Educenter : Jurnal Ilmiah Pendidikan
Vol 3 No 1 Januari 2024
ISSN: 2827-8542 (Print) ISSN: 2827-7988 (Electronic)
Open Access: https://jurnal.arkainstitute.co.id/index.php/educenter/index

The influence of the guided discovery learning model on critical thinking abilities and scientific attitudes

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Article Info

Article history:
Received October, 15th 2023
Revised December, 17th 2023
Accepted January, 25th 2024

Keyword:
Critical thinking; Scientific attitude; Guided discovery learning model; Free discovery learning model; Elementary science learning

ABSTRACT

This research aims to examine improving students' critical thinking skills and scientific attitudes using the Guided Discovery Learning learning model. Critical thinking and scientific attitudes are important aspects to develop in learning, especially in science learning in elementary schools. Critical thinking is part of the cognitive work process and a scientific attitude develops affective aspects. A quasi-experimental study using a pretest-posttest control group design is the research methodology. Students in the fifth grade at SDN Bukit Duri 05 in South Jakarta served as the research subjects. The control group received therapy using the Free Discovery Learning learning model, whereas the experimental group received treatment using the Guided Discovery Learning learning model. According to the study's findings, there was no difference between the experimental class's and the control group's early critical thinking skills. The results showed that there was no difference between the experimental class and the control class in terms of early scientific attitude abilities. Additionally, compared to students in the control class, those in the experimental class showed a different growth in critical thinking abilities. Lastly, it was discovered that the experimental class and the control class had different rising scientific views.

INTRODUCTION

Education plays an important role in developing the character and morals of the Indonesian nation. Various studies show that education functions as a control and to give birth to people with knowledge and noble character in order to build a more prosperous society. One of the studies is in the Islamic religious books, namely the Al-Qur'an and Hadith. Islam gives great attention to education. There are many verses in the Koran that show the glory of educated people, namely people who have knowledge. Education is expected to be able to transfer knowledge and know-how which gives someone the opportunity to be able to solve problems in everyday life and professional tasks, including in the world of education. However, in increasingly dynamic conditions such as now, often the knowledge we have cannot be used to solve problems that arise. With the development of this era, we should have the ability to obtain, select and manage valid information in increasingly competitive situations. Therefore, a skill called critical thinking is needed to solve problems in increasingly developing life.

The 2013 curriculum places a strong emphasis on pupils mastering information, skills, and attitudes that make up holistic competences. Among the competences that must be cultivated during the learning process in order to produce high-caliber human resources are 21st century skills. The utilization of information and communication technology and the development of critical thinking abilities during the educational process are two 21st-century innovations. The ability to think critically and solve problems, along with creativity, communication skills, and the capacity for collaborative work are the four main competencies that students need to master in order to succeed in the twenty-first century. Through the development of a society composed of quality human resources, namely having an independent and willing personality as well as the ability to realize their ideals, national education in the twenty-first century seeks to realize the ideals of a nation with an honorable and equal position with other nations in the global world. nation-wide values.

Critical thinking according to Rachmantika & Wardono (2019) is the ability to think at a complex level and use analysis and evaluation processes. Critical thinking skills include skills in inductive thinking, such as recognizing correlations, analyzing open-ended problems (with various resolution methods), determining cause and effect and making conclusions based on valid and relevant

data collection. In modern times and sophisticated technology that makes all information easier, critical thinking is very important for everyone. Zakiah & Lestari (2019) said that critical thinking allows readers to assess evidence for what they read and can identify invalid reasoning or information. In other words, critical thinking in the learning context is related to students' ability to carry out logical reasoning regarding a phenomenon/symptom that occurs in the surrounding environment. Students are given the opportunity to develop their personalities in assessing and evaluating an event or phenomenon related to learning.

In Indonesia, the level of critical thinking skills is still low. This is proven by the average results of students' mathematics, science and literacy learning outcomes according to PISA (Program for International Student Assessment). In the PISA (Program for International Student Assessment) data published in 2018 above, it can be seen that Indonesia is ranked 71st in the world with an average score in mathematics, science and reading of 382. This data also shows that Indonesia is still relatively low (score below 450) in science, mathematics and literacy skills. The second data was obtained from the results of the education quality report card, the results showed that numeracy skills were still below the minimum competency and literacy skills had reached the minimum competency but were still below the district/city average value. The ANBK implementation on 15-18 November 2021 was attended by 30 main participants and 5 reserve participants. The data shows that the quality of learning outcomes of students with literacy skills has reached the minimum competency value (Education Unit Value 1.92). Meanwhile, numeracy skills are below the minimum competency (Education Unit Value 1.63). However, the education unit value in literacy skills (1.92) is still below the average education unit value in the district/city (2.00) and also below the provincial average value (1.95). Meanwhile, for national gains, the education unit literacy score is still above the national average (1.71). For the numeracy ability score for the Education unit (1.63), the score is below the district/city average (1.72) and also below the provincial average (1.69). Meanwhile, for national results, the education unit numeracy score is still above the national average (1.57).

Next, the researcher collected preliminary pre-research data by conducting a test at SDN Bukit Duri 05 on September 28 2022. The number of questions consisted of 10 multiple choice items, 5 short description items and 1 essay item. The test was carried out on October 11 2022. Test data was collected on class 5A and 5C samples with the following results.

Table 1. Pre-Research Pretest Data

Class	$\bar{X}$ PG	$\bar{X}$ Description	$\bar{X}$ Essay	$\bar{X}$ Final score
5A	69	69,67	64,33	67,67
5C	66,67	67,67	65	66,45

Source: Pre-Research Test Results

Data shows that learning outcomes are still below the KKM (75). The average final score for class 5A was 67.67 and class 5C was 66.45. From the three data, namely PISA, school quality report card scores and average pretest results, it can be concluded that students' critical thinking abilities are below the minimum completeness criteria score and below the regional average. The results of interviews and observations using questionnaire instruments with class V teachers at SDN Bukit Duri showed that students' critical thinking skills and scientific attitudes were still in the low category.

According to Cintia et al. (2018), the discovery learning paradigm instructs students to find concepts using a variety of facts or data gathered through experimentation or observation. According to Yuliana (2018), the use of the discovery learning model may both improve each person's capacity for discovery and transform originally passive learning environments into ones that are more dynamic and creative. Discovery learning is learning that is student-centered or centered on students. In this case, the role of the teacher is as a facilitator who provides services and convenience in the teaching and learning process so as to create a conducive and enjoyable learning climate. Sherviyana & Mansurdin (2020)stated that the discovery learning model is able to make students' learning more active in increasing student discovery and solving their own problems so that the results obtained will be easy for students to remember for a long time and not easy for students to forget. because the learning process involves students actively.

According Asfar (2020), the Guided Discovery learning paradigm enables students to learn on their own by including them in discussions, reading, and trying. Through a methodical and logical process of mental reasoning, guided discovery learning is aimed to make it easy for students to discover ideas and principles. With the help of the instructor acting as a facilitator, guided discovery learning places an emphasis on student participation. In the teaching and learning process teachers technically guide students in investigation activities of problems that are contextual or related to everyday life. Guided discovery learning is designed in such a way that students can easily discover concepts and principles through a logical and systematic mental reasoning process. Guided discovery learning emphasizes student activity through the guidance and supervision of the teacher as facilitator. In the teaching and learning process teachers technically guide students in investigation activities of problems that are contextual or related to everyday life.

A scientific attitude is a certain attitude taken and developed by scientists to achieve the expected results (Sole & Anggraeni, 2017). A scientific attitude can be developed through student activities in science learning when conducting discussions, experiments, simulations and project activities in the field (Karini et al., 2020). Karini et al. (2020) stated that science learning in elementary school is generally only product-oriented, while students' scientific processes and attitudes to achieve these products receive little attention. A scientific attitude is one of the important components to be developed in elementary schools, especially in science subjects. A scientific attitude encourages students to focus not only on results but also on the learning process. Research conducted by Karini et al. (2020) shows the low level of instilling scientific attitudes in students in science learning at the elementary school level, especially elementary schools in Gugus II, Kubu District. Parwati et al. (2020) also conducted research through initial observations and interviews with the results of a low scientific attitude.

The current literature emphasizes a lack of focus on fostering scientific attitudes among elementary school students, specifically in Gugus II, Kubu District. Research suggests that there is room for improvement in instilling scientific attitudes in elementary school students during science learning. This highlights the importance of targeted interventions in this area. This study aims to fill a gap in research by examining how the Guided Discovery Learning model affects the critical thinking abilities and scientific attitudes of class V students at SDN Bukit Duri 05. This text explores the combination of critical thinking skills and scientific attitudes in Guided Discovery Learning. It provides valuable insights into the potential effectiveness of this instructional approach in promoting a well-rounded development of students' cognitive and attitudinal aspects in the field of science education.

Based on the explanation above, this research was conducted with the aim of finding out the influence of the Guided Discovery Learning learning model on the critical thinking abilities of class V students at SDN Bukit Duri 05 and to determine the effect of the Guided Discovery Learning learning model on the scientific attitudes of class V students at SDN Bukit Duri 05. It is hoped that This research can provide benefits for students, educators, schools, and other research in order to improve critical thinking skills and scientific attitudes.

RESEARCH METHODS

A quasi-experimental design research approach is the technique employed in this study. This study measures the impact of the guided discovery learning model, which is based on distance learning, on students' scientific attitudes and critical thinking skills in class V of primary schools using quantitative methods expressed in numerical form. Among the design types utilized in experimental research are factorial, quasi-experimental, actual, and pre-experimental designs. A quasi-experimental research design was used in this investigation. As its experimental research design, this study used a pretest-posttest control group design. Two groups that were not selected at random will be included in this investigation. Then, using the guided discovery learning paradigm, a pretest was administered to both of them to ascertain the starting circumstances and identify the differences between the experimental group, or group that received treatment, and the control group, or group that did not receive treatment.

The participants in this study were all SDN Bukit Duri 05 class V students. The experimental class, class V-A, had thirty students using the guided discovery learning model, while the control class, class V-C, had thirty students using the free-discovery learning model. These two classes made up the

sample for this study. In this work, a purposive sampling strategy was employed in conjunction with a nonprobability sampling technique. This is because the sampling in this research was not chosen randomly but was chosen based on certain considerations (Alwi, 2015). The data collection using test techniques used by researchers is multiple choice, complex multiple choice, short description questions and essays in order to determine students' critical thinking abilities. Furthermore, non-test assessment methods are carried out through interviews, observations and questionnaires. The non-test data collection used by researchers is a questionnaire to determine scientific attitudes towards learning and implementation in implementing the learning model used.

The pretest and posttest findings from the experimental class and control class were processed using the N-gain test as part of the data analysis that was done. This exam gauges a person's capacity for critical thought. With the aid of SPSS 25.0 for Windows, the Gain test was conducted. Using the following formula, the normalized average N-gain value is calculated using the criteria set out by Hake in Masykhur & Risnani (2020) to assess the growth in scientific attitudes and critical thinking abilities following the completion of learning activities.

$$N - Gain = \frac{\text{Skor Posttest} - \text{Skor Pretest}}{\text{Skor Maksimal Ideal} - \text{Skor Pretest}} \quad (1)$$

RESULTS AND DISCUSSION

Posttests were carried out to see the level of students' critical thinking abilities after learning took place. A description of the posttest scores for the experimental class and control class is presented in Table 2 below.

Table 2. Descriptive Statistics of Posttest Data on Critical Thinking Ability and Scientific Attitude

Class	N	XMin	XMaks	Mean	Std Deviation	Variance
Critical Thinking Ability						
Experiment	30	53.47	91.67	78.170	8.777	77.051
Control	30	50.69	90.28	70.810	8.717	75.992
Scientific Attitude						
Experiment	30	67.50	96.67	80.889	8.174	66.818
Control	30	61.67	89.17	75.028	10.127	102.559
Ideal Maximum Score: 100						

Source: Processed Results of SPSS version 25 (2023)

The mean (Sample) after-test results for critical thinking ability in the experimental class was 78.17, while the mean (average) post-test score for critical thinking ability in the control class was 70.81. Mathematically, the posttest averages of the two classes are different, with a difference of 7.36. Then the mean (average) scientific attitude post-test score for the experimental class was 80.89, while the mean (average) scientific attitude post-test score for the control class was 75.03. Mathematically, the posttest averages of the two classes are different, with a difference of 5.86.

The Normality test used is the Shapiro-Wilk test. The results of posttest normality test calculations for critical thinking abilities for each class are presented in Table 3 below.

Table 3. Posttest Score Normality Test for Critical Thinking Ability and Scientific Attitude

Class	*Shapiro-Wilk*		
	Statistic	***Df***	***Sig.***
Critical Thinking Ability			
Experiment	.938	30	.079
Control	.969	30	.511
Scientific Attitude			
Experiment	.948	30	.149
Control	.880	30	.068

Source: Processed Results of SPSS version 25 (2023)

It is evident from Table 3 above that the experimental class and control class have significant figures or probabilities greater than 0.05. The data is therefore regularly provided. The probability of the experimental class and control class for the Shapiro-Wilk test is greater than 0.05, as can be seen in the picture below. This indicates that there is a normal distribution of posttest data about scientific views.

A difference test between two averages was performed after the post-test data had been checked for normality to see if the experimental class's and the control class's final skills were the same or different. The t test is the statistical test employed since the post-test data on scientific attitudes and critical thinking abilities are normally distributed. The following are the findings of the t test used to compare the two average posttest scores for critical thinking abilities.

Table 4. T Test Results Posttest Data Critical Thinking Ability and Scientific Attitude

	t-test for equality of means		
	T	*df*	*Sig. (2-tailed)*
Critical Thinking Ability	-3.258	58	.002
Scientific Attitude	-2.467	58	.017

Source: Processed Results of SPSS version 25 (2023)

First, the Sig value is known based on the output of statistical test results obtained from Table 4's t test. It is 0.002 (2-tailed). Considering the Sig value. Given that (2-tailed) = 0.002 < 0.05, H1 is accepted while Ho is denied. The aforementioned analysis's findings lead to the conclusion that students using guided discovery learning and those using free discovery learning differ in their development of critical thinking abilities.

Second, the acceptance of H1 is based on the knowledge that the Sig (2-tailed) value for the hypothesis test findings from Table 4 is 0.017 < 0.05. This indicates that the experimental class and the control class differ in their capacity for a scientific mindset. Thus, it can be said that there is a considerable difference in the students' final scientific attitude abilities between the experimental class and the control class. The aforementioned analysis's findings lead to the conclusion that students using guided discovery learning and those using free discovery learning have different attitudes about science.

The quality of developing scientific attitudes and critical thinking abilities through the application of the guided discovery learning model can be demonstrated by analyzing the differences in these areas between the experimental and control classes using N-gain data analysis.

Table 5. Descriptive Statistics of N-Gain Critical Thinking Ability and Scientific Attitude

Class	N	XMin	XMaks	Mean	Std Deviation	Variance
Critical Thinking Ability						
Experiment	30	.55	.99	.8050	.09673	.009
Control	30	.21	.87	.4800	.17114	.029
Scientific Attitude						
Experiment	30	.55	.99	.8627	.11411	.013
Control	30	.78	.12	.4447	.15534	.024

Source: Processed Results of SPSS version 25 (2023)

According to the N-gain criteria, the quality of critical thinking skills of experimental class students is at a high level while the control class is at a medium level. Mathematically, the average N-gain of the two classes is different, with a difference of 0.325. Then according to the N-gain criteria, the quality of scientific attitudes of experimental class students is at a high level while the control class is at a medium level. Mathematically the N-gain of the two classes is different. the difference is 0.418. To find out whether the average gain scores in the two classes are significantly different or not, a statistical test must be carried out.

The normality test used is the Shapiro-Wilk test. The results of the N-gain normality test calculation for students' critical thinking abilities in each class are presented in Table 6 below.

Table 6. N Gain Normality Test Critical Thinking Ability and Scientific Attitude

Class	*Shapiro-Wilk*		
	Statistic	***Df***	***Sig.***
Critical Thinking Ability			
Experiment	.968	30	.488
Control	.963	30	.379
Scientific Attitude			
Experiment	.885	30	.775
Control	.950	30	.167

Source: Processed Results of SPSS version 25 (2023)

It is evident from Table 6 above that each class has a significant figure or probability of critical thinking skill greater than 0.05. The experimental class and control class's N-gain data are therefore regularly distributed. Then, it is evident that each class (experimental class and control class) has a significance number or likelihood of scientific attitude that is more than 0.05. As a result, the experimental class and control class's N-gain data are regularly dispersed.

Following an assessment of the N-gain data's normality, a difference test between two averages was performed to determine if the average N-gain between the two classes differed or not. The t test is the statistical test employed since the N-gain scores for scientific attitudes and critical thinking are regularly distributed. The following are the findings of the difference test utilizing the t test between the two average N-gain understandings of critical thinking abilities.

Table 7. T Test Results Posttest Data Critical Thinking Ability and Scientific Attitude

	t-test for equality of means		
	T	*df*	*Sig. (2-tailed)*
Critical Thinking Ability	9.055	58	.0001
Scientific Attitude	11.878	58	.0001

Source: Processed Results of SPSS version 25 (2023)

From the output of statistical test results via the t test in table 8, the Sig value is known. (2-tailed) critical thinking ability is 0.0001. Because the Sig value. (2-tailed) = 0.0001 < 0.05, thus H0 is rejected and H1 is accepted. This means that there is a difference in the increase in critical thinking skills of students who study with Guided Discovery Learning and students who study with Free Discovery Learning. Furthermore, the results of the hypothesis test from table 8 obtained T count = 11,878 with Sig. difference of two means of Sig. (2-tailed) scientific attitude is 0.0001 < 0.05, then H0 is rejected and H1 is accepted. This suggests that the rise in scientific attitudes was different for the experimental class and the control class. Therefore, it can be concluded that there is a significant difference between the experimental and control classes in terms of the development of students' scientific mindset abilities.

Discussion

Increased Critical Thinking Ability

Students who get guided discovery learning have a larger growth in critical thinking than students who receive free discovery learning or direct learning, according to data processing from the study results given in the preceding section. Therefore, it may be concluded that guided discovery learning helps students become more adept at critical thinking. Following action in both the control class (free discovery learning model action) and the experimental class (guided discovery learning), students' critical thinking abilities were evaluated using a post-test. The average post-test scores for the experimental class and the control class were, respectively, 78.17 and 70.81. The results of the t test, which was used to compare the average end skills (achievement) of the two courses, showed that there was a difference in the average critical thinking posttest between the experimental class and the control class. Stated differently, there are disparities in the experimental and control groups' pupils' ultimate critical thinking skills.

We performed an n-gain average difference test before making any judgments. Since the n-gain scores for critical thinking ability were normally distributed, a mean n-gain difference test was used to determine if there was a difference in the growth in students' critical thinking ability in the class. the experimental and control groups. The test findings showed that the critical thinking skills of the students in the experimental class developed differently than those of the students in the control class. The experimental class's mean (average) N-gain of critical thinking abilities was 0.8050, whereas the control class's mean (average) N-gain of critical thinking abilities was 0.4800. The N-gain interpretation results showed that critical thinking skills increased rather significantly in the experimental class whereas they increased just somewhat in the control group. The results of the difference test in the average increase in students' critical thinking skills using the t test and a significance level of a = 0.05 showed that there was a significant difference between the increase in students' critical thinking in the experimental class and the control class because the average in the experimental class was higher than the average in the control class. Therefore, compared to free discovery learning, guided discovery learning can enhance critical thinking abilities more. This is consistent with the findings of a study conducted by Sucipta (2018), which shows that students who use the guided discovery learning model will develop their critical thinking abilities more than those who use the free discovery learning model.

Increasing Scientific Attitude Ability

Data processing from the research results, which were discussed in the preceding part, indicates that students who get guided discovery learning have much stronger scientific attitude abilities than students who receive free discovery learning. In light of this, it may be concluded that guided discovery learning greatly contributes to students' growing attitudes toward science. The degree of confidence or a indicates the likelihood of the sample value occurring in the event that the null hypothesis is true. This interpretation is consistent with his findings. Based on the post-test data, it is determined that the experimental class's average post-test score (80.89) is greater than the control class's average post-test score (75.03). The results of the t test, which was used to compare the average end skills (achievement) of the two courses, showed that the experimental class and the control class had different attitudes about science.

Prior to making any conclusions, the t test was used to compare the average N-gain to see if there was a difference between the experimental and control groups in terms of the growth in students' scientific views. The test results showed that the experimental class students' growth in scientific attitudes was different from the control class students' growth in the same domain. The mean (average) N-gain for the experimental class is 0.8627, while the mean (average) N-gain for the control class is 0.4447. The N-gain interpretation results showed that the experimental class had a relatively substantial increase in scientific attitudes whereas the control group had a moderate increase. The findings of the test of differences in the average rise in scientific attitudes using the t test and a significance threshold of a = 0.05 showed that there was a significant difference between the growth in students' scientific attitudes in the experimental class and the control class. This occurred as a result of the experimental class's average exceeding that of the control class. Hence, compared to free discovery learning, it may be said that guided discovery learning can result in a greater rise in scientific views. Researchers discovered that, at every meeting, students who studied under guided discovery learning were more actively following the phases of group learning and encouraged to be actively involved in their scientific attitudes—both of which are signs of collaborative learning. The high percentage of engaged students is consistent with the cooperative learning paradigm proposed by Melani et al. (2012), which holds that because discovery learning involves group activities related to markers of scientific attitudes, it can enhance students' attitudes toward science. With more organized information, the guided discovery learning model group in the class completes worksheets and presentations that are more pertinent to real-world instances of applying solutions. Students in the control group were unable to determine if categorization comprised single chemicals or mixes, and several reports were submitted that did not meet the required competences. Based on scientific attitude indicators, guided discovery learning aims to foster high levels of curiosity, critical thinking, objective perseverance, open thinking, and cooperation in students (Sudana & Sudarma, 2018). In this case, cooperation entails mutual assistance amongst group members. This supports the findings of Hidayat et al. (2019) study, which show that guided discovery learning can enhance attitudes toward science.

CONCLUSION

The conclusion that the Guided Discovery Learning learning paradigm has quite a big influence on elementary school students' critical thinking abilities is based on the problem formulation, learning results, and discussion of the research results presented. These findings also show that there are variations in the development of scientific attitudes and critical thinking skills between students who receive guided discovery learning and students who receive free discovery learning, as well as differences in critical thinking skills and scientific attitudes between the two groups of students. This research shows that children who learn through guided discovery have superior attitudes toward science and critical thinking skills compared to those who learn through free exploration. Children who received free discovery learning had different growth in critical thinking abilities compared to children who received guided discovery learning. Students who take part in guided discovery learning have a higher increase in critical thinking skills than students who take part in guided discovery learning. The findings of this research provide guidance to educators so they can improve their own teaching and the learning outcomes achieved by their students by focusing on relevant learning models that foster scientific attitudes and critical thinking skills in them.

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