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Analysis of Junior High School Students' Scientific Literacy Skills in Supporting the Achievement of Sustainable Development Goals (SDGs)

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Abstract: This research is meant to analyze students' scientific literacy skills. Scientific literacy is one of the key skills needed to develop a generation capable of solving problems and overcoming challenges, which will support the achievement of the Sustainable Development Goals (SDGs). This research is descriptive research using a mixed method, and uses data collection techniques in the form of scientific literacy tests and interviews with science teachers. The competencies used as a reference for analysis are the scientific literacy competencies developed by PISA, namely: the first competency is explaining phenomena scientifically; the second competency is constructing and evaluating designs for scientific investigations and critically interpreting scientific data and evidence; and the third competency is researching, evaluating, and using scientific information for decision-making and action The results of a research study conducted at a public junior high school in the Bangkalan area, involving 68 students, showed that the students' scientific literacy skills were still in the low category, with many influencing factors, both external and internal to the students. The conclusion of this study is that low science literacy skills pose a challenge to supporting the SDGs. Therefore, a transformation in science learning processes is needed to train students' scientific literacy skills to support the achievement of several SDGs.

Keywords: PISA competencies; Scientific literacy; SDGs

Introduction

The 21st century is an era that demands quality in all endeavors and performance. The development of science and technology in this century has brought about significant changes to various aspects of life (Yusmar & Fadilah, 2023). Therefore, humans need the ability to solve challenges and problems that will be faced and can be accounted for. Based on existing problems and challenges, the following abilities are needed: adaptability, communication, problem solving, critical thinking, use of technology, and scientific literacy (Febrianti, 2021). In this century, technology and science are the main pillars of life, and the goal of science education is to train students' scientific literacy skills (Az-Zahra et al., 2023). This is supported by research by Zulanwari et al. (2023) regarding scientific literacy skills, which are the ability to use existing knowledge to identify problems and draw conclusions based on scientific evidence, as well as understand and make decisions related to existing problems and challenges.

The Programme for International Student Assessment (PISA) developed three broad dimensions of scientific literacy, namely scientific process, scientific content, and scientific application context (OECD, 2023a). Scientific literacy in PISA measures three

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competencies based on logic, reasoning, and critical analysis (Sabila et al., 2023). Literacy has benefits for improving the quality of education. This is supported by research by Nata et al. (2024) which states that literacy plays a role in improving the quality of education because it can train students to evaluate, access, and use information or knowledge effectively. Students learn to understand the meaning of scientific information and data, distinguish between facts and opinions, and recognize arguments based on scientific evidence through scientific literacy (Tillah & Subekti, 2025). This scientific literacy introduces students to concepts relevant to their daily lives, thereby assisting them in making personal decisions needed to solve problems in their surroundings (Limiansih & Susanti, 2021).

Scientific literacy plays an important role in shaping society to be more aware and concerned about global issues and sustainable development. This is in line with the Sustainable Development Goals (SDGs), which are a global agenda agreed upon by various countries (Djirong et al., 2024). The SDGs are a set of development goals designed to protect financial security and living standards in society, including education (Nurfatimah et al., 2022) The SDGs have the goal of reducing poverty, protecting the environment, and ensuring the well-being of society (Al-hinai et al., 2025). These SDGs are divided into four categories, namely economic development, social development, institutional development, and environmental development (Aswirna et al., 2022). Based on these four categories, there are 17 main goals in the SDGs. These goals will be achieved through efforts to develop quality education, which will be a significant investment in economic, social, institutional, and environmental development (Wahab et al., 2025). The goals of the SDGs are interrelated and require contributions from various institutions within society, one of which is education.

The connection between scientific literacy and related SDGs supports SDGs 3 on healthy and prosperous lives, SDGs 4 on quality education, and SDGs 13 on climate action (Afnan et al., 2024). Scientific literacy skills enable individuals to participate in the realization of sustainable development (Juliana et al., 2023). Individuals with good scientific literacy skills will be better prepared to engage in sustainable decision-making and contribute to sustainable development (Safitri et al., 2022). Therefore, scientific literacy skills are needed in every individual as a strategy to support the achievement of the SDGs.

However, the fact is that the scientific literacy test conducted on students by PISA showed that Indonesia ranked low compared to other countries. In the last three assessments conducted in 2015, Indonesia ranked 62nd out of 69 countries, in 2018 it ranked 70th out of 78 countries, and in 2022, the PISA scientific literacy results showed a slight improvement from the previous year, but it still falls within the low category (OECD, 2023b). Other studies have also found that Indonesia is in the low performance quadrant with high equity (Zulaiha & Kusuma, 2021). There have been several studies conducted on various topics to determine students' scientific literacy skills. First, in kinetic and linear motion, which obtained an average score of 57.50% (Sutrisna, 2021). In the subject of temperature and heat, the average score was 42.34% (Milanto et al., 2021). And in vertebrate material, the average score was 37.66% (Niate & Djulia, 2022). The low level of scientific literacy among students in Indonesia can be attributed to several internal and external factors, which cause these abilities to vary from one individual to another (Martiasari et al., 2022). Based on these conditions, it is important and serious to support the achievement of the SDGs.

Analyzing scientific literacy skills is essential to determine the extent to which students understand and are able to solve problems relevant to their world, as well as to identify their ability to connect and apply their knowledge to their surroundings. The results of the analysis can be used as a basis for designing innovative and effective learning models that can train students' scientific literacy skills. It can also produce education that emphasizes strengthening scientific literacy skills and is capable of realizing sustainable development.

Method

This study is a quantitative-qualitative analysis (mixed methods) aimed to analyze students' scientific literacy skills based on the three scientific literacy competencies developed by PISA. These competencies enable students to acquire skills that can support the achievement of sustainable development goals (SDGs). This research was conducted at a public junior high school in Bangkalan, targeting eighth-grade students with a total of 68 participants. The research instruments used were a scientific literacy test and interviews. These instruments were validated by several experts and were deemed valid and reliable with a reliability percentage of 90% (highly reliable). Data related to scientific literacy among students was analyzed descriptively using the following percentage formula:

$$\text{Scientific literacy skills scores} = \frac{Scored\ value}{Maximum\ score} \text{ x } 100\% \quad (1)$$

The results of the scientific literacy skills assessment of the students were categorized based on the following criteria:

Table 1. Scientific Literacy Criteria (Patigu et al., 2024)

Score	Criteria
86-100	Very Good
72-85	Good
58-71	Fair
43-57	Low
≤42	Very Low

Result and Discussion

The scientific literacy test questions given to students were based on the Programme for International Student Assessment (PISA) material on the interaction of living things, which refers to one dimension of scientific literacy, namely competence, and consists of three scientific competencies, namely explaining phenomena scientifically, evaluating information, and evaluating scientific information for decision making. The literacy questions consisted of six essay questions. Based on the results of the test, the results are presented in the table 2.

The scientific literacy test administered to assess scientific literacy competence yielded low results. This competence emphasizes the ability of students to understand the material and existing phenomena, so that students can connect and explain these phenomena scientifically based on their existing understanding (Manzulina et al., 2024). These competency results also illustrate students' ability to justify accurate predictions, offer clear hypotheses, and explain using their knowledge (Putri et al., 2025). The research conducted Permatasari (2022) states that there are factors that can cause this competency to be low because students do not sufficiently explore the concepts they learn and relate them to their daily lives. This is in agreement with research conducted by Dinata et al. (2024) which explains that students are unable to reconnect the scientific knowledge they have understood, because most students tend to only memorize concepts without knowing their application and relevance to real phenomena. This competency is related to SDGs 3 on healthy and prosperous lives, where students are unable to explain the impact of pollution caused by human interaction and its impact on the ecosystem. It is also related to SDGs 13 on climate action, where students lack understanding in linking the process of climate change to human interaction.

Table 2. Results of Scientific Literacy Tests

Competency	Percentage	Category
Explaining phenomena scientifically	50%	Low
Constructing and evaluating designs for scientific investigations and critically interpreting scientific data and evidence	56.66%	Low
Searching, evaluating, and using scientific information for decision-making and action	55%	Low

Competence in constructing and evaluating designs for scientific investigations and critically interpreting scientific data and evidence obtained results in the low category. This competency emphasizes the ability of students to interpret data, so students are encouraged to have the ability to read data and evaluate methods of investigation, as well as critically prove the ideas presented (Saputro, 2022). The research conducted by Salsabilla et al. (2022), this ability is low because the ability to interpret data and scientific evidence requires students to think critically by exploring and expressing ideas, whereas students lack practice in doing these things. This is also supported by research Hasanah et al. (2024) which reveals that the learning process that takes place is most likely only a transfer of conventional knowledge, so that participants only memorize concepts without knowing how to solve problems or the process of problem solving. Students also think that presenting data is hard, so they don't want to try to solve problems related to data without giving it a shot first. This competency is related to SDGs 4 on quality education, where students are unable to solve existing problems with the knowledge they have.

Competence in researching, evaluating, and using scientific information for decision-making and action obtained results in the low category. This competency focuses on the ability of students to research and evaluate scientific information obtained, thereby sorting and selecting such information, not accepting it uncritically, and using it to make decisions (Mellyzar et al., 2022). This low level of competence is in line with research conducted by Nasrun et al. (2023) which explains that students are not yet able to evaluate the quality of information obtained, making it difficult for them to make decisions on issues based on the information they have. The research conducted Ta'gan et al. (2024) also explains that students are also less skilled in receiving and selecting information obtained due to a lack of understanding of the concepts involved. Students have a tendency to accept all information without processing it. The competencies and concepts in this material are related to SDGs 3 on health and well-being, where students are unable to read data on environmental diseases, resulting in low awareness of the importance of healthy living and a clean environment. It is also related to SDGs 13 on climate

action, where students are unable to make data-driven decisions to understand the interaction with climate change risks.

Based on Table 2 it can be explained that the three competencies show that students' science literacy skills are classified as low. According to research conducted by Chasanah et al. (2022) revealed that the cause of low scientific literacy skills is that students are less responsive to issues in their surrounding environment. This is because students are unable to comprehend the information they receive, most of them simply memorize without understanding the information and concepts. This results in students being unable to connect or apply their understanding to existing problems (Ihsan & Jannah, 2021). In addition, students become less interested in learning because there are too many things they do not understand, which makes them feel bored.

The scientific literacy skills of students in explaining phenomena scientifically are lower than in the other two competencies. has been shown to be effective in reducing the incidence of Milanto et al. (2021) the underlying reason for this difference is the type of knowledge possessed by students and their mastery of the content of the material being taught. Based on interviews conducted with science teachers, the factors causing this low competency are that students tend to memorize the theories taught, lack of practice, and poor command of scientific vocabulary, making it difficult for students to construct sentences. This has an impact on SDGs related to low critical awareness of global issues and hinders science-based behavioral change. It also leads to a lack of awareness among students about environmental health.

An interview conducted with a science teacher at a public junior high school in Bangkalan revealed that the low level of scientific literacy among students was due to several obstacles at school, obstacles posed by parents, and obstacles within the students themselves. The first obstacle mentioned by teachers was the lack of investigative and experimental activities carried out in the learning process due to limited infrastructure available at the school, resulting in students lacking practice in investigation and problem solving. Without direct investigation training, students will find it difficult to apply their theoretical knowledge to problem solving (Farokhah et al., 2025). The second obstacle described relates to the lack of integration of scientific literacy skills in science education. Science subjects are often taught in isolation, without any connection to actual issues in the surrounding environment. This causes students to be less sensitive to issues in their immediate surroundings (Minsih et al., 2025). The third obstacle relates to the condition or status of schools. In a research study conducted by Arsyad et al. (2024) Explaining the school profile also has an impact because the student selection and admission system causes students with potential to end up in good schools, while those who are less capable end up in remote schools with inadequate facilities. And the fourth obstacle explained is that students tend to have difficulty reading data in the form of graphs, tables, or scientific phenomena that are described. This is due to a lack of practice in interpreting data. As a result, students find it difficult to make decisions that support problem solving in their environment based on available evidence and data (Deta et al., 2025).

Obstacles from parents related to their knowledge and thinking. Parents' knowledge manifests itself in their parenting patterns, because a high level of knowledge leads to a fairly good mindset in several aspects, such as in providing facilities and assistance in the learning process at home (Rahmati et al., 2024). The internal obstacles faced by students, as explained by teachers, are a lack of motivation and concern on the part of students. Some students study science only to pass exams, without understanding its practical application in everyday life. This has resulted in a lack of awareness among students in practicing their scientific literacy skills to support the goals of the SDGs (Ihsan et al., 2025). Based on the results of the interviews conducted, it can be seen that the low level of scientific literacy is not only related to the cognitive level of the students, but also to learning based on real contexts. This has an impact on students' critical thinking skills, ability to interpret data, and decision-making skills (Hawariah et al., 2024). The results of the scientific literacy analysis show that students' scientific literacy skills are still low due to several factors in the learning process. Therefore, measures are needed to develop scientific literacy skills, one of which is an effective learning process with adequate facilities to train students' scientific literacy skills. This needs to be done in order to support the achievement of the SDGs.

Conclusion

Based on the results of the research that has been conducted, it can be seen that there are several factors that influence students' scientific literacy skills. The results of student tests based on scientific literacy competencies according to PISA, namely the first competency of explaining phenomena scientifically, the second competency of constructing and evaluating designs for scientific investigation and critically interpreting scientific data and evidence, and the third competency of researching, evaluating, and using scientific information for decision-making and action, are still low. Factors influencing the low level of scientific literacy among students include several

external obstacles (school and environment) and internal obstacles within the students themselves. Low scientific literacy skills result in a lack of abilities among students, which in turn limits their role in supporting the achievement of sustainable development goals (SDGs). Therefore, changes are needed in the learning process to support the improvement of students' scientific literacy skills so that they can become a young generation capable of actively contributing to the achievement of the SDGs.

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