thinking skills, 36 students (30.77%) fell within the 'basic' level, and 37 students (31.62%) were categorized as 'adequate'. A relatively small number of students, 32 (27.35%), were in the 'superior' category, while only 6 students (5.13%) reached the 'exceptional' level.

After engaging in the experiential learning program, a significant redistribution occurred. The number of students in the lower-level categories declined sharply: 'emergent' decreased to 2 students (1.71%), 'basic' to 5 students (4.27%), and 'adequate' to 19 students (16.24%). Conversely, the number of students classified as 'superior' increased to 47 (40.17%), and those in the 'exceptional' category rose dramatically to 44 students (37.61%). This shift reflects a substantial elevation in the overall quality of critical thinking among participants.

This redistribution corresponds to a 13.9% average improvement in critical thinking scores and demonstrates a clear movement from lower-order to higher-order thinking levels. The increase in students occupying the 'superior' and 'exceptional' levels suggests that the experiential learning model successfully cultivates advanced cognitive skills. These include the ability to evaluate evidence, synthesize diverse information, draw personal inferences, construct summaries, and apply reasoning in complex problem-solving contexts.

Such findings provide compelling empirical support for the efficacy of experiential learning as a transformative pedagogical tool. By placing students in authentic, inquiry-driven, and reflective learning situations, this approach not only enhances knowledge acquisition but also fosters deeper intellectual engagement. Within the context of higher education, especially in teacher education programs, the ability to develop students' critical thinking through experiential means is essential for preparing reflective, adaptive, and innovative future educators.

2. Discussion

The study discovered that experiential learning contributed meaningfully to the enhancement of students' critical thinking skills. As outlined by Walker (2003), experiential learning is often credited with fostering critical thinking due to its problem-based nature (Mumtaz & Latif, 2017; Nelson & Crow, 2014). However, the mere existence of problems is not what stimulates critical thought. Rather, it is the demand placed on students to challenge presumptions, make deductions, and defend their arguments in frequently complex real-world conditions that does so (Savery, 2015; Yew & Goh, 2016). This dynamic engagement signals a distinct change from conventional instruction, where remembering information is often more important than actively engaging with it (Park & Choi, 2014).

From a psychological standpoint, Kim et al., (2013) argued that experiential learning aligns with constructivist theories, indicating that knowledge is internalized through active participation and reflective processes (Hodges, 2020). Yet, it should be noted that not all experiential learning automatically leads to critical thinking. For students to be able to relate experiences to broader concepts, a structured reflection and guided facilitation are needed. This is particularly underscored by Kolb's (1984) cyclical model, which emphasizes the necessity of intentional reflection and experimentation. In addition, Schön (2017) also stressed that reflective practice fosters metacognitive awareness necessary for critical inquiry.

If seen from a pedagogical viewpoint, experiential learning is often commended for encouraging inquiry-based learning and teamwork—two factors that are commonly linked to the growth of critical thinking abilities (Espey, 2018; Mumtaz & Latif, 2017). However, the notion that these kinds of settings naturally encourage critical thinking needs closer scrutiny. According to Lombardi et al. (2021), inquiry-based learning can pique students' interest and encourage participation, but how well it works largely depends on how the inquiry is structured and how difficult the activities are cognitively. Without critical discourse or scaffolding, simply encouraging questions could result in limited investigation rather than in-depth study.

Similarly, experiential learning's focus on real-world applications and authentic tasks (Hwang et al., 2018; Koohang et al., 2016) can promote meaningful learning. However, this is only if these tasks are purposefully created to call for evaluation, synthesis, and problem-solving—all of which are essential elements of critical thinking. Without such intentionality, students will likely prioritize completing a task instead of reflecting and engaging analytically. Moreover, Kolb and Kolb (2017) added that the pedagogical value of experiential approaches is not just in the activities themselves, but also in how they are framed and facilitated to challenge presumptions and develop critical thinking.

As a further point, Espey (2018) maintained that experiential learning also has a component of cooperative learning since it often involves collaborative activities. Cooperative learning is a teaching approach within the framework of experiential learning that promotes collaboration and shared responsibility among students (Johnson et al., 2008). These interactions expose students to diverse perspectives and ideas (Loes et al., 2018), challenging them to think critically and consider alternative viewpoints. Also, through these interactions, students can develop social skills like collaboration, negotiation, and conflict resolution; all of which are vital for successful teamwork (Virtanen et al., 2017; Olivares et al., 2020). Additionally, experiential learning allows students to practice and refine their communication skills (Johnson et al., 2008). They learn to express their ideas clearly, actively listen to others, and engage in meaningful dialogue, thereby improving their ability to communicate effectively (Betti et al., 2022). In short, cooperative learning in experiential learning can nurture other graduate attributes of students such as effective communication and teamwork (Ginaya et al., 2022).

In this study, the data suggest a significant transition in students' cognitive performance—from lower to higher levels of critical thinking—after the experiential intervention. Yet, it is important to reflect on why a small portion of students remained at the 'basic' or 'adequate' levels even post-intervention. This may point to individual learner differences, varying degrees of prior exposure to critical thinking tasks, or perhaps instructional factors such as inconsistencies in facilitation across activities. According to Sidiq et al. (2021) and Tanti et al. (2020), such differences may also stem from educational disparities between urban and rural students, which affect their foundational science process skills and, consequently, their capacity for reflective analysis. Hence, while the general trend shows improvement, a one-size-fits-all pedagogical approach may not be sufficient to reach all learners effectively.

Furthermore, although this study affirms the effectiveness of experiential learning in the Indonesian context, it also calls for a critical examination of practical challenges in implementation. Indonesian classrooms, as noted by Suprapto et al. (2021), still rely heavily on traditional teaching methods, where lecture-based instruction is predominant. The shift toward experiential learning would require not only pedagogical reorientation but also institutional support, training for instructors, and the development of infrastructure that enables hands-on, inquiry-based, and reflective learning. These structural constraints should be addressed in future research and policy-making to ensure the sustainable integration of such methods.

The global relevance of these findings is another key consideration. Although this study was conducted in Indonesia, the principles of experiential learning can be adapted to various educational settings worldwide as stated by Kolb & Kolb (2017). However, cultural and institutional differences must be accounted for when implementing this approach in different contexts. In Japan, for instance, group harmony and collective learning are frequently emphasized in educational practices (Futaba, 2016). Therefore, it may be necessary to develop experiential activities that foster collaboration while honoring these cultural norms. Similarly, in Scandinavian countries where outdoor education is a significant part of the curriculum (Remmen & Iversen, 2023), experiential learning might focus more on nature-based activities that complement local values and environmental awareness. By considering these localized adaptations, experiential learning can remain globally relevant while being contextually appropriate.

Finally, the implications of this study extend beyond critical thinking alone. Experiential learning has the potential to support the broader development of graduate attributes such as creativity, autonomy, resilience, and ethical reasoning—dimensions not explored in this study but worthy of future investigation. Moreover, while this study used a quantitative approach, future mixed-method or qualitative research could offer deeper insights into the student experience, especially about emotional engagement, motivation, and internalization of values, as suggested by Fisher et al., (2017) and Hurd et al., (2014). Understanding these nuanced dimensions may provide a more holistic view of how experiential learning shapes learner identity and professional preparedness.

In light of the above, the findings of this study also hold significant global implications, particularly as higher education systems around the world grapple with the challenge of cultivating 21st-century competencies among graduates. As emphasized by Archer and Davison (2008), employers across diverse economies increasingly value attributes such as critical thinking, problem-solving, and adaptability—skills that are universally relevant across disciplines and national boundaries. The demonstrated success of experiential learning in enhancing such attributes within the Indonesian context provides a replicable model for other developing countries facing similar educational constraints. Moreover, this study contributes empirically to the international discourse on curriculum reform and pedagogical innovation, particularly in science education where student engagement, inquiry-based approaches, and critical reflection remain global priorities (Murawski, 2014; Hénard & Roseveare, 2012).

By operationalizing Kolb's experiential learning cycle in a non-Western, resource-constrained educational environment, this research offers a compelling case for the broader applicability and scalability of experiential pedagogies across different cultural and institutional settings (Kolb & Kolb, 2017; Schreck et al., 2020). It also responds to international calls for inclusive and context-sensitive models of active learning that transcend traditional lecture-based paradigms (Prince, 2004; Hodges, 2020). As such, this study does not merely address a national pedagogical issue, but rather speaks to the global need for evidence-based strategies that can drive transformative learning and support the development of resilient, ethical, and critically minded graduates in an increasingly complex and interconnected world.

D. Conclusion

This study concludes that the experiential learning approach significantly improves students' critical thinking skills, as evidenced by the statistical increase in post-test scores and the upward shift in critical thinking levels among participants. Through structured engagement in hands-on tasks, reflective practices, and problem-solving activities situated in real-world contexts, students demonstrated enhanced abilities in analyzing, evaluating, and synthesizing information—cognitive skills essential for academic and professional success in the 21st century.

The findings validate the relevance of Kolb's experiential learning theory (1984) and Schön's reflective practice (2017), reinforcing that learning through direct experience, when accompanied by intentional reflection and facilitation, can effectively foster higher-order thinking. This research affirms that experiential learning is not merely an instructional alternative, but a necessary pedagogical transformation for educational institutions striving to cultivate graduates equipped with critical thinking, autonomy, collaboration, and communication—key competencies for employability and lifelong learning (Espey, 2018; Johnson et al., 2008; Kolb & Kolb, 2017).

Furthermore, the findings offer valuable implications for educational policymakers and curriculum designers. The demonstrated effectiveness of experiential learning supports its integration into teacher training programs and higher education curricula. For example, teacher education could incorporate workshops that train pre-service teachers to design inquiry-based learning environments, implement cooperative group projects, and facilitate student reflection. These efforts can ensure that experiential learning is not only understood conceptually but also practiced with pedagogical fidelity and contextual sensitivity.

The study also underscores the importance of local adaptation and cultural responsiveness in the implementation of experiential approaches. Given the diversity of educational settings in Indonesia and other nations, successful application of experiential learning requires thoughtful adjustments that consider student demographics, institutional readiness, and sociocultural norms. As such, experiential learning should not be viewed as a one-size-fits-all model but rather as a flexible and adaptable framework that can be tailored to specific educational landscapes while preserving its core principles.

Although this research provides robust evidence for the potential of experiential learning in science education, it is not without limitations. The focus on a single institutional context and the absence of a control group constrain the generalizability of findings. Moreover, the study examined only one graduate attribute—critical thinking—leaving open questions about how experiential learning influences other essential skills such as creativity, ethical reasoning, or digital literacy. Future studies could adopt comparative or mixed-method designs, expand across disciplines and institutions, and explore longitudinal impacts to further illuminate the broader contributions of experiential learning.

In conclusion, this study contributes both empirically and conceptually to the discourse on educational innovation in higher education, particularly within the Indonesian context. By offering evidence-based insights into how experiential learning strategies can be operationalized to enhance critical thinking, the research bridges pedagogical theory and classroom practice. It calls for systemic support and commitment from educators, institutions, and policymakers to embed experiential learning within curricula, thereby empowering graduates to thrive in complex, dynamic, and globally connected environments.

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