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Science Literacy Profile of Junior High School Students on Climate Change Material

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Abstract: This research aims to describe the profile of scientific literacy abilities in science subjects with material on climate change for class VIII students at SMPN 3 Cileungsi. The research was conducted using the ex-post-facto method on 76 respondents. Data collection was carried out using an interview guide sheet and a scientific literacy test which consisted of competency aspects in explaining scientific phenomena, evaluating and designing scientific investigations, and interpreting scientific evidence and data. The scientific literacy data was then analyzed using quantitative descriptive tests. Based on the results obtained, the average scientific literacy score was 31.58% in the low category. The highest level of knowledge was in the low category in 47 respondents with a score of 61.8%, while the highest score was in the 29 respondents with a score of 38.2% in the medium category. The low scientific literacy abilities of students are influenced by several factors such as learning resources that lack scientific literacy coverage, evaluation questions that do not refer to scientific literacy indicators, and digital teaching materials that are able to increase scientific literacy. Based on the data obtained, it can be concluded that students' scientific literacy in climate change material is still relatively low.

Keywords: Climate change; Junior high school; Scientific literacy

Introduction

Developments in the 21st century can be observed from the rapid development of science and technology. Every effort is made to improve the quality and quality of education (Makhrus et al., 2018). In the 21st century, one of the goals of learning is to prepare students to face every aspect of global life (Huryah et al., 2017). Due to the magnitude of the challenges faced by society, changes are needed in the education system that can provide the components of 21st century skills needed by students (Pratiwi et al., 2019). One of the skills needed from the 16 skills analyzed by the World Economic Forum is scientific literacy (World Economic Forum, 2015).

Regarding science, there are many problems that students will face (Komalasari et al., 2019) and with the learning process, these problems can be solved. Students' ability to apply scientific knowledge so that they are able to describe problems and make decisions is called scientific literacy (OECD, 2013). Scientific literacy is the ability to understand scientific concepts and processes and use scientific knowledge to solve problems (Kartika et al., 2019). From here, the scientific literacy learning process that is implemented is also in line with the development of life skills (Holbrook et al., 2009).

Scientific literacy is important for students to understand the environment, modern society, technology, health and economics. However, in reality, currently students' scientific literacy abilities are still very low. This is also in line with research conducted by Sujudi et al. (2020) which states that students' scientific literacy abilities are still relatively low. According to the Program for International Student Assessment (PISA), scientific literacy is the ability to apply scientific knowledge, identify questions, and determine conclusions based on scientific evidence to understand and make decisions regarding nature and its changes due to human activities (Robertson, 2021).

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The Organization for Economic Cooperation and Development (OECD) through PISA in 2018 regarding the results of international science learning assessments found that Indonesia's scientific literacy was ranked 72nd out of 78 participating countries (OECD, 2019). The results of the PISA study of the scientific literacy abilities of Indonesian students from 2000 to 2018 are presented in Table 1.

Table 1. PISA Study Results of Indonesian Students' Science Literacy Skills (OECD, 2001, 2004, 2007, 2010, 2016, 2019)

Year	Average Score	Level	Number of Countries
2000	393	38	41
2003	395	38	40
2006	393	50	57
2009	385	60	65
2012	375	64	65
2015	403	62	70
2018	396	70	78

Table 1 shows that the average scientific literacy score of Indonesian students from 2000 to 2018 is still in the low category and is still below the average score of PISA participating countries. This shows that Indonesian students are not yet able to understand the concepts and processes of science and are not able to apply the knowledge they learn in their daily lives.

The development of students' scientific literacy in Indonesia, which is still below average, shows that students still lack mastery of concepts, processes and attitudes towards scientific phenomena in everyday life (Pratiwi et al., 2019). This is also supported by research by Ardianto et al. (2016) regarding the results of research on students' scientific literacy in Bogor City, showing that scientific literacy rankings have not shown good results. Students' scientific literacy scores are quite low, namely an average of 30% overall, consisting of 29% content, 30% process and 31% attitude (Ardianto et al., 2016). The research results show that in general in the city of Bogor students' scientific literacy is still low. Therefore, related to findings showing that scientific literacy in Indonesia is still lacking, efforts are needed to improve science learning in schools (Wahyu et al., 2020).

The low scientific literacy abilities of Indonesian students in general can be caused by learning activities that do not focus on developing scientific literacy. Ardianto et al. (2016) said that low scientific literacy is caused by several factors, namely the condition of school infrastructure, school management and school human resources. This is also in accordance with the results of several studies which show that students' scientific literacy abilities are still low. The low scientific literacy abilities of Indonesian students originate from several factors such as the curriculum and education system, the choice of teaching models and methods by teachers, learning facilities and teaching materials (Anisa et al., 2021).

According to Yusnia (2019), one of the low levels of scientific literacy is the lack of innovation in learning media which already contains aspects of scientific literacy so that learning tends to be boring (Yusnia, 2019) Angraini (2014), the scientific literacy of class X high school students in Solok City is still relatively low or low. This is because the material tested has never been presented by educators, students are not used to working on questions that use reading and discourse, and the learning process does not support students in developing scientific literacy skills (Angraini, 2014). This was also conveyed by Rizkita et al. (2016) that the scientific literacy abilities of students in Malang City High Schools are still low. This is because the learning process does not involve a scientific process (Rizkita et al., 2016). Apart from that, the results of Diana's research (2015) stated that the scientific literacy abilities of class (Rohana et al., 2020). Based on the results of interviews conducted by researchers with four science teachers in several junior high schools in Bogor Regency, it shows that during the learning process, teachers have difficulty making students active and independent. This is because students are used to the material delivered directly by the teacher, so students are less actively involved in learning to seek knowledge. Students are also not able to connect a concept with other concepts that have been studied as evidenced by the student's inability to answer questions that require analytical skills. Apart from that, students' scientific literacy and the factors that influence it are not yet known with certainty because learning is not oriented towards measuring scientific literacy. Teachers only measure students' knowledge of the material they have studied.

Based on the problem of low scientific literacy among Indonesian students and the importance of scientific literacy for life in the 21st century, researchers aim to describe the profile of students' scientific literacy in climate change material at State Middle Schools in Bogor Regency.

Method

This research is research using an ex-post facto method which aims to find impacts that enable behavior change and explore the things that influence (Permadi et al., 2020). The research instrument used to obtain data is the scientific literacy test. The scientific literacy questions applied are questions adapted from PISA. Students' scientific literacy questions include aspects of content, competence and attitudes. In summary, PISA scientific literacy is defined by three competencies,

namely explaining phenomena scientifically, evaluating and designing scientific investigations, and interpreting scientific data and evidence.

The scientific literacy instrument refers to the Test of Science Literacy Skills (TOSLS). The indicators used in TOSLS are identifying appropriate scientific arguments; using effective literature searches; evaluate the use of scientific information; understand the elements of research design and how students influence scientific discovery; create graphs that can represent data; reading and interpreting data; solve problems using quantitative skills; (understanding and interpreting basic statistics; and presenting conclusions, hypotheses based on quantitative data (Gormally et al., 2012).

Mardhiyyah et al. (2016) developed an instrument to assess students' scientific literacy. The results of his research stated that the scientific literacy assessment instrument was developed based on high-level thinking skills which emphasize students' ability to analyze, predict scientific phenomena in everyday life (Mardhiyyah et al., 2016). The population in this study were class VII students of SMP N 3 Cileungsi. The samples in this study were selected using a cluster random sampling technique, namely classes VIII-5, VIII-6, and VIII-7.

The total sample was 76 students. The data obtained is quantitative data from test results using scientific literacy tests and qualitative from interviews with teachers and students. The scientific literacy test was developed based on indicators of scientific literacy competency aspects. The indicators of the scientific literacy competency aspect in this research refer to the PISA (2018) competency aspect indicators, namely explaining phenomena scientifically, evaluating and designing scientific investigations, and interpreting data and evidence scientifically. Data analysis of scientific literacy skills is carried out using the following steps:

Scoring

The science literacy questions used to measure students' science literacy are multiple-choice questions. The scoring system is carried out with scoring rules giving a score of 1 if the answer is correct and a score of 0 if the answer is incorrect.

Value Determination

Data obtained from test results that have been scored are then converted into grades. Convert scores to grades using the formula:

$$\text{Value} = \frac{\text{score of students}}{\text{score maximal}} X\ 100 \quad (1)$$

The value of science literacy achievement obtained is then interpreted based on the criteria presented in Table 3.

Table 2. Science Literacy Achievement Criteria

Range of Values	Criterion
67–100	High
33–66	Moderate
< 33	Low

Analysis of Interview Results

The results of interviews with teachers and students were then analyzed to deepen and expand information about students' science literacy achievements in grade VIII in Bogor Regency to analyze factors that affect students' science literacy.

Result and Discussion

Data on scientific literacy of students at SMP Negeri 3 Cilengsi in Bogor Regency was obtained using a scientific literacy test in multiple choice form. The test in question was prepared using material on climate change and its impact on the ecosystem. Data on the results of science educators' scientific literacy tests are as shown in Table 3.

Table 3. Students' Scientific Literacy Scores

No	Scientific Literacy Scores	Subject	Percent	Category
1	10	4	5.3	Low
2	20	14	18.4	Low
3	30	29	38.2	Low
4	40	24	31.6	Currently
5	50	5	6.6	Currently
Amount		76	100.0	

Based on Table 3, students' scientific literacy competencies can be categorized into 2 as in Table 4.

Table 4. Student Science Literacy Test Results

Range of Science Literacy Scores	Number of Students (%)	Average (%)
67–100	0	31.58
33–66	3.2	(low)
< 33	61.8	
Amount	100	

The results of data analysis show that the description of the scientific literacy profile of students in classes VIII-5, VIII-6, and VIII-7 can be categorized into the low group at 61.8% and the medium category at 38.2%. Based on the scientific literacy scores achieved, students are in the low category with an average score of 31.58%. The highest score obtained by students was 50 by 5 people and the lowest score was 10 by 4 people

on a scale of 0-100. From the scientific literacy scores that have been obtained, it can be seen that there is a need to increase scientific literacy.

The data in Table 4 shows that students' overall scientific literacy is in the low category. The low level of students' scientific literacy skills is caused by students' inability to work on scientific literacy questions which include understanding and analysis of the questions. Students are not used to working on questions that require analysis and understanding because the evaluation questions given by teachers in formative and summative tests are questions that only require students' memory of the material they have studied. The results of Sumandya et al. (2020) research concluded that on average teachers did not understand the process of preparing HOTS questions. HOTS questions or assignments have the following characteristics: (1) their solutions are unpredictable or do not use direct formulas, (2) they are not routine, (3) they require open-ended answers, and (4) they require more activity in solving them (Sumandya et al., 2020). Therefore, students must be accustomed to working on problems that require critical analysis and the ability to understand open-ended contextual problems.

Open problems will encourage students to develop their abilities and creative ideas in solving the problems they face. According to Pantiwati et al. (2014), science assessments should not only be oriented towards mastery of scientific material but also on thinking skills and the ability to carry out scientific processes in real life (Pantiwati et al., 2016). The research results of Huryah et al. (2017) concluded that students who are not used to working on questions that require analysis are one of the factors causing students' low scientific literacy abilities (Huryah et al., 2017).

Giving questions that only require students' memory tends to make students memorize the lesson material. This causes students to be unable to understand and develop their thinking abilities. Zawawi et al. (2005) stated that the tendency of students to use memorization techniques to master science rather than thinking skills causes students to memorize concepts that they do not understand or comprehend (Zawawi et al., 2005). The research results of Azrai et al. (2020) concluded that critical thinking skills have a positive relationship with students' scientific literacy with a contribution of 19.9%. Therefore, it is necessary to train thinking skills to improve students' scientific literacy. This can be done through the learning process and teaching materials (Azrai et al., 2020).

Mastering science material and learning methods well is a scientific literacy skill that students have. It is very important for students to hone their scientific literacy because they have high competitiveness in facing challenges in the current and future era of information technology which is marked by global competition.

Astuti (2016) say that scientific literacy is a skill that needs to be sharpened in facing globalization. In connection with the importance of scientific literacy and information literacy, namely in solving problems both personally, participation and economic productivity. Scientific literacy consists of several types of literacy such as numerical literacy, reading and digital literacy (information technology). In terms of scientific literacy learning, it can be applied through learning strategies that can deepen students' ability to think at a higher level. Apart from that, multimedia-based or computer-based methods can increase digital literacy. Thus, scientific literacy can be included in the curriculum so that science learning, especially science, can increase knowledge, especially scientific or technological concepts (Astuti, 2016).

Students' lack of interest in reading and repeating learning material is also a factor in students' low scientific literacy. The results of the author's interviews with students revealed that students only read books and repeat learning material when facing exams or if there are assignments given by the teacher. Reading is very necessary for students to increase their insight and knowledge because by reading students can associate newly acquired knowledge with the knowledge they already have. This opinion is supported by the research results of Ayu et al. (2018) who concluded that there is a positive relationship between reading habits and students' scientific literacy (Ayu et al., 2018). The ability to read, write and count are basic skills. This ability makes a more significant contribution to society and can understand the world (Supriadi et al., 2020) and develop into the ability to apply various competencies and skills in life (Haqiqi et al., 2018).

Conclusion

Based on the results of the students' science literacy analysis research, it can be concluded that the average score of students' science literacy is still low, which is 31.58. The low science literacy of students is influenced by several factors such as low interest in reading, lack of teaching materials that focus on science literacy, and evaluation tools that have not led to the development of science literacy. The advice that the author can convey for further research is expected to future researchers who want to research student science literacy to use test instruments by paying attention to the same number and level of questions in every aspect of science literacy and the content of the material tested. In addition, it is necessary to develop teaching materials that can help

students more easily understand science and apply the knowledge they have in everyday life.

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Conflicts of Interest
No conflict interest.

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