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ENHANCING CRITICAL THINKING SKILLS THROUGH THE GUIDED INQUIRY LEARNING MODEL IN SCIENCE EDUCATION

Nurhalisa[1*], Arda[1], Rahmawaty[2]

[1]Department of Natural Science Education, State Islamic University Datokarama Palu, Central of Sulawesi, Indonesia
[2]Department of Islamic Elementary School Teacher Education, State Islamic University Datokarama Palu, Central of Sulawesi, Indonesia

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ABSTRACT

This study investigates the enhancement of students' critical thinking skills through the implementation of the guided inquiry learning model in science instruction for eighth-grade students at MTs Negeri 2 Kota Palu. Employing a quasi-experimental nonequivalent pretest-posttest control group design, the study involved two classes, with the experimental group receiving instruction via the guided inquiry learning model and the control group taught using a conventional learning model. This study is important because Indonesian students' critical thinking skills remain low, and the guided inquiry learning model offers a promising pedagogical approach to address this issue in science education. Data were collected through a test consisting of 15 items, validated for both reliability and validity. Before conducting hypothesis testing, the assumptions of normality and homogeneity were verified. Further analysis using an independent samples t-test revealed that students in the experimental group showed significantly greater improvement in critical thinking abilities compared to the control group. These results suggest that the guided inquiry learning model effectively enhances students' critical thinking skills in science education.

Corresponding Author:
Nurhalisa, Department of Natural Science Education, State Islamic University Datokarama Palu, Central of Sulawesi, Indonesia
Email: lisahalisa1005@gmail.com

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INTRODUCTION

Science education holds an essential role in developing students' capacity for critical, logical, and reflective thinking, transcending the mere delivery of factual knowledge (Pursitasari et al., 2020; Wahidin & Romli, 2020). Positioned as a central pillar in both primary and secondary curricula, science equips learners with meaningful opportunities to engage in authentic scientific inquiry through observing natural phenomena, conducting experiments, analyzing data, and formulating conclusions(Marta et al., 2025; Usmeldi et al., 2017). These inquiry-driven activities foster not only scientific literacy but also promote essential cognitive skills, such as reasoning, argumentation, and evidence-based decision-making, which are vital for understanding and responding to the complexities of the natural world (Hasnunidah et al., 2020).

Effective science education should position students as active constructors of knowledge rather than passive recipients of information. Learning activities that promote questioning, exploration, and hypothesis testing are essential for fostering critical thinking skills and deeper conceptual understanding (Toheri et al., 2020). However, in actual classroom practice, science instruction often remains dominated by conventional, teacher-centered methods in which the teacher is regarded as the sole authority and students are positioned as passive learners. Consequently, students may rely heavily on rote memorization of scientific concepts, with limited engagement in the reasoning processes through which these concepts are developed and applied in real-world contexts (Astuti et al., 2019; Setiawaty et al., 2024).

This challenge is clearly reflected in the persistently low levels of students' critical thinking skills within science education, as evidenced by both national and international assessment outcomes. Indonesian students continue to struggle with interpreting scientific texts, analyzing data, and solving problems rooted in real-life contexts (Hidayati & Sinaga, 2019; Pamungkas et al., 2018). Findings from PISA (Programme for International Student Assessment) consistently indicate that Indonesia's performance in scientific literacy remains below the OECD average. Core competencies such as evaluating arguments, drawing logical inferences, and critically assessing the credibility of scientific information are still underdeveloped and demand urgent pedagogical attention (Azrai et al., 2020; Ismawati et al., 2023).

A fundamental change in teaching strategies is needed to address this problem and enhance science education's quality and results. Through active student participation in the scientific inquiry process, the guided inquiry learning model presents a promising strategy for fostering the development of critical thinking skills. Students are encouraged to examine problems systematically by posing questions, developing hypotheses, planning and execution of experiments, analyzing results, and drawing conclusions. In this learner-centered approach, teachers function as facilitators by offering personalized guidance and support that align with each student's individual needs and learning progression (Duran & Dökme, 2016; Putra et al., 2018).

An active, engaging, and meaningful learning environment is fostered through implementation of the guided inquiry learning model. Rather than relying exclusively on lectures or worksheets, students are encouraged to build knowledge through exploration and critical reflection. This approach fosters a classroom culture that emphasizes the cognitive process itself rather than focusing solely on end results. Throughout each phase of learning, activities such as questioning, discussion, interpretation of observations, and the construction of logical arguments serve to consistently nurture and strengthen students' critical thinking skills (Aiman et al., 2020; Pursitasari et al., 2020).

MTs Negeri 2 Kota Palu has actively implemented various active learning strategies in science education to boost student participation and engagement. Nevertheless, students' critical thinking skills, particularly in information processing, data analysis, and constructing evidence-based logical reasoning, remain underdeveloped. This situation suggests that previous instructional approaches have not sufficiently promoted deep scientific thinking. This condition essentially reflects a broader national challenge regarding the low level of students' critical thinking skills in science education. This is reinforced by findings from international assessments such as PISA, which indicate that students continue to struggle with scientific reasoning and problem-solving.

Consequently, the guided inquiry learning model presents a suitable alternative, as it integrates students' independent exploration with systematic and structured facilitation by the teacher. The effectiveness of this model in enhancing critical thinking skills has been repeatedly demonstrated in numerous studies (Lindriani & Suwarna, 2023; Nisa et al., 2018; Samadun et al., 2023). However, few studies have specifically examined the implementation of the guided inquiry learning model on the excretory system topic with an in-depth analysis of each critical thinking skill indicator. This indicates a research gap regarding how the model supports the development of specific cognitive processes in junior high school science education.

Based on this background, the author is motivated to conduct research titled "Enhancing Critical Thinking Skills through the Guided Inquiry Learning Model in Science Education". The novelty of this study lies in its focused application of the guided inquiry learning model to the excretory system topic, combined with a detailed analysis of five indicators of critical thinking skills. This integrated approach offers a more comprehensive understanding of how guided inquiry supports students' cognitive development in science education.

METHOD

This study examines the effects of the guided inquiry learning model on the critical thinking skills of eighth-grade science students at MTs Negeri 2 Kota Palu, using a quasi-experimental design with a nonequivalent pretest-posttest control group. Students' critical thinking skills served as the dependent variable, while the guided inquiry learning model was the independent variable. The study population consisted of all 231 eighth-grade students at the school. Two classes, each comprising 34 students, were purposefully selected from this population: class VIII A served as the control group and class VIII B as the experimental group. The sampling technique used was purposive sampling, with the two classes selected based on comparable academic ability, teaching schedule availability, and input from subject teachers. These criteria were intended to ensure consistency and feasibility in implementing the learning interventions, as well as to minimize potential bias and enable a more controlled comparison between the experimental and control groups.

The instrument used in this study was a critical thinking skills test consisting of 15 items. It was validated by two subject matter experts based on content relevance and alignment with the five indicators of critical thinking skills. Content validity was established through expert judgment, while reliability was assessed through a pilot test involving students with similar characteristics to the target population. This instrument was used in both the pretest and posttest to measure changes in students' critical thinking skills. The validation results indicated that the instrument was appropriate and credible for assessing students' critical thinking skills.

Both descriptive and inferential statistical techniques were used in the data analysis for this study. The mean, standard deviation, maximum, and minimum scores from the posttest measuring critical thinking abilities were compiled using descriptive statistics. Inferential statistics were used for hypothesis testing, beginning with the normality and homogeneity tests to confirm presumptions. An independent samples t-test was used to determine whether the experimental and control groups' posttest scores differed significantly after these requirements were verified. The statistical significance of the guided inquiry learning model's effect on students' critical thinking skills was ascertained through this analysis.

RESULT AND DISCUSSION

The excretory system was the primary topic of the research, which was carried out through educational activities in both the experimental and control classes. While the control group received instruction using conventional methods, the experimental class was taught using the guided inquiry learning model. Students in both classes first took a pretest to determine their baseline skills. With average scores of 33.74 for the experimental class and 33.94 for the control class, the pretest results showed similar starting competencies between the two groups. Upon completion of the instructional period, a posttest was conducted to evaluate students' understanding of the material covered. The posttest results, presented in Table 1, show that the experimental class achieved a higher mean score (83.74) compared to the control class (77.69).

Table 1. Posttest Results

Class	Maximum	Minimum	Mean	Std. Deviation	Std. Error Mean
Experimental	93	67	83.74	6.552	1.124
Control	87	67	77.69	6.140	1.085

An independent samples t-test was used to test the hypothesis based on the posttest results. Assumption tests, such as tests for homogeneity and normality, were carried out before the t-test. To ascertain whether the data were normally distributed, the Kolmogorov-Smirnov test was used to evaluate normality. The findings verified that both groups' data had a normal distribution. Levene's Test was then used to test for homogeneity of variance, and the results showed that the variances between the groups were equal. The independent samples t-test was judged suitable to assess the significant difference in mean posttest scores between the experimental and control groups because both assumptions were encountered.

Table 2. Independent Samples T-Test

		Levene's Test for Equality of Variances		*t-test for Equality of Means*						
		F	*Sig.*	*t*	*df*	*Sig. (2-tailed)*	*Mean Difference*	*Std. Error Difference*	*95% Confidence Interval of the Difference*	
									Lower	*Upper*
Critical thinking skills	*Equal variances assumed*	.159	.692	3.863	64	.000	6.048	1.565	2.920	9.175
	Equal variances not assumed			3.871	63.999	.000	6.048	1.562	2.927	9.169

The value of 2-tailed significance is 0.000, which is below the 0.05 threshold, was determined using the independent samples t-test. This suggests that the guided inquiry learning model significantly influences the critical thinking abilities of eighth-grade science students at MTs Negeri 2 Kota Palu, as the alternative hypothesis (H_a) is accepted and the null hypothesis (H_0) is rejected.

Table 3 shows how the experimental and control groups differed in their average scores for each component of critical thinking abilities.

Table 3. Differences in Average Scores of Critical Thinking Skills

No	Indicator	Experimental	Control
1	Elementary clarification	30.19	27.28
2	Basic support	16.07	16.24
3	Inference	20.39	19.79
4	Advanced clarification	5.10	3.96
5	Strategies and tactics	11.95	10.41

The differences between the experimental and control groups' average scores for each critical thinking skill indicator are presented in Table 3. The experimental group outperformed the control group in four out of five indicators. However, the control class showed a slightly higher score in the basic support indicator (16.24) compared to the experimental class (16.07). This result is likely due to the conventional teaching approach, which emphasizes memorization and direct instruction. The basic support indicator involves students' ability to use facts and data to support arguments, skills often reinforced through explicit explanations provided by the teacher. In contrast, guided inquiry learning prioritizes the development of higher-order thinking skills such as analysis and inference, which may shift students' focus away from basic factual support.

This difference in scores suggests that the guided inquiry learning model was more effective in developing students' abilities in the indicators of elementary clarification, inference, advanced clarification, and strategies and tactics. These four indicators reflect higher-order thinking processes such as interpreting information, drawing conclusions, evaluating arguments, and planning problem-solving strategies, skills that are actively fostered through inquiry-based learning activities. In guided inquiry, students are encouraged to formulate questions, explore problems, analyze observations, and justify their reasoning collaboratively. The teacher serves as a facilitator who provides scaffolding as needed, while allowing students to construct knowledge independently through critical engagement. Consequently, students in the experimental group had greater opportunities to develop deep analytical and reflective thinking skills, which contributed to their higher scores in these four indicators.

Further evidence from classroom observations and student feedback indicated that the most impactful stage of the guided inquiry process was the exploration and concept formation phase, where students engaged in active information analysis and collaborative argument construction. During these stages, learners were frequently involved in interpreting experimental results, synthesizing information, and discussing alternative explanations. These are activities closely aligned with the development of critical thinking skills.

The findings of this study are consistent with previous research highlighting the effectiveness of the guided inquiry learning model in enhancing students' critical thinking skills. Students who engaged with the guided inquiry approach demonstrated significant improvements in their analytical and evaluative abilities compared to those taught using conventional methods (Cahyati & Subali, 2022; Fauziah & Novita, 2021; Nurmawati & Novita, 2022). Other studies have revealed that the guided inquiry model offers broader opportunities for students to actively explore the material and enhance higher-order thinking skills such as synthesis and reflection (Novitra et al., 2021; Purwasi, 2020).

In contrast to previous studies, the present research provides a more detailed analysis of each indicator of critical thinking to identify which cognitive domains benefit most from guided inquiry instruction. Moreover, by focusing on the excretory system, a topic that has received limited attention, this study not only reinforces the general advantages of the guided inquiry model but also contributes to the literature by highlighting its specific impact on distinct aspects of critical thinking skills in science education.

The facilitator role of the teacher in guided inquiry learning has proven to be crucial in fostering a learning environment that encourages collaboration and discussion among students. Teacher guidance helps systematically direct students' thinking processes, enabling the ideal development of their critical thinking skills.

In addition, the findings of this study also support the theoretical framework of critical thinking, which emphasizes core cognitive skills such as clarification, inference, and strategy use. The improvements observed among students in the experimental group are consistent with the constructivist perspective that knowledge is constructed through active engagement, inquiry, and reflection. Moreover, the slight advantage in the basic support indicator among students in the control class reinforces the idea that structured, teacher-centered instruction can effectively develop foundational cognitive processes. These insights suggest that combining inquiry-based strategies with explicit instructional support may offer a more comprehensive approach to fostering critical thinking skills in science education.

CONCLUSION

The guided inquiry learning model was effective in enhancing the critical thinking skills of eighth-grade science students at MTs Negeri 2 Kota Palu has been established. Students who participated in the learning process using this model demonstrated greater improvements in their critical thinking skills than those who received traditional instruction. Evaluation results showed significant difference between posttest scores in the experimental class compared with the control class. The guided inquiry learning process stimulates students to be more active, sharpening their abilities to ask questions, make observations, analyze information, and draw conclusions both independently and collaboratively. This model not only contributes to improved learning outcomes but also fosters a scientific mindset that is critical and reflective in understanding science concepts.

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AUTHOR CONTRIBUTIONS

Author One played a central role in shaping the research concept, drafting the initial manuscript, revising the content, and developing the visual elements. Meanwhile, Authors Two and Three, as advisors, provided valuable guidance, supported the writing of the literature review, conducted methodological analysis, and oversaw validation and supervision throughout the research process. The contributions of each author were essential to the successful completion of this study.

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