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Journal of Elementary Education
Attadib: Journal of Elementary Education
Web Jurnal: https://ejournal.uika-bogor.ac.id/index.php/at-tadib/index
p-ISSN: 2614-1760, e-ISSN: 2614-1752
UIKA
Universitas Ibn Khaldun Bogor
Edisi : Vol. 10, No. 1, April/2026, hlm. 221-232

A Comparative Study of the Guided Inquiry and Problem-Based Learning Models on the Critical Thinking Ability of Fifth-Grade Elementary School Students in Natural Science

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Abstract

Critical thinking ability is one of the essential 21st-century competencies that students must develop. However, empirical evidence indicates that critical thinking skills among elementary school students in Indonesia remain at a low level, partly due to teacher-centered instructional methods. This study aims to compare the Guided Inquiry learning model and the Problem-Based Learning model in terms of their effectiveness in developing the critical thinking ability of fifth-grade students in Natural Science, with the topic of Ecosystem Harmony in Life. A quasi experimental design with a Non equivalent Control Group was employed, involving 33 students from SD Plus Intan Al-Sali, Bandung (15 students in the experimental class using Guided Inquiry and 18 in the control class using Problem-Based Learning). It is acknowledged that this sample size is relatively small; future comparative studies should consider larger and more representative samples to enhance the generalizability of findings. Data were collected through pretest and posttest instruments comprising 12 essay items aligned with Ennis's twelve critical thinking indicators. Results demonstrated that the Guided Inquiry class achieved a mean posttest score of 87.86 with an N-Gain of 0.79 (high category), while the Problem-Based Learning class achieved a mean posttest of 61.28 with an N-Gain of 0.29 (low category). The Mann-Whitney test yielded Sig. = 0.00 < 0.05, indicating a significant difference in critical thinking ability between the two groups. These findings confirm that the Guided Inquiry model is comparatively more effective than Problem-Based Learning in developing students' critical thinking ability in Natural Science at the elementary school level.

Keywords: Guided Inquiry; Problem-Based Learning; Comparative Study; Critical Thinking Ability; Natural Science; Elementary School.

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INTRODUCTION

Critical thinking ability has been widely recognized as a key competency for the 21st century. According to the Partnership for 21st Century Learning (2020), critical thinking constitutes one of the four core skills known as the 4Cs (Critical Thinking, Creativity, Communication, and Collaboration) that individuals must possess to thrive in a globalized, knowledge-intensive era. In the context of Natural Science (IPA) education at the elementary school level, critical thinking enables students not merely to memorize scientific facts but to analyze natural phenomena, evaluate scientific information, and solve problems based on valid evidence (Kuhn & Dean, 2021).

Despite its acknowledged importance, the critical thinking ability of Indonesian elementary students remains relatively low. The 2022 Programme for International Student Assessment (PISA) results reported that Indonesia ranked 69th out of 80 participating countries, with a science score of 383, reflecting a decline from the preceding cycle. Facione (2015) attributes this condition to the persistence of teacher-centered instructional approaches that afford students limited opportunities to develop higher-order thinking.

This challenge was directly observed at SD Plus Intan Al-Sali, Bandung. A preliminary study revealed that the average critical thinking scores for class V A and V B were 63.67 and 65.11, respectively both categorized as low. Observations and student interviews revealed that the prevailing instructional model Problem Based Learning (PBL) was implemented in a manner where the teacher predominantly served as a facilitator directing students to seek help from group leaders, resulting in passive engagement among students who were reluctant to ask questions. Consequently, critical thinking processes such as analyzing, evaluating, and drawing independent conclusions were not adequately stimulated for all students.

In response to these findings, the Guided Inquiry model presents itself as a theoretically and empirically grounded alternative. Guided Inquiry is an inquiry based instructional approach in which the teacher provides structured scaffolding at each stage of the investigative process while still allowing students to explore and construct knowledge independently (Siregar et al., 2024). According to Piaget's cognitive development theory, fifth grade elementary students are transitioning from the concrete operational to the formal operational stage and therefore require concrete, guided experiences to develop abstract thinking (Suparno, 2001). Guided Inquiry, through its six sequential stages orientation, problem formulation, hypothesis formulation, data collection, hypothesis testing, and

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conclusion drawing (Sanjaya, 2006) provides precisely this kind of structured cognitive scaffolding.

Previous research supports the effectiveness of Guided Inquiry. Pardede and Simorangkir (2022) found that Guided Inquiry helps students develop critical thinking and problem-solving skills by connecting taught concepts with real-world phenomena they observe. Fatmawati et al. (2024) demonstrated that innovative learning models with systematic structures and active student involvement significantly improve critical thinking in fifth-grade elementary students. Compared to other inquiry-based or problem-based approaches, Guided Inquiry provides a higher degree of teacher guidance, making it particularly suitable for students who need structured support to engage in critical reasoning. Notwithstanding this evidence base, three significant gaps remain in the existing literature that this study seeks to address. First, prior studies on Guided Inquiry at the elementary level (e.g., Pardede & Simorangkir, 2022; Fatmawati et al., 2024) have predominantly examined the model in isolation, measuring its effect against a passive or conventional instructional approach. No comparative study has directly placed Guided Inquiry alongside Problem Based Learning (PBL) an active, student-centered model already widely adopted in Indonesian elementary schools to determine which provides stronger scaffolding for critical thinking at this developmental stage. This head-to-head comparison is precisely the design gap the present study fills. Second, existing comparative research on inquiry-based and problem-based approaches has largely focused on secondary or university-level learners; evidence situated specifically at the elementary school level, where students are cognitively transitioning between Piaget's concrete and formal operational stages, remains limited. Third, the Ecosystem Harmony in Life topic which integrates biotic-abiotic components, food chains, and human roles in ecosystems has rarely served as the content vehicle in comparative instructional studies despite its multi-dimensional complexity and its direct relevance to students' lived environments, qualities that make it theoretically optimal for stimulating all twelve of Ennis's (1985) critical thinking indicators simultaneously. By addressing all three gaps within a single quasi-experimental design, this study makes the following specific contributions to elementary science pedagogy: (a) it provides the first direct empirical comparison of Guided Inquiry and PBL on all twelve Ennis critical thinking indicators in a fifth-grade IPA context; (b) it establishes Guided Inquiry's superiority in stimulating higher-order indicators particularly perspective-taking, hypothesis formulation, and evaluative reasoning that PBL without structured scaffolding fails to consistently

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activate; and (c) it offers Indonesian elementary school teachers and curriculum designers a concrete, evidence-based rationale for selecting or integrating Guided Inquiry in science units with complex, interconnected ecological content. The current study therefore addresses the following research questions: (1) How does critical thinking ability develop in the class using Guided Inquiry? (2) How does critical thinking ability develop in the class using Problem Based Learning? (3) Is there a significant difference in critical thinking ability between the two classes after treatment? (4) Which learning model is comparatively more effective in enhancing the critical thinking ability of fifth-grade elementary school students in Natural Science?

RESEARCH METHODS

This study employed a quantitative approach with a quasi-experimental method using a Non-equivalent Control Group Design (Arifin, 2020). Two intact classes were assigned to experimental V A, Guided Inquiry and control V B, Problem Based Learning conditions without random assignment. Both classes were administered a pretest prior to the intervention and a posttest upon its completion. This design allowed for comparison of both pre- and post-intervention performance and for the assessment of within-group improvement through normalized gain scores.

The study was conducted at SD Plus Intan Al-Sali, located in Cilengkrang, Bandung, during the even semester of the 2025/2026 academic year (March 2026). The total population comprised all 33 Grade V students. The Guided Inquiry class V A consisted of 15 students and the Problem-Based Learning class V B consisted of 18 students. Sampling employed the simple random sampling technique, as both classes were treated as naturally formed groups. It is acknowledged that the total sample of 33 students is relatively small for a comparative study. This limitation may affect the statistical power of the findings and the generalizability of conclusions. Future comparative research is therefore recommended to involve larger samples drawn from multiple schools or districts to strengthen external validity.

The critical thinking instrument consisted of 12 open ended essay items, each representing one of Ennis's (1985) twelve critical thinking indicators. Contextual items were developed around the Ecosystem Harmony topic. Two item sets Type A and Type B were developed and tried out with 31 students prior to the main study. Validity was assessed using Pearson product-moment correlation; items were retained if $r \geq$ the r-critical value at $\alpha =$

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0.05. Reliability was evaluated using Cronbach's Alpha: Type A achieved $\alpha = 0.92$ and Type B $\alpha = 0.91$, both classified as highly reliable (threshold: $\alpha \geq 0.70$).

Table 1. Final Instrument Validity Summary

Item No.	Indicator	r-value	Difficulty	Status
1	Recognizing Problems	0.801	Easy	Valid
2	Formulating Problems	0.669	Easy	Valid
3	Collecting Information	0.750	Easy	Valid
4	Analyzing Arguments	0.788	Moderate	Valid
5	Finding Assumptions	0.666	Moderate	Valid
6	Evaluating Evidence	0.836	Moderate	Valid
7	Evaluating Assumptions	0.898	Moderate	Valid
8	Recognizing Perspectives	0.777	Moderate	Valid
9	Evaluating Perspectives	0.854	Moderate	Valid
10	Drawing Conclusions	0.686	Moderate	Valid
11	Communicating Thinking	0.831	Easy	Valid
12	Decision Making	0.823	Easy	Valid

The intervention spanned three learning sessions for each class. Each session in the experimental class followed the six Guided Inquiry stages. The control class followed the five Problem Based Learning stages, with the teacher primarily acting as a facilitator while students worked in groups. Classroom implementation in both classes was documented through observer checklists covering both teacher activity and student activity on a five point scale a present in bar chart:

RESULTS AND DISCUSSION

A. Research Result

The results of observations of the learning process during the first, second, and third sessions in both the experimental and control classes show differences in the average scores obtained in each session. The following is a summary of the observation results for the learning process in each session:

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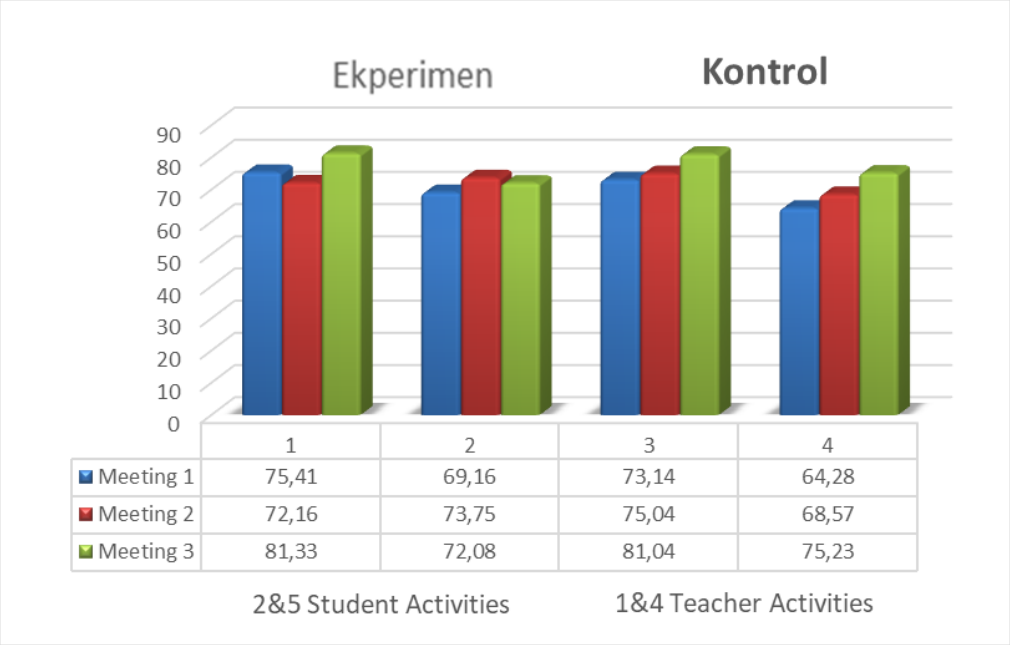

Chart 1. Graph of All Observations in the Experimental and Control Classes

The quality of instructional implementation in both classes was observed across all three sessions. In the experimental class (Guided Inquiry), the overall mean teacher activity score progressively increased from 75.41% (Session 1) to 72.16% (Session 2) and 81.33% (Session 3), yielding an overall mean of 76.30% (Good). Student activity followed a similar trajectory: 69.16% → 73.75% → 72.08%, with an overall mean of 71.66% (Good). In the control class (Problem Based Learning), teacher activity improved from 73.14% to 75.04% to 81.04%, averaging 76.40% (Good), while student activity increased from 64.28% to 68.57% to 75.23%, averaging 69.36% (Good). These data confirm that both models were implemented at an equivalent quality level, thereby strengthening the internal validity of the comparative analysis.

The improvement in critical thinking skills among fifth grade students in the experimental class was more pronounced than among those in the control class, as evidenced by the n-gain test results. The n-gain test was conducted to determine the effectiveness of the Guided Inquiry and Problem Based Learning models in enhancing the critical thinking skills of elementary school students.

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Table 2. N-Gain Test Results

Class	Skor N-Gain	Kategori
Eksperimen	0,79	High
Kontrol	0,29	Low

The results for each student in the two classes were also categorized into the groups defined in the Hake N-gain test, as shown in the table below

Table 3. Percentage of Students by N-Gain Category

No	Category	Number of Students in the Experimental Class	Percentage of Experimental Class	Number of Students in the Control Class	Percentage of Control Class
1	Low		-	11	61,1%
2	Medium	4	26,7%	7	38,9%
3	High	11	73,3%		-

The results of the n-gain score calculations for each student in the experimental class show that 26.7% of all students 4 students fell into the moderate category, while 73.3% of all students 11 students fell into the high category. In the control class, 61.1% of all students fell into the low category 11 students, while 38.9% of all students fell into the moderate category 7 students.

Having identified the differences in N-Gain scores between these two classes, the researchers used the Mann-Whitney U test to compare the critical thinking skills of students in the Guided Inquiry class with those in the Problem-Based Learning class. This non-parametric test is appropriate for comparing two independent groups with small sample sizes and non normally distributed data. The results are presented in the table below:

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Table 4. Results of the Mann-Whitney U Test of N-gain Data on Elementary School Students' Critical Thinking Skills in Science

Uji Mann-Whitney U	U hitung	U maks ($n_1 \times n_2$)	Sig.	Notes
Eksp vs Kontrol	260	270	0,00 < 0,05	H_0 REJECTED There is a Significant Difference

The results of the Mann-Whitney U test yielded a significance level of 0.00 < 0.05; therefore, H_0 was rejected and H_1 accepted. This indicates that there is a statistically significant difference in critical thinking ability between the Guided Inquiry class and the Problem-Based Learning class. The higher N-Gain of the Guided Inquiry class (0.79) compared to the Problem-Based Learning class (0.29) further confirms that Guided Inquiry is comparatively more effective in developing critical thinking skills among fifth-grade elementary school students in Natural Science.

B. Discussions

The superior performance of the Guided Inquiry group is theoretically consistent with Piaget's (Suparno, 2001) stage theory, which posits that Grade V students ages 10–11 are in transition between concrete operational and formal operational thinking. The six sequential stages of Guided Inquiry provide the scaffolding necessary for this developmental transition: orientation concretizes the phenomenon; problem formulation trains analytical articulation; hypothesis generation develops predictive reasoning; data collection builds evidence-gathering skills; hypothesis testing fosters logical evaluation; and conclusion drawing cultivates synthesis and communication all core components of the twelve Ennis (1985) critical thinking indicators assessed in this study.

The finding that all twelve critical thinking indicators reached High N-Gain in the Guided Inquiry class contrasts sharply with the control class, where seven indicators remained at Low. This pattern suggests that Problem Based Learning, in the absence of structured teacher scaffolding, fails to consistently stimulate the full range of critical thinking processes particularly perspective-taking and problem formulation in elementary school contexts. This is corroborated by the observation data, which reveal that student activity in the control class consistently trailed teacher activity scores, indicating that students remained relatively passive even within the Problem Based

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Learning framework. This finding aligns with Faturrahman's (2022) argument that Problem Based Learning without structured teacher guidance is insufficient to foster comprehensive critical thinking development in all students.

The N-Gain of 0.79 achieved by the Guided Inquiry class exceeds the thresholds reported in comparable studies involving active learning models at the elementary level: Hasanah and Kristin (2022) obtained N-Gain = 0.65 with Discovery Learning, and Anggraeni and Zulfiati (2023) achieved N-Gain = 0.58 with Think Pair Share. Crucially, however, neither of those studies placed their target model in direct comparison with Problem Based Learning a model already institutionally embedded in the school under study. The present study therefore advances beyond prior work in two specific ways. First, whereas previous comparative studies in Indonesian elementary science education have typically measured inquiry models against conventional (teacher-lecture) approaches, this study benchmarks Guided Inquiry against an equally active, student-centered competitor (PBL), thereby yielding a more rigorous and practically meaningful comparison for school practitioners. Second, by employing all twelve Ennis indicators as the measurement framework rather than a global critical thinking score, this study generates indicator-level diagnostic evidence: Guided Inquiry produced High N-Gain across all twelve indicators, while PBL failed to reach the High threshold on seven particularly those requiring independent hypothesis formulation, perspective evaluation, and argumentative reasoning. This indicator-level granularity represents a distinct methodological contribution to the literature on elementary science pedagogy, providing teachers with actionable insight into which cognitive processes each model effectively stimulates. The higher overall gain may additionally be attributed to the thematic coherence of the Ecosystem Harmony content which provided rich, multi-layered phenomena for inquiry as well as to the structural alignment between the six Guided Inquiry stages and the twelve Ennis critical thinking indicators, an alignment that PBL's five-stage framework does not replicate with equivalent specificity at this school level.

These comparative results carry specific and actionable implications for elementary science pedagogy, representing contributions that extend beyond what prior single-model studies have been able to offer. For classroom teachers, the findings provide a clear, evidence-based basis for model selection: when the instructional goal is the comprehensive development of critical thinking across all twelve Ennis indicators particularly the higher-order processes of hypothesis formulation, perspective evaluation,

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and argumentative reasoning Guided Inquiry is demonstrably more effective than PBL in fifth-grade IPA contexts. This is a pedagogically significant finding because both models are actively promoted in Indonesian Merdeka Belajar curriculum guidelines, yet no prior empirical study at this school level has directly adjudicated between them on a criterion as detailed as Ennis's full twelve-indicator framework. For curriculum designers and school principals, the study offers a concrete, replicable model-pairing design Guided Inquiry vs. PBL in a Non-equivalent Control Group that can be adapted to other IPA topics beyond Ecosystem Harmony, enabling schools to build their own contextual evidence base for model selection. For teacher educators, the indicator-level data demonstrating that seven Ennis indicators remained at Low N-Gain under PBL suggest that pre-service and in-service training should specifically address how to structurally embed scaffolding for these higher-order indicators within PBL lesson plans, particularly at the elementary level where students have not yet fully entered the formal operational stage. The Guided Inquiry model offers a structural template for this scaffolding. Nevertheless, the small sample size in this study (n = 33) is a notable limitation; findings should be interpreted with caution. Future comparative studies should extend to larger, multi-site samples to improve generalizability, examine the long-term retention of critical thinking gains, and explore the integration of digital media within the Guided Inquiry framework.

CONCLUSION

This comparative study demonstrates that the Guided Inquiry learning model is significantly more effective than the Problem-Based Learning model in developing the critical thinking ability of fifth-grade elementary school students in Natural Science, specifically on the Ecosystem Harmony in Life topic. The Guided Inquiry class achieved a mean posttest score of 87.86 (N-Gain = 0.79, High), compared to 61.28 (N-Gain = 0.29, Low) for the Problem-Based Learning class. The Mann Whitney U test yielded a significance level of $0.00 < 0.05$, confirming a statistically significant difference between the two groups. It should be noted, however, that the sample size of this study (n = 33) is relatively small, which limits the generalizability of these findings.

All twelve of Ennis's critical thinking indicators reached High N-Gain improvement in the Guided Inquiry class, whereas seven indicators remained at the Low level in the Problem-Based Learning class. This comparative pattern indicates that Guided Inquiry

provides more comprehensive and balanced stimulation of critical thinking across its full spectrum than Problem-Based Learning at the elementary school level. The study distinguishes itself from prior research in three key respects: (1) it is the first to directly compare Guided Inquiry with Problem-Based Learning rather than with conventional instruction at the fifth-grade IPA level, providing a more rigorous and practically relevant benchmark for school practitioners; (2) it employs Ennis's complete twelve-indicator framework as its measurement tool, yielding indicator-level diagnostic evidence that global critical thinking scores cannot provide; and (3) it situates both models within the ecologically rich Ecosystem Harmony topic, demonstrating that content complexity and model-indicator alignment are jointly important determinants of critical thinking outcomes. These contributions offer specific guidance for Indonesian elementary science pedagogy: Guided Inquiry should be prioritized or integrated as a primary instructional model for IPA units with complex, interconnected concepts, while PBL implementation at this level should be structurally enhanced to incorporate explicit scaffolding for the higher-order Ennis indicators that it currently fails to stimulate. Future comparative studies should replicate and extend these findings with larger, multi-site, and more diverse samples.

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