Analysis of Scientific Literacy in Disaster Mitigation at SMAN 1 Kotaagung: Sustainability Measure

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Abstract. The aim of this research is to analyze students' scientific literacy abilities at SMAN 1 Kotaagung in the aspects of content, process and context. The research method used is quantitative descriptive by measuring students' scientific literacy abilities using the instrument in this research, which is a question of scientific literacy abilities which was created referring to PISA 2015, using biodiversity material combined with disaster mitigation material. Apart from that, this research also used an interview instrument as a supporting instrument for the test questions which were given as many as 10 questions which had previously been validated by lecturers who were experts in their fields. The results obtained are the percentage per indicator of scientific literacy questions and the percentage of the total number obtained in each school. The sample used was at SMAN 1 Kotaagung school (30 students). The sample chosen was a class that had studied material in the biodiversity chapter. At SMAN 1 Kotaagung, the average achievement of scientific literacy in the content aspect was 51.77% in the "very poor" category, in the process aspect 53.20% in the "very poor" category and in the context aspect 40% in the "very poor" category overall. An average of 48.32% where this achievement is considered "very low".

1 Introduction

In everyday life, of course, we coexist closely with the environment in facing problems related to problem solving and knowledge and competence in solving problems which is commonly known as scientific literacy, which is the ability to apply aspects of life consisting of knowledge, skills, reason critically and communicate effectively [1]. To be able to measure scientific literacy abilities, PISA is an international survey conducted every three years. This activity is carried out to evaluate education systems throughout the world by testing the abilities and knowledge of students from the age of 15 who have the knowledge and skills important to participate fully in modern society. Consisting of content, process and context, PISA will be last tested in 2028 [2].

Based on research conducted by the OECD, Indonesian students' scientific literacy is ranked 10th last compared to other countries [2]. The Ministry of Education and Culture conducted a PISA survey conducted from 19 March 2018 to 19 April 2018 [3]. The survey involved 12,098 students in grades 7 to 12 from 397 schools throughout Indonesia. This survey looked at reading, mathematics and science abilities, with reading as the main subject.

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in PISA 2018. [4] Based on this statement, education is very important in developing human resources (HR). In 2025, Indonesia has a vision to create an intelligent, comprehensive and competitive Indonesia [5]. Literacy is very important for every individual who is able to learn and live in today's modern society which is very much influenced by developments in science and technology. Scientific literacy is also very important in order to have sensitivity in solving global problems that occur such as the environment, health and the economy. With scientific literacy, it is hoped that every individual can meet the demands of the times such as social problems by having a competitive, innovative, creative, collaborative and characterful personality [6]. As time goes by, literacy culture continues to develop to support a golden Indonesia in 2045 [7].

Scientific literacy activities are also related to personal character, related to natural resources which are included in biological science. Science that studies living things and organisms requires mitigation education, which is important in order to build students' awareness of mitigation, because it is closely related to the concept of science and various natural phenomena, including the phenomenon of earth disasters, science concepts are combined with mitigation education [8]. The high number of natural disasters occurring in Indonesia shows the importance of knowledge about disasters and their mitigation, which can be given to students through science education and which is the focus of science education, namely scientific literacy [9].

This research describes an analysis of students' scientific literacy skills in disaster mitigation which is closely related to biodiversity material in Biology learning. The scientific literacy abilities studied include several aspects, namely content, process and context. This research is related to disaster mitigation because the topography of the hills is undulating, so this research was carried out to open students' insight into disaster mitigation. Mitigation is carried out to be able to reduce losses that occur as a result of disasters that occur, whether it is loss of life or loss of property which greatly affects human life and activities in the future. With disaster mitigation, students will be more responsive when a disaster occurs, because insight has been formed. students towards disaster mitigation.

In the application of scientific literacy itself, it has been carried out in the implementation of biology learning on ecological material which directly explores the surrounding environment. Students are asked to be able to observe what components exist in the environment, such as abiotic and biotic, which students are asked to be able to differentiate. Scientific literacy is very closely related to science learning such as biology which has real action in its application in the environment. Contextually by providing learning directly related to the environment. When we interact directly with the environment, of course we cannot be separated from disasters that occur. To minimize the occurrence of these disasters, mitigation is necessary. Disaster mitigation is often referred to as countermeasures before a disaster occurs. Disaster mitigation is very necessary because there is a need for knowledge regarding disaster mitigation because of the topographic location of Tanggamus, which is hilly and mountainous, this will of course be prone to natural disasters occurring. At SMA Negeri 1 Kotaagung there has never been any training related to disaster mitigation. This training is of course very important, when a disaster occurs, students can handle it with a calm and safe attitude, of course in rescue efforts. Improving scientific literacy requires addressing and correcting misconceptions via the process of reasoning, especially when it comes to catastrophe mitigation [10].

The school was chosen as a research subject because of Kotaagung's geographical location which is close to the sea and mountains. This research was conducted because it is still rare to conduct research related to disaster mitigation scientific literacy. The school sampling technique for this research uses a purposive sampling technique and this research has never been carried out in Tanggamus Regency. With this research, it is hoped that students will be more protective of their environment and be prepared for disasters.
Method

This research is research using descriptive analysis methods with a qualitative approach [11]. The research was conducted in class X with 30 students at SMAN 1 Tanggamus. The instrument used is the scientific literacy test. Students' scientific literacy abilities are measured using questions that have been developed with disaster mitigation in biodiversity material. The questions consist of 10 questions with descriptive answers that have been tested for validity, reliability, level of difficulty and distinguishing power. The technique of analyzing students' scientific literacy is carried out with the total score of each student which is converted into a percentage form that can be calculated, then interpreted using the IDI approach.

Quantitative data collection uses scientific literacy-based instruments, namely content, process and context [12,13]. The instruments used were tests and interviews. Test instruments to be able to see scientific literacy abilities and interviews were carried out to strengthen quantitative data and find out the factors that influence students' scientific literacy abilities. The scientific literacy test questions used in the research are in the form of essays with material on biodiversity that meets the scientific literacy indicators. Data analysis to determine the level of students' scientific literacy abilities was carried out by first providing raw scores on all questions. The raw scores obtained by students are then converted into percentages through an equation using the following formula:

\[
NP = \frac{R}{SM} \times 100\%
\]

Information:

\(NP\) = percent value obtained
\(R\) = Raw score obtained
\(SM\) = Maximum Score
100 = Fixed number

Then the percentage of students' scientific literacy ability scores is calculated using the percentage between the correct score and the maximum score of the criteria for assessing students' scientific literacy abilities in the following table[14].

**Table 1. Criteria for assessing students' scientific literacy abilities**

<table>
<thead>
<tr>
<th>Intervals</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>86% - 100%</td>
<td>Very good</td>
</tr>
<tr>
<td>76%-85%</td>
<td>Good</td>
</tr>
<tr>
<td>60% - 75%</td>
<td>Enough</td>
</tr>
<tr>
<td>55% - 59%</td>
<td>Not enough</td>
</tr>
<tr>
<td>(\leq 54%)</td>
<td>Very less</td>
</tr>
</tbody>
</table>

Before the scientific literacy questions are used, validation of the questions that will be used during the research is carried out. Validation is a measuring tool used to measure what will be measured. The validity test that researchers use is content validation. The content validation test functions to determine a test instrument that has high content validity in research conducted through assessment. This assessment is carried out by experts in their field.
3 Results and Discussion

From the results of scientific literacy carried out, each individual obtained the following:

Table 2. Results of Science Literacy Ability Score Analysis

<table>
<thead>
<tr>
<th>Components of Scientific Literacy</th>
<th>Number Question Items</th>
<th>Percentage Items (%)</th>
<th>Percentage Average Competence (%)</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Content</td>
<td>1. 40.00</td>
<td></td>
<td>51.77</td>
<td>Very less</td>
</tr>
<tr>
<td></td>
<td>2. 52.22</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. 56.66</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. 53.33</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5. 56.66</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Process</td>
<td>6. 48.33</td>
<td></td>
<td>53.20</td>
<td>Very less</td>
</tr>
<tr>
<td></td>
<td>7. 42.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>8. 67.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>9. 54.44</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Context</td>
<td>10. 40</td>
<td>40</td>
<td></td>
<td>Very less</td>
</tr>
</tbody>
</table>

This is in line with research conducted by Narut 2019 based on a literature review, research on scientific literacy which is related to natural phenomena, one of which is disaster, is still relatively small and scientific literacy abilities are low because science students have not facilitated optimal scientific literacy abilities and there are gaps in treating education [15]. And similar research was also conducted by Fuadi et al, the low scientific literacy of Indonesian students is closely related to the learning that is applied, the cause of the low scientific literacy of Indonesian students is caused by several things, including: teacher-centered learning, the low positive attitude of students in studying science, there are competencies that students do not like regarding content, process and context [16].

From the results obtained, it can be said that students' scientific literacy abilities are not caused by accreditation and the curriculum taught by the school. During post-research, researchers conducted interviews with students, based on interviews that differentiated students' experiences of disasters, both directly and during the learning process. In general, literacy in Indonesia has been established in schools, but the scientific literacy abilities of students in several schools are still relatively low based on 2016 data from the Ministry of Education and Culture [17], as found by researchers at school B, which was 54.68% in the very poor category. Low levels of one dimension of scientific literacy will affect other dimensions of scientific literacy. Students' low conceptual understanding of scientific knowledge will have an impact on low science applications [18].

Scientific literacy in the content aspect consists of 5 questions with different indicators used, namely, understanding phenomena that occur around us related to biodiversity, prevention, mitigation and analyzing impacts on the environment. The question grid presented is where students can mention the importance of mitigation prevention as an effort to preserve natural resources. Students can explain natural disasters that occur and efforts to prevent them and students can analyze events that occur.
Based on the results of scientific literacy, the content aspect obtained by students still lacks understanding of the learning material, where learning in schools in principle emphasizes the content aspect, but in its application, students' mastery of the concept of this content is still very low. The low scientific literacy achievements of students are not yet able to fully apply the knowledge they have and relate it to everyday life.

In question number 1, students are expected to be able to understand phenomena that occur around them related to various levels of biodiversity. Mitigation prevention and analyzing impacts on the environment. The PISA scientific literacy indicator understands the phenomenon in the content dimension of scientific literacy. Based on this, in question number 1, students can mention factors that influence biodiversity and can mention the importance of preventing mitigation as an effort to preserve natural resources. In question number 1, questions are presented regarding problems that occur in an area related to pest explosions. This question asked about preventative measures that could be taken to prevent a similar incident from occurring.

The process aspect is a very important part for students in solving problems. According to Yuliana, the process aspect is related to how students are able to complete their knowledge in the real world [19–21].

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**Fig. 1. Student Answers on Content Aspects.**

**Fig. 2. Student Answers on Content Aspects.**
In question number 6, students are expected to be able to understand preparedness and analyze preparedness for conservation. PISA Scientific Literacy Indicators identify scientific questions, explain scientific phenomena, use scientific evidence, process dimensions of scientific literacy. In question number 6, a question is presented relating to disaster preparedness and its conservation regarding the threat of extinction of fauna in Indonesia. The question given relates to extinct animals based on statistics from the Ministry of Environment and Forestry and students are asked to provide factors that influence this.

Fig. 3. Student Answers on Context Aspects

In question number, 10 students were asked to be able to solve problems in restoration, rehabilitation, reconstruction, as an effort to preserve biodiversity. Questions related to natural resources and ecosystem diversity. The PISA scientific literacy indicator solves problems in the context dimension of scientific literacy.

3 Conclusion

Based on the results of research on students' scientific literacy abilities, the results showed that the average percentage achieved was 3 aspects of scientific literacy (content, process and context). It was found that the results of the scientific literacy abilities of class in the "very less" category and 40% in the "very less" category.

4 Recommendation

Based on the results of the research that has been carried out, there are several suggestions that researchers put forward, namely that students need to be familiarized with being given scientific literacy questions, disaster mitigation training needs to be included in the curriculum and holding training related to disaster mitigation, and for future researchers, there needs to be research to improve scientific literacy skills.

References

1. F. Mufarriha, S. 1#, and T. Sunarti, Titin Sunarti 12, 11 (2023)