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# Analysis of the Science Literacy Profile of Students at State Junior High School

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**ABSTRACT**

**Objective:** This study aims to determine the achievement of scientific literacy skills of junior high school students in the competency aspect. The competency aspects measured in this study are the competence to explain scientific phenomena, interpret data and scientific evidence, and evaluate and design. **Methods:** The research was conducted using the test method. The data was collected using a competency aspect scientific literacy test using a multiple choice test of 20 items on the scientific literacy test. The sampling technique used stratified random sampling, amounting to 67 students. Data analysis techniques using quantitative descriptive. **Results:** Based on the research conducted by the results of data analysis, it was found that the scientific literacy aspect of students' competence was included in the low category, with an overall average of 55.15%. The aspects of scientific literacy competency measured in this study are explaining scientific phenomena, interpreting data and scientific evidence, and evaluating and designing. The results of each scientific literacy competency indicator are as follows: (1) students' ability to explain scientific phenomena, the average percentage only reaches the deficient category; (2) students' ability to interpret data and scientific evidence in the deficient category and (3) students' ability to evaluate and design in the deficient category. **Novelty:** This study reveals an urgent need to develop appropriate innovations, methods, and designs to improve students' science literacy, especially the learning models used. These findings encourage teachers to improve learning continuously.

## INTRODUCTION

21st-century education plays a vital role in supporting the process of developing the quality of human resources, so the 21st century demands education to prepare students who can face global competition. Rohmawati et al. (2018) believe that one of the skills needed in the second century is scientific literacy. Scientific literacy is a person's ability to use scientific knowledge and processes to make decisions about the universe. Students with scientific literacy skills can apply the knowledge learned to solve problems in everyday life well (Jufrida et al., 2019).

Scientific literacy is an individual's scientific knowledge and use of knowledge to identify questions, acquire new knowledge, explain scientific phenomena, and draw evidence-based conclusions about issues related to science, an understanding of the distinctive characteristics of science as a form of human knowledge and inquiry, an awareness of how intellectual science, and technology, and culture, the environment and a willingness to engage in science, issues, and ideas related to science (Utami et al., 2022). Developing scientific literacy is very important because it can contribute to social and economic life and improve decision-making skills at the community and personal levels (Arrafi et al., 2022; Azura et al., 2021; Melinda et al., 2021; Salahuddin et al., 2021).

International standards can measure students' scientific literacy abilities through the Program International Student Assessment (PISA). The results of the PISA survey in Indonesia for the scientific literacy ability category 2018 were ranked 71st out of 79 countries (OECD, 2019). In 2015, Indonesia's scientific literacy ability was ranked 62nd out of 69 countries (OECD, 2016). In 2012, Indonesia's scientific literacy ability was ranked 64th out of 65 countries (OECD, 2013). These results show Indonesia's scientific literacy is below the international average score. According to Sutrisna (2021), students still need to be able to understand scientific concepts and processes and cannot apply the scientific knowledge they have learned in everyday life.

Based on the 2018 OECD, PISA has three scientific literacy competencies, including explaining phenomena scientifically, evaluating and designing investigations scientifically, and interpreting data and evidence scientifically. Scientific literacy skills can be obtained from various aspects of literacy according to the expected goals. The more aspects of literacy that students master, the better their knowledge to use scientific concepts meaningfully, think critically, and make balanced and adequate decisions on problems that have relevance to students' lives. In line with this, Pahrudin (2019) states that increasing students' scientific literacy skills will support them in facing the Industrial Revolution 4.0 because the Industrial Revolution 4.0 is a development of the integration of science and technology. So, scientific literacy skills are critical to improve to be competitive.

Several factors can influence students' scientific literacy. Internal and external factors influence the level of students' scientific literacy abilities. Internal factors arise within the child, such as health, mindset, intelligence, motivation, and participation. External factors include family, community, friends, teachers, media, learning media facilities, and infrastructure (Jufrida et al., 2019). According to Kusumastuti et al. (2018), learning materials, learning models, learning environments, homework assignments, and scientific literacy-based assessment instruments can influence students' scientific literacy. In addition, teacher instructions are often ineffective in fostering scientific literacy, contributing to Indonesian students' low scientific literacy (Sutrisna, 2021). This can be caused by the fact that most science learning in schools is still conventional. Teachers often ignore the importance of the ability to read and write in science as a competency that students must have (Kurniawati & Hidayah, 2019). The current Indonesian curriculum supports one of the education goals: helping students achieve their full intellectual and personal potential (Apriyani et al., 2020). Various related studies have also found that the absence of application or application, analysis, and evaluation of concepts is the main reason for the low scientific literacy of students.

The results of research by Rohmah & Hidayati (2021) show the percentage of indicators achieved by students at 1st Gresik State Junior High School (JHS) is as follows: average value 69.00% for indicators that conclude and provide reasons for a phenomenon based on related facts or events, average value 66.00% for the indicator of formulating scientific questions, an average value of 44.00% for the indicator of finding steps and deciding on solutions to problem-solving, an average value of 48.00% for the indicator of concluding the results of graphic data analysis and identification results and an average value of 57.00% for the indicator of explaining phenomena scientifically.

Results of scientific literacy measurements carried out by Nofiana & Julianto (2018) on junior high school students in Purwokerto City showed that the scientific literacy profile of junior high school students was still low, namely content aspects (53.80%), process aspects (44.38%), and context aspects (35.88%). Jufrida et al. (2019) stated that

the low level of scientific literacy in Indonesia reflects that most students need help to analyze and apply concepts to solve a problem. Scientific literacy ability is a critical competency that is very important for building human welfare because it can shape thought patterns and behavior and build human character to be caring and responsible. Scientific literacy not only requires knowledge of scientific concepts and theories but also knowledge of general procedures and scientific practices. Learners must find, interpret, and assess evidence in different conditions or situations. If relevant evidence is not collected, then the concepts collected will not help students understand conditions or events that are or will occur.

So far, there is little data regarding the profile analysis of scientific literacy abilities in grade IX students at 26th Gresik JHS, considering the need for every student to have scientific literacy abilities. Therefore, research needs to be carried out to determine the profile analysis of the scientific literacy abilities of grade IX students at 26th Gresik JHS. The competency indicators analyzed refer to PISA 2018: explaining phenomena scientifically, evaluating and designing scientific investigations, and interpreting data and evidence scientifically.

## RESEARCH METHOD

### General Background

This research is a qualitative descriptive study that aims to determine the scientific literacy profile of students in terms of the competence aspect of scientific literacy, which includes explaining phenomena scientifically, interpreting data and evidence scientifically, and evaluating and designing scientific investigations.

### Participants

This research was conducted at one of the State Junior High Schools in Gresik. The study population was 664 classes VII, VIII, and IX students. This study used a sampling technique, namely stratified random sampling with grades VII, VIII, and IX, as much as 10% of all students. The sample used in each class consisted of 3-4 students consisting of grades VII, VIII, and IX, totaling 67 students.

### Instrument and Procedures

The method used in this study is the test method. The test instrument used was a multiple-choice test adapted from PISA development questions. The test instrument consists of 20 questions covering aspects of scientific literacy competence.

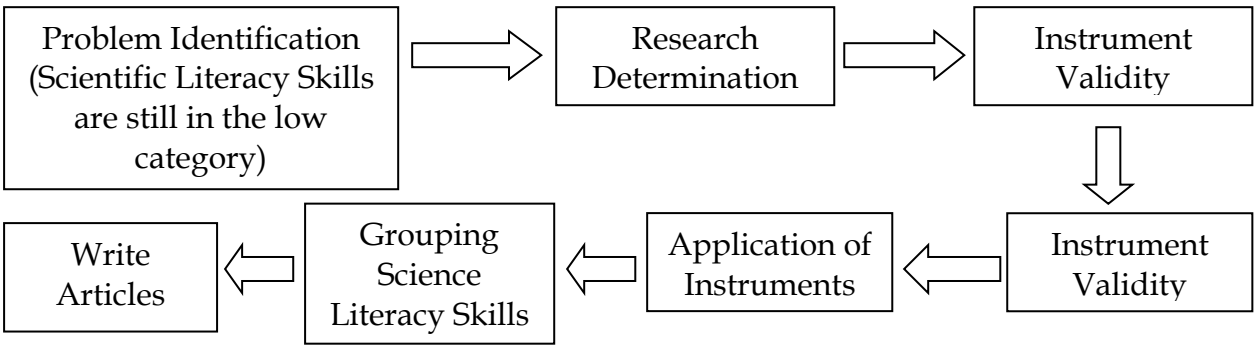


**Figure 1**. Research flowchart.

Based on Figure 1, the initial stage in this research procedure is for researchers to identify scientific literacy skills based on previous research. Next, the research objectives can be determined. After determining the research objectives, the researcher validated the instrument, and the two validators validated the instrument. The validity results obtained were 94.00%, with a reliability value of 91.00%. The next step is the implementation instrument. Then, after applying the instrument, the data was analyzed based on indicators of scientific literacy skills.

**Data Analysis**

Data analysis techniques using quantitative descriptive. Data analysis is based on students' answers from the tests given. The final results of all test instruments are overall percentages and each indicator of scientific literacy ability. The final score is categorized based on the level of scientific literacy ability consisting of very high, high, medium, low, and very low. Correct answers are scored 1 (one), and wrong or unanswered answers are given a 0 (zero).

The data obtained from the test results are then analyzed based on indicators of scientific literacy achievement, where the calculation of the scores obtained and the conditions for the scores can be seen as follows.

$$\text{Score} = \frac{Total\ score\ obtained}{Maximum\ score} x100\%$$

The value of students' scientific literacy skills is calculated using the percentage calculation between the correct score and the maximum total score.

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

| No | Category | Value Intervals |
|---|---|---|
| 1 | Very high | 86.00-100.00 |
| 2 | High | 76.00-85.00 |
| 3 | Moderate | 60.00-75.00 |
| 4 | Low | 55.00-59.00 |
| 5 | Very low | ≤54.00 |

## RESULTS AND DISCUSSION

### *Results*

Based on the research that has been done, the results of the data analysis present a profile of scientific literacy skills in the competency aspects, as in Table 2.

**Table 2**. Profile of students' science literacy skills.

| Category of Student Science Literacy Skills | The number of students | Percentage (%) |
|---|---|---|
| Very high | 0 | 0.00 |
| High | 1 | 1.49 |
| Moderate | 17 | 25.37 |
| Low | 12 | 17.91 |
| Very low | 37 | 55.22 |
| **Amount** | **90** | **100.00** |
| **Average** | | **55.15** |

The categorization of the student's scientific literacy profile is presented in Figure 2 and Table 3.

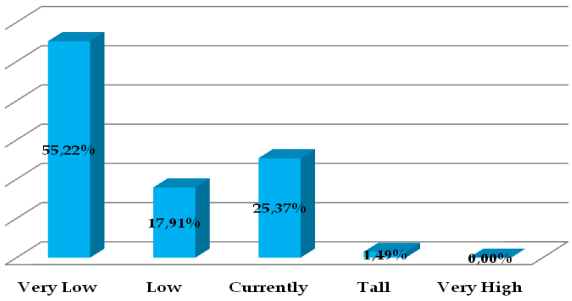


**Figure 2**. Categorization of students' scientific literacy profiles.

**Table 3**. Average results for each aspect of student science literacy competence.

| No | Science Literacy Competence | Average (%) | Category |
|---|---|---|---|
| 1 | Explain phenomena scientifically | 50.82 | Very low |
| 2 | Interpret data and evidence scientifically | 38.97 | Very low |
| 3 | Evaluating and designing scientific investigations | 44.82 | Very low |

***Discussion***

The analysis of instruments distributed to students in grades VII, VIII, and IX shows that the profile of students' scientific literacy abilities is relatively low because the average score percentage, in general, is 55.15%. Table 2 shows that of the 67 students, 55.22% of students have meager category scientific literacy abilities, 17.91% of students have low category scientific literacy abilities, 25.37% of students have medium category scientific literacy abilities, and 1.49% of students have high category scientific literacy abilities. This shows that students still need to become familiar with scientific literacy questions. Based on the low ability to answer scientific literacy questions in the competency aspect, treatment needs to be given in introducing students to scientific literacy questions because scientific literacy is a combination of two insights related to scientific knowledge, as well as several skills, including investigation, critical thinking, problem-solving, and decision making.

Based on research data obtained from written tests conducted by a sample of research objects, the global percentages were obtained as follows: (1) the average percentage of students' ability to explain scientific phenomena was only 50.82%, (2) the average percentage of students' ability to explain scientific phenomena was -on average only reached 50.82%, (2) students' ability to explain scientific phenomena on average only reached 50.82%, (2) interpreting data and scientific evidence 38.97% and (3) students' ability to evaluate and design 44.82%. The percentage results for each indicator of scientific literacy ability are seen in Table 3. The achievement of the first scientific literacy indicator is to explain phenomena scientifically. Explaining scientific phenomena measures the extent to which students understand the concept of material so that they can use the knowledge they already have based on phenomena that occur in their surrounding life. In this way, students understand that science is very close to their lives.

Table 3 shows that the first indicator, namely explaining phenomena scientifically, has an average percentage of 50.82%, which is deficient. This is because students' ability to find keywords related to the problems that occur has yet to be well-honed (Karademir & Ulucinar, 2017). Apart from that, teachers still focus the learning process on memorization, so it is essential to teach meaningful learning so that students do not just memorize concepts (Afina et al., 2021). Meanwhile, most of the learning carried out

in class by teachers is focused on theory and memorization. This causes students' low ability to think critically and carry out inductive/deductive reasoning and critical analysis (Aprilia et al., 2021). Therefore, it is necessary to have a learning process that requires students to pay attention to a problem in detail so that students can compare existing information and determine which variables should be used or changed (Sutrisna, 2021).

The achievement of the second scientific literacy competency indicator, namely interpreting data and evidence scientifically, obtained the smallest average percentage, 38.97%. In this case, students still need to be skilled in interpreting data. Data interpretation skills are knowledge in interpreting data containing theories, ideas, facts, and information (Zakaria & Rosdiana, 2018). Content knowledge with competence in interpreting data and facts scientifically requires students to interpret scientific evidence to make conclusions and communicate, identify assumptions and evidence that support conclusions, and explain the social implications of science. In the test questions, students must be able to interpret environmental damage caused by acid rain based on the discourse presented.

Students have difficulty interpreting data scientifically because they have yet to become skilled in connecting the scientific context to everyday life. This is in line with the research results of Subaidah et al. (2019), which stated that the low scientific literacy of students was caused by students' abilities being limited to remembering and recognizing scientific knowledge without relating scientific topics to everyday life. Students need help to apply the theory they learn. Students are very good at memorizing but less skilled at applying the knowledge they have. Apart from that, when students work on scientific literacy test questions with indicators of interpreting data, students immediately answer concisely without explaining scientifically, which should be obtained from appropriate discourse reasoning. In line with research (Suparya et al., 2022) state that the cause of students' low scientific literacy is their lack of interest and reading habits.

According to Eliza (2022), a low level of students' scientific literacy abilities is caused by many things, namely the education system, curriculum, learning models and methods, study sources, and study habits that do not support improving scientific literacy abilities. Apart from that, students' scientific literacy abilities could be improved due to students' lack of interest in reading and understanding discourse; the learning process in class is also very influential. Some teachers have implemented learning models that can increase student creativity and literacy skills. However, most teachers still apply material-oriented teaching models dominated by monotonous learning methods. Learning objectives still emphasize students' ability to memorize scientific facts and concepts. There are still few teachers who pay attention to aspects of scientific literacy. Teachers' habits of giving test questions as learning evaluations are in the form of routine questions and are rarely linked to literacy.

Achievement of scientific literacy competency in evaluating and designing scientific investigations obtained a result of 44.82%. The analysis results show that students' ability to carry out scientific investigations still needs to improve because learning often emphasizes memorization without being followed by the understanding that can be applied in real life. Hence, students' scientific competence abilities are still relatively low (Mijaya, 2019). Apart from that, the learning process does not involve a scientific process. Therefore, learning is needed that emphasizes students being oriented to real contexts that often occur in everyday life so that students become independent learners.

Writing, analyzing, and solving problems as preparation for facing the future (Bagasta et al., 2018; Saenab, 2023)

Students' ability to understand scientific content is quite good, but many students still need to pay attention to the sources used as characteristics of scientific investigations. If students can pay attention to this, then some students can determine the proper steps for carrying out scientific investigations. They were taken when investigating problems. This is by research conducted by Mellyzar et al. (2022), which shows that students' scientific literacy abilities are still in the medium category, with a result of 49.65%. Students' scientific literacy skills can be improved by descriptions of students' characteristics and potentially developing learning materials, which must be adapted to the student's learning environment.

Based on this description, students' abilities in each indicator of scientific literacy ability are different. The average ability of students in each indicator of scientific literacy ability is included in the low category, namely 6.3. This shows that students still need to apply their knowledge in everyday life. According to Mijaya (2019), someone who is literate or literate in science can apply the knowledge they have in life. The low level of students' scientific literacy skills is because students need to get used to working on questions with types of questions such as scientific literacy. Students are used to being faced with questions closely related to content, which is contrary to the characteristics of scientific literacy questions developed by PISA. PISA scientific literacy questions are closely related to applying scientific thinking in everyday life and require high levels of reasoning to work on scientific literacy questions (Handayani, 2020). So, getting used to working on scientific literacy-type evaluation questions that require high reasoning abilities is necessary. The high and low levels of scientific literacy are also caused by teachers' understanding of science learning, which leads students to form scientific literacy.

Another factor that causes students' low scientific literacy skills is the intensity of practicum provision. Students who often do practicums have superior scientific literacy competencies to those who never do practicums (Setiawan, 2019). This is because carrying out practicums will train students' science process skills. This skill supports students' achievement of scientific literacy competencies because students play an active role in learning, not just understanding theory. In line with this, Jufrida et al. (2019) said that students tend to memorize concepts but are less able to use their knowledge. Learning that tends only to memorize concepts, theories, and laws causes students to have difficulty applying the knowledge gained in everyday life.

Scientific literacy is necessary to study the extent of students' understanding of science. So, teachers need a lot of habits, strategies, and appropriate learning methods to improve scientific literacy skills. Apart from that, teachers also need to provide access to learning resources from various sources. However, increasing students' scientific literacy relies on more than just the role of a teacher. Students must also be trained to become literate, hone critical and creative thinking, and be skilled in making decisions to solve problems and communicate (Bustami et al., 2019). This is because, according to Kusumastuti et al. (2019), scientific literacy positively affects student development and planned learning systematics. Therefore, aspects of scientific literacy must be improved so that students' goals can be achieved (Deta et al., 2019; Husniyyah et al., 2023; Mahtari et al., 2021; Zayyinah et al., 2022).

## CONCLUSION

**Fundamental Finding:** Based on the research that has been done, the results show that students' scientific literacy skills in the competency aspect are still in the low category, including (1) students' ability to explain scientific phenomena, the average percentage is in the deficient category, (2) the ability students in interpreting scientific data and evidence in the deficient category and (3) students' ability to evaluate and design in the deficient category. **Implication:** Students are not used to doing science learning directly with the environment; learning tends to be done in the classroom alone, causing low scores in students' literacy skills. **Limitation:** This research is limited to describing the profile of scientific literacy in only one junior high school. The literacy profile studied is only on competence in science learning. **Future Research:** More research is needed to develop innovations, methods, designs, and policies in improving students' scientific literacy skills at the junior high school level.

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