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Students' Science Literacy Profile in Terms of Argumentation Competence on Ecosystem Material

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ABSTRACT

Current curricula integrate technological skills, knowledge, abilities, and competencies, as well as skills and attitudes, with reading and writing teaching. As a result, information and communication technology is crucial to the implementation of a typical curriculum. Students in Indonesia generally have a low level of science literacy. Therefore, this study aims to test the availability of science literacy skills of high school students. The sample selected for this study was a student of 7 grader consisting of 34 people. The methodology used in this study is descriptive-quantitative research, where this study uses descriptives, such as size, quantity, or frequency in its range. The instrument used in this study is a double-selection test, consisting of six subjects according to the competence indicator of science literacy ability. In this study it was found that the achievement of scientific literacy competence aspects of competence on indicators explain the phenomena scientifically categorized very well, then the ability on the indicator to evaluate and design scientific research categorized well. So, it can be concluded that the average literacy of science on the overall aspect of competence is in good category.

Introduction

The development of the times in this century is also followed by the development of science and technology. These advances affect the development of education in Indonesia. So that the current curriculum integrates technological proficiency, knowledge, abilities, and competencies, as well as skills and attitudes, with the teaching of reading and writing. As a result, information and communication technology is essential for the implementation of a typical curriculum (Nugraha, 2022). It shows that curriculum, teaching strategies, and more sophisticated supporting resources are all evolving rapidly throughout the educational process. Overall, it can be said that such modifications constitute a revitalization of the education system intended to keep pace with scientific and technological advances around the world. Education can also act as a catalyst for improvement (Wulandari & Wulandari, 2016).

In other words, this rapidly developing technology requires competencies that are able to keep up with these advances. One of the abilities that students must have in facing the

development of the 21st century is science literacy. The importance of science literacy is so that students can apply science. In addition, knowledge, context, competence, and attitude are four aspects of science literacy that are interrelated and usually highlighted. According to OECD (2019) the ability to apply, knowledge to formulate new hypotheses, explain phenomena scientifically, draw conclusions based on data, and foster critical thinking are components of science literacy that enable people to engage in discussions about issues and concepts related to science (Fuadi *et al*., 2020). Science literacy refers to the capacity of individuals to apply scientific methods and information in decision making, science literacy is becoming increasingly relevant in everyday life (Jufrida *et al*., 2019). The assessment of science literacy evaluates students' comprehension of scientific concepts, scientific methods, and the context of scientific applications. The thought processes that students go through in order to answer challenges are referred to as the science process (Kamariah *et al*., 2023). Science literacy skills are integrated into an increasing pool of knowledge that demands argumentation skills in the 21st century. In the same way one uses scientific data to identify problems, explain scientific events, and use scientific evidence (Setyaningsih *et al*., 2019).

In addition, because science literacy is related to argumentation, this ability contributes to the development of a tolerant society, argumentation skills are very important for education in the 21st century. In accordance with research by (Abbas & Sawamura, 2009) that the goal of teaching science through problem-based learning is to encourage students to formulate their own arguments by presenting them with a science problem and asking them to solve it using the science principles they have learned. Thus, a classroom that encourages debate might help students become more proficient at communicating their ideas and expressing viewpoints in order to construct a coherent line of reasoning. One well-known trait of science-literate kids is their ability to use scientific ideas to solve problems. Therefore, science literacy skills are related to argumentation competence.

Improved reading, writing, reasoning, problem-solving, information gathering and use, and argumentation skills are all needed to help learners better adapt to the demands of the 21st century. Carl (2013) argues that critical thinking, which includes reasoning, analysis, and decision-making, as well as problem-solving, is an ability that one must acquire. Teaching and learning is transformed by engaging learners in communities to engage in negotiation, refinement of ideas, problem solving, and community support (Nurtamara *et al*., 2019). The advancement of science and technology depends on human survival and forms very important new discoveries (Herawati *et al*., 2019).

Decision-making is also seen first from an alternative point of view based on scientific evidence. Based on this, it can be seen that an understanding of science can affect the way a person thinks. Consequently, a fundamental component of science literacy is having an awareness of the nature of science (Al Sultan *et al*., 2021). Students who are conversant with scientific knowledge, comprehend the scientific method, recognize the relationship between science, technology, and society, and comprehend the nature of science are considered to be science literate (Kim & Hamdan Alghamdi, 2020).

Students in Indonesia generally have a low level of science literacy. This is based on PISA survey data which shows that Indonesian students' science literacy scores between 2000 and 2018 were far below the PISA average (Yusmar & Fadilah, 2023). Similarly, the findings of the study carried out by (Marpaung *et al*., 2021) according to information gleaned from interviews with a science instructor at SMPN 26 Bandar Lampung, student learning outcomes were categorized as low (below the requirements). Furthermore, there is still a lack of science literacy among students. Science literacy skills, signs of science literacy

skills, and methods for developing science literacy skills have not been adequately defined by educators. Furthermore, the scientific curriculum at this school continues to emphasize memorization of ideas and concepts, and teachers have not made an effort to allow pupils to participate in practicums or direct observation.

In addition, the results of research (Setiawan & Jumadi, 2023) that the average student writing ability is still lacking. And using a data sample of 40 science teachers and 546 students interviewed in Bandar Lampung City between October and November. Since argumentation and science literacy can help students' express opinions from different points of view in an argumentative manner and can also help them evaluate what has been conveyed and provide justification for information from various sources during the investigation or observation process, it is crucial to assess these skills for every student in the classroom. This is because argumentation and science literacy can help students produce conclusions that are also supported by science theory or science facts.

The results demonstrate that Indonesian pupils' science literacy is still generally low. To ascertain the degree to which pupils have mastered scientific concepts, it is crucial to measure their science literacy. in order to enhance scientific instruction in classrooms. Precise information regarding students' attainment of science literacy, particularly among junior high school pupils, is vital to bolster initiatives aimed at enhancing the caliber of instruction within educational institutions. Instructors can enhance their classroom instruction and make sure that students are meeting curricular requirements by utilizing the science literacy profile of junior high school pupils. In this study, the measurement of science literacy skills is reviewed from argumentation competencies related to science literacy competencies according to OECD (2013).

Science literacy competencies according to OECD (2013) include explaining phenomena scientifically (identifying, providing, and assessing explanations for a range of technology and natural events), evaluating and designing investigations scientifically (explaining and evaluating scientific research and suggesting methods for arriving at scientific conclusions), interpreting scientific data and evidence (examining and assessing information, assertions, and arguments in many contexts in order to reach relevant scientific findings) (Noor, 2021).

In this study, the material context measured is ecosystem material at the junior high school level. The selection of ecosystem material in this study is because it can be learned in everyday life and students can understand nature. Students are not only expected to master facts, but students are expected to master through the process of discoveries found in everyday life. So that ecosystem material is suitable for this study because it is to measure science literacy in the aspect of argumentation competence.

Method

The methodology used in this research is descriptive-quantitative research is quantitative research that uses descriptive techniques, such as size, number, or frequency in its description. Research data is collected, processed, and presented exactly as it is. The research conducted explains a condition as it is, not using treatment, manipulating independent variables, or changing them.

The study was carried out in a public junior high school in Cirebon, West Java. The study's population consisted of all seventh-grade courses in the 2023/2024 academic year. Using the cluster random sampling technique, one class was chosen at random to serve as

the research sample. The sample selected in this study was class VII-C students consisting of 34 people. The research was conducted on December 30, 2023.

A science literacy assessment was used, consisting of 6 multiple-choice questions covering ecosystem-related topics, to measure learners' science literacy competencies. Two knowledgeable lecturers with backgrounds in each branch of science verified the accuracy of the literacy test questions. In addition, the questions were piloted as part of the question instrument validation procedure. The validity, reliability, distinguishing power and difficulty level of the questions were then assessed using the Anates V4 application program. Table 1 shows the distribution of questions in the knowledge component and science competencies.

Table 1. Distribution of Questions on Aspects of Science Literacy Competency

Aspects of Science Literacy Competency	Question number
Explaining phenomena scientifically	1, 2, 3, 4
Evaluate and design scientific investigations	5
Interpret data and evidence scientifically	6
Total	10

This study involved 34 students of class VII-C who had learned the concept of ecosystem. The science literacy test was conducted in two class lessons (2 x 40 minutes). The Microsoft Excel application was used to evaluate the research data. Using Arikunto's (2013) in (Wulandari & Wulandari, 2016) descriptive interpretation of the percentage of science literacy attained as a basis, the criterion for student learning outcomes were used:

Table 2. Learning Outcome Criteria

Nilai	Criteria
80-100	Very good
66-79	Good
56-65	Simply
40-55	Weniger
30-39	Very Poor

Results and Discussion

The research was conducted for one meeting on November 30, 2023 with a time allocation of 2 x 40 minutes. Before the research was carried out, a test of the questions was carried out first with the aim that researchers could determine the feasibility of the research instruments to be used. The questions that were tested amounted to 10 multiple choice questions made based on indicators of science literacy and argumentation skills. The indicators of science literacy according to OECD (2013) are explaining phenomena scientifically, evaluating and designing scientific investigations, and interpreting data and evidence scientifically (Noor, 2021). After the trial of the questions was completed, then the research was carried out, data collection and data processing of the research results. The questions obtained from the results of the trial as many as 6 items, then used in the implementation of research to analyze the results of science literacy skills.

The achievement of students' science literacy skills from the average percentage of students who answer correctly each question on the question. Table 3 displays the findings of the calculation of students who answered each item correctly.

Table 3. Percentage of Students who Answered Correctly

Question Number	N	Percentage (%)
1	29	85
2	29	85
3	30	88
4	27	79

5		25	74
6		21	62
	Average		79

Table 3 shows that 79% of science literacy competency components are achieved overall, with an excellent category covering the majority of skills. Next, there are three things for questions that pupils in the excellent category can answer, and for the sufficient category there is 1 item. Students' literacy skills have a significant impact on their argumentation skills; the higher the students' literacy, the higher their argumentation skills. Students' argumentation skills are still relatively low, but they can improve as they learn (Anjiani & Bestiantono, 2023; Nurramadhani *et al.*, 2017).

Table 4. Literacy Test Results Per Aspect of Science Literacy Competency

Science Literacy Competency	**Percentage (%)**	**Criteria**
Explaining phenomena scientifically	85	Very good
Evaluate and design scientific investigations	74	Good
Interpreting scientific data and evidence	62	Simply

Table 4 illustrates that there are variations in the percentage of science literacy abilities achieved across all indicators. In the first competency indicator, namely explaining phenomena scientifically, 85% was obtained with a very good category. this first competency indicator is the highest percentage among the others. This is because this competency only requires knowledge. In accordance with research (Noor, 2021) indicates the skills necessary to retain and apply theories, information, facts, and explanatory ideas collectively known as content knowledge are required for this competency indication. Understanding how information was acquired and our level of trust in any scientific assertion are also necessary for providing scientific explanations.

Furthermore, the second competency indicator evaluates and designs scientific investigations at 74% with a good category. This is because in this competency students are required to have the ability to propose scientifically. In accordance with research (Noor, 2021) that under this competency, information gathered and acquired via observation and experimentation both in the field and in the laboratory leads to the creation of models and hypotheses that explain phenomena and enable predictions that can then be put to the test through experiments. This skill makes use of content knowledge, procedural knowledge (understanding the broad procedures employed in research), and epistemological knowledge (understanding the role played by procedures in supporting scientific findings).

Whereas in the third science literacy competency indicator, namely interpreting data and scientific evidence, 62% in the moderate category. This is because the third science literacy competency indicator is a high level, so many students still cannot answer correctly. In accordance with research (Noor, 2021) because it requires the use of analysis tools from statistical software and spreadsheets, as well as more complicated data sets. In addition, people with knowledge in science should know that uncertainty is a fundamental component of all measurements. The probability that a finding occurs randomly is one of the factors used to determine how confident we are in the finding. People who are knowledgeable about science should determine whether the statements are appropriate and whether the following statements are supported.

The problems discussed in the items are problems faced in everyday life. The problems are investigated and then solved by finding data to clarify and address problems arising from natural processes. The capacity to make decisions based on scientific data is one-way problem-solving exercises can help learners improve their science literacy. In accordance with research (Muhammad *et al*., 2018) that through teacher-led class discussions, learners

who are proficient in using scientific evidence to explain natural events can progress and become more comfortable expressing their viewpoints both orally and in writing based on their research.

The results of research on indicators of science literacy competence are also supported by previous research by (Merta *et al*., 2020) a tiny percentage of students' processing abilities for content presented in the form of tables, diagrams, or graphs are still deficient, according to markers of students' science literacy competency in analyzing data and scientific evidence. Students also demonstrated an inability to review the data, make pertinent inferences, and discern between arguments based on scientific and non-scientific evidence.

In school learning, students rarely encounter science questions in the form of discourse, requiring them to understand the meaning of each line in the discourse. This is just one of the many aspects that impact on students' science literacy skills. The low application of science will result from the low understanding of students' conceptions of scientific information. Research shows that while learners excel at memorization or recall, they are not so adept at applying what they have learned. Every student in Indonesia must have high science literacy because this ability determines the ability of a country to progress (Nofiana, 2017).

It is possible to raise Indonesia's poor science literacy rate by making reforms in the educational system. The primary tenet of Indonesia's efforts to increase the capacity of its human resources is education (Marwah & Pertiwi, 2024). So, Indonesia must restructure its curriculum to address the PISA results. Curriculum is considered the core component of the education process. Modifying the curriculum means changing the proficiency of educators, learners, and school administration as a whole. The evaluation scores of exam questions containing HOTS such as the 2018 National Exam questions were also included to show the effectiveness of the Indonesian curriculum. The PISA evaluation states that this curriculum modification in Indonesia is an attempt to satisfy societal preferences. Moreover, it should train the teacher to implement HOTS in the classroom by comprehend the contextual topic so that when their students learn, they would improve their scientific literacy (Pursitasari & Nurramadhani, 2021).

Conclusion

Based on the results of the research that has been done, it is found that the average ability of science literacy on ecosystem material in the overall competency aspect is 79% with a good category. The achievement of science literacy skills in the competency aspect on the indicator of explaining phenomena scientifically is categorized as very good, then the ability to evaluate and design scientific investigations is categorized as good. While the competency indicator of interpreting data and scientific evidence is categorized as sufficient. The competency aspect of science literacy skills is a component in determining the level of students' science literacy skills. The findings can be used to support efforts to improve the quality of teaching in schools. And teachers can use the science literacy profile of junior high school students as a tool to help improve classroom teaching and ensure that learning meets curriculum requirements. Recommendations from this study are the need for further research on measuring science literacy with different materials, as well as habituation of science literacy of students by teachers in learning. And the need for learning tools that support the improvement of students' science literacy to support curriculum programs in Indonesia.

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