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The Effectiveness of Contextual Learning Using the Guided Inquiry Approach to Improve Students' Scientific Literacy Ability

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Abstract: This study aims to evaluate the effectiveness of contextual learning using guided inquiry to increase prospective physics teachers' scientific literacy skills. This study used the One Group Pretest-Postest design. Students in the physics education undergraduate program at Universitas Negeri Surabaya who took thermodynamics courses were the research subjects. The results showed that students' scientific literacy abilities before participating in the learning were already in a reasonably good category, and these students scientific literacy abilities experienced an increase after participating in contextual learning with a guided inquiry approach. The evaluation results of the n-gain test based on the pretest and posttest scores obtained an n-gain score of 0.64 or 64%. Accordingly, it can be concluded that contextual learning combined with the guided inquiry approach can effectively increase prospective teacher students' scientific literacy skills based on the evaluation results of the n-gain test.

Keywords: Contextual learning; Guided inquiry; Scientific literacy.

Introduction

Science education faces challenges due to the large amount of fake news related to social science issues, such as global warming and climate change (Momsen & Ohndorf, 2022). This is exacerbated by the lack of ability of the next generation to explain phenomena scientifically (Calavia et al., 2022). So from these conditions, scientific literacy skills are essential because they can help someone understand and study natural phenomena in everyday life. (Pertiwi et al., 2018). One of the competencies often used as an indicator of achieving scientific literacy is the ability to explain phenomena scientifically (Amadi, 2021). This ability is to explain natural and social phenomena using established scientific principles and methods. This includes identifying hypotheses, conducting appropriate experiments, collecting and analyzing data, and concluding results logically and rationally. The ability to explain phenomena scientifically is an essential ability for students. This ability can not only improve students' ability to understand science concepts but can also improve students' ability to apply the knowledge gained in everyday life (Ginting, 2022).

Global warming is a significant phenomenon and has a broad impact on human life. Learning about global warming and climate change can help students become global citizens who are more responsive to environmental problems and have a role in solving these problems. However, in Indonesia, students' ability to explain phenomena scientifically is still relatively low (Astuti et al., 2021; Budiarso et al., 2020). This can also be seen from the results of the Program for International Student Assessment survey, which shows that the scientific literacy ability of Indonesian students is still relatively low compared to other countries. This is because learning in schools is not conveyed contextually, so students cannot find the essence of learning in their daily lives (Fuadi et al., 2020).

One of the learning methods that can be used to improve students' ability to explain the phenomenon of global warming science is learning that is delivered contextually. This approach aims to make learning more relevant and easily understood by students. In

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contextual learning, the subject matter is taught concerning actual situations or contexts, so students can find connections between what is learned and their daily lives (Anggraini, 2017; Matondang et al., 2021; Ramdani, 2018; Sinaga & Silaban, 2020). In addition, learning must be student-centered. In this case, the teacher needs to encourage students to be active in learning activities by using the inquiry process approach. The inquiry process is understanding something by finding out and asking questions about something unknown or not understood. Inquiry is usually made to find answers to unanswered questions or to understand something better. Inquiry can be made formally, as in scientific research. Inquiry can be done individually or in groups and is integral to learning and understanding the world.

In physics lessons, global warming can be taught as part of materials on energy, temperature changes, and other thermodynamic materials. Students can improve their ability to explain phenomena related to global warming through an inquiry process based on their knowledge of thermodynamic concepts. Through this inquiry process, students can improve critical thinking skills and understand the context of global warming in solving social science problems such as climate change (Indawati et al., 2021; Prasetiyo & Rosy, 2020; Rahayu et al., 2022). Previous research also explained that learning that links social science issues could improve scientific literacy skills, and researchers also emphasize the need for further development and other innovations in inquiry learning (Fibonacci et al., 2017).

One learning model that supports students' inquiry process in the classroom is the guided inquiry learning model (Suyono, 2019). Guided inquiry learning is a learning approach that emphasizes inquiry activities carried out by students with guidance and direction from the teacher. This approach places students as learning subjects with different needs, interests, and potential. The teacher acts as a facilitator who provides direction, guidance, and feedback needed for students to solve problems or find answers to questions they face. Inquiry learning focuses on learning processes driven by questions and student exploration, thus enabling students to practice critical thinking skills (Nisa et al., 2018). With these critical thinking skills, students can develop scientific literacy skills, such as understanding scientific concepts, using scientific methods effectively, and making inferences based on evidence. (Kusumastuti, 2019). So based on this explanation, it can be seen that contextual learning with a guided inquiry approach can be used as a learning innovation method to improve students' scientific literacy skills.

Previous studies also state that learning delivered contextually using a guided inquiry approach has proven effective in increasing learning achievement (Sarwi et al., 2019; Widia et al., 2021; Yunianti et al., 2019). However, there is still no more in-depth evaluation regarding the effectiveness of this learning in increasing students' abilities to explain the phenomenon of global warming scientifically. So, to find out how effective contextual learning with the guided inquiry approach is in improving these abilities, further evaluation is still needed. So, based on the results of the evaluation, it is hoped that it will provide input for teachers to improve their students' scientific literacy skills.

Method

The method used in this research is descriptive quantitative. The research subjects were 28 students who were programming thermodynamics courses. The research design is One Group Pretest-Posttest. This research design is commonly used to evaluate the effect of treatment on research subjects. The research instrument was a scientific literacy skill sheet to measure students' ability to scientifically explain the global warming phenomenon. The data collection technique uses the test method. Students performed the tests before and after participating in contextual learning with a guided inquiry approach.

To determine the effectiveness of this learning, the students' pretest and posttest scores must be tested for normality using the Lilliefors test. This testing technique can be used on small samples (Wei & Chen, 1983). If the pretest and posttest results are normally distributed, then the next step is the n-gain test. Here is the equation to find out the n-gain score:

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

The n-gain score is then determined by the criteria based on Table 1.

Table 1. N-gain score criteria

N-Gain Score	Criteria
$g > 0.7$	High
$0.3 \leq g \leq 0.7$	Medium
$g < 0.3$	Low

In addition, the n-gain score can also be limited to a percentage, and its effectiveness can be interpreted. The following table shows the distribution of n-gain scores in proportion

Table 2. Interpretation of n-gain score percentages

Percentage (%)	Interpretation
< 40	Ineffective
40 - 55	Less effective
56 - 75	Effective enough
> 76	Effective

Result and Discussion

There are interesting findings based on the results of data analysis on the pretest scores of students who are the subject of this study, namely that it is known that, on average, students already have relatively good scientific literacy skills. The aspects of scientific literacy measured in this study are (1) the ability to explain the phenomenon of differences in the temperature of the Earth's poles using the concept of thermodynamics, (2) the ability to explain the factors that cause differences in the temperature of the Earth's poles using the concept of heat capacity, (3) the ability explaining the phenomenon of differences in the speed of melting of the polar ice caps of the Earth using the concepts of work and heat, and (4) the ability to explain the phenomenon of differences in the temperature of the Earth's poles using the laws of thermodynamics. The following is a diagram of the results of measuring the four aspects of scientific literacy.

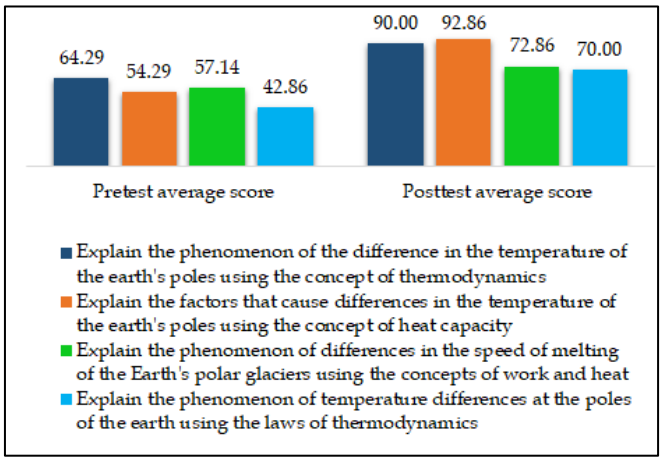

Figure 1. Diagram of the Measurement Results of the Four Aspects of Scientific Literacy

The results of the initial evaluation through the pretest, it is known that the average ability of students to explain the phenomenon of differences in the temperature of the Earth's poles using the concept of thermodynamics is 64.29, explaining the factors that cause differences in the temperature of the Earth's poles using the concept of heat capacity of 54.29, explaining the phenomenon of the difference in the speed of melting of the polar ice caps using the concepts of work and heat is 57.14. The ability of students to explain the phenomenon of differences in the temperature of the Earth's poles using the laws of thermodynamics is an average of 42.86.

After the researchers carried out the treatment using guided inquiry-based contextual learning, the results of the evaluation through the posttest showed an increase in students' ability to explain the phenomenon of differences in the temperature of the Earth's poles using thermodynamic concepts, an average of 90.00, explaining the factors that cause differences in the temperature differences of the Earth's poles. The polar Earth uses the concept of heat capacity of 92.86, explains the phenomenon of differences in the speed of melting of glaciers using the concept of work and heat of 72.86, and the ability of students to explain the phenomenon of differences in temperature of the Earth's poles using the laws of thermodynamics averages 70.00.

Based on the comparison of the average pretest and posttest results, it is known that contextual learning using the guided inquiry approach is the most effective in increasing students' ability to explain the factors that cause differences in the temperature of the Earth's poles using the concept of heat capacity. This is most likely because the student inquiry activity sheet emphasizes more on students so they can explain the factors that cause differences in the temperature of the Earth's poles using the concept of heat capacity.

The results showed increased students' scientific literacy skills after participating in contextual learning with a guided inquiry approach. The following is a data presentation of student pretest and posttest scores.

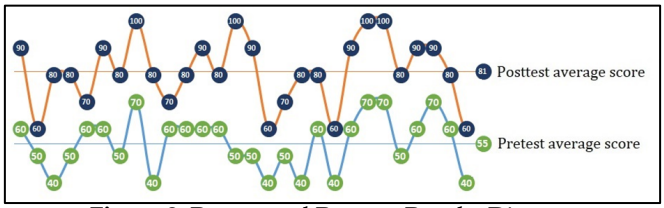

Figure 2. Pretest and Posttest Results Diagram

Figure 2 is a data presentation from a graph of students' scientific literacy abilities measured through the pretest and posttest. From the picture, it can be seen that the student's ability before participating in the learning got an average value of 55; it can be interpreted that the average student already has a pretty good ability to explain phenomena scientifically. The ability of these students experienced an increase after they took part in guided inquiry-based contextual learning. Based on the posttest results, these students got an average score of 81, which is very good.

Based on the normality test results using the Lilliefors test, it is known that the population of student scores, both pretest and posttest, is typically distributed. The normality test results are presented in Table 3.

Table 3. Normality test results

Data	N	L_o	L_{abel}	Interpretation
Pretest	28	0.149	0.164	Normal distribution
Post-test	28	0.153	0.164	Normal distribution

Table 3 shows that the L_o value for pretest and posttest data is smaller than S_{table}, so it can be interpreted that the data is typically distributed. Based on the results of the n-gain test, it is known that guided inquiry-based

contextual learning is quite effective in increasing students' ability to explain scientific phenomena. The following are the results of the n-gain test presented in Table 4.

Table 4. N-gain test results

Pretest	Post-test	<g>	Criteria
54.64	81.43	0.61	Medium

The n-gain value obtained based on the pretest and posttest data is 0.61. This value is in the medium criteria, so if the n-gain value is converted into a percentage, then this value can be interpreted that the learning is effective enough to improve students' ability to explain phenomena scientifically. The results of this learning evaluation have implications for the development of innovative teacher learning to improve the scientific literacy skills of their students in the future. However, the authors admit that this research has limitations. Evaluation of the effectiveness of contextual learning using the guided inquiry approach is only limited to explaining phenomena scientifically, so it is necessary to further evaluate the effectiveness of this learning in improving students' abilities in other aspects of scientific literacy.

Conclusion

Based on the results of this study, it is known that contextual learning using the guided inquiry approach is quite effective in increasing students' ability to explain phenomena scientifically. The average ability of students previously in the pretty good category increased to the excellent category. Contextual learning with the guided inquiry approach in this learning is most effective in increasing students' ability to explain the factors that cause differences in the temperature of the Earth's poles using the concept of heat capacity. This is because the student inquiry activity sheet emphasizes more on students so they can explain the factors causing differences in the temperature of the Earth's poles using the concept of heat capacity.

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