

Pedagogical Efficacy of Guided Inquiry Modules: Enhancing Critical Thinking in Elementary Education Through Quasi-Experimental Validation

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Abstract

The current research aims to examine the impact of guided inquiry-based learning on elementary school students' critical thinking. A quasi-experimental research design with one group pre-test and post-test was employed. The participants were 24 elementary school students selected based on the convenience sampling method. Pre and post-tests were given to the participants, and the data gathered was analysed through a paired sample t-test. The result of the paired sample t-test is significant with a p-value < .001, indicating the significant increase in the difference between the pre-test and post-test of the students' critical thinking. Other than that, the standard deviation of the difference is 10.60, with a standard error of 1.53, with the mean difference between posttest and pretest being 77.33 points, indicating the different result of the posttest with the pretest. Furthermore, the values 2.08 for Cohen's d and 2.01 for Hedges' correction indicate that the guided inquiry module had a strong and meaningful impact on enhancing students' critical thinking abilities. In this case, the hedges and Cohen's d value emphasise the significance of guided inquiry-based learning for the development of students' critical thinking. Therefore, the current research confirms the significance of the use of guided inquiry-based learning to improve elementary school students' critical thinking.

Keywords: collaborative learning, critical thinking, guided inquiry-based learning, learning engagement, personalized learning

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1. Introduction

In the current development era, one of necessary skill that need to be introduced since elementary school level is the critical thinking skill. according to Jumanto et al. (2024), critical thinking is the ability of synthesizing information from various sources with different perspective. Abbasi & Izadpanah (2018) stated that this ability prepares students to engage constructively with the social issue which is necessary to strive

in the current advance era. This skill is particularly importance in the era where the falsehoods and hoax can spread rapidly driving students to confusion, misunderstanding and poor decision making. In this case, students can critically assess sources and evaluate arguments rigorously that can hinder them with the untrue information letting them take and follow the right path (Spector & Ma, 2019).

Trigueros et al. (2020) emphasize that the ability to critically assess information encourages independence and autonomy in students, prompting them to question assumptions and engage in deeper inquiry rather than accepting information at face value. Therefore, it can equip and protect the students with unnecessary behaviour or decision. Other than sorting positive and importance information, critical thinking also promises students for academic success. It is because the critical thinking is necessary for learning engagement and knowledge retention. Through the ability of critically assess the information, students can actively investigate and reflect materials emphasizing their comprehension and mastery on the subject matter (Manurung et al., 2022; Hidayat et al., 2024). It was emphasized by Phan (2008) who stated that when students engage deeply with the material through critical analysis, students tend to exhibit improvement in academic mastery. Furthermore, critical thinking help students to answer academic question which can directly improve academic achievement.

Liu et al. (2023) stated that students with critical abilities have more tendencies to be able to solve problem rationally. In this case, the ability of analysis, evaluation and inference is a part of critical thinking, having this skill make students have superiority in making reasonable judgment which is critical for answering academic question (Kanwal & Butt, 2021; Uslan et al., 2024). Therefore, it is importance to equip elementary school students for critical thinking as its cultivate the academic achievement and social retention.

In regard to the importance of critical thinking for students' social retention and future academic success, cultivating the elementary school students critical thinking is necessary. However, the current literature

indicates the low critical thinking level among elementary school students in indonesia. In this case, a study by Achmad & Utami (2023) posit that the Indonesian elementary school students critical thinking was only 54%, underscoring a substantial shortfall in their critical thinking capabilities. This data was emphasized by Herlawan et al. (2023) who report only 45% of Indonesian students transferring from elementary to higher education displayed the basic critical thinking skills required for university-level curriculum, showing a significant shortfall in elementary level. Other than that, a study conducted among primary school students indicated that around 45% of the polled students admitted that they did not fully comprehend what critical thinking comprised, while 65% expressed a desire to enhance their critical thinking skills (Halim et al., 2023). These data not only demonstrate the magnitude of the problem but also suggest that students' limited understanding of critical thinking may be linked to the way it is taught or emphasized in classrooms.

Previous studies have pointed to factors such as teacher-centered instruction (Parmin, 2021), limited use of inquiry-based learning models (Baskara, 2023), and a heavy focus on rote memorization as contributing causes of low critical thinking skills at the elementary level in Indonesia (Septiana et al., 2022). The problem is also reflected in international assessments: Indonesian students scored an average of 397 in mathematics and science, ranking 46th out of 51 participating countries in the Trends in International Mathematics and Science Study (TIMSS), which measures students' thinking abilities in these subjects (Pasaribu, 2023). Taken together, these findings highlight not only the low level of critical thinking among Indonesian elementary students but also the urgent need for peda-

gogical approaches such as guided inquiry that directly cultivate these skills.

Responding to the above problem, more research on the best strategies or pedagogical approach for cultivating students critical thinking is importance. In this case, one of the possible pedagogical approach that might influence the elementary school students critical thinking in the classroom is the guided inquiry learning approach.

The guided inquiry learning approach is an educational strategy that emphasises student participation in the learning process through active exploration and discovery, while offering structures to support them in their inquiry. This pedagogical method is designed to foster a deeper understanding of content through critical thinking, problem-solving, and collaborative learning. According to [Eriyanti et al. \(2023\)](#) Guided inquiry is fundamentally different from free inquiry in that it provides systematic guidance in the form of probing questions or prompts that steer students' exploration. This approach enables students to take initiative in their learning by discovering information and building knowledge while receiving support from instructors who function as facilitators ([Igboanugo, 2023](#); [Ghazali et al., 2024](#)). In this case, the guiding questions or instruction work as triggers that stimulate students to think critically, therefore developing their analytical skills and encouraging active engagement ([Tanjung et al., 2022](#)).

One of the reason that the guided inquiry learning can cultivate students critical thinking is its requiring students independent thinking and problem solving. [Aswirna et al. \(2024\)](#) affirm that when students face a real challenge framed by the teachers, students can develop their critical thinking effectively compare to the traditional method. It is because the students assess information, formulate hypothesis and draw conclusion on the

aspect being investigated. Other than that, based on nature of this approach that emphasize teachers guidance on the learning process, teachers can navigate the students classroom activities to the activities that have tendencies in cultivating the critical thinking aspect ([Triwiyanti et al., 2023](#); [Rahmatika et al., 2024](#)).

Furthermore, the characteristics of the guided inquiry-based learning might be a significant factor in enhancing students current critical thinking deficiencies. For example, the one of the characteristics of the guided inquiry-based learning is it structured yet open ended. This characteristic is significant in cultivating the students current critical thinking deficiencies as it allows students to engage with the content material structurally while let them explore various pathways in their inquiry process. [Maknun \(2020\)](#) stated that a structured procedures drive students in the right path of the cognitive development as the students critical thinking was guided through the structured questioning procedures. In this case, the structured questioning make sure the question given to the students is a relevant question that can cultivate students critical thinking. Other than that, through structured procedure, students can be guided in the right way of empowering their critical thinking, which they might not received in unstructured procedure where there is no direction or guiding principle. Other than that, in regard to its open-ended procedure, the students can delve beyond surface-level responses, promoting deeper analytical and evaluative thinking. For example, the students are unrestricted in giving the responds while follow the procedure to give a critical respond.

In this case, [Saekawati & Nasrudin \(2021\)](#) stated that questions that permit multiple responses empower students to take ownership of their learning by posing their

inquiries and determining the areas of investigation. In this condition, students are more engaged and willing to explore complex concepts when they are invited to think critically rather than to provide memorized answers (Rusiana, 2024).

Another characteristic of the guided inquiry-based learning is it based on students center approach. The word of “guided” means that the teachers not lecturing the students but the teachers are facilitating the learning environment encouraging the students to actively participate in their learning. This is significant because when the teachers facilitate the learning, they design the classroom that encourage the students to formulate their own understanding and explore the topics deeply (Aswirna et al., 2024). This approach nurtures agency in learners, as they take charge of their educational journeys, leading to better engagement and increased motivation to think critically. Miftakhurrohman et al. (2023) emphasized that guided inquiry-based learning is a students center learning where the students allowed to investigate and draw conclusion based on their understanding, and the teachers support this inquiry development by guiding and driving the students throughout the learning process. Furthermore, the role of a teachers as facilitator enables personalised learning based on the needs of each individual student. Solikah & Novita (2022) indicate that teachers who take on the role of facilitator can help students navigate complex challenges by offering organised support while allowing for independent investigation. This personalised approach helps students develop critical thinking abilities and builds confidence as they express their discoveries and ideas.

In term of the possibilities of guided inquiry-based learning to cultivate Indonesian elementary school students critical thinking skill, several research attempted to prove this

significancy can be found in literature. In this case, several research proved the significant of guided inquiry-based learning on students critical thinking skill with the addition of some context. For instance, Lestari et al. (2023) examine the impact of guided inquiry-based learning on elementary school students critical thinking in the context of virtual laboratories, peer instruction (Ahaddin et al. 2020), social inquiry based learning (Bahtiar & Desiningrum 2024), moderating role of learning motivation (Alawiah et al. 2024). These researchs proved the significant of the guided inquiry based-learning on elementary school students critical thinking skill but since additional context given, it might not reflect the true effect of the guided inquiry based learning on elementary school students critical thinking.

Research that proves the impact of guided inquiry-based learning solely without additional elements on the elementary school students critical thinking is needed. Furthermore, much of the current literature focus in the context of higher school level (Wulandari et al., 2022; Miftakhurrohman et al., 2023;), and little research have been conducted in the elementary level. More research in the context of elementary school students in indonesia need to be emphasized in order to emphasize the significant of the guided inquiry-based learning on elementary school students critical thinking skill. Therefore, the current research aims to examine the impact of guided inquiry-based learning on elementary school students critical thinking.

Based on it purpose to examine the impact of guided inquiry-based learning on elementary school students in Indonesia, this research contributes to provides empirical evidence on the effectiveness of guided inquiry-based learning in fostering critical thinking at Indonesian elementary level, and

it offers practical implications for teachers and curriculum designers seeking to improve classroom practices and learning outcomes. Overall, the current research will bridges the gap between observed deficiencies in students' critical thinking and actionable instructional strategies that can enhance these essential skills.

2. Method

The current research aims to examine the impact of guided inquiry-based learning on elementary school students' critical thinking skills. Quantitative research of one group pre- and post-test quasi-experiment design research was used. A quasi-experiment is a research procedure that seeks to examine the impact of an intervention or a treatment on a specific outcome (Gopalan et al., 2020). This researcher procedure mainly involves the comparison between one dataset to another, allowing for more detailed analysis of the cause and effect of a particular intervention (Suryani et al., 2024). Zajić and Maksimović (2022) revealed that one typical model of quasi-experiment research is one-group pre-test and post-test research.

This design facilitates preliminary examination of the intervention by examining the pre-existing condition of the subject studied and comparing it with the post-condition; it directly depicts the effect attained on the intervention procedure

(Aryanti et al., 2023). This design was utilised in the current research where a group of students were given an inquiry-based learning approach as the intervention; the students' critical thinking was examined before and after the intervention.

The participants of the current research are 24 elementary school students selected based on the convenience sampling method. The intervention based on guided inquiry-based learning was given to the students. The learning process mainly emphasises the activities of questioning, experiencing projects, exploring, and presenting. These interventions were given in two learning sections with 35 minutes for each section. The sections were conducted on different days. Therefore, the intervention was given in two days with 35 minutes on each day. On the first day, the learning activities were focused on students questioning, triggering students to think critically. In this case, a video of "states of matter and their changes" was given to students, and some questions related to the video were given. Other than that, the students also experience the learning process by conducting a simple science project. On the second day, the intervention emphasised the exploration and presentation where students identified the changes in the states of matter that occur and explained how these changes can take place. Detail information about the intervention given in the table 1 and table 2.

Table 1. Description of the Intervention Day 1

Activities	Sub-activities	Sub-Sub-activities
Material	"States of Substances and Their Changes"	
Learning objectives	1. Students able to recognize materials and their characteristics. 2. Students able to characterize the states of matter/materials. 3. Students able to explain how changes in the states of matter occur. 4. Students able to process and understand quickly, capable of attaining higher-order thinking skills (HOTS), and possessing leadership skills.	

Activities	Sub-activities	Sub-Sub-activities
Activities	1. Q&A session	In this activities, students were given question stated below; Introduction to the Topic • What is matter? • Why can water stored in the refrigerator turn into ice? • What is the difference between water and ice? Topic: How the States of Matter Change • What is melting and freezing? • What is evaporation and condensation? • What is sublimation?
	2. Students were divided into group and given project to finish	In this activity, students were given a video about states of matter. in group, they were asked to watch the video and demonstrate the process of changes in the states of matter and explain the energy involved.
	3. Reflection	Teachers and students do reflection where the review the learning process and guide the students understanding.
	Duration	35 minutes

Table 2. Description of the Intervention Day 2

Activities	Sub-activities	Sub-Sub-activities
Material	“States of Substances and Their Changes”	
Learning objectives	1. Improve students’ ability to recognize and describe the characteristics of solid, liquid, and gas states of matter; identifying whether a substance encountered in everyday life is a solid, liquid, or gas; and distinguishing the characteristics of solid, liquid, and gas states of matter.	
	2. Improving students’ ability to identify changes in the states of matter that occur and explain how these changes can take place.	
	3. Improve students’ ability to demonstrate the process of changes in the states of matter and to explain the energy involved.	
Activities	1. Q&A session	In this activity, students were given question stated below; • Have you ever seen objects around you? • What kinds of objects do you see? • Why can water in the refrigerator freeze?
	2. formulate question	Students are asked to pose questions related to the problems they have observed. If the students do not ask questions, the teacher prompts them by providing questions. In this stage, students are guided until they are able to formulate the related problems.
	3. Plan an investigation	Students are asked to propose tentative answers to the formulated questions

Activities	Sub-activities	Sub-Sub-activities
4.	Collect data/information and conduct an investigation.	Students search through activities in the worksheets, textbooks, learning materials, or by asking the teacher. This information is the information needed to solve the problem
5.	Analyse the data	The teacher helps students connect the information they have obtained with their initial concepts in order to test the correctness of the answers they have proposed.
6.	Make conclusion	The teacher guides students to draw conclusions
7.	Communicate the result	Students present their findings in oral or written form. In addition, students are also asked to apply the findings they have obtained to solve problems
Duration	35 minutes	

In between the interventions, a test in the form of an essay question examining students' critical thinking was given. The questions were arranged based on Bloom's taxonomy, emphasizing high-level thinking, namely critical thinking skills. The indicators of the question were analysing and relating concepts, drawing conclusions and providing logical reasoning, explaining cause and effect, and analyzing and categorizing information.

The use of essay-based questions in this research is significant, as it demands a higher level of cognitive processing compared to traditional tests, which means that it can reflect the students' critical thinking skills. [Jumariati et al \(2022\)](#) emphasise that writing essays lets students analyse problems and provide answers, thus displaying their cognitive ability through performance assessments ([Jumariati et al., 2022](#)). This is consistent with the concept of critical thinking, in which skills like analysis, assessment, inference, and problem-solving are examined ([Johan, 2024](#)). Furthermore, the students were scoring numerically, where the rate score ranged from 0 to 100.

In terms of the data analysis, the data in the form of pre- and post-tests were

examined for their normality before testing for the hypothesis. Data normality refers to the degree to which the data conforms to a normal distribution. Checking the data normality is essential since many statistical analyses depend on the data normality to be able to conduct the analysis ([Irwan et al., 2019](#)). In this case, using not normally distributed data in a statistical analysis that requires normality can lead to erroneous conclusions and interpretations ([Uslan, 2022](#)). In the current research, proving the data is normally distributed can determine the statistical analysis that will be used to conduct the hypothesis testing. If the data are normally distributed, the parametric analysis will be used; on the contrary, the nonparametric analysis will be used.

3. Result and Discussion

The current research aims to examine the impact of guided inquiry based learning on elementary school student thinking skills. Before testing the hypothesis, the data was checked for its normality. The result of the normality test can be seen in table 3.

Table 3. Normality test

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
value	.102	48	.200*	.964	48	.142

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Table 3 displays the result of the data normality test. The result shows that the p-value on Kolmogorov-Smirnov was 0.200, which is higher than 0.05. and the p-value in the Shapiro-Wilk was 0.142. Based on the standard given, when the p-value is higher than 0.05, the data is meant to be normally

distributed. Therefore, for this dataset, the parametric analysis, namely the paired sample t-test, will be conducted. The result of the paired sample t-test can be seen in the following table:

Table 4. Paired sample t-test

Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	One-Sided p	Two-Sided p
			Lower	Upper				
77.33333	10.59774	1.52965	74.25607	80.41060	50.556	47	<.001	<.001

Based on table 4, the standard deviation of the difference is 10.60, with a standard error of 1.53, with the mean difference between the posttest and pretest being 77.33 points, indicating the different result of the posttest with the pretest. It was emphasised in the result of the significance of the p-value

$t(47) = 50.56$, $p < .001$ (two-tailed). It reveals the significant increase from pre-test to post-test. More detail information regarding the mean difference between pretest and posttest displayed in table 5.

Table 5. Descriptive Analysis

	N	Minimum	Maximum	Mean	Std. Deviation
PreTest	24	60.00	81.00	70.1667	6.84402
PostTest	24	72.00	100.00	87.5000	6.59380
Valid N (listwise)	24				

Based on the descriptive analysis revealed in the table 5. The mean score of the students pre-test was 70.16 with the standard deviation of 6.84, while the mean score of the students post-test was 87.50 with the standard deviation of 6.59. meaning that there is an average increase of about 17.33

points between the Pretest and Posttest. Therefore, it can be stated that the use of the guided inquiry based learning is significant to improve the elementary school students' critical thinking skills. Furthermore, the result of the mean difference presented in figure 1.

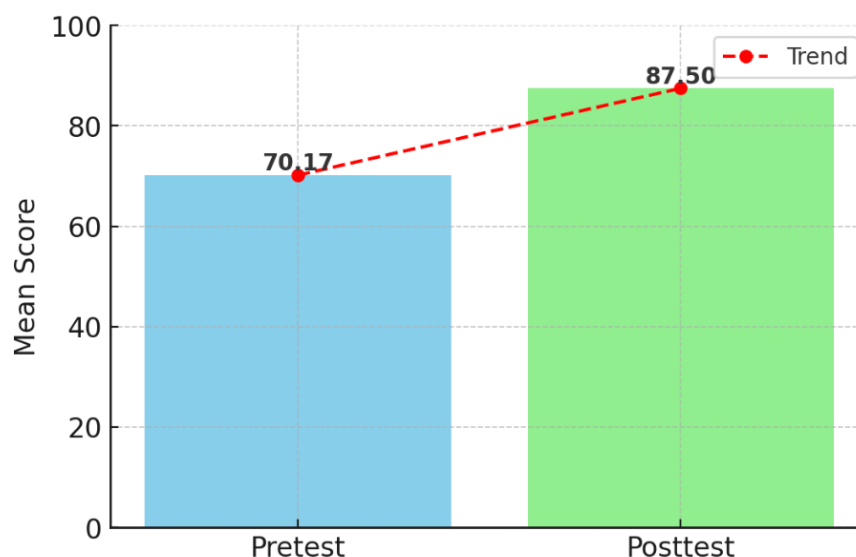


Figure 1. Mean Difference of the Pre-Test to Post-Test

The bar chart compares the mean scores of participants on the Pretest and Posttest. The blue bar represents the Pretest mean score of 70.17, while the green bar represents the Posttest mean score of 87.50. A red dashed line connects the two means, illustrating the upward change from Pretest to Posttest. Participants' mean score increased from 70.17 on the Pretest to 87.50 on the Posttest. This shows a marked

improvement of about 17 points following the intervention. The upward slope of the trend line visually reinforces this increase, suggesting that the program or treatment applied between the Pretest and Posttest had a substantial positive effect on participants' performance. Other than that, figure 2 show the Clustered Error Bar Chart showing PreTest and PostTest scores side-by-side.

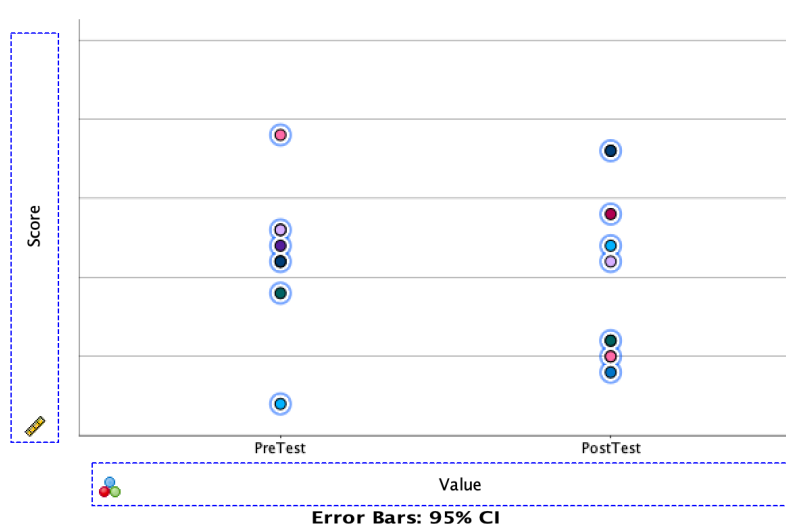


Figure 2. Clustered Error Bar Chart

Figure 2 presents a clustered error bar chart comparing participants' scores on the PreTest and PostTest. Each dot represents an

individual participant's score. The vertical lines show the 95% confidence intervals around the mean score for each condition,

indicating the precision of the mean estimates. The cluster of dots for the PostTest appears higher on the y-axis than for the PreTest, indicating that, on average, participants scored higher after the intervention. The 95% confidence intervals for PreTest and PostTest have limited overlap, suggesting that the increase in scores from PreTest to PostTest is

statistically meaningful and not likely due to random variation. This pattern supports the conclusion that the intervention had a positive effect on participants' performance.

Looking specific to the detailed of each pretest and posttest result, the stacked bar chart showing the count of cases (participants) for the PreTest and PostTest conditions displayed in figure 3.

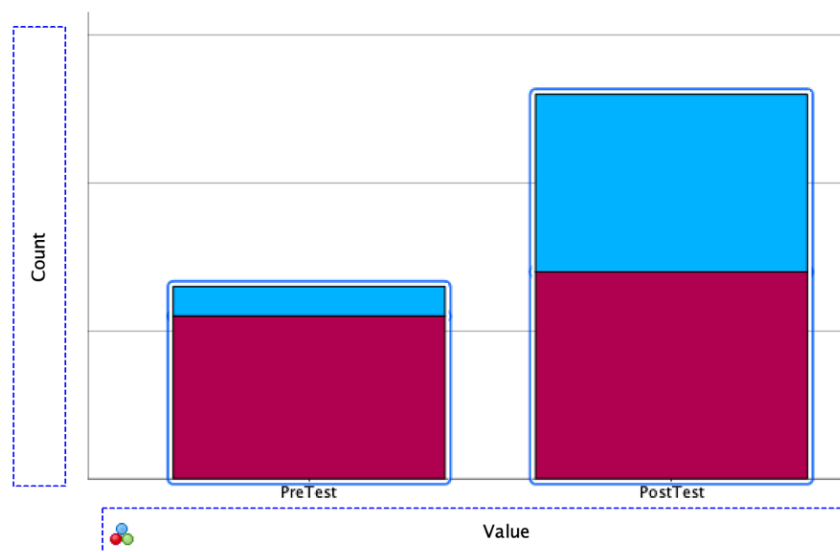


Figure 3. Stacked Bar Chart

Figure 3 displays a stacked bar chart showing the count of cases (participants) for the PreTest and PostTest conditions. Each bar represents the total number of observations at that stage, divided into two color segments (maroon and blue), which indicate different categories or groupings within the data. The PreTest bar is shorter than the PostTest bar, meaning that more responses or higher frequencies were recorded in the PostTest condition, and more participants fell into higher score categories after the intervention. The blue segment becomes much larger in the PostTest bar, which suggests that the proportion of participants in that category increased substantially compared to PreTest. This pattern indicates an overall shift in participants from the lower segment

(maroon) to the higher segment (blue) between PreTest and PostTest, consistent with the improvement in mean scores seen in your other chart.

The paired sample t-test, clustered error bar chart and the stacked bar chart indicates the significant difference in students' critical thinking skills before and after experiencing the intervention in the form of guided inquiry-based learning. This finding is consistent with the existing evidence in literature. For example, [Poerwanti et al. \(2022\)](#), in their research, demonstrate the measurable critical thinking improvement as the result of guided inquiry-based learning. It was proved with the evidence that the students' critical thinking pre-test mean score was at 61.6, while the post-test mean score was 71.47, emphasising the significance of

this learning approach. In other research, [Ahaddin et al. \(2020\)](#), through the peer instruction with the guided inquiry-based learning model, bolstered the students' critical thinking, making students more adept at problem-solving and creativity that required engaging investigation. These components reflected an atmosphere where critical thinking flourished, as evidenced by subsequent research revealing that peer interactions within the guided inquiry paradigm greatly boost cognitive engagement and critical analysis among learners ([Pratiwi et al., 2019](#)). [Syahgiah et al. \(2023\)](#) conducted research to support these assertions, outlining a meta-analysis of inquiry learning approaches that demonstrates a substantial association between such pedagogical practices and the strengthening of students' scientific process skills as well as critical thinking faculties. The emphasis on scientific inquiry captures the essence of critical thought processes by

challenging students to not only engage with information but also to evaluate, assess, and control their learning, preparing them for complex cognitive tasks outside of the classroom ([Duran & Dökme, 2016](#)).

Furthermore, the current research reveal the strength of the impact of guided inquiry based learning on students critical thinking. It was examined through the Cohen's and Hedges correction value displayed in table 5. Both measure the mean difference between pretest and post-test relative to the standard deviation differences. The values 2.08 for Cohen's d and 2.01 for Hedges' correction indicate that the guided inquiry module had a strong and meaningful impact on enhancing students' critical thinking abilities. Therefore, the hedges and Cohen's d value emphasise the significance of the interactive-based learning on the guided inquiry module for the development of students' critical thinking.

Table 5. Paired Sample Effect Sizes

				95% Confidence Interval	
		Standardizer ^a	Point Estimate	Lower	Upper
Pair 1	value - id	Cohen's d	8.31273	2.08	1.4
		Hedges' correction	8.31273	2.01	1.35

a. The denominator used in estimating the effect sizes.

Cohen's d uses the sample standard deviation of the mean difference.

Hedges' correction uses the sample standard deviation of the mean difference, plus a correction factor.

Based on the Cohen's and Hedges correction value, the impact of guided inquiry based learning is strongly significant. One might be the reason on this is the guided inquiry-based learning promotes the students' engagement that can trigger the student critical thinking cultivation. [Aswirna et al. \(2024\)](#) stated that guided inquiry-based learning provides the learning environment where students are required to generate questions and pursue enquiries. In this

condition, students' motivation to engage in the cognitive process is elevated as their sense of ownership improves; that is significant for critical thinking development ([Pulungan & Simamora, 2024](#)).

It is aligned with the current research setting wherein, in the first-day intervention, students were driven to the activities of the question, which could trigger self-directed learning and critical thinking. It was emphasised by [Karim et al. \(2021\)](#), who

stated that in guided inquiry-based learning, students are required to formulate hypotheses, analyse data and synthesise information, which are the essential traits in the development of critical thinking. Furthermore, guided inquiry fosters a collaborative learning environment.

Students frequently communicate and explore ideas during inquiry-based activities, resulting in deeper comprehension and critical engagement with concepts (Ningtiyas & Nasrudin, 2021). Sado & Aminatum's (2019) research shows that cooperation in GIBL contexts enhances overall classroom dynamics and develops an engaged learning community, which supports the beneficial implications of collaborative inquiry.

Furthermore, another reason on this strong impact is the guided inquiry based learning promotes the evidence-based reasoning. As explained in the method, students were given a video followed by a related question; students were also given a project to be completed. These activities might provide evidence-based reasoning activities as the students analyse and interpret the video and the project. This was aligned with what was proposed by Sugiharti & Kurnia (2021), who stated that guided inquiry-based learning encourages students to explore topics and sharpen intellectual skills through hands-on experience, emphasising the students' reasoning based on evidence. Sugiharti & Kurnia (2021) explained that guided inquiry learning emphasises the students searching for concepts, which is important to empower the ability of practical scientific processes that are necessary for analysing and interpreting evidence. Other than that, guided inquiry requires students to formulate hypotheses, conduct experiments, and draw conclusions based on obtained evidence. According to Hasnaini et al. (2024), this systematic

investigation of scientific problems helps pupils improve their thinking skills. Yulianti et al. (2021) emphasise that students, via guided inquiry, develop skills to critically engage with real-world problems, improving their capacity to support findings with relevant evidence. Furthermore, the iterative nature of guided inquiry requires students to continuously test the validity of their results against empirical data. Roys et al. (2023) stated that the process of questioning, experimenting and reflecting develops a mindset orientation to the evidence-based reasoning, which is significant for critical thinking development. This is significant to not only develop the critical thinking but also encourage the development of argument-based evidence generated during the enquiries.

The limitation of the current research lies in its methodological procedure such as the number of sample and the one-group pre and post test research design. This research test the impact of the guided inquiry based learning on elementary school critical thinking in only 24 elementary school students selected using a convenience sampling technique. This small number of sample can restricts the generalizability of the findings to broader student populations. Second, the quasi-experimental design employed a one-group pre-test-post-test approach without a control group limits the ability to attribute the observed improvement in critical thinking solely to the guided inquiry-based learning intervention, as other factors may have influenced the results.

Future research should address these limitations to build a more comprehensive understanding of the impact of guided inquiry-based learning on students' critical thinking. Studies employing larger and more diverse samples across multiple schools or regions would enhance the external validity

and generalizability of the findings. Furthermore, incorporating a control or comparison group or using true experimental designs would allow for a more rigorous assessment of the causal effects of the intervention. Additionally, future studies could explore moderating factors, such as teacher experience, student motivation, or classroom environment, to better understand under what conditions guided inquiry-based learning is most effective.

4. Conclusion

This research provides empirical evidence that guided inquiry-based learning significantly enhances elementary school students' critical thinking skills. The quasi-experimental findings, supported by a highly significant paired sample t-test result ($p < .001$), demonstrate a substantial improvement from pre-test to post-test. The large effect sizes, as reflected in Cohen's d (2.08) and Hedges' correction (2.01), further confirm the strong and meaningful impact of the guided inquiry module. These results highlight that engaging students in active investigation, questioning, and evidence-based reasoning fosters deeper cognitive development. Accordingly, the study underscores the importance of incorporating guided inquiry-based learning into elementary education as an effective pedagogical approach to strengthen students' critical thinking competencies. In this case, future research should examine the long-term effects of guided inquiry-based learning on critical thinking, its applicability across diverse student populations and educational settings. Such studies will help validate and extend the present results while providing a stronger evidence base for developing comprehensive instructional models that enhance critical thinking in elementary education.

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