



Students' Science Literacy Ability: Study on the Topic of Environmental Pollution at SMPN 2 Merbau Mataram

Dina Maulina^{1*}, Fatimah Triyaningsih², Berti Yolida¹, Sayid Cipta¹

1. Biology Education, Faculty of Teacher Training and Education, University of Lampung, Indonesia
2. Teacher Professional Education, Faculty of Teacher Training and Education, University of Lampung, Indonesia

ARTICLE INFO	ABSTRACT
<p>Artikel History: Received: 20 October 2022 Revised: 06 January 2023 Published: 13 January 2023</p>	<p>Scientific literacy is one of the determining factors in preparing competent human resources in the future. This study aimed to determine students' scientific literacy skills based on the PISA framework. This research is ex post facto research, with a cross-sectional survey design. The research sample was selected by purposive sampling of 224 students in class VIII SMP Negeri 2 Merbau Mataram. Quantitative data from students' scientific literacy competency scores obtained with PISA questions were then analyzed descriptively. The results of students' scientific literacy competence in this study were in the "very low" category (30.06 ± 1.8). Based on the aspect of scientific competence, identifying scientific problems (33.35 ± 2.58) has the highest score, then using scientific evidence (36.18 ± 3.21), and the lowest score is the aspect of explaining scientific phenomena (20.7 ± 1.7). Thus, the results of this study concluded that students' scientific literacy abilities at SMPN 2 Merbau Mataram were in the very low category.</p>
<p>Keywords: Scientific literacy Junior high school Environmental pollution</p>	



©2023 @author.

This article is under the Creative Commons Attribution 4.0 license (<https://creativecommons.org/licenses/by/4.0/>)

Corresponding Author:

Dina Maulina

Biology Education, Faculty of Teacher Training and Education, University of Lampung, Indonesia

*email: dina.maulina@fkip.unila.ac.id

INTRODUCTION

The increasingly advanced and developing era of globalization has multidimensional impacts with increasingly complex problems. This condition requires quality Human Resources (HR) who are adaptive in utilizing advances in Science and Technology (IPTEK) and skilled in solving problems. The world of education must prepare qualified students who are aware of science, have values, attitudes, and high-level thinking skills so that critical human resources emerge, think creatively, make decisions and solve problems (Afandi et al., 2019). Scientific literacy is an appreciation of science by increasing the learning component within oneself so that it can contribute to the social environment (Wardah Nabilah, Elok Sudiby, 2022). Another opinion states that scientific literacy influences students' decisions about personal and social problems (Akramova Surayo Renatovna, Akramova Gulbahor Renatovna, 2021).

Today there are more and more jobs that demand high-level skills and require people who can learn, reason, think creatively to make decisions and solve problems. Rapid changes in the 21st century in science and technology have greatly improved the quality of human life. These changes are often accompanied by new problems related to ethics, morals, and global issues that can threaten human dignity and survival. These problems can be solved if the community has scientific literacy (Maulina et al., 2022). According to PISA, scientific literacy is the ability to identify scientific problems, explain scientific phenomena, and use scientific evidence. Scientific literacy is a person's ability to understand science (oral and written) and apply scientific knowledge to solve problems so that they have a high sensitivity to themselves and their environment in making decisions based on scientific considerations. Based on these two definitions, it can be concluded that scientific literacy is the ability of students to identify problems and phenomena by including scientific evidence and concepts that are important for students to master (Rohmani et al., 2022).

The importance of mastering aspects of scientific literacy makes most countries prioritize the level of scientific literacy of students in their countries. Several countries, especially the United States, prioritize creating people with high scientific literacy to prepare a competent workforce for the future. An evaluation of international literacy conducted by the OECD (Organization for Economic Cooperation and Development) through the Program for International Student Assessment (PISA) shows that the value of scientific literacy in Indonesian students is still low at level 1 and places Indonesia in 60th place out of 72 countries (OECD, 2019) & (Bybee et al., 2009). Criteria for level 1 are students can use content and procedural knowledge to identify simple scientific phenomena; students can carry out structured scientific investigations with no more than two variables (OECD, 2019). The ability of scientific literacy in each country varies, influenced by the country's education system. Different countries can implement educational reforms rationally based on their cultural traditions and social realities using PISA data with care and discretion (Hernawati et al., 2020).

The results of a preliminary study at SMP Negeri 2 Merbau Mataram, carried out through interviews with science teachers teaching in class VIII, showed that scientific literacy was 65% low and 35% high. Opinions expressed by educators about the achievement of scientific literacy of students at the school by researchers, teachers do not understand the meaning of scientific literacy, so the science learning process has not been oriented towards achieving scientific literacy. One of the causes of low scientific literacy competence is the lack of interest of students in learning, which has an impact on the low desire of students to apply knowledge in solving problems in everyday life or scientific literacy skills. Learning science is very closely related to everyday life phenomena that require scientific literacy skills. Through the learning process, ideally, students have good scientific literacy skills. The hope is that the determination of the curriculum through the learning process requires a scientific approach for students to have good literacy skills and even increase in line with the increase in educational levels.

METHOD

Research Design & Procedures

This research is ex post facto research, with a cross-sectional survey design (Creswell, 2019) carried out at SMP N 2 Merbau Mataram. Quantitative data were obtained from student scores in scientific literacy tests using PISA questions in Biology. The stages and procedures of this research are shown in Figure.1.

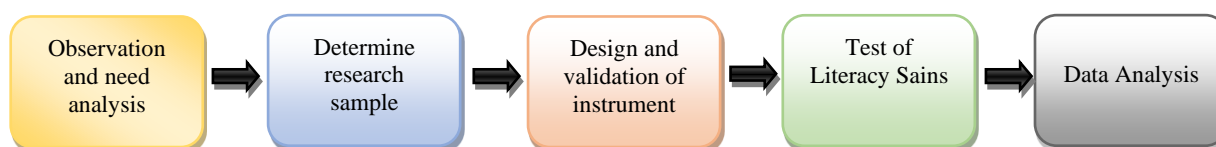


Figure 1. Research procedure

Population and Sample

The population used in this study were all students at SMP Negeri 2 Merbau Mataram for the 2021/2022 academic year. Samples were taken using a purposive sampling technique, with the minimum age criteria for children to be examined for scientific literacy is 15 years. The sample for this study was taken from a population of seven classes, namely VIII A, VIII B, VIII C, VIII D, VIII E, VIII F and VIII G of 224 students (Table 1).

Table 1. Distribution of the number of samples

Class	Number of Students
Class VIII A	32
Class VIII B	32
Class VIII C	32
Class VIII D	32
Class VIII E	32
Class VIII F	32
Class VIII G	32
Total	224

Data Collection and Instrument

Data Collection Techniques Data collection techniques in this study are: a. Written tests are used to obtain results in the form of scientific literacy scores for junior high school students using PISA questions in the context of Biology Science which is included in the material on Basic Competency grades VIII and. The written test consists of 30 questions with details, namely 30 choice questions which refer to indicators of achievement of scientific literacy competencies according to PISA 2006 (Bybee et al., 2009). Literacy questions, specifically with biology learning material on the topic of environmental pollution.

In the competency aspect "identifying scientific questions" with a total of 7 questions, including numbers 1, 2.5, 6, 13.16 and 20. The next aspect is "explaining scientific phenomena". There are 7 questions including numbers 3, 10.13, 14, 15, 18, and 19. The next aspect is using scientific evidence, there are 6 questions, including numbers 4,7, 8, 9,11, 12, and 17. All questions have been validated with validators in the scientific field and language.

Table 2. Indicators of achieving scientific literacy competence

No.	Aspect of Scientific Literacy Competence	Achievement Indicator
1	Identify scientific problems	1. Identify problems that can be investigated scientifically 2. Identify keywords to obtain scientific information 3. Recognize the features of scientific inquiry
2	Explain scientific phenomena	1. Apply scientific knowledge in a given situation 2. Describe or interpret scientific phenomena and predict change 3. Identify descriptions, explanations
3	Using scientific evidence	1. Interpret scientific evidence and make and communicate conclusions. 2. Identify assumptions, social evidence, and developments in science.

Data Analysis

The data obtained based on the answers to students' scientific literacy tests and questionnaires will be calculated to determine student competence and the factors influencing scientific literacy acquisition. The explanation of data analysis techniques for each instrument is as follows: 1. Test 23. If students answer the question correctly, they get a score of 1; if they answer incorrectly or don't answer, they get 0. Exceptions for open-ended questions, if students answer incorrectly, get a score of 0.5. The data obtained is entered into the score distribution table for the literacy test results for each aspect of the measured competency. The maximum score on the scientific literacy test in this study is 30. The score obtained by students is raw data that must be processed into a standardized score of 100 to determine the achievement of students' mastery of scientific literacy competencies (Arikunto, 2010). So that the average score obtained is converted into a standardized score of 100 (Arikunto & Jabar, 2018).

The values obtained are interpreted into criteria in the scores range with the intervals described in table 3.

Table 3. Criteria for assessing students' scientific literacy abilities

Intervals	Intervals
86-100	Very high
76-85	High
60-75	Medium
55-59	Low
< 54	Very Low

RESULT AND DISCUSSION

The scientific literacy competence of SMPN 2 Merbau Mataram students is included in the "very low" criteria (Table 4). Based on the data that has been obtained, it can be seen that the results of this study indicate that the scientific literacy competence of class VIII students of SMP Negeri 2 Merbau Mataram in the Merbau sub-district of Mataram is in the "very low" category. This can be seen in students' total scientific literacy competence with a score of less than ≤ 60 , which is equal to 58.7. Scientific literacy competence in the questions tested consists of 3 aspects of competency, including identifying scientific questions, explaining scientific phenomena, and using scientific evidence. Based on the study's results, it was found that the identification of scientific questions had

the highest correct answers, namely 33.35. While using scientific evidence has a percentage of correct answers of 20.7. In addition, the aspect of explaining scientific phenomena is 36.18 (Table 7).

The scientific literacy competence of each class has various results. Class VIII F has the highest scientific literacy competency among others, namely 41.9, while class VIII D has the lowest scientific literacy competency, 18.0. However, this sets students' scientific literacy competence into the "very low" category. This is similar to research (Angraini, 2014) that the scientific literacy ability of class X high school students in Solok city is still in the low category. Besides that, other studies (Ginna, 2013) stated that the scientific literacy competence of class X high school students in Garut was very low. This is also supported by previous research by Diana (2015: 285). Based on the Scientific Literacy Assessment (SLA) the average student competency results are included in the very low category.

Table 4. Students' scientific literacy competencies based on competency aspects

Sample	Aspects of scientific literacy competence			Average scientific literacy score	Criteria
	Identifying scientific problems Explaining	scientific phenomena	scientific Using evidence Mean		
	mean				
Class VIII A	33,6 ± 1,6	24,0 ± 1,3	27,1 ± 2,5	28,2 ± 1,2	SR
Class VIII B	39,2 ± 2,8	29,1 ± 1,9	37,4 ± 3,4	35,2 ± 1,8	SR
Class VIII C	35,1 ± 1,5	26,2 ± 1,2	23,4 ± 1,8	28,2 ± 0,8	SR
Class VIII D	23,5 ± 1,9	17,3 ± 1,8	13,3 ± 2,1	18,0 ± 1,5	SR
Class VIII E	37,7 ± 2,4	34,7 ± 1,6	41,1 ± 3,7	37,8 ± 1,4	SR
Class VIII F	39,1 ± 4,7	41,3 ± 4,1	45,4 ± 5,5	41,9 ± 3,9	SR
Class VIII G	25,3 ± 3,2	12,9 ± 1,5	25,3 ± 3,5	21,1 ± 1,5	SR
Total	33,35 ± 2,58	20,7 ± 1,7	36,18 ± 3,21	30,06 ± 1,8	SR

Note: SR = Very Low

All aspects of competence are in the "very low" criteria in Table 4. Overall the "identifying scientific problems" aspect has the highest average score. Furthermore, the aspect of "using scientific evidence" while the lowest aspect is "explaining scientific phenomena". The competency aspects of each class are also in the "very low" category.

The highest competency aspect is the competency of "using scientific evidence". This competency asks students to use scientific evidence available in the articles provided. Just as in learning, students need supporting learning facilities. At SMP Negeri 2 Merbau Mataram, the classroom learning facilities are sufficient to create good learning so that students can easily accept the material provided. Providing material, especially biology lessons, which contain a lot of explanations of a scientific process.

The results showed that students could explain scientific phenomena in the very low category. Students have not been able to demonstrate the ability to apply scientific knowledge, identify, and represent models, make predictions correctly, explain hypotheses clearly and explain the implications of scientific knowledge for society in the literacy test questions presented. Students have not been able to explain and evaluate scientific investigations or propose ways to answer scientific questions by demonstrating the ability to identify questions explored in a scientific study. Students distinguish questions that may require scientific investigation, propose ways to scientifically explore a given question, describe and evaluate how scientists ascertain reliable and objective data, and generalize them. The ideal condition states that explaining scientific phenomena to students aged 15 years must be able to explain clearly and generalize issues and studies related to literacy fluently (Xiufeng & Liu, 2009).

Students have not been able to analyze and evaluate scientific data, claim and give opinions in various forms of scientific representations, draw appropriate conclusions showing the ability to change data from one representation to another, analyze and interpret data, draw appropriate conclusions, identify assumptions, evidence, and reasoning in texts, distinguishing between arguments based on scientific evidence and theories and those based on the judgments of others, evaluating scientific arguments and evidence from different sources (Guerrero & Torres-Olave, 2022); (Xiufeng & Liu, 2009).

Students have not been able to analyze and evaluate scientific data, claim and give opinions in various forms of scientific representations, draw appropriate conclusions showing the ability to change data from one representation to another, analyze and interpret data, draw appropriate conclusions, identify assumptions, evidence, and reasoning in texts, distinguishing between arguments based on scientific evidence and theories and those based on the judgments of others, evaluating scientific arguments and evidence from different sources (Ginna, 2013) competency in explaining scientific phenomena is the highest achievement compared to other competency aspects. In addition, this study only used biological content. Still, the results were also inversely proportional to the results of PISA in 2009, namely, the competency aspect of explaining scientific phenomena was the highest competency (OECD, 2019).

The results of the study show that learning biology on the topic of environmental pollution material explains low literacy skills. Other factors that also affect students' literacy skills to be very low (Maulina et al., 2022) can occur due to internal or external students. This research shows that student's understanding of the presentation of discourse contexts, charts and graphic data, and table tabulations has not been fully mastered. Thus, the context of environmental pollution that often occurs around us cannot be explained scientifically by students regarding the causes, impacts, and alternative solutions to overcome them.

CONCLUSION

The results of this study concluded that students' scientific literacy abilities at SMPN 2 Merbau Mataram were in the very low category, with the aspect of literacy competence in explaining scientific phenomena at the lowest score.

REFERENCES

- Afandi, Sajidan, Akhyar, M., & Suryani, N. (2019). Development frameworks of the Indonesian partnership 21 st -century skills standards for prospective science teachers: A Delphi study. *Jurnal Pendidikan IPA Indonesia*, 8(1), 89–100. <https://doi.org/10.15294/jpii.v8i1.11647>
- Akramova Surayo Renatovna, Akramova Gulbahor Renatovna. (2021). Pedagogical and psychological conditions of preparing students for social relations on the basis of the development of critical thinking. *Psychology and Education Journal*, 58(2), 4889–4902. <https://doi.org/10.17762/pae.v58i2.2886>
- Angraini, G. (2014). Analisis Kemampuan Literasi Sains Siswa Sma Kelas X Di Kota Solok. *Prosiding Mathematics and Sciences Forum 2014*, 161–170.
- Arikunto, S. (2010). *Prosedur Penelitian Suatu Pendekatan Praktik-Revisi Ke X*.

- Arikunto, S., & Jabar, C. S. A. (2018). buku cepi - Copy.pdf. In *Evaluasi Program Pendidikan* (p. 228).
- Bybee, R., McCrae, B., & Laurie, R. (2009). PISA 2006: An assessment of scientific literacy. *Journal of Research in Science Teaching*, 46(8), 865–883. <https://doi.org/10.1002/tea.20333>
- Creswell, J. W. (2019). *Research Design*. SAGE Publications, Inc. California. https://fe.unj.ac.id/wp-content/uploads/2019/08/Research-Design_Qualitative-Quantitative-and-Mixed-Methods-Approaches.pdf
- Ginna, S. (2013). *Profil Capaian Literasi Sains Siswa Sma Di Garut Berdasarkan Kerangka Pisa (The Programme For International Student Accesment) Pada Konten Pengetahuan Biology*. Universitas Pendidikan Indonesia. <http://repository.upi.edu/id/eprint/396>
- Guerrero, G. R., & Torres-Olave, B. (2022). Scientific literacy and agency within the Chilean science curriculum: A critical discourse analysis. *The Curriculum Journal*, 33(3), 410–426. <https://doi.org/10.1002/curj.141>
- Hernawati, D., Maulina, D., Fitriani, R., & Putra, R. R. (2020). Bio-literacy perspective: A study of the implementation of outdoor learning-based science process skills in plant introduction. *JURNAL BIOEDUKATIKA*, 8(1), 31. <https://doi.org/10.26555/bioedukatika.v8i1.15067>
- Maulina, D., Widyastuti, W., Maulina, H., & Mayasari, S. (2022). Kajian Faktor Intrinsik Dan Kemampuan Literasi Sains Siswa SMP DI Kota Bandar Lampung. *LENSA (Lentera Sains): Jurnal Pendidikan IPA*, 12(1), 1–8. <https://doi.org/10.24929/lensa.v12i1.201>
- OECD. (2019). PISA 2018 insights and interpretations. In *OECD Publishing*.
- Rohmani, R., Distrik, I. W., Herpratiwi, H., & Maulina, D. (2022). *analysis of primary school science teachers' perceptions in north lampung on science literacy based on eight science literacy indicator le No Title*. 14(2), 162–171. <https://doi.org/https://doi.org/10.15408/es.v14i2.28582>
- Wardah Nabilah, Elok Sudibyoy, and E. V. A. (2022). Foster Student's Science Literacy Skills On Envirinmental Pollution Topics Through The Etnoscience Approach. *J Pijar MIPA*, 17(8.5.2017), 2003–2005. <https://doi.org/10.29303/jpm.v17i3.3506>
- Xiufeng, & Liu. (2009). *Science and the Public*. *International Journal of Environmental & Science Education*. 4(3), 301–311. <http://www.ijese.com/>