

High School Students' Scientific Literacy in the Context of Covid-19 Pandemic

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ABSTRACT

Many previous researchers have indeed done research related to scientific literacy. However, few studies discuss scientific literacy related to the context of the COVID-19 virus on biological materials. The goal of this study is to find out how well students understand science in the context of the COVID-19 virus. The descriptive quantitative research method was applied. The sample consisted of 107 students from class XI science at a Madrasah Aliyah in Tangerang Selatan. The results showed the students' scientific literacy ability with an average percentage of 75.65% with good interpretation. Scientific literacy tested are 73.89% contextual aspects with sufficient interpretation, knowledge aspects, 75.29% with adequate interpretations, 75.47% competence aspects with sufficient interpretations, and 84.35% with good interpretations. The study concludes that students in class XI science can comprehend scientific literacy in the context of a current scientific occurrence, namely, the COVID-19 virus. The findings have implications for how teachers can develop students' scientific literacy skills by providing contextual examples of the COVID-19 virus so that students understand it and apply it in everyday life.

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1. INTRODUCTION

Science and technology necessitate that students have comprehensive knowledge and excellent skills in obtaining knowledge and technology in the more advanced Industrial Revolution Era 4.0. One approach to accomplish this is through scientific literacy education. Scientific literacy is the ability to acquire scientific knowledge based on scientific facts and traits that can influence the environment, intellectual environment, and cultural environment through science and technology (OECD, 2016). Assessments in science learning activities can reveal a student's scientific literacy ability. The Program for

International Student Assessment (PISA) is a program operated by the Organization for Economic Cooperation and Development (OECD) that assesses students' scientific knowledge and attitudes in everyday life (Listiani & Aidil Adhan, 2018).

The results of the PISA assessment are very useful for each country that participates in the program to determine scientific literacy skills and understand the education system in the countries involved in PISA (Awara, 2019). The 2015 PISA results show that of the 72 countries that took the PISA test, which had an average score of 493, Indonesia was ranked 60th with a score of 403; these results show that Indonesia has increased from the previous year in 2012 (Kemendikbud, 2016). According to the findings of the PISA survey, Indonesian students' average score is still poor compared to the global average. Students are accustomed to remembering concepts, theories, and laws, making it difficult for them to apply their knowledge in everyday situations. Students' literacy abilities can be improved by using learning methods and models that teach students how to interpret scientific phenomena and use the environment as a learning resource (Jufrida et al., 2019). By using an inquiry-based learning paradigm, the application of learning aims to increase students' scientific literacy skills (Ni'mah, 2019). In its assessment, PISA identifies three dimensions of scientific literacy: Competence, scientific knowledge substance, and the context in which science is applied. PISA introduced four measures of scientific literacy, the feature of scientific attitudes, in 2006. PISA, which was updated in 2015, states that scientific literacy comprises four components: context, knowledge, competency, and attitudes (Yana, 2018).

According to Knapp and Schell (2001), students can learn in certain contexts to provide a lot of experience. Students can use their knowledge to identify and solve problems in new situations (Windyariani, 2017). The backdrop for applying science in PISA is drawn from everyday life rather than from content studied in school. One of the issues leading to Indonesian students' inadequate scientific literacy is a gap between science study in schools and the demands of PISA (Ardianto & Rubini, 2016). Another issue contributing to inadequate scientific literacy is that students have not been taught how to address problems similar to those found in PISA questions (Huryah et al., 2017). According to Eko hariadi (2009), interest, learning intensity, and students' attitudes towards science also affect students' low scientific literacy achievement. Widowati et al. (2017), say that learning about science can help students improve their literacy skills by making them think more critically about what they learn and how they learn it.

Students' scientific literacy abilities must be further enhanced to comprehend the situation of surrounding environmental challenges and adapt to future advances in science and technology. Applying science principles to everyday life is one way to achieve scientific literacy (Yana, 2018). Students must study science to respond to a current science and technology development issue. Students can be influenced and used to making decisions about personal and social problems through scientific literacy, resulting in increased high-level reasoning and innovative problem-solving skills. Therefore, following technological developments and understanding science are important things for students to have.

Students' literacy skills can be developed through scientific phenomena and problems related to students' daily lives. Several studies that raised students' daily problems, including Jufrida et al. (2019), showed that students' scientific literacy was in the medium category. Meanwhile, in other science contexts related to static fluids, students' scientific literacy abilities are in the medium category (Sunarti, 2021) and the expansion phenomenon (Santhalia & Yuliati, 2021). In addition, the results of research related to COVID-19 show that students understand how COVID-19 is transmitted (Purnomo et al., 2021). However, what distinguishes this research from previous research is the association of biological material, namely viruses. Students can relate biological material to the current phenomenon, namely the COVID-19 virus pandemic, which can be used as a context to improve students' scientific literacy skills. The COVID-19 pandemic has caused health, environmental, social, educational, economic, and political problems. From these problems, globally, they are starting to compete in utilizing scientific and technological knowledge to create, build, and organize knowledge to overcome this pandemic. Therefore, the context of the Covid-19 virus can direct students to improve their scientific literacy skills to better understand the environment, health, and economy, as well as the problems faced by the Covid-19

phenomenon by involving advances in technology and science. Based on this description, this study aims to determine students' scientific literacy skills in the context of the COVID-19 virus by using four aspects according to PISA, namely aspects of context, knowledge, competence, and attitudes.

2. METHODS

The descriptive quantitative research method was applied. For the academic year 2020/21, the samples were all students in class XI IPA at MAN Tangerang Selatan, totalling 107 students, and were chosen using the purposive sampling technique. The preparation stage includes determining the research location, determining the number of participants and research samples, creating test instruments and questionnaires based on scientific literacy, having the instrument judged by an expert before testing, and testing the validity and reliability of the research instrument after it has been judged by an expert. Stage one of implementation: offering students instructions on how to complete the instrument; delivering students test instruments, which they must complete for 60 minutes via a Google form. They continue to fill out a questionnaire to gauge students' scientific literacy attitudes for 30 minutes after completing the test instruments, assigning scores to the ability test answers. The data from the research instrument is then managed by utilizing a specified formula to calculate the score for each item and questionnaire, defining the picture of students' scientific literacy based on the criteria for scientific literacy ability, and analyzing it using descriptive statistics.

3. FINDINGS AND DISCUSSION

The scientific literacy ability of class XI IPA students was assessed using an essay-based exam instrument to determine scientific literacy abilities in the context, knowledge, and competence elements and a questionnaire to assess the attitude component. The instrument used for the research has been tested for validity by several experts. The distribution of students' scientific literacy results was found by figuring out how many points each student got on each test.

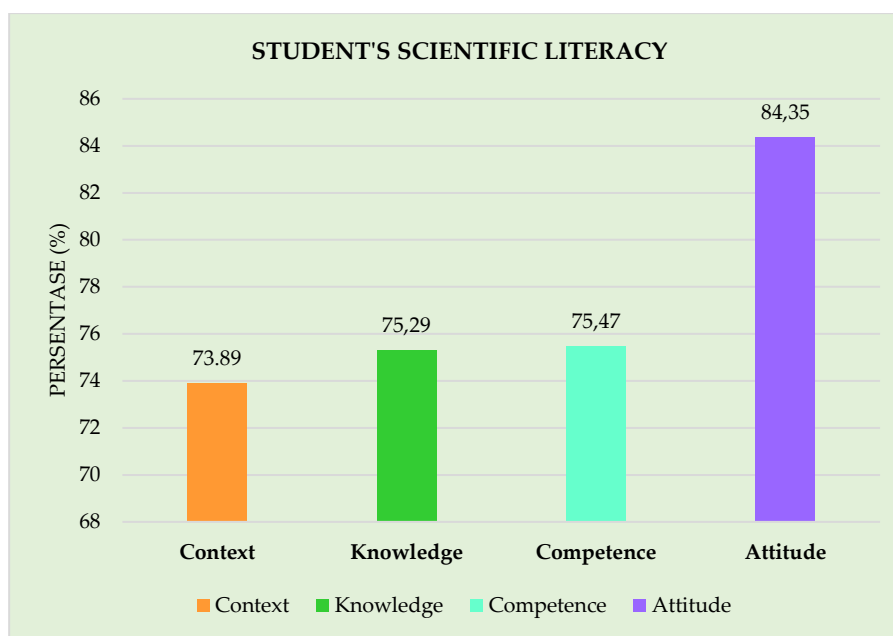


Figure 1. The Results: Aspect of Students' Scientific Literacy

As seen in the diagram above, students' scientific literacy skills in the attitude aspect have the highest percentage, namely 84.35% in the good category. The context aspect has the lowest percentage, at 73.89%, in the good category. As follows: Table 1. Scientific literacy ability, which consists of four

aspects: context aspect, knowledge aspect, competence aspect, and attitude aspect, can be seen in Table 1. as follows:

Table 1. The Result : Student's of Scientific Literacy

Aspect	Items	Percentage (%)	Average Percentage (%)	Category
Context	Personal	77,41	73,89	Enough
	Local	65,65		
	Global	78,60		
Knowledge	Content	77,41	75,29	Enough
	Procedural	78,97		
	Epistemic	69,47		
Competence	Explaining Scientific Phenomena	77,34	75,47	Enough
	Evaluating and Designing Scientific Investigations	79,60		
	Interpreting Scientific Data and Evidence	69,47		
Attitude	Interest in science	81,29	84,35	Good
	Appreciate/value the scientific approach	82,48		
	Concern for the environment	89,29		

2.1. Students' Scientific Literacy Ability Context Aspect

Personal, local, and global items are included in scientific literacy skills in context aspects. Figure 2 shows the percentage of the context aspect in the form of a bar chart, as follows:

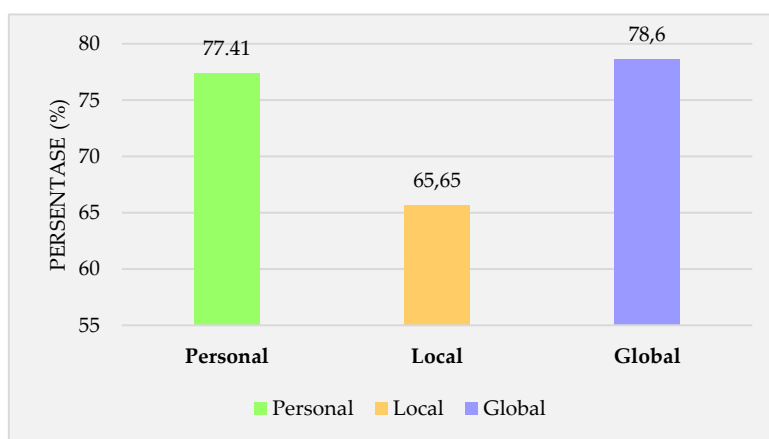


Figure 2. Students' Scientific Literacy Ability Context Aspect

In Figure 2, students' scientific literacy skills in the context of global objects receive the highest proportion, around 78.6 percent. The lowest rate is roughly 65.65% for local commodities. Table 4.2 shows the average literacy skills in the context aspect, which is 73.89 percent, which falls into the excellent category. Based on the acquisition of class XI IPA students' capacity to comprehend scientific concerns in the context of the COVID-19 virus relates to personal, community, and global life. The context aspect measures students' ability to use scientific knowledge to understand personal, local, and global scientific phenomena by taking a scientific approach that functions for investigation through

cases in supporting the acquisition and application of science and technology (OECD, 2017). Class XI IPA students can understand scientific issues in the context of the COVID-19 virus related to personal, community, and global life. According to Windyariani (2017), the context of scientific phenomena can be used by various aspects of everyday life to familiarize students with dealing directly with scientific phenomena. Students can have experience and knowledge to identify problems, make hypotheses, conclude, and make conclusions. Students will be accustomed to solving difficulties in the context of scientific occurrences that occur, according to her definition. Using the context of the COVID-19 virus, this can be used as a scientific phenomenon problem that students can learn to improve their scientific literacy.

The findings of the context analysis, students do not fully understand the notion of questions connected to the context of the COVID-19 virus. This is because students can only remember and recognize scientific knowledge without relating scientific topics to everyday life (Permanasari, 2016). Mastery of concepts in science learning that is more emphasized on students than applying concepts in a context being studied also affects students' understanding of questions (Subaidah et al., 2019). According to Desy & Erman (2019), a lack of pupils working on questions relating to a variety of material and real events is one factor contributing to students' lack of understanding of the questions. Teachers need to guide and direct students' critical thinking skills toward the importance of scientific evidence so that students can relate their arguments (Rini et al., 2021).

2.2. Students' Scientific Literacy Ability Aspects of Knowledge

Content, procedural, and epistemic items make up the knowledge aspect of scientific literacy skills. Figure 3 shows the percentage of the knowledge aspect in the form of a bar chart, as follows:

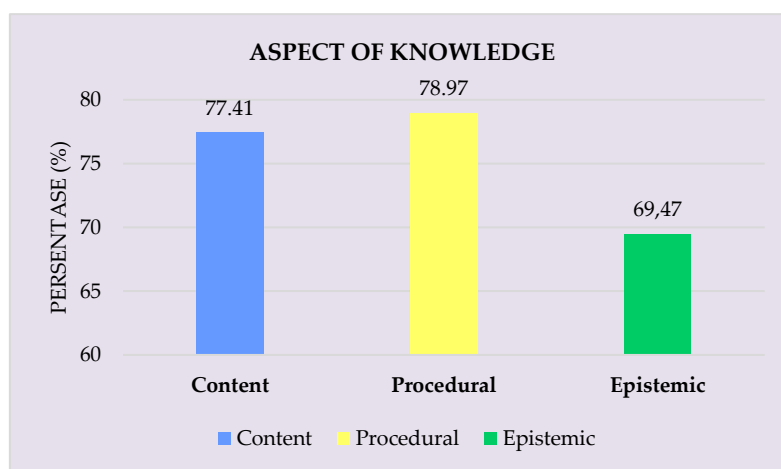


Figure 3. Students' Scientific Literacy Ability Aspects of Knowledge

Students' scientific literacy skills in the knowledge part of procedural questions receive the maximum percentage of around 78.97 percent. In comparison, epistemic things receive the lowest rate of about 69.47 percent, as shown in Figure 3. Table 4.2 shows the average percentage of scientific literacy skills in the knowledge element, 75.29 percent, which falls into the excellent category. This study demonstrates that scientific literacy abilities, when applied to students' knowledge, can describe scientific occurrences by utilizing students' scientific understanding of the COVID-19 virus. The knowledge aspect measures students' ability to form the basis of scientific knowledge in understanding and explaining scientific phenomena based on facts, concepts, and theories (OECD, 2017). The findings revealed that scientific literacy abilities in the context of students' knowledge might be used to explain scientific occurrences utilizing the COVID-19 virus's scientific knowledge. According to Narut & Supradi (2019), increasing literacy knowledge can be done by implementing a scientific approach.

Asyhari & Hartati (2015) demonstrate this in their research, which shows that using a scientific method improves students' reading skills in competence and knowledge.

Students can learn about research and conduct scientific experiments to generate scientific evidence (OECD, 2017). Procedural knowledge is the ability to describe thoughts in systematic steps to solve problems with the concept of knowledge possessed (Bintang et al., 2020). According to Khoirul Arief (2015), students who are not accustomed to solving problems that require students to carry out procedural analysis in stages and improve their scientific literacy can be carried out by applying levels of inquiry at the inquiry lesson stage to train students to use their procedural knowledge in solving problems. The epistemic knowledge aspect is the lowest ability mastered by students. Epistemic knowledge increases students' understanding of scientific procedures to make hypotheses, theories and scientific observations (OECD, 2017). Epistemic knowledge is associated with scientific identification, justifying data, and providing scientific arguments naturally (Pahrudin et al., 2019). The factor that affects students who cannot understand scientific evidence data is that students are not used to dealing with questions in the form of discourse, which means students have to understand every sentence contained in the discourse (Merta et al., 2020).

Content knowledge can be easily accessed because of modern technology to apply knowledge and curiosity about science, mathematics, technology, and engineering (Flores, 2017). Knowledge of the content in the questions is related to biological concepts and scientific theories relevant to real life. Students who have not been able to connect their knowledge with the phenomena that occur because they only understand biological concepts as rote without relating them to the context of everyday life. In the learning process, teachers tend to provide knowledge by explaining things verbally. Students are not accustomed to applying their knowledge to dealing with problems in their real lives (Suciati et al., 2014). The learning process is declared successful if students understand the material being studied and apply it to solve problems in everyday life. Learning in these students can be developed by conducting scientific literacy learning to develop students' knowledge related to science (Pertiwi et al., 2018). According to Yacoubian Yacoubian (2018), teachers need to support students to develop knowledge of pedagogic content in critical thinking and decision making.

2.3. Students' Scientific Literacy Ability Aspects of Competence

In the competency aspect, students' scientific literacy skills include explaining scientific phenomena, evaluating and designing scientific research, and understanding scientific data. Figure 4 is a bar chart depicting the percentage of competency elements, as follows:

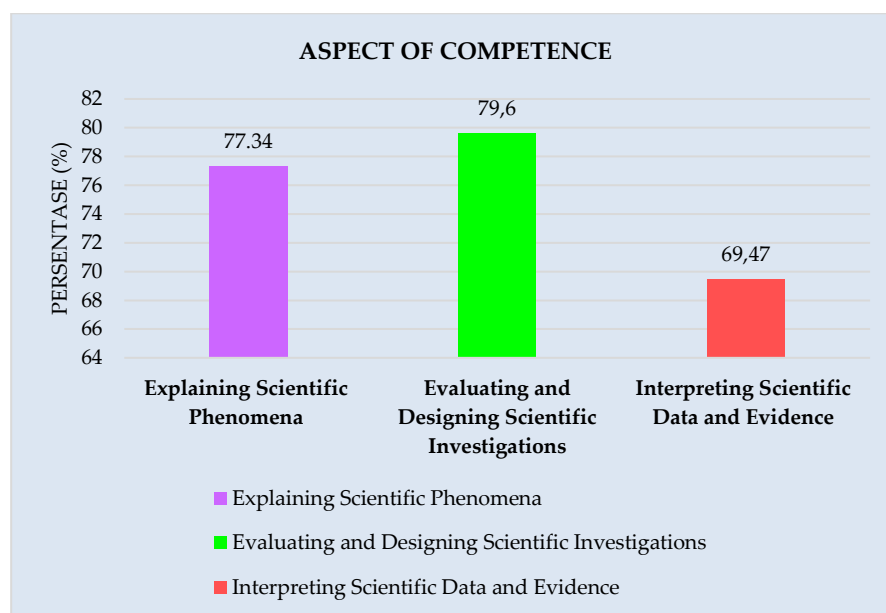


Figure 4. Students' Scientific Literacy Ability Aspects of Competence

Figure 4 depicts the findings of students' scientific literacy skills in evaluating and designing scientific studies. The items interpreting scientific data and evidence receive the highest percentage, about 79.60 percent, while those interpreting scientific data and proof receive the lowest rate, around 69.47 percent. Table 4.2 shows the average proportion of students' scientific literacy skills ineptitude, 75.47 percent, which falls into the excellent group. Students can explain scientific phenomena, analyze scientific investigations, and interpret scientific proof data based on current scientific phenomena such as the COVID-19 virus, according to the conclusions of the study. Students can benefit from this area of expertise as they work toward scientific literacy. Among other abilities, students must be able to describe scientific phenomena, evaluate and design scientific research, and comprehend scientific data and evidence (OECD, 2017). Students are quite capable of explaining scientific phenomena, analyzing scientific studies, and interpreting scientific evidence data through scientific phenomena that are currently occurring in the context of the COVID-19 virus, according to the findings of the study. According to García Carmona & Acevedo Díaz (2018), experimental activities help students understand science by allowing them to interact directly with scientific phenomena through the manipulation of objects, materials, observations, and measuring tools.

Students' ability to solve problems has not been optimally due to low awareness of metacognition (Anindya et al., 2019). The mastery of student competencies can use the concept of scientific knowledge in conducting scientific investigations to solve a problem (Merta et al., 2020). Students can develop scientific literacy skills based on indicators of evaluating and designing scientific investigations through teachers' providing opportunities for students to collect relevant information about scientific phenomena around them to prove whether or not the hypothesis that they have set is true. It's possible for teachers to use the inquiry lab learning model to help students learn this skill. They can teach them how to look at experimental data tables, interpret experimental data, and draw conclusions from the evidence that has been collected.

Knowledge of how to interpret data and scientific evidence Based on the evidence supplied, students can analyze, give comments, make inferences, and form hypotheses (OECD, 2017). Students, on the other hand, have not comprehended, examined facts, drawn conclusions, or distinguished viewpoints based on scientific evidence. According to Arifin & Sunarti (2017), one of the key reasons is students' interest in science. Students that are uninterested in science will struggle to respond to queries. Identifying problems, processing data, and making judgments are among the challenges faced. When students make sure that the hypotheses they make and connect through the results of data

processing in discussion activities on their findings get feedback from friends and teachers, they can improve their ability to interpret scientific data (Merta et al., 2020).

In the context of the COVID-19 virus, students can understand scientific phenomena. Explaining scientific events, according to Arifin & Sunarti (2017), is more than just memorizing and applying theories, concepts, information, and facts; it also entails acknowledging, proposing, and assessing explanations for natural phenomena that occur. According to Ridho et al. (2018), one of the causal factors affecting scientific literacy is students' lack of interest in reading, which causes them to be less careful when reading the question description and consider the text or description of the question to be too long, preventing them from understanding the essence of the question. For explaining scientific phenomena, students need knowledge of theories, concepts, and models used in making observations and understanding related to scientific phenomena to be observed to justify their scientific knowledge (Merta et al., 2020). Students will be able to use scientific evidence in explaining scientific phenomena that occur in everyday life by carrying out discussion activities with students and teachers so that students can develop and be able to express opinions orally or in writing through scientific phenomena (Listiani & Aidil Adhan, 2018).

2.4. Students' Scientific Literacy Ability Aspects of Attitude

Interest in research, appreciating/valuing scientific approaches, and care for the environment are all examples of scientific literacy skills in the attitude category. Figure 5 shows the percentage of the attitude aspect in the form of a bar chart.

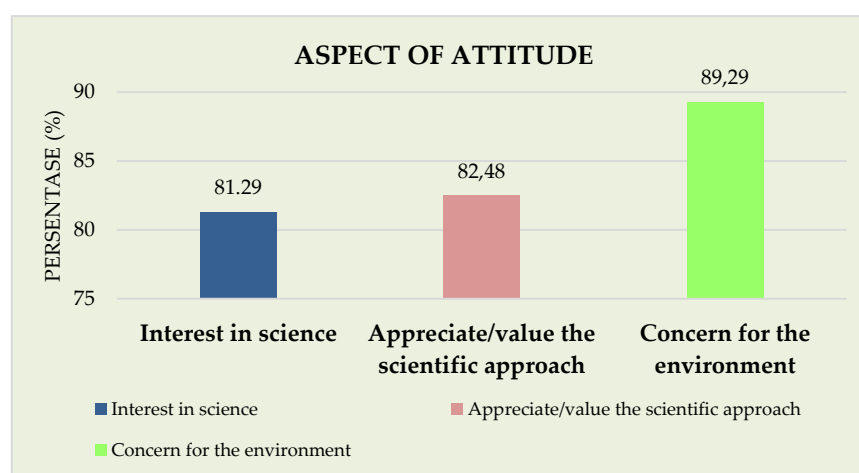


Figure 5. Students' Scientific Literacy Ability Aspects of Attitude

The attitude aspect directs students to develop attitudes toward science through scientific phenomena problems with students' interests, concerns, and responses to science and technology (OECD, 2017). The scientific literacy attitude that students must apply is an interest in science, appreciation of/valuing scientific approaches, and concern for science. Aspects of student attitudes based on research results are categorized as good. This shows that students have a good literacy attitude towards the context of the COVID-19 virus. According to C ezar & Pinto (2017), the school environment significantly influences students' attitudes towards improving attitudes towards science. Students can understand science with a scientific approach and conduct investigations into scientific phenomena by applying science and technology. Through scientific phenomena Akmalia (2019), students need to be guided to develop attitudes and morals about life.

In the context of the COVID-19 virus, students can understand how to keep the surrounding environment clean and healthy, which is useful for reducing the spread of the virus so that students

have a sense of responsibility toward the surrounding environment. Students can understand the perception of environmental issues around them, which makes students optimistic about maintaining a clean environment and implementing health protocols. Students who observe changes in the surrounding environment are useful for fostering a sense of love for the environment, and environmental sustainability arises (Dinata et al., 2018). By understanding the problems that exist in the environment, students can solve problems through solutions that can be realized in learning (Elvianasti et al., 2021).

Students who have an interest in science can be seen by their interest in learning, learning motivation, grouping knowledge, and taking advantage of the use of technology in learning. This can show students' interest in learning science through various media to gain scientific knowledge. The context of the COVID-19 virus is the context of the scientific phenomenon that is happening now, and to increase knowledge about the COVID-19 virus, students can learn through the latest reading sources related to the COVID-19 virus by using technology that students can access to classify the knowledge gained based on concepts, theories, and facts. According to (Akgunduz & Akinoglu (2016) research, learning utilizing the blended learning model can promote students' scientific attitudes and direct students in acquiring skills via social media. Students that are interested in science desire to learn more about it by consulting various sources and employing scientific procedures (Dinata et al., 2018). The attitude of students who respect each other's opinions and criticisms of the information and scientific evidence they receive related to the COVID-19 virus is an attitude to assess and appreciate the scientific approach. A study by Genç (2015) says that when students carry out scientific study activities, they positively affect how students think about science and how they find their interests and talents.

Students' scientific literacy based on the scientific phenomenon of Covid-19 is an ability that can help students in responding to the current outbreak phenomenon. In the aspect of students' attitudes are categorized as good. This shows that students already understand how to respond to Covid-19 by complying with the government's rules, and students obtain online information that can be accessed anywhere and anytime. Meanwhile, for aspects of competence related to psychomotor, students need to be given problem-solving exercises.

4. CONCLUSION

The current COVID-19 phenomenon can be used as a material to measure students' scientific literacy skills. This context is related to students' daily experiences and includes essential material in high school biology. So that students understand what and how the transmission of COVID-19 is, but can master virus material through the COVID-19 phenomenon. From the findings, it is suggested that teachers can provide contextual examples such as the phenomenon of the COVID-19 outbreak on virus material. In addition, it is necessary to develop an appropriate learning method so that students can improve their scientific literacy. Weaknesses in the study refer to the number of samples limited to one school only, so it is necessary to increase the number of samples from several schools. The results of this study open up opportunities for further researchers to examine other aspects of scientific phenomena that are happening in society and are related to students' daily experiences.

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