Biodidaktika

Analysis of Students' Scientific Literacy Abilities on Environmental Changes Concepts

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Abstract

This research aimed to describe the profile of students' scientific literacy abilities on environmental change. The sample in this research was class X students at a senior high school in Pandeglang, Indonesia. This research uses a descriptive method; data collected using scientific literacy skills tests and interviews. The research results show that students' average scientific literacy ability is 46.61%. Students' ability to explain scientific phenomena is 43%, evaluate and design scientific investigations is 56%, interpret scientific evidence and data is 37%, interest in scientific issues is 48%, support for inquiry activities is 52%, and response to natural resources and the environment by 78%. Based on the results of the interviews, that the learning process in schools still needs to develop students' scientific literacy skills.

Keywords: scientific literacy, biology learning, environmental changes

INTRODUCTION

Scientific literacy comes from the words Literatus, literacy, and Scientia, which means knowing. Scientific literacy is using scientific knowledge, identifying questions, and drawing conclusions based on scientific evidence to understand and make decisions about nature and its changes due to human activities (Sutrisna, 2021). Scientific literacy is the ability to apply scientific knowledge, identify questions, and draw conclusions based on existing evidence to understand and make decisions about events in the natural environment (Noor, 2020). Scientific literacy is the knowledge to identify questions and draw conclusions based on evidence to understand and make decisions (Irwan et al., 2019). So scientific literacy is a person's ability to understand science, communicate science, and apply scientific knowledge to solve a problem, to have high characteristics and sensitivity towards themselves and their environment, and to make decisions based on scientific considerations.

Relevant research regarding students' scientific literacy abilities, such as Sutrisna's (2021) research results, namely that the scientific literacy abilities of high school students in Sungai Penuh City are in the low category. There are also research results from Siagian et al. (2017) that found that students' scientific literacy skills in the Labuhanbatu Utara based on the dimensions of content, process, and context were in a low category. Furthermore, the results of research from Rusilowati et al. (2016), namely students' low scientific literacy abilities, indicate a percentage of mastery of scientific literacy below 50% for each aspect.

The results of observations, show that Biology learning in schools has yet to lead to the development of students' scientific literacy. In delivering learning, teachers have yet to present

scientific phenomena, so students experience difficulties relating the concepts they are learning to phenomena in everyday life. Teachers have carried out learning using practical methods on certain materials, but these activities only confirm the concepts students master. Students carry out investigations in the practicum using the procedures set by the teacher, resulting in less development of students' creative thinking abilities. Apart from that, the test questions teachers give only measure students' understanding and do not develop students' critical thinking skills.

Thus, measuring students' scientific literacy abilities is very important to determine the extent of students' literacy in the scientific concepts they have studied. The profile of students' scientific literacy abilities can be used as an initial assessment to determine the characteristics of students, so the results of this research can be a source of information for teachers in schools when preparing their learning tools. This research aims to analyze the profile of students' scientific literacy abilities on environmental change.

METHOD

This research conducted in May 2021 at at a senior high school in Pandeglang, Indonesia. The method used in this research is qualitative with data collection techniques, namely tests and interviews. The sample in this study consisted of 140 students and 2 Biology teachers. The test instrument consists of 20 multiple-choice questions. The test instrument is used to measure students' scientific literacy abilities, which contain indicators of scientific literacy, namely explaining scientific phenomena, evaluating and designing scientific investigations, interpreting scientific evidence and data, interest in scientific issues, support for inquiry activities, and response to natural resources and the environment. Apart from that, this research also used an interview instrument. The results of students' scientific literacy ability tests calculated using a formula:

$$NP = \frac{R}{SM} \times 100\%$$

Where NP is the value of scientific literacy ability, R is the number of scores on questions answered correctly, and SM is the maximum score on the test.

The percentage of scientific literacy abilities is interpreted based on the criteria according to Erniwati et al. (2020), which can be seen in Table 1.

Table 1. Interpretation Criteria for Students' Scientific Literacy Scores

Value Range	Criteria
86 – 100	Very good
72 – 85	Good
58 – 71	Enough

Value Range	Criteria
43 – 57	Low
≤ 42	Very low

RESULTS AND DISCUSSION

Based on the results of students' scientific literacy ability tests, an average score of 46.61% with low criteria was obtained. The average value obtained for each indicator can be seen in Figure 1.
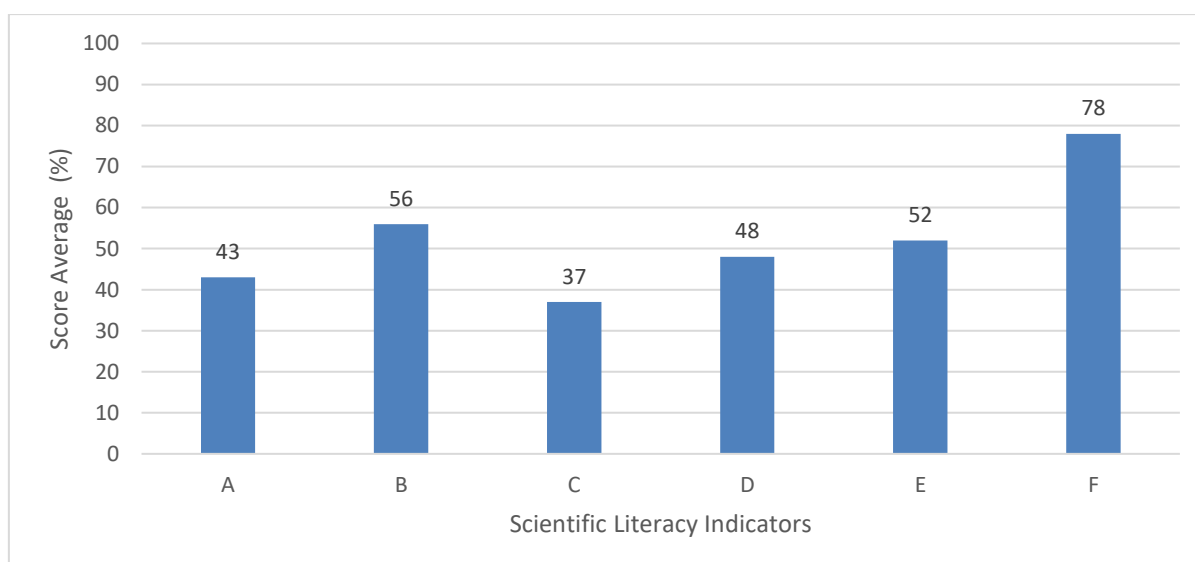

Figure 1. The average value of students' literacy skills for each indicator. (A) Explain scientific phenomena, (B) Evaluate and design scientific investigations, (C) Interpret scientific evidence (and data, (D) Interest in science issues, (E) Support for inquiry activities, and (F) Response to natural resources and the environment.

Figure 1 shows that the indicator explaining scientific phenomena received an average student score of 43%. It shows that student's literacy skills still need to improve in explaining how a greenhouse occurs, why hybrid cars are considered environmentally friendly cars, and why using spray has a harmful environmental impact. Based on the interview results, the teacher gave students time to conduct group discussions, but they are focus on completing student worksheets by looking for the answers in the textbook. It shows that students only remember the textbook's contents if they conduct further analysis related to the subject matter they are studying. Sutrisna (2021) believes that students tend to learn by memorizing so that students have knowledge that does not come from the thinking process. The way students learn by rote means they need help understanding and cannot correctly explain scientific phenomena. Another cause is the habit of science learning in schools, which places more emphasis on cognitive aspects rather than developing students' thinking skills.

The average score of students' scientific literacy skills in evaluating and designing scientific investigations is 56%, are given cases about land clearing activities to establish

industrial areas and cases regarding environmentally friendly roads contraction. Students are good at providing their assessments regarding this matter. Students use their thinking skills to understand a case or problem presented and provide reasons and conclusions for the case. Based on the interview results, information showed that students understood the meaning of the problem asked in the question and could determine the correct answer. Apart from that, in the learning process, the teacher always allows students to ask or answer questions from the material be learn to stimulate students' skills in making judgments or conclusions. This matter is in accordance with the research results of Irwan et al. (2019), namely that in questions with indicators for evaluating scientific data, students rely not only on memorization but also on students' thinking abilities to understand a problem and provide reasons or conclusions.

Indicators interpreting scientific evidence and data are showed in the questions by providing graphs and tables about the earth's temperature and the amount of CO_2. The average score obtained by students was 37%, including shallow criteria (Figure 1). It indicate that students still need to understand relationships or patterns in the data and have difficulty understanding information from the data in the problems given. Students' ability to interpret data depends on their understanding of certain concepts. Students are used to memorizing lesson material that they don't understand. Apart from that, based on the results of interviews, teachers are used to giving questions that require students to remember the material they have studied. So when problems presented in graph or table form, students need help digesting and explaining the data. According to Sutrisna (2021), students' low scientific literacy skills caused by a learning process that does not support students in developing scientific literacy skills, students are not used to working on questions that use discourse, and students are not used to working on questions that require analysis.

The indicator of interest in science issues obtained a score of 48% with low criteria (Figure 1). In this indicator, questions given in articles related to current atmospheric conditions and diagrams about the carbon cycle in the air. When answering these questions, students must be able to read and understand the science issues given, as well as relate them to students' daily lives. Based on the interviews with students, information obtained that students read books and repeat lesson material when facing exams or when they have assignments from the teacher. Reading is necessary to increase students' knowledge and insight because by reading, students can link their new knowledge with previous knowledge. Irwan et al. (2019) argue that high school students' abilities still involve recognizing basic facts. They still need to be able to communicate and relate various science topics, so they need help connecting subject matter concepts and applications in everyday life.

The average score of students' scientific literacy abilities on the indicator of support for inquiry activities is 52%, including low criteria (Figure 1). The questions given in this indicator are in the form of experimental questions, where students must be able to make conclusions and analyze the results of their experiments. Based on the results of interviews, teachers rarely carry out the learning process using practical methods due to limited study time and inadequate school facilities. Thus, it is natural that students' inquiry abilities must be better developed. According to Fitri and Yuni (2019), inquiry activities or inquiry learning can facilitate students' building and constructing their knowledge about the natural world and provide opportunities to develop their scientific literacy skills.

Based on Figure 1, the highest average score for students' scientific literacy skills is 78% (good), with indicators of response to natural resources and the environment. This indicator measures how much students respond to natural resources and the environment. This indicator explores students' ability to determine human activities that are environmentally friendly and do not cause global warming. Students can decide examples of these activities, including walking, planting trees, and raising poultry. It is in line with the opinion of Rusilowati (2013), namely that the attitude towards scientific literacy is that students respond excellently to resources and the environment.

The results of the interviews found that the learning process influenced students' literacy skills. Teachers are used to carrying out the learning process by explaining lesson material, group discussions, and testing students' understanding with daily tests. Teachers rarely apply learning models and practical methods in the classroom. Teachers need to provide more stimulus to develop students' scientific literacy skills. The observation results also show that students more intensely with textbooks than teachers. According to Hidayah et al. (2019), teachers' learning strategies, interest in science, learning motivation, and school facilities influence students' scientific literacy abilities. Erniwati (2020) believes that scientific literacy abilities influenced by the learning resources students use and learning programs that support students' science skills.

CONCLUSION

Based on the results of students' scientific literacy ability tests, it visible that the indicator for explaining scientific phenomena is 43%, the indicator for evaluating and designing scientific investigations is 56%, the indicator for interpreting scientific evidence and data is 37%, the indicator of interest in scientific issues is 48%, the indicator of support for inquiry activities amounted to 52%, and indicators of response to natural resources and the environment amounted to 78%

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