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Effect of the Guided Inquiry Learning Model with a Scientific Approach on Critical Thinking Skills in the Classification of Living Things Material

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Abstract: This study was motivated by the low level of students' critical thinking skills in science learning, particularly in the classification of living things material, which contains complex and interconnected concepts. Teacher-centered learning practices also limit students' opportunities to develop analytical and problem-solving skills. Therefore, this study aimed to determine the effect of the Guided Inquiry Learning Model with a Scientific Approach on the critical thinking skills of Grade VII students at SMPN 35 Medan. This study employed a quasi-experimental design with a nonequivalent control group. The sample consisted of Class VII-6 as the experimental group and Class VII-8 as the control group. Data were collected through essay tests based on Ennis' critical thinking indicators and observation sheets. Data analysis included normality, homogeneity, and independent sample t-test using SPSS version 32. The novelty of this study lies in the integration of the Guided Inquiry Learning Model with a Scientific Approach in the classification of living things material and the assessment of critical thinking skills using Ennis-based instruments. The results showed that the average pretest scores of the experimental and control groups were 40.08 and 37.50, respectively. After the treatment, the average posttest score of the experimental group increased to 81.17, while the control group's increased to 66.42. Observation results also indicated improvements in students' critical thinking skills during the learning process. Hypothesis testing revealed a Sig. (2-tailed) value of less than 0.05, indicating a significant effect of the learning model on students' critical thinking skills. These findings demonstrate that the Guided Inquiry Learning Model with a Scientific Approach is effective in improving students' critical thinking skills and can be applied to support 21st-century learning.

Keywords: Classification of Living Things; Critical Thinking Skills; Guided Inquiry Learning Model; Scientific Approach.

Introduction

Twenty-first century education demands a shift in learning paradigms from teacher-centered instruction toward the development of students' higher-order thinking skills. In the era of globalization and rapid advancement of science and technology, students are expected not only to master factual knowledge but also to possess critical thinking, problem-solving, communication, and collaboration skills [1]. Critical thinking skills are considered essential competencies because they enable students to evaluate information, analyze evidence, assess assumptions, and make logical decisions based on relevant facts [2]. Furthermore, critical thinking skills help students understand concepts more deeply and connect acquired knowledge to real-life situations [3]. In addition, twenty-first century learning emphasizes the development of Higher Order Thinking Skills (HOTS), including critical thinking, creativity, collaboration, and problem-solving abilities that are necessary for students to face increasingly complex global challenges [6]. Science education is closely related to the development of critical thinking skills because science learning emphasizes scientific processes in understanding natural phenomena. Science learning does not merely aim to help students memorize concepts, but also encourages them to observe, question, experiment, reason, and communicate their findings systematically [7]. Through science learning, students are expected to actively construct knowledge through scientific inquiry, making learning more meaningful and contextualised. Therefore, science instruction should provide opportunities for students to become actively involved in the learning process so that critical thinking skills can develop optimally [4]. Moreover, learning biology plays an important role in developing students' analytical thinking, scientific literacy, communication, collaboration, and creativity through investigative learning activities [5].

However, the reality on the ground indicates that Indonesian students' critical thinking skills remain relatively low. Results from the Programme for International Student Assessment (PISA) in 2018 showed that Indonesia ranked 71st out of 79 participating countries, indicating that students' abilities in solving analytical and problem-solving questions remain below the international average [8]. This condition indicates that students' critical thinking skills in science learning have not yet developed to an optimal level [9]. Furthermore, Indonesia's science literacy scores have continuously declined over recent years, showing that students still experience difficulties in analyzing information, evaluating arguments, and applying scientific concepts in new contexts [10]. One of the factors contributing to this problem is that classroom instruction is

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still dominated by conventional teaching approaches such as lectures, causing students to become passive learners who focus more on memorizing concepts rather than understanding scientific processes deeply [11]. Consequently, students are less trained to analyze problems, connect concepts, and draw conclusions based on scientific evidence [12].

Low critical thinking skills are also found in science learning at the junior high school level, particularly in the topic of Classification of Living Things. This topic is conceptual in nature because it encompasses various interconnected scientific concepts, such as the characteristics of living organisms, taxonomic levels, scientific naming systems, and the use of determination keys for classifying living organisms. Students are required to identify characteristics of living things, compare similarities and differences, and analyze relationships among organisms systematically. In addition, students must understand scientific terminology, especially Latin-based terms, which often pose obstacles to comprehensive understanding of classification concepts [13]. These conditions indicate that the topic of Classification of Living Things requires strong analytical thinking and deep conceptual understanding.

Based on preliminary observations conducted in Grade VII at SMP Negeri 35 Medan, students' critical thinking skills were still categorized as low. Initial test results consisting of six essay questions based on Ennis' critical thinking indicators showed an average score of 47, categorized as moderately critical. The percentage results indicated that 51.61% of students were categorized as moderately critical and 38.71% were categorized as less critical. In addition, interviews with science teachers revealed that classroom instruction was still dominated by lectures and simple discussions, leading to low student engagement in learning activities. Students tended to be passive, focusing only on teacher explanations and not actively participating in scientific inquiry activities. As a consequence, students' abilities to analyze problems, provide evidence-based reasoning, and draw logical conclusions had not yet developed optimally. One alternative learning approach to improving students' critical thinking skills is the guided inquiry learning model. Guided inquiry is a learning model that emphasizes students' active involvement in investigative processes to discover concepts through observation, data collection, analysis, and conclusion drawing under teacher guidance as a facilitator [14]. This model provides students with opportunities to construct knowledge independently through meaningful learning experiences, making them more actively engaged during instruction. Furthermore, guided inquiry learning can develop students' logical, systematic, and critical thinking skills for problem solving [15]. Inquiry-Based Learning is considered effective in developing 21st-century skills such as critical thinking, creativity, collaboration, and problem-solving abilities [16]. In inquiry learning, students are involved in scientific stages such as formulating questions, conducting investigations, collecting data, analyzing information, and drawing conclusions based on the evidence obtained [17]. Furthermore, implementing systematic inquiry phases can help students build conceptual understanding and improve analytical thinking skills throughout the learning process [16]. To ensure that the learning process becomes more systematic and aligned with the characteristics of science education, the guided inquiry model is integrated with the scientific approach, which emphasizes the stages of observing, questioning, gathering information, reasoning, and communicating [18]. Through this approach, students do not passively receive information but actively construct knowledge through scientific processes. In the topic of Classification of Living Things, students can be directed to observe various organisms, identify their characteristics, compare similarities and differences, and classify organisms based on certain characteristics. Such activities help students understand classification concepts more deeply while simultaneously improving their critical thinking skills in analyzing and solving scientific problems.

Several previous studies have demonstrated that the guided inquiry learning model is effective in improving students' critical thinking skills. [19] reported that the implementation of guided inquiry in the topic of Classification of Living Things received positive student responses of 86.48% and improved students' activities in observing, analyzing, and drawing conclusions. [20] also found that students taught using guided inquiry achieved higher critical thinking scores compared to those taught through conventional learning, with average scores of 77.52 and 59.96, respectively. In addition, [21] stated that guided inquiry learning improved students' critical thinking skills by 18.75%. Research conducted by [22] further revealed that guided inquiry integrated with the scientific approach significantly affected students' critical thinking skills in ecosystem earning. Similarly, [23] found that guided inquiry learning significantly influenced students' critical thinking and scientific literacy skills because students were actively involved in scientific investigations and problem-solving activities during instruction. Meanwhile, [24] reported that guided inquiry learning effectively enhanced junior high school students' critical thinking skills by encouraging them to analyze, evaluate, and formulate logical conclusions based on scientific evidence discovered throughout the learning process.

Other studies have also shown that the success of inquiry learning is strongly influenced by students' active engagement during learning activities. Learning processes that provide opportunities for students to conduct investigations, engage in group discussions, explore concepts, and solve problems independently have been shown to improve critical thinking skills and conceptual understanding. In addition, the use of interactive learning media and innovative instructional approaches can help students understand scientific concepts more concretely and in context, making learning more engaging and meaningful [25]. Interactive and technology-based media have also been shown to increase student participation, motivation, and conceptual understanding in science learning [26].

Nevertheless, studies specifically investigating the effect of guided inquiry integrated with the scientific approach on students' critical thinking skills in the topic of Classification of Living Things at the junior high school level remain limited. Most previous studies have been conducted across various topics and educational levels and have focused more on cognitive learning outcomes than on the comprehensive development of critical-thinking indicators. In addition, previous research has not specifically examined the implementation of guided inquiry integrated

with the scientific approach in learning about the Classification of Living Things, which requires students to classify, compare, and systematically identify the characteristics of living organisms. Therefore, this study offers novelty by systematically integrating the guided inquiry model and the scientific approach to investigate their effect on Grade VII students' critical thinking skills in the topic of Classification of Living Things. Based on the description above, this study aims to determine the effect of the guided inquiry learning model, integrated with the scientific approach, on Grade VII students' critical thinking skills on the topic of Classification of Living Things at SMP Negeri 35 Medan. This study is expected to contribute to the development of more innovative, contextual, and effective science learning strategies for improving junior high school students' critical thinking skills.

Research Methods

Research Type and Design

This study employed a quasi-experimental design using a Nonequivalent Control Group Design, in which the experimental and control groups were selected without random assignment, and both groups were administered pretests and posttests to evaluate changes in students' critical thinking skills before and after the intervention. The samples were selected using purposive sampling based on similarities in students' academic characteristics, teachers, learning materials, and instructional schedules. To minimize potential selection bias, both groups completed a pretest to examine their baseline critical thinking skills. The pretest results indicated no statistically significant difference between the experimental and control groups ($p > 0.05$), suggesting that both groups had equivalent initial abilities before the intervention. The experimental group received instruction through the Guided Inquiry Learning Model integrated with the Scientific Approach over three instructional sessions, following the stages of orientation, problem formulation, investigation, data collection and analysis, conclusion drawing, and communication of findings. Meanwhile, the control group was taught using conventional teaching methods. To ensure treatment fidelity, the instructional procedures in the experimental group were implemented consistently across all sessions using validated lesson plans, student worksheets, and assessment instruments [27]. Furthermore, the teacher followed the same instructional syntax throughout the intervention to ensure that any observed differences in students' critical thinking skills could be attributed to the implementation of the Guided Inquiry Learning Model integrated with the Scientific Approach rather than to variations in instructional delivery.

Research Location and Time

The study was conducted at SMPN 35 Medan, located on Jalan William Iskandar Pasar V Medan, Bandar Selamat, Medan Tembung District, Medan City, North Sumatra Province. The research was carried out during the second semester of the academic year.

Population and Research Sample

The population of this study consisted of all Grade VII students at SMPN 35 Medan. The sampling technique used was purposive sampling. The research sample consisted of two classes with a total of 60 students. Class VII-6, consisting of 30 students, was selected as the experimental class, while Class VII-8, consisting of 30 students, was selected as the control class.

Data Collection Techniques

Data collection techniques in this study included tests and observations. The tests consisted of pretests and posttests administered to both experimental and control classes. The pretest was administered before treatment to assess students' initial critical thinking skills, and the posttest after treatment to assess improvement in those skills. Observations were conducted during the learning process to assess students' participation and critical thinking activities.

Research Instruments

The instruments used in this study consisted of test and non-test instruments. The test instrument was an essay test developed based on Ennis' critical thinking indicators, namely focus, reason, inference, situation, clarity, and overview. The test consisted of 10 essay questions used to measure students' critical thinking skills. The non-test instrument was an observation sheet used to record students' critical-thinking activities during the learning process.

Data Analysis Techniques

Data analysis techniques included normality tests, homogeneity tests, and hypothesis testing. The normality test was conducted using the Shapiro–Wilk test, while the homogeneity test was conducted using Levene's test with the assistance of SPSS version 32. Hypothesis testing was performed using an independent-samples t-test. The decision-making criterion stated that if the Sig. (2-tailed) value was less than 0.05, H_0 was rejected, and H_a was accepted.

Results and Discussion

The Effect of the Guided Inquiry Learning Model with a Scientific Approach on Students' Critical Thinking Skills

The study found that students' critical thinking skills improved after the implementation of the Guided Inquiry Learning Model with a Scientific Approach. The average pretest score of the experimental class was 40.08, while the control class obtained an average score of 37.50. After treatment, the average posttest score of the experimental class increased to 81.17, whereas the control class reached 66.42. These results indicate that both classes improved in critical thinking skills; however, the increase in the experimental class was greater than that in the control class.

The comparison of students' pretest and posttest scores in the experimental and control classes is presented in Figure 1. The experimental class showed higher posttest achievement than the control class, indicating that implementing the Guided Inquiry Learning Model with a

Scientific Approach was more effective in developing students' critical thinking skills.

Table 1. The Average Pretest and Posttest Scores of Students' Critical Thinking Skills in the Experimental and Control Classes

Class	N	Pretest				Posttest			
		Min	Max	Mean	SD	Min	Max	Mean	SD
Experiment	30	20	65	40.08	13.95	55	95	81.17	10.35
Control	30	12	67	37.5	15.37	45	82.5	66.42	10.21

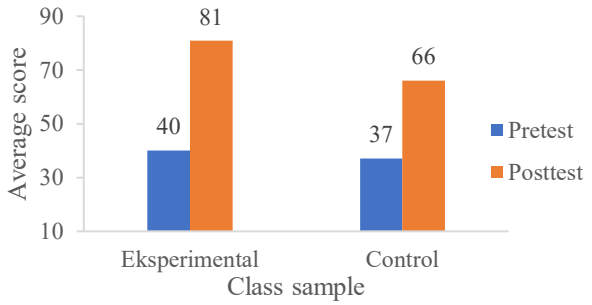


Figure 1. Comparison of Pretest and Posttest Scores in Experimental and Control Classes

Normality Test

Before conducting hypothesis testing, normality and homogeneity tests were performed to assess whether the data met the assumptions of parametric statistical analysis. The normality test was conducted using the Shapiro–Wilk test. The results showed that the significance values of the pretest and posttest data in both the experimental and control classes were greater than 0.05. Therefore, the data were normally distributed, as presented in Table 2.

Table 2. Normality Test Results

Class	Test	Sig. Value	Significance Level
Experimental	Pretest	0.106	> 0.05
Experimental	Posttest	0.107	> 0.05
Control	Pretest	0.383	> 0.05
Control	Posttest	0.432	> 0.05

Homogeneity Test

The homogeneity test was conducted using Levene's test. The results showed that the significance values of the pretest and posttest data were 0.463 and 0.919, respectively. Since both values were greater than 0.05, the variances of the experimental and control classes were considered homogeneous. These results indicate that the data fulfilled the homogeneity requirement for further statistical analysis, as presented in Table 3.

Table 3. Homogeneity Test Results

Data	Sig. Based on Mean	Significance Criterion ($\alpha = 0.05$)
Pretest (Experimental and Control Classes)	0.463	0.05
Posttest (Experimental and Control Classes)	0.919	0.05

Hypothesis Testing

Furthermore, hypothesis testing was conducted using an independent-samples t-test in SPSS version 31.0.2. The results showed a t-value of 5.557, with 58 degrees of freedom and a significance value (2-tailed) of less than 0.001. Since the p-value was less than 0.05, H_0 was rejected and H_a was accepted. These findings indicate that the Guided Inquiry Learning Model with a Scientific Approach had a significant effect on students' critical thinking skills, as presented in Table 4.

Table 4. Results of the Independent Samples t-Test Hypothesis Testing

Class	Mean	Std. Deviation	t	df	Sig. (2-tailed)
Experimental	81.17	10.35	5.557	58	<0.05
Control	66.42	10.20			

The results of this study showed a significant difference between the experimental class, which implemented the Guided Inquiry Learning Model with a Scientific Approach, and the control class, which used conventional learning. The experimental class obtained an average posttest score of 81.17, whereas the control class obtained 66.42, indicating a mean difference of 14.75 points. Compared with the pretest results, the experimental class improved from 40.08 to 81.17, representing an increase of 41.09 points, while the control class improved from 37.50 to 66.42, representing an increase of 28.92 points. These findings indicate that the Guided Inquiry Learning Model with a Scientific Approach was more effective in improving students' critical thinking skills than conventional instruction. This occurred because the Guided Inquiry Learning Model places students at the center of learning (student-centered learning), enabling them to actively participate in discovering concepts through observing, questioning, collecting data, analyzing information, and drawing conclusions based on obtained facts. Through this process, students were trained to think logically, systematically, and critically in solving the given problems. In this study, the Guided Inquiry Learning Model with a Scientific Approach on the topic of the classification of living things was implemented through contextual problems related to grouping living organisms based on specific characteristics and differences among them. Students were guided to identify problems, observe various types of living things, collect information from different sources, conduct group discussions, analyze similarities and differences among living organisms, and present the results of their investigations.

These activities encouraged students to become more

active in understanding the classification of living things and solving problems independently, resulting in better development of students' critical thinking skills than conventional learning methods. The findings of this study are consistent with the research conducted by [28], which stated that the Guided Inquiry Learning Model effectively improves students' critical thinking skills because the learning process emphasizes investigation and independent concept discovery. Furthermore, [29] explained that the Scientific Approach provides opportunities for students to develop critical, logical, analytical, and systematic thinking skills through observing, questioning, experimenting, reasoning, and communicating activities. In contrast to the experimental class, students' critical thinking skills in the control class using conventional learning showed less development. This occurred because the learning process was still dominated by the teacher, causing students to receive information passively. In conventional learning, students spent more time listening to the teacher's explanations and taking notes rather than participating directly in investigative and problem-solving activities. As a result, students' abilities to analyze information, provide logical reasoning, and draw conclusions did not develop optimally.

These findings are supported by the study conducted by [30], which found that the lecture method is less effective at improving students' critical thinking skills because students are not actively involved in discovering concepts. The study also explained that teacher-centered learning causes students to become less active in developing critical thinking and problem-solving skills. In addition to influencing cognitive aspects, implementing the Guided Inquiry Learning Model with a Scientific Approach also had positive effects on students' affective aspects. During the learning process, students became more active in discussions, more confident in expressing opinions, more capable of collaborating in groups, and more confident when presenting discussion results to the class. This finding indicates that learning activities not only improved students' critical thinking skills but also supported the development of students' social and communication skills. These findings are reinforced by the study conducted by [28], which found that the Guided Inquiry Learning Model improves learning activities, critical thinking, and communication skills through investigation and group discussion. [29] also explained that the Scientific Approach creates a more active, interactive, and meaningful learning environment, enabling students to understand learning concepts more deeply. Based on these findings, it can be concluded that the Guided Inquiry Learning Model with a Scientific Approach had a significant effect on the critical thinking skills of Grade VII students at SMP Negeri 35 Medan. Through learning activities involving investigation, analysis, and active problem-solving, students became more skilled at understanding problems, formulating logical arguments, drawing conclusions, using relevant information, and evaluating solutions systematically.

Students' Critical Thinking Skills Based on Ennis' Indicators

The assessment of students' critical thinking skills, based on each indicator, aimed to identify differences in students' achievement levels between the experimental class implementing the Guided Inquiry Learning Model with a Scientific Approach and the control class receiving conventional instruction. The critical thinking indicators analyzed included Focus, Reason, Inference, Situation, Clarity, and Overview, based on Ennis' critical thinking indicators. The results of the analysis are presented in Figures 2 and 3 to provide a comparison of each indicator's achievement between the experimental and control classes.

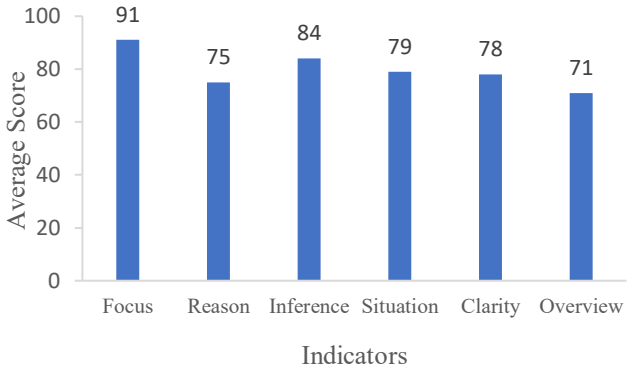


Figure 2. Classification of Critical Thinking Skills in the Guided Inquiry Learning Class with a Scientific Approach Based on Each Indicator

Figure 2 shows the classification results of students' critical thinking skills in the Guided Inquiry Learning Class with a Scientific Approach based on each critical thinking indicator. The Focus indicator obtained the highest average score of 91.25, categorized as very critical. This result indicates that students were able to understand problems, identify important information, and effectively focus on the main concepts of the classification of living things material during the learning process. The Inference indicator had an average score of 84.58, indicating that students were able to draw conclusions from observations and investigations during the learning activities. Furthermore, the Situation indicator obtained an average score of 79.17, while the Clarity indicator achieved a score of 78.33. These findings demonstrate that students were able to understand problem situations, explain concepts systematically, and communicate their ideas effectively during discussions and presentations. In the Reason indicator, students obtained an average score of 75.83. This finding indicates that students were sufficiently capable of providing logical arguments and using scientific information to answer the given problems. Meanwhile, the lowest score was recorded for the Overview indicator, with an average of 71.67. Nevertheless, this score was still categorized as critical. The lower achievement on this indicator suggests that some students still had difficulty evaluating problems comprehensively and identifying systematic problem-solving strategies.

The higher achievement of the Focus indicator indicates that students became more capable of identifying the core of a problem because they were actively involved in observing phenomena and formulating investigable questions at the beginning of the Guided Inquiry learning process. These activities helped students concentrate on relevant information before conducting further investigations. These findings are consistent with [31], which stated that the Guided Inquiry Learning Model improves students' ability to understand and identify

problems through systematic investigation. Likewise, the Inference indicator showed a higher level of achievement because students were repeatedly encouraged to interpret evidence, analyze findings, and formulate conclusions based on empirical data obtained during investigation activities. This ability developed through investigation, data collection, and information analysis activities. Students were trained to connect various pieces of information and organize them into conclusions relevant to the investigated problems. The Scientific Approach also helps students develop logical and systematic thinking skills in formulating conclusions [32].

The Situation indicator obtained an average score of 79.17, categorized as critical. This result indicates that students were sufficiently capable of using relevant information and connecting various sources of information to solve problems. This ability developed through information-processing and problem-solving activities during Guided Inquiry Learning with a Scientific Approach. Students were trained to relate the facts obtained to real-life situations to determine appropriate solutions to given problems. The Clarity indicator obtained an average score of 78.33, categorized as critical. This finding indicates that students were capable of providing detailed, clear, and understandable explanations of their answers and conclusions. This ability developed through group discussions and presentation activities during the learning process. Students became more accustomed to organizing explanations systematically and communicating ideas clearly. Furthermore, the Reason indicator obtained an average score of 75.83, categorized as critical. This result indicates that students were able to provide logical reasons and use relevant facts or evidence to support their answers. This ability was developed through data collection and information association activities. Students were encouraged to gather information from various sources and use the facts obtained to construct arguments logically and systematically. In contrast, the Overview indicator obtained the lowest score because evaluating the accuracy of conclusions and reflecting on the entire problem-solving process require higher-order metacognitive skills that generally develop through continuous practice. During this study's implementation, most instructional time was devoted to observation, investigation, discussion, and presentation activities, leaving relatively few opportunities for students to evaluate and refine their own reasoning. Consequently, students' ability to review and evaluate their conclusions was less developed than their ability to identify problems or draw inferences.

Meanwhile, the indicator with the lowest average score was Overview, with a score of 71.67, although it was still categorized as critical. This finding indicates that students' ability to recheck their problem-solving steps and to evaluate the relationship among data, reasoning, and conclusions still needs improvement. This ability can be developed through reflection and evaluation activities during Guided Inquiry Learning with a Scientific Approach. Overall, the results indicate that implementing the Guided Inquiry Learning Model with a Scientific Approach improved students' critical thinking skills across all indicators. The improvement occurred because students actively participated in observing, questioning, collecting data, synthesizing information, and communicating learning outcomes, enabling them to think logically, systematically, and critically when solving problems.



Figure 3. Classification of Critical Thinking Skills in the Conventional Class Based on Each Indicator

Figure 3 shows the classification results for students' critical thinking skills in the conventional class, by critical thinking indicator. The Focus indicator obtained the highest average score of 72.08, categorized as critical. This result indicates that students were sufficiently capable of understanding problems and identifying important information related to the classification of living things material during the learning process. The Overview indicator obtained an average score of 71.83, indicating that some students were able to evaluate problems and determine general problem-solving strategies. Furthermore, the Situation indicator obtained an average score of 65.42, while the Inference indicator achieved a score of 64.17. These findings show that students were fairly capable of understanding problem situations and drawing conclusions based on the information obtained during the learning process. In the Reason indicator, students obtained an average score of 63.75. This finding indicates that students still experienced difficulties in providing logical arguments and using scientific information appropriately in answering the given problems. Meanwhile, the lowest score was recorded for the Clarity indicator, with an average of 62.50. The lower achievement in this indicator indicates that some students were still less capable of explaining concepts systematically and communicating their ideas clearly during learning activities.

Overall, the results presented in Figure 3 indicate that conventional learning improved students' critical thinking skills, although the improvement was not yet optimal. This condition occurred because the learning process was still dominated by teacher-led explanations, limiting students' involvement in analysis, discussion, investigation, and problem-solving. As a result, students were less accustomed to actively and independently developing critical thinking skills. The differences in the achievement of critical thinking indicators between the experimental and control classes indicate that learning activities involving direct investigation provide greater opportunities for students to practice critical thinking. In the experimental class, students were encouraged to identify problems, examine information, discuss findings, and formulate conclusions independently with teacher guidance. In contrast, the conventional learning process provided fewer opportunities for students to investigate and develop their reasoning independently. These findings show that the Guided Inquiry Learning Model with

a Scientific Approach supported the development of students' critical thinking skills across the six indicators.

Development of Students' Critical Thinking Skills During the Learning Process

Observations of students' critical thinking skills were conducted in both the experimental and control classes over three learning meetings. These observations focused on students' actual activities and behaviors during the learning process to identify the development of their critical thinking skills directly. The observation activities examined students' participation in asking questions, expressing opinions, analyzing information, connecting concepts, participating in discussions, and responding to problems presented during the learning process. The observation instrument was developed based on Ennis' critical thinking indicators, namely Focus, Reason, Inference, Situation, Clarity, and Overview. Based on observations conducted in the Guided Inquiry Learning Class with a Scientific Approach, students' critical thinking skills showed continuous improvement across meetings throughout the learning process. This improvement was reflected in students' active participation in learning activities, such as asking questions, expressing opinions, analyzing information, connecting concepts, engaging in discussions, and drawing conclusions based on investigations conducted during the classification of living things material. Through the implementation of the Guided Inquiry Learning Model with a Scientific Approach, students became more actively involved in the learning process by participating directly in observation, investigation, and problem-solving activities. This learning model helped students develop their critical thinking skills in a more systematic and in-depth manner. The observation results of students' critical thinking skills in the Guided Inquiry Learning Class with a Scientific Approach and the conventional class are presented in Table 5.

Table 5. Observation Results of Students' Critical Thinking Skills in the Guided Inquiry Learning Class with a Scientific Approach and the Conventional Class

Class	Indicator	Meeting I		Meeting II		Meeting III	
		Mean	Category	Mean	Category	Mean	Category
Guided Inquiry with Scientific Approach (Experimental)	Focus	43.75	Not Critical	67.00	Less Critical	93.33	Very Critical
	Reason	40.00	Less Critical	73.00	Moderately Critical	93.33	Very Critical
	Inference	51.67	Less Critical	73.00	Moderately Critical	88.33	Very Critical
	Situation	50.00	Not Critical	68.00	Less Critical	86.67	Very Critical
	Clarity	47.50	Not Critical	68.00	Less Critical	85.00	Very Critical
	Overview	35.00	Not Critical	66.00	Less Critical	86.67	Very Critical
Conventional (Control)	Focus	35.00	Not Critical	59.17	Less Critical	61.67	Less Critical
	Reason	43.33	Not Critical	65.00	Moderately Critical	60.00	Less Critical
	Inference	42.50	Not Critical	61.67	Less Critical	69.17	Moderately Critical
	Situation	34.17	Not Critical	58.33	Less Critical	68.33	Moderately Critical
	Clarity	30.00	Not Critical	55.83	Less Critical	70.83	Moderately Critical
	Overview	26.67	Not Critical	57.50	Less Critical	72.50	Critical

Based on observations from three learning meetings, students' critical thinking skills in both the Guided Inquiry Learning Class with a Scientific Approach and the conventional class improved at each meeting. However, the improvement in the experimental class was higher than that in the conventional class. These findings indicate that implementing the Guided Inquiry Learning Model with a Scientific Approach was more effective at developing students' critical thinking skills during the learning process. In the Guided Inquiry Learning Class with a Scientific Approach, the average observation score of students' critical thinking skills in the first meeting was 43.75, categorized as less critical. This result indicates that at the beginning of learning, students were not yet accustomed to actively participating in thinking processes, expressing opinions, and solving problems independently. Some students tended to be passive and still required guidance during investigation and group discussion activities.

In the second meeting, the average score increased to 69.03, categorized as fairly critical. This improvement indicates that students began adapting to the implementation of the Guided Inquiry Learning Model with a Scientific Approach. During the learning process, students became more active in observing problems, asking questions, discussing ideas, and expressing opinions based on observations. In the third meeting, the average score increased significantly to 88.89, categorized as very critical. This finding indicates that students had become actively involved in the learning process and demonstrated good development in critical thinking skills. Students became more skilled at understanding problems, connecting information, providing logical reasoning, and drawing conclusions based on the facts obtained.

Meanwhile, students in the conventional class also showed improvements in critical thinking skills at each meeting, although the improvements were lower than those in the experimental class. In the first meeting, the average observation result was 35.28, categorized as not critical. In the second meeting, the score increased to 59.58, categorized

as less critical, and further increased in the third meeting to 67.08, categorized as fairly critical. The observation results consistently supported the statistical findings. The average observation score in the experimental class increased from 43.75 in the first meeting to 69.03 in the second meeting and reached 88.89 in the third meeting, whereas the control class increased from 35.28 to 59.58 and finally 67.08. The consistent improvement throughout the three learning meetings indicates that students became progressively more active in observing, questioning, analyzing information, discussing evidence, and drawing conclusions. Therefore, the effectiveness of the Guided Inquiry Learning Model with a Scientific Approach is supported not only by the hypothesis-testing results but also by the observational data collected during the learning process. Overall, the results indicate that the Guided Inquiry Learning Model with a Scientific Approach had a greater effect on students' development of critical thinking than conventional learning methods. This learning model created an active learning environment, encouraged students to participate directly in the discovery of concepts, and trained them to think logically, analytically, and systematically.

This study has several limitations that should be considered when interpreting the findings. First, the study involved only 60 students from a single junior high school; therefore, the findings cannot be generalized to broader educational contexts without caution. Second, the use of purposive sampling may limit the sample's representativeness. Third, the intervention was conducted over only three instructional meetings, which may not have been sufficient to optimize all dimensions of critical thinking, particularly the Overview indicator. In addition, differences in classroom dynamics and teacher facilitation may also have influenced students' learning outcomes despite the use of standardized learning instruments and lesson procedures. Despite these limitations, the findings demonstrate that the Guided Inquiry Learning Model integrated with the Scientific Approach provides meaningful opportunities for students to develop critical thinking skills through observation, investigation, discussion, and evidence-based reasoning. Future studies are recommended to involve larger samples from different schools, extend the duration of the intervention, and incorporate additional analyses such as normalized gain (N-gain) or effect size to provide more comprehensive evidence regarding the practical effectiveness of the learning model.

Conclusion

Based on the study's results, it can be concluded that the Guided Inquiry Learning Model, integrated with a Scientific Approach, has a significant effect on improving the critical thinking skills of Grade VII students at SMPN 35 Medan on the topic of Classification of Living Things. This is evidenced by the higher average posttest score of the experimental class (81.17) compared to the control class (66.42), as well as the results of hypothesis testing showing a Sig. (2-tailed) value of less than 0.05. In addition, observation results indicated continuous improvement in students' critical thinking skills throughout the learning process. Therefore, the Guided Inquiry Learning Model with a Scientific Approach is effective in improving students' critical thinking skills and can be applied as an alternative learning strategy in science education.

Author's Contribution

R. Suriana: contributed to the conceptualization and design of the research, data collection, data analysis, and writing of the manuscript. W. Ningsih: supervised the research process, provided academic guidance and theoretical input, and reviewed the final version of the manuscript. All authors have read and approved the final manuscript.

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References

[1] O. Sarigoz, "Education and 21st century skills: A conceptual framework," *International Journal of Educational Studies*, vol. 15, no. 1, pp. 1–10, 2023.

[2] M. Pedaste, M. Mäeots, L. A. Siiman, T. de Jong, S. A. N. van Riesen, E. T. Kamp, C. C. Manoli, Z. C. Zacharia, and E. Tsourlidaki, "Phases of inquiry-based learning: Definitions and the inquiry cycle," *Educational Research Review*, vol. 14, pp. 47–61, 2015, doi:10.1016/j.edurev.2015.02.003.

[3] D. Lewis and J. Estis, "Improving Mathematics Content Mastery and Enhancing Flexible Problem Solving through Team-Based Inquiry Learning," *Teaching & Learning Inquiry*, vol. 8, no. 2, 2020, doi:10.20343/teachlearninqu.8.2.11.

[4] M. Pedaste et al., "Phases of inquiry-based learning: Definitions and the inquiry cycle," *Educational Research Review*, vol. 14, pp. 47–61, 2015, doi:10.1016/j.edurev.2015.02.003.

[5] R. Silaen and H. Sipahutar, "Biology learning and the development of students' scientific literacy skills," *Jurnal Pendidikan Biologi Indonesia*, vol. 8, no. 3, pp. 210–219, 2022, doi:10.33394/bioscientist.v13i3.15292.

[6] S. K. W. Chu, R. B. Reynolds, N. J. Tavares, M. Notari, and C. W. Y. Lee, *21st Century Skills Development Through Inquiry-Based Learning*. Singapore: Springer, 2017, doi:10.1007/978-981-10-2481-8.

[7] D. Melta, M. Azhar, Y. Yohandri, F. Arsih, and A. Razak, "Argument-driven inquiry learning model to improve students' argumentation skills in science learning: Systematic literature review," *Edu Sains: Jurnal Pendidikan Sains dan Matematika*, vol. 12, no. 1, pp. 46–54, 2024, doi:10.23971/eds.v12i1.5843.

[8] R. Komala, E. P. Azrai, and M. W. Handayani, "Improving Students' Critical Thinking Ability Through Guided Inquiry Model with Scientific

Approach on Ecosystem Material," *Biodidaktika: Jurnal Biologi dan Pembelajarannya*, vol. 20, no. 1, pp. 31–42, 2025, doi:10.30870/biodidaktika.v20i1.27095.

[9] M. Pedaste, G. Mitt, and T. Jürivete, "What Is the Effect of Using Mobile Augmented Reality in K–12 Inquiry-Based Learning?," *Education Sciences*, vol. 10, no. 4, Art. 94, 2020, doi:10.3390/educsci10040094.

[10] N. Sutrisna, "Science literacy achievement of Indonesian students in PISA," *Jurnal Pendidikan IPA Indonesia*, vol. 10, no. 1, pp. 1–9, 2021, doi:10.15294/jpii.v10i1.27657.

[11] A. Nadkarni, R. Costa-Pinto, T. Hensman, E. V. Harman, F. Yanase, B. G. Lister, C. P. Nickson, and J. S. Thomas, "Evaluating an inquiry-based learning program," *Advances in Physiology Education*, vol. 47, no. 4, pp. 930–939, 2023, doi:10.1152/advan.00050.2023.

[12] W. Ningsih, D. Y. C. Sipayung, and H. Simatupang, "The Effect of Guided Inquiry with Differentiated Learning to Enhance Students' Critical Thinking Skills," *Jurnal Biolokus: Jurnal Penelitian Pendidikan Biologi dan Biologi*, vol. 8, no. 1, pp. 17–31, 2025, doi:10.30821/biolokus.v8i1.2744.

[13] T. T. S. Strat, E. K. Henriksen, and K. M. Jegstad, "Inquiry-based Science Education in Science Teacher Education: A Systematic Review," *Studies in Science Education*, vol. 60, no. 2, pp. 191–249, 2024, doi:10.1080/03057267.2023.2207148.

[14] I. G. Margunayasa, N. Dantes, and D. P. Parmiti, "Guided Inquiry Learning Model and Its Effect on Students' Critical Thinking Skills," *Journal of Physics: Conference Series*, vol. 1318, no. 1, 2019, doi:10.1088/1742-6596/1318/1/012084.

[15] M. B. Mutanga, "Students' Perspectives and Experiences in Project-Based Learning: A Qualitative Study," *Trends in Higher Education*, vol. 3, no. 4, pp. 903–911, 2024, doi:10.3390/higheredu3040052.

[16] M. A. Fadillah, Y. I. Tanjung, U. Usmeldi, L. Lufri, F. Festiyed, and M. Mawardi, "Review metodologi penelitian dalam pengembangan model inquiry untuk pendidikan," *Jurnal Muara Pendidikan*, vol. 10, no. 1, pp. 83–92, 2025, doi:10.52060/mp.v10i1.2502.

[17] A. Rasyid, M. Mustari, Y. N. Aziziy, and D. S. Nahdi, "Guided Inquiry with Sparkol Videoscribe in Science Learning: A Study of Students' Scientific Attitudes," *International Journal of Educational Innovation and Research*, vol. 1, no. 1, pp. 34–41, 2022, doi:10.31949/ijeir.v1i1.1899.

[18] H. J. M. Stokhof, B. De Vries, R. L. Martens, and T. J. Bastiaens, "How to Guide Effective Student Questioning: A Review of Teacher Guidance in Primary Education," *Review of Education*, vol. 5, no. 2, pp. 123–165, 2017, doi:10.1002/rev3.3089.

[19] Y. Mulyono, S. Sapuadi, Y. Yuliarti, and S. Sohnui, "A framework for building scientific literacy through an inquiry learning model using an ethnoscience approach," *International Journal of Advanced and Applied Sciences*, vol. 11, no. 8, pp. 158–168, 2024, doi:10.21833/ijaas.2024.08.017.

[20] N. Falentina, M. Saptasari, and S. Indriwati, "Peningkatan Keterampilan Berpikir Kritis melalui Penerapan Model Inkuiri Terbimbing pada Peserta Didik SMA," *Jurnal Pendidikan: Teori, Penelitian, dan Pengembangan*, vol. 5, no. 10, pp. 1397–1404, 2020, doi:10.17977/jptpp.v5i10.14077.

[21] N. Falentina, M. Saptasari, and S. Indriwati, "Peningkatan keterampilan berpikir kritis melalui penerapan model inkuiri terbimbing pada peserta didik SMA," *Jurnal Pendidikan: Teori, Penelitian, dan Pengembangan*, vol. 5, no. 10, pp. 1397–1404, 2020, doi:10.17977/jptpp.v5i10.14077.

[22] R. Komala, E. P. Azrai, and M. W. Handayani, "Improving Students' Critical Thinking Ability Through Guided Inquiry Model with Scientific Approach on Ecosystem Material," *Biodidaktika: Jurnal Biologi dan Pembelajarannya*, vol. 20, no. 1, pp. 31–42, 2025, doi:10.30870/biodidaktika.v20i1.27095.

[23] R. S. Agustina, H. Sipahutar, and D. S. Diningrat, "Penerapan model inkuiri terbimbing berbantuan aplikasi kodular dalam pembelajaran sistem gerak pada manusia untuk meningkatkan kemampuan berpikir kritis dan literasi sains siswa kelas XI SMA," *Bioscientist: Jurnal Ilmiah Biologi*, vol. 13, no. 3, pp. 2184–2198, 2025, doi:10.33394/bioscientist.v13i3.15292.

[24] W. Ningsih, D. Y. C. Sipayung, and H. Simatupang, "The effect of guided inquiry with differentiated learning to enhance students' critical thinking skills," *Jurnal Biolokus: Jurnal Penelitian Pendidikan Biologi dan Biologi*, vol. 8, no. 1, pp. 17–31, 2025, doi:10.30821/biolokus.v8i1.2744.

[25] A. A. U. Hasibuan et al., "Pengembangan Monopoli Berbantuan Teknologi QR Code sebagai Media Pembelajaran IPA pada Materi Keanekaragaman Hayati Indonesia di SMP Negeri 27 Medan," *JB&P: Jurnal Biologi dan Pembelajarannya*, vol. 12, no. 1, pp. 46–59, 2025, doi:10.29407/jbp.v12i1.24840.

[26] A. A. U. Hasibuan et al., "Pengembangan monopoli berbantuan teknologi QR code sebagai media pembelajaran IPA pada materi keanekaragaman hayati Indonesia di SMP Negeri 27 Medan," *JB&P: Jurnal Biologi dan Pembelajarannya*, vol. 12, no. 1, pp. 46–59, 2025, doi:10.29407/jbp.v12i1.24840.

[27] S. K. W. Chu, R. B. Reynolds, N. J. Tavares, M. Notari, and C. W. Y. Lee, 21st Century Skills Development Through Inquiry-Based Learning. Singapore: *Springer*, 2017, doi: 10.1007/978-981-10-2481-8.

[28] N. I. Oktavianti and A. R. Purnomo, "Penerapan model pembelajaran inkuiri terbimbing untuk meningkatkan keterampilan berpikir kritis peserta didik," *BIOCHEPHY: Journal of Science Education*, vol. 4, no. 2, pp. 712–725, 2024, doi:10.22437/jmpmipa.v9i2.16970.

[29] E. T. Ong, D. Govindasamy, C. K. Swaran Singh, M. N. Ibrahim, N. Abdul Wahab, M. T. Borhan, and S. W. Tho, "The 5E inquiry learning model: Its effect on the learning of electricity among Malaysian students," *Jurnal Cakrawala Pendidikan*, vol. 40, no. 1, pp. 170–182, 2021, doi:10.21831/cp.v40i1.33415.

[30] N. Falentina, M. Saptasari, and S. Indriwati, "Peningkatan Keterampilan Berpikir Kritis melalui Penerapan Model Inkuiri Terbimbing pada Peserta

Didik SMA," *Jurnal Pendidikan: Teori, Penelitian, dan Pengembangan*, vol. 5, no. 10, pp. 1397–1404, 2020, doi:10.17977/jptpp.v5i10.14077.

[31] R. S. Agustina, H. Sipahutar, and D. S. Diningrat, "Penerapan Model Inkuiri Terbimbing Berbantuan Aplikasi Kodular dalam Pembelajaran Sistem Gerak pada Manusia untuk Meningkatkan Kemampuan Berpikir Kritis dan Literasi Sains Siswa Kelas XI SMA," *Bioscientist: Jurnal Ilmiah Biologi*, vol. 13, no. 3, pp. 2184–2198, 2025, doi:10.33394/bioscientist.v13i3.15292.