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Analysis of Science Literacy Ability of 8th Grade Students in Junior High School

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Abstract (10pt italic)

Analysis of Science Literacy Ability of 8th Grade Students in Junior High School. *This study aims to determine the scientific literacy skills of 8th-grade students at SMP Cendekia Sidoarjo. This research is a non-experimental quantitative study using a survey method and descriptive statistical analysis techniques. The population and sample of this study consisted of 90 students, selected from the entire 8th-grade population at SMP Cendekia Sidoarjo. Data collection was carried out using an instrument consisting of a scientific literacy test with 18 questions based on scientific literacy indicators. The students' abilities were classified into achievement categories: very good, good, sufficient, poor, and very poor. The results indicate that the average scientific literacy ability of students falls into the sufficient category, with 75% on indicator 3, 67% on indicator 5, 72% on indicator 4, 64% on indicator 6, and 67% on indicator 9. Meanwhile, the poor and very poor categories are observed in indicator 7 (55%), indicator 1 (36%), indicator 2 (51%), and indicator 8 (53%). The study concludes that low scientific literacy skills can be influenced by various factors, including students' low reading interest, assessment tools that do not focus on developing scientific literacy, and the lack of practice in solving problems with PISA-style characteristics. Additionally, factors such as students' backgrounds, interests, study intensity, and attitudes toward science also contribute to the low scientific literacy achievements of students in Indonesia.*

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INTRODUCTION

Scientific literacy is the ability of individuals to understand and communicate science, as well as apply scientific knowledge aimed at solving problems, thereby developing a high sensitivity to oneself and the environment, as well as attitudes when making decisions based on scientific considerations (Durasa et al., 2022). Science literacy emphasizes that science literacy is aligned with the development of life skills, where the development of life skills is a statement that acknowledges the importance of reasoning skills in a social context and emphasizes that science literacy applies to everyone (Nurlaili et al., 2023). Scientific literacy or science literacy not only influences the development of technology and science but also broadly affects human life, reflecting the culture of a community. For industrialized democratic countries, scientific literacy is very important for everyone to possess. Everyone is expected to have good science literacy skills because science literacy plays an important role in using scientific abilities, understanding, and applying scientific knowledge to solve everyday problems, so that students can develop positive attitudes and sensitivity. According to PISA (Program for International Student Assessment), in order to communicate and make decisions,

one must possess a certain level of scientific literacy, which includes the ability to identify problems and draw conclusions based on facts (Sholikah & Pertiwi, 2021). The nine indicators used in science literacy are: 1) identifying accurate and correct scientific opinions, 2) assessing source validation, 3) evaluating the appropriateness of misuse and use of scientific information, 4) understanding various elements of research design and their impact on findings or conclusions, 5) accurately displaying graphs based on provided data, 6) reading and interpreting graphical representations of data, 7) solving problems using quantitative conclusions including basic statistics, 8) understanding and interpreting basic statistics, and 9) making predictions and drawing conclusions based on data (Hallonsten, 2021). The nine indicators of scientific literacy are expected to be included in the learning process. In a learning context, the integration of science plays an important role for students, as they not only understand science as a concept but also can apply that scientific knowledge in everyday life. According to the National Research Council (Arlis et al., 2020). The development of science literacy is very important because, through science literacy, one can achieve a sense of satisfaction after understanding and studying science. Everyone has access to find information and think scientifically in making decisions, as well as participate in public discussions and debates on important issues related to science and technology. Scientific literacy plays a crucial role in the workplace, so every individual is required to study science, use logic and reasoning, think creatively, make decisions, and solve problems. One of the fields of work that requires knowledge of science in today's society, such as researchers, doctors, and construction workers (Hanushek & Woessmann, 2023), from a personal perspective, is that scientific literacy helps people respond to emerging problems and challenges. That is when science or knowledge gives an individual the ability to make decisions without being influenced by others' opinions when they are faced with problems that have a significant social impact. Science literacy is implemented through science education by emphasizing several elements found in Core Competencies and Basic Competencies in the Natural Sciences subject. Teachers need to equip students with science literacy skills by implementing them into the science learning process. The material applied to implement the integration of science literacy can be realized through various science experiment activities. Science learning must be contextual and habituate students to observe various science objects so that students can gain direct experience (Sinyanyuri et al., 2022).

The experience gained through the implementation of science literacy in science learning can stimulate the science literacy skills possessed by students. This can provide significant contributions to the country; if the country's science literacy skills are high, then the country can also experience rapid development. Based on the results of the PISA study from 2000 to 2018 for the science literacy skills of Indonesian students, they are categorized as low. This is because the average PISA proficiency scores are higher than the scores obtained by students in Indonesia in science literacy. Based on data from 2018 shown by the OECD (Organization for Economic Cooperation and Development), the reading proficiency of students in Indonesia received an average score of 371, while the average score in the OECD was 487. In the aspect of science, the average score achieved by students in Indonesia is 389, while the OECD average score is 489. In this case, it is clear that Indonesian students' abilities in the field of scientific literacy are considered low on an international scale (Erdani et al., 2020). There are several factors that cause this to happen, including the low contribution of science learning to student success due to the detachment of learning, where science education only emphasizes mastery of material, the use of inappropriate assessments so that students are only prepared to master knowledge, and the reading activities of students (Saptaningrum et al., 2023).

In line with previous research revealing about science literacy, including the study by Sutrisna (Nana, 2020), which states that low science literacy is influenced by evaluation instruments that have not yet focused on the development of science literacy, low student reading interest, and the lack of teacher knowledge regarding science literacy. The research has similarities with the study that will be conducted, namely revealing the facts about science literacy abilities but with different objects and types of approaches, specifically on high school students in Sungai Penuh City with an unknown research focus and a descriptive research type using a mixed method with a sequential explanatory design, whereas the upcoming research will focus on science literacy in science learning using a survey method. There is also previous research conducted by Ramadhani & Sukmawati (2022), which differs from this study, where the previous research revealed the level of students' science literacy comprehension, whereas this study reveals the level of science literacy ability. Another study by Zulaiha and Kusuma (Zulaiha & Kusuma, 2021) also focuses on science literacy at the junior high school level. However, the difference between the previous study and the one to be conducted is that the former tested the instruments on eighth-grade students at public junior high schools with A and B accreditation in Cirebon City, whereas the upcoming study will test the instruments on all eighth-grade students at SMP Cendekia. SMP Cendekia, which is one of the private schools in Sidoarjo. Based on the interview results, activities to explore science literacy at SMP Cendekia have been conducted through Minimum Competency Assessment practice questions, but the science literacy abilities of the students at the school are still unknown. With this in mind, the researcher is interested in analyzing the science literacy skills of eighth-grade students at SMP Cendekia Sidoarjo.

METHODS

This research was conducted at SMP Cendekia Sidoarjo. The type of research used in this study is non-experimental quantitative research employing a survey method to obtain data from a specific natural setting. The researcher conducts data collection treatments, such as distributing questionnaires, tests, structured interviews, and so on (treatments that are not like experiments). The data analysis technique used in this study is descriptive statistical analysis, which involves calculating the percentage of student responses for each indicator of science literacy. This analysis helps to identify the distribution of science literacy levels among students and determine which indicators are most or least mastered. The survey technique can be used to measure several populations through samples regarding the level of science literacy as a variable in this research. The population consists of all eighth-grade classes, which are made up of 3 classes, each with 28-32 students. The sampling technique used is the saturated sampling technique, where the sample size is taken from all classes, namely 3 classes with a total of 90 students. This research uses test questions as a data collection instrument. The technique used in this research is the use of test instruments as a tool for collecting information or data. The instrument used was adapted from Agustin (Agustin, 2022) and was structured in the form of multiple-choice questions with four answer options, which were then categorized based on nine indicators of science literacy skills by Gormally (Gormally et al., 2012) presented in Table 1.

Table 1. Indicators of Science Literacy Ability (Ridwan & Ramdhan, 2021)

Indicator
1. Identifying accurate and correct scientific opinions
2. Assessing source validation
3. Evaluating the appropriateness of the misuse and use of scientific information
4. Understanding the various components of research design and their influence on findings or conclusions
5. Showing the graph accurately based on the given data
6. Reading and interpreting graphical representations of data
7. Solving problems using quantitative conclusions including basic statistics
8. Understanding and defining basic statistics
9. Making predictions and drawing conclusions based on data

The data analysis technique uses descriptive statistics. From the obtained data, students' answers were analyzed by giving a score of 2 for correct answers and a score of 0 for incorrect answers, according to the scoring set by PISA (Program for International Student Assessment). Before conducting data analysis, the instrument validation process was carried out to ensure the quality and accuracy of the test items. This involved validity testing using expert judgment and item analysis to evaluate the level of difficulty and discrimination index of each question. The reliability test was also conducted using Cronbach's Alpha to assess the consistency of the instrument. A reliability coefficient above 0.70 was considered acceptable for this study.

In addition to descriptive analysis, this research also applied inferential statistical techniques to explore deeper relationships between variables. For this purpose, normality and homogeneity tests were first conducted to ensure that the data met the assumptions for further analysis. Subsequently, a correlation test was employed to determine the strength and direction of the relationship between students' science literacy levels and other relevant factors such as learning resources or frequency of science-related activities. All analyses were conducted using SPSS software version 25.0.

Whereas for essay questions, if the answer is only partial or incomplete, it will receive a score of 1. Next, the total score obtained is calculated using the percentage formula for science literacy achievement below and categorized according to the science literacy assessment criteria found in Table 2.

$$\text{Presentase (P)} = Jb/\text{N} \times 100\%$$

Explanation: Jb = Number of questions answered correctly, N = Maximum score
Table 2. Criteria for Assessing Students' Science Literacy Skills

Table 2. Science Literacy Assessment Criteria

Percentage	Criteria
86% ≥ P ≤ 100%	Excellent
76% ≥ P ≤ 85%	Good
60% ≥ P ≤ 75%	Enough
55% ≥ P ≤ 59%	Poor
P ≤ 54%	Very Poor

RESULTS AND DISCUSSION

The analysis of science literacy skills in the science learning of eighth-grade students at SMP Cendekia Sidoarjo is shown in Table 3. The analysis of students' science literacy

abilities was obtained through a science literacy ability test given to 90 students, which was analyzed according to the science literacy ability criteria as shown in Table 3.

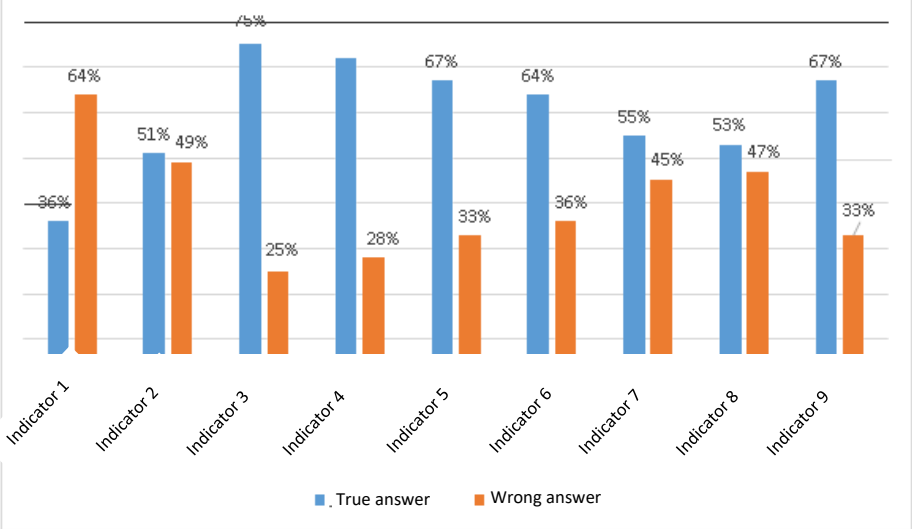
Table 3. Results of Student Science Literacy Ability Analysis

Indicator	Percentage	Criteria
1. Evaluating the appropriateness of the misuse and use of scientific information	75%	
2. Show the graph accurately based on the given data	67%	
3. Understanding the various components of research design and their influence on findings or conclusions	72%	Sufficient
4. Reading and interpreting graphical representations of data	64%	
5. Making predictions and drawing conclusions based on data	67%	
6. Solving problems using quantitative conclusions, including basic statistics	55%	Insufficient
7. Identifying accurate and correct scientific opinions Identifying accurate and correct scientific opinions	36%	
8. Assessing source validation	51%	Very insufficient
9. Understanding and defining basic statistics	53%	

The research results show that the science literacy skills of eighth-grade students at SMP Cendekia Sidoarjo are classified as sufficient because the average percentage score is 60%. In Table 3, out of 90 students, none had very good literacy skills, which was also the case for the good category. Meanwhile, students with sufficient literacy skills averaged 69%, those with poor literacy skills averaged 55%, and those with very poor literacy skills averaged 47%. In this study, the results of the percentage per indicator of science literacy skills among eighth-grade students at SMP Cendikia Sidoarjo can be seen in Table 3 and Graph 1. Based on Table 3 it shows that in the first indicator, identifying correct and accurate scientific opinions falls under the science literacy ability with a very low criterion, where the percentage of correct answers from students on questions 1 and 15 is 36%, while the percentage of incorrect answers is 64%. Then, in the second indicator, assessing the validity of sources falls under the science literacy ability with a very low criterion, where the percentage of correct answers from students on questions 2 and 11 is 51%, while the percentage of incorrect answers is 49%. on the third indicator, evaluating the appropriateness of the misuse and use of scientific information falls within the science literacy ability with a sufficient criterion, where the percentage of correct answers from students on questions 3 and 16 was 75%, while the percentage of incorrect answers was 25%, on the fourth indicator, understanding various components of research design and their influence on findings or conclusions falls under the science literacy ability with a sufficient criterion, where the percentage of correct answers from students on questions 4 and 14 was 72%, while the percentage of incorrect answers was 28%, on the fifth indicator, showing graphs accurately based on the given data falls under the science literacy ability with a sufficient criterion, where the percentage of correct answers from students on questions 5 and 12 is 67%, while the percentage of incorrect answers is 33%, on the sixth indicator, reading and interpreting graphical representations of data falls under the science literacy ability with a sufficient criterion, where the percentage of correct answers from students on questions 6 and 17 is 64%, while the percentage of incorrect answers is 36%, then on the seventh indicator, solving problems using quantitative conclusions including basic statistics falls into the science literacy ability with a poor criterion, where the percentage of correct answers from students on questions 7 and 18 is 55% while the percentage of incorrect answers is 45%, Meanwhile, on the eighth indicator, understanding and defining basic statistics falls under the science literacy

ability with a "very low" criterion, where the percentage of correct answers from students on questions 8 and 10 is 53%, while 47% of students answered incorrectly. On the ninth indicator, making predictions and drawing conclusions based on data falls under the science literacy ability with a "sufficient" criterion, where the percentage of correct answers from students on questions 9 and 13 is 67%, while 33% of students answered incorrectly. Based on the achievement of science literacy scores, this indicates that students' science literacy skills are highest in the indicator of evaluating the appropriateness of the misuse and use of scientific information and lowest in the indicator of identifying correct and accurate scientific opinions. This is reinforced by the data on the science literacy skills of SMP Cendekia Sidoarjo students, which shows the number of correct and incorrect answers summarized in the following graph.

Figure 1. Graph of the Percentage of Correct and Incorrect Answers by Indicator of Students' Science Literacy Skills



Based on Figure 1 and Table 3, it shows that the highest average score is on the indicator of evaluating the appropriateness in the misuse and use of information at 75%, while the lowest average score is on the indicator of identifying the correct and accurate scientific opinion at 36%. This shows that students are able to read graphical representations of the given data. Through the questions presented in the form of a graph regarding the number of hotspots at a confidence level of > 50% and the increase in the number of hotspots, students were able to accurately determine the true or false statements in the provided columns. In this study, the highest literacy ability indicator that students were able to achieve was in the competence of using scientific evidence, which is found in the indicator of evaluating the appropriateness of the misuse and use of scientific information. On this indicator, the achievement of science literacy skills can be seen in students when answering questions in the form of data interpreted through tables and images in the science literacy test instrument used in this study. In addition, the ability to evaluate the appropriateness of the misuse and use of scientific information is demonstrated by the evidence and reasoning that students are able to determine the correct scientific information.

The low level of students' science literacy on indicators such as identifying correct and accurate scientific opinions, assessing source validation, and understanding and defining basic statistics, shows that students are very lacking in understanding and defining basic statistics, assessing source validation, as well as identifying correct and accurate scientific opinions. This is because the knowledge concepts possessed by students affect their ability to define or

interpret scientific phenomena. The sufficient category obtained on the indicators of identifying correct and accurate scientific opinions, assessing source validation, and understanding and defining basic statistics, illustrates that students' abilities are not yet optimal in understanding and defining basic statistics, evaluating source validation, and also identifying scientific phenomena triggered by several factors that can influence the achievement of literacy skills (Haerani et al., 2020). There are several factors that can influence the mastery of science literacy skills, namely in science learning, an approach or teaching method used by the teacher is needed to build a learning concept. This way, during the learning process, students' curiosity will increase when discussing the learning topic, and students will have the motivation to solve problems. Therefore, this indicates that most students still have deficiencies in understanding sources of information presented in the form of tables, diagrams, or graphs. Additionally, students cannot analyze data and draw accurate conclusions, as well as distinguish between arguments based on scientific and non-scientific evidence (Haerani et al., 2020). The ability to use authentic and scientific evidence is also influenced by the development of science and technology. There are several factors that influence students' science literacy skills, such as rarely or never encountering science questions in text form that require an understanding of each sentence in the text. The low science literacy skills of students can also be caused by their inability to solve science literacy questions, which require understanding and analyzing the questions. However, these students are not accustomed to solving questions that require comprehension and analysis because the questions given by teachers during daily quizzes, midterms, and finals are easy for students to memorize based on the material they have learned, questions that do not require understanding and analysis (Nana, 2020). Therefore, students need to be accustomed to solving questions that require comprehension and analysis, as well as being contextual with everyday life. With this, students will become accustomed to developing their understanding of the material they have received and learned. This is in line with Pantiwati's opinion. (Putri et al., 2024) This states that science assessment should not only focus on mastery of science material, but also on thinking skills and the ability to carry out scientific processes in everyday life.

There are several factors that contribute to the low science literacy skills of students, including the lack of support in the learning process to develop students' reading skills, topics or subject matter that have not been taught, and the lack of students' habits in working on text-based questions (Riskayanti, 2023). Meanwhile, science literacy assessment uses tests that begin with the exposure of several phenomena aimed at encouraging students to recognize phenomena often observed in daily life through reading (Ramadhani & Sukmawati, 2022). Students tend to work on questions that emphasize memorization and rarely encounter questions in the form of texts or questions that develop students' analytical skills (Agustin & Sartika, 2022). There is also another factor, which is the low reading culture among students. The low reading culture among students is caused by a lack of desire to take the time to read. This fact is reinforced by one of the research findings that shows students from several junior high schools have a low level of reading and writing culture (Purnami & Febriani, 2025). In addition, science literacy must also be supported by good reading competence because the texts in science literacy questions contain scientific phenomena that each student must study to solve problems related to those phenomena (Merta et al., 2020). In Indonesia, there are several factors that influence science literacy skills, including the curriculum, education system, teaching materials, learning resources, and so on. With this, what needs to be improved is not only the teachers or students but all aspects of education; an evaluation is necessary to improve the imperfect education system from both schools and other educational institutions (Emilya & Mufit, 2024). Another factor contributing to the low science literacy of Indonesian students, based on PISA research, is that students are not yet accustomed to solving problems with

characteristics that meet PISA criteria (Rahmadani et al., 2022). Therefore, in order to improve science literacy or scientific literacy, teachers need science literacy-based evaluation tools in the learning process. However, it often happens that teachers do not understand how to create science literacy-based evaluation tools, so these science-based evaluation tools are often neglected (Humairah & Wahyuni, 2024). Another factor is the intensity of students' learning, their interest in studying, and their attitude towards science, which can also affect the low level of science literacy (Hermanto et al., 2024).

The review of students' science literacy levels still needs to be improved, considering that students must be able to master the content or material of science well. This is considered very important so that students can understand the facts, concepts, principles, and theories of natural sciences correctly and can be scientifically accountable. (Muliani et al., 2023). With the implementation of science literacy in learning, it is expected that students will have an understanding of scientific concepts, and possess the ability in terms of scientific knowledge as well as the processes required for participation in the digital era society, skills to seek and determine answers to questions arising from curiosity about daily experiences, the ability to describe, explain, and predict phenomena, the ability to read and understand articles about natural sciences and engage in social conversations, the ability to identify scientific issues underlying scientific decisions and information technology, skills to evaluate scientific information based on the sources and methods used, and the capacity to evaluate arguments based on evidence (Jamaluddin et al., 2019).

CONCLUSION

In this study, it can be concluded that the science literacy ability of 8th-grade students at SMP Cendekia Sidoarjo is overall categorized as sufficient, with an average percentage of indicators at 60%. From the results of this study, there are several indicators that fall into the categories of sufficient, insufficient, and very insufficient. In the sufficient category, the highest percentage is found in the third indicator, evaluating the appropriateness of the misuse and use of scientific information, with 75% of students answering correctly. In the insufficient category, the seventh indicator, solving problems using quantitative conclusions, including basic statistics, has a percentage of 55%. Meanwhile, the lowest percentage in the very insufficient category is found in the first indicator, identifying the correct scientific opinion, with 36% of students answering correctly. Thus, to improve students' science literacy skills, all aspects of education, both from the school and other educational institutions, need to be improved and also evaluated regarding the understanding and analysis of the questions used to enhance the imperfect education system. Therefore, through the application of science literacy in learning, it is hoped that students will have good science literacy ability.

SUGGESTION

To enhance the scientific literacy of 8th-grade students at SMP Cendekia Sidoarjo, interactive learning strategies such as inquiry-based and project-based learning should be implemented, along with the integration of PISA-style questions in daily assessments. Schools need to promote a reading culture by providing engaging science materials, while teachers should develop evaluation instruments that assess conceptual understanding and real-life applications of science. The use of technology in learning, teacher training on scientific literacy, and parental involvement in scientific discussions at home are also crucial for

improving students' comprehension. Additionally, further research is needed to identify the most effective methods for developing students' scientific literacy.

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