

## Identification of the Scientific Reasoning Ability of Students on Environmental Pollution During the Covid-19 Pandemic

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Received Juny 30, 2022; accepted March 20, 2023; published March 30, 2023

### ABSTRACT

This study aims to identify students' scientific reasoning abilities in biology lessons during the Covid-19 pandemic. This research uses descriptive qualitative and quantitative methods. Sampling used a table for determining the number of samples from a certain population with an error rate of 10%, amounting to 131 students. The research samples were 23 students of class VIII A, 23 students of VIII B, 23 students of VIII C, and 23 students of VIII D. The data collection used the scientific reasoning ability test method in the form of an essay. Based on the results of the scientific reasoning ability test, students fall into the less category, namely as much as 55.43%. The research obtained can be concluded that the scientific reasoning ability of students is in the poor category, especially in the indicators of compiling and providing reasons or evidence for the correctness of the solution, drawing conclusions from statements

### KEYWORDS

Scientific Reasoning  
Covid-19 Pandemic  
Environmental pollution

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### 1. Introduction

The world is currently experiencing a COVID-19 pandemic. Covid-19 is a new type of virus that was discovered in 2019. The Covid-19 infection was first detected in December 2019 in China and has spread rapidly throughout the world (Retna Ningsih et al, 2020). The current Covid-19 virus has an impact in various fields, one of which is education, therefore education plays a very important role in human life. Based on law number 20 of 2003 concerning the National education system, Article 1 paragraph 1 states that education is a conscious and planned effort to create a learning atmosphere and learning process so that students actively develop their potential to have religious-spiritual strength, self-control, personality, intelligence, noble character and skills needed by himself, the community, nation and state (Law No. 20, 2013). Education is the basic foundation that can improve the quality of human life which is achieved after humans can develop their potential through the learning process (Prayitno, 2009, Dadan, 2021).

Learning carried out during the COVID-19 pandemic requires students to study remotely. Based on the circular letter of the Minister of Education and Culture of the Republic of Indonesia Number 4 of 2020, learning is carried out at home through distance learning to provide a meaningful learning experience for students. The learning process during the COVID-19 pandemic is certainly not an easy thing for students (Gillet, 2017). Difficulties arise not only in terms of skills in using technology but also related to a large workload considering that many subjects must be faced during this Covid-19 pandemic. This happens because students are accustomed to face-to-face learning regularly, whereas distance learning was previously only done incidentally. (Rahadjo, 2020). Another problem is that online learning is more theoretical and minimal in practice because it does not allow direct interaction with students. This makes it difficult for students to learn because of the reduced ability of students to think and understand the subject matter. The difficulty of students' thinking skills affects students' scientific reasoning abilities. (Lai, 2012, Subiki, 2018) suggest that learning in schools should develop scientific reasoning abilities that can help students face problems in the real world to think and reason.

The ability of scientific reasoning (scientific reasoning) is the ability to conclude based on the existing evidence. The reasoning is the ability to know supporting reasons based on relevant situations and facts (Winarti, 2015). Scientific reasoning ability is also a very important part of the learning process to lead students to their future. In addition, the ability of scientific reasoning is important to know to symbolize the set of skills and abilities needed to solve problems in the process of scientific investigation (Han, 2013). Reasoning ability is important so that scientific reasoning can be known so that it has the potential to develop scientific reasoning abilities by the 21st-century learning paradigm as a pedagogical framework in the learning process. Several studies have shown that reasoning abilities affect student learning outcomes (Markawi, 2013, Akuba, 2020), critical thinking skills (Winarti, 2015), and problem-solving (Nurhayati et al, 2016). Reasoning ability affects students' critical thinking skills because reasoning requires deep thinking to analyze the questions given.

Based on the results of interviews with teachers at SMPN 1 Paloh, it shows that student learning is still limited to memorizing material but does not understand what is memorized. When students are given assignments, students fill in the questions by tracing from books, this is because students still have difficulty in connecting theory with the assignments given, this is supported by the results of interviews with students, they say that when filling out questions given by the teacher they always see the answers from the students. books, they give the reason it is done so that they remember what they have learned. By giving these reasons, it can be concluded that students do not understand what the teacher has explained and as in the opinion of the teacher also says that students have difficulty in connecting theory with the given task. The difficulty in connecting theory and assignments can be seen in some of the materials taught one of which is environmental pollution.

Based on the results of the interviews above, shows that students' reasoning abilities are still low. With students' reasoning abilities still low, it will affect their ability to think and solve problems. Therefore, researchers are interested in researching reasoning abilities. Knowing the reasoning ability also makes it easier for teachers in the learning process and evaluation of science learning, so that learning is easier for students to understand. Therefore, researchers are interested in conducting a study entitled "Identification of scientific reasoning abilities of class VIII SMPN 1 Paloh students regarding environmental pollution during the Covid-19 pandemic.

## 2. Method

This study used the descriptive qualitative method. The purpose of this description method is to make a systematic description, picture or painting of the facts, characteristics and relationships of the phenomena being investigated. This study provides a detailed explanation or description of the reasoning abilities of class VIII SMPN 1 Paloh students. The test used in this research is in the form of an essay which consists of 10 questions. The sample selection was carried out after the homogeneity test, the Barlet test on the daily test of the life organization system, namely,  $X^2$  count of 4.158, which is smaller than the  $X^2$  table of 7.81. So it can be concluded that the variance of the data from each class is homogeneous. Sampling was done by determining the number of samples from a certain population with an error rate of 10%, totalling 92 students. The sampling technique was carried out randomly, namely by preparing 4 papers containing each class, namely class VIII A, VIII B, VIII C, and VIII D. Then the paper was rolled up and shuffled 23 times in each class, in each class taken as many as 23 students.

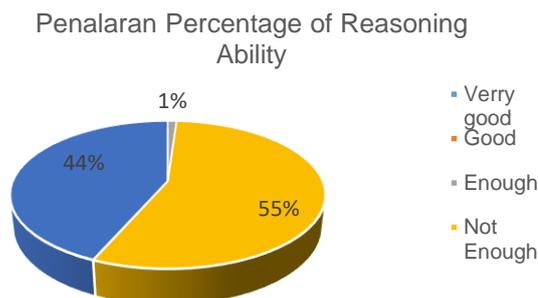
## 3. Result and Discussion

Students' scientific reasoning abilities are assessed based on reasoning indicators, where students must be able to compose and provide reasons or evidence for the correctness of solutions, propose conjectures, draw conclusions from statements.

**Table 1.** Average indicators of scientific reasoning ability

Class	Reasoning Indicator			Average
	1	2	3	
VIII A	33,28	20,72	42,26	31,75
VIII B	33,67	28,33	44,5	35,5
VIII C	18,22	15,34	32,18	21,91
VIII D	25,47	27	31,14	27,87
<b>Average</b>	27,41	22,84	37,52	29,25

The categories of students' reasoning ability levels in each class can be seen in Figure 1.



**Figure 1.** Diagram of the reasoning ability level categories of students in grades VIII A, VIII B, VIII C, VIII D.

Based on the results of the reasoning ability obtained is very low in the less category, namely in the sufficient category as much as 1.08%, in the less category as much as 55.43% and in the very poor category as much as 43.47%. The average student falls into the category of less and very less, this can be seen in the indicators, compiling and providing reasons or evidence for the correctness of the solution, the indicators propose assumptions and the indicators conclude statements

Indicators compile and provide reasons or evidence for the correctness of the solution. found in questions number 1, 7, and 8. In question number 1, as many as 17 students or 18.47% could answer the question but it was not quite right, while in questions number 7 and 8 students could not answer the question at all. In the indicator of proposing allegations, there are questions number 2, 4, 9, and 10. 2. In question number 2, 21 students can answer correctly or a percentage of 22.82%, in question number 4, students who can answer questions but less precise as many as 4 people or as much as 4.34% percentage, in question 9 none of the students can answer it, in question number 10 students who can answer the question but less precise as many as 9 students or 9.78%. In the indicator concluding the statement contained in questions number 3, 5, and 6. in question number 3, as many as 11 students or 11.92% of students were able to answer the causes of environmental pollution but were incomplete regarding the definition of water pollution. In question number 5, there were 11 students or 11.92% who can answer the question correctly, and in question number 6, as many as 10 students or 10.86% can answer the question correctly.

The indicator draws conclusions, compiles evidence, and provides reasons or evidence for several solutions, in question number 1, as many as 17 students or 18.47% can answer the question but are not quite right. One student revealed that “because plastic waste is difficult to decompose or it takes thousands of years for it to decompose, the way to overcome this is to reduce the use of plastic when shopping and bring your bag from home”. This happens because students do not understand the material on environmental pollution and in this question students can give reasons why plastic waste can pollute the soil but are not precise in explaining it, and students cannot provide the right solution to overcome plastic waste. That reason would be better if it is written: “Plastic waste can pollute the soil because plastic is difficult to decompose by microbes, it takes years to decompose plastic. If

plastic waste is scattered, it will accumulate and water will be difficult to enter the ground so that the plants become wilted and infertile, and then the area becomes arid (Wulandari, 2021). The right solution is to make special waste for plastic and the plastic will be recycled so that it can be reused.

For questions number 7 and 8 students cannot answer the questions at all, this can happen because students do not understand the content of the questions given. In question number 7, one of the students said "if you want to produce palm oil, don't destroy the peat ecosystem or burn the land which causes thick smog". The reason would be better if it was written "The government must directly control the system from the operation of palm oil companies. Making work standards that pay attention to AMDAL for all actions taken by the company. Impacts such as forest fires and land that has been used to become infertile can be overcome by carrying out regular watering during the dry season and unproductive palm oil it can be uprooted and replanted, thus PT palm oil goes on and donates (Pardamean, 2012). In question number 8, one of the students said "because the dung causes a smell, treat the dung by making fertilizer", it would be better if the student wrote, Livestock dung contains ammonia gas, so it can pollute the air if exposed and combines with other compounds. if not treated properly it can cause an unpleasant odour, and large amounts of ammonia gas when inhaled can cause burns to the nasal passages, and throat, causing shortness of breath or even respiratory failure. The right solution is that animal dung can be buried and processed into biogas, flammable methane resulting from fermentation can be used as fuel for cooking and so on (Wahyuni, 2013, Fildza, 2018). students' scientific indicators for concluding, compiling evidence, and providing reasons or evidence for several solutions are still low with very poor criteria. This happens because students are never given questions related to reasoning abilities. After all, in the learning process at school, students usually only follow orders and cues from the teacher in solving a problem. So that when students solve the problems given, the procedure is the same as exemplified by the teacher. This also affects the activeness and limited insight of students because every aspect of learning depends on the teacher (Reta, 2012, Jannah, 2020).

The indicator proposes a guess, students are asked to express their opinion based on the illustration of the story questions are given. This can be seen from the students' answers. Some students can answer the questions correctly and some students carelessly fill in the questions, some even don't fill in at all. The indicator of proposing allegations can be seen from the percentage results per question obtained by students. In question number 2, 21 students can answer correctly or a percentage of 22.82%, most of the students only answer one question, even though in question number 2 there are 2 questions, this can happen because students do not understand the content of the question. given, it would be nice if students answered air and noise pollution.

in question number 4, students who can answer the question but are not quite right are 4 people or a percentage of 4.34% and students who are unable to answer as much as 95.65%. one of the students said "there is because it causes the animals to die instantly due to exposure to the chemical. It would be better if students answered, Yes, because one of the sources of soil pollution is the excessive use of chemical pesticides. In question number 9, none of the students could answer the question. One of the students said, "herbicide fertilizers include chemical pesticides, these fertilizers can damage the soil and pollute the water". It would be nice if students answered questions like this, excessive herbicide fertilizers can damage the soil structure so that it becomes infertile. Excessive fertilizer is also not absorbed by plants so that it will be spread on the surface of the soil, the rain will bring these substances into the water, algae blooms will occur, and algae will thrive which causes the water surface to close. This algae plant covers the surface of the water, thereby reducing the amount of sunlight that enters the water (Barus, T. A. (2020). As a result, the photosynthetic process of plankton is disrupted so that dissolved oxygen levels in the water decrease, and it makes it difficult for small fish to find food, over time they will die and run out, humans cannot get food or protein from fish.

Question number 10 students who can answer the question but are less precise as many as 9 students or 9.78% and students who are not able to answer as many as 90.21%. One of

the students said, "it is polluted so that it can flood when it rains". It would be nice if students answered the questions, in a period of 10 years, the Sambas river will experience siltation so that it cannot accommodate large volumes of river water, as a result, there will be flooding in the rainy season. Based on this, it can be seen that the scientific reasoning ability of students is still low with very poor criteria. The low reasoning ability can be seen in the students not being able to examine the problems given. As a result, they cannot provide conjectures on the given problem, so students find it difficult to find patterns or the nature of the questions given. Therefore, students cannot manipulate the problems given. Reasoning ability is needed by students both in the process of understanding themselves and in everyday life (Rahayu, 2013, Aruan, 2020).

Indicators conclude statements, students can conclude from the results obtained from analyzing questions, understanding concepts and understanding concepts and making logical arguments (Wardhani, 2008, Firda, 2019). On indicators conclude statements, in question number 3, for interpreting data, using ideas that are used as conclusions. While the indicators propose allegations, students can think or formulate a truth before answering questions, as many as 11 students A total of 11.92% of students can answer the causes of environmental pollution but are incomplete about the definition of water pollution, and as many as 88.04% of students are unable to answer questions. One of the students revealed that "indiscriminate dumping of garbage is the result of human activity". The reason would be better if written down, pollution is the entry of substances or other components that disturb the environmental balance and harm living things in a space of interaction of living things to survive (Nurkisanawati, B.2020). Environmental pollution occurs because Environmental pollution occurs due to human activities or natural processes. In question number 5, as many as 11 students or 11.92% could answer the question correctly and as many as 88.04 students were unable to answer the question.

Question number 6, as many as 10 students or 10.86% can answer the question correctly and as many as 89.13% of students are not able to answer the question. One of the students revealed that "the cause of people in Palmi Village getting sick is the waste from the textile factory". It would be nice if students wrote down, plastic bags, textile factory waste, and excessive fertilizer. Based on the results the reasoning ability obtained is very low, this is in line with the results of teacher and student interviews. Based on the results of interviews conducted with teachers and students. The results of interviews with students revealed that students did not understand the questions, because, at the time of the evaluation given by the teacher, they never got questions like the ones that the researchers made, and the results of interviews with the teacher said that in class VIII all their children were on average less because at the time learning is done online, so students do not understand the material that has been taught. Therefore, teachers need to know the profile of students' reasoning abilities so that the learning process runs effectively. This profile of students' reasoning abilities also helps teachers in designing learning (Bancong & Subaer, 2013; Gunawan, 2016; Utama et al, 2018).

Based on this, it can be seen that the students' scientific reasoning ability on the indicators of compiling and providing reasons or evidence for the correctness of the solution, submitting conjectures and indicators concluding statements is still low with fewer criteria. This happens because students are never given questions related to reasoning abilities, students are not careful in analyzing questions and are still weak in reading, questions that are usually done by students all answers are directly available in books, so students are less in thinking. Students also have not been able to develop their reasoning skills, do not have the habit of reading while thinking and working to understand the content in solving problems, and still tend to "receive" information and then forget it (Wardhani & Rumiati, 2011, Hasibuan, 2019). The low scientific reasoning ability of students is also supported by the results of teacher and student interviews, the results of interviews with students reveal that students do not understand the questions, because at the time of the evaluation given by the teacher, they never got reasoning questions, and the results of interviews from the teacher said that In class VIII all of their children are on average less, because when learning is done online, so students do not understand the

material that has been taught. Therefore, teachers need to know the profile of students' reasoning abilities so that the learning process runs effectively. This profile of students' reasoning abilities also helps teachers in designing learning (Bancong & Subaer, 2013; Gunawan, 2016; Utama et al, 2018).

Students only follow orders and cues from the teacher in solving a problem. So that when students solve the problems given, the procedure is the same as exemplified by the teacher. This also affects the activeness and limited insight of students because every aspect of learning depends on the teacher (Reta, 2012). Reasoning abilities are required to be mastered by students so that students are easy to examine a problem faced with the information obtained. Through reasoning, students can better understand the concept of the subject matter itself, not just rote (Sofyana, 2018). Therefore, research on reasoning abilities was carried out at SMPN 1 Paloh to analyze students' reasoning abilities, but from the results obtained, the cognitive development of students on the questions of reasoning abilities that were made was not following students' abilities, this was due to several factors that resulted in students' cognitive development not developing. Some of them have learning difficulties.

Students have difficulty in learning because they are still learning online, when given material, most of the students are lazy to read so when given questions by the teacher, the results of the student scores obtained are low on average due to lack of ability to understand the material, this results in students' cognitive development being hampered so that when giving questions about reasoning abilities on indicators, draw conclusions from statements and submit allegations that students are unable to answer them (Unzila, 2018). Another factor that causes the low scientific reasoning ability of students is because learning is dominated by the expansion approach, namely teacher-centred learning activities (Mariyam, 2016, Rachmaniar, 2018).

#### 4. Conclusion

The results showed that the reasoning ability of students 55.43% was in the less category. Especially in the aspect of compiling and providing reasons or evidence for the correctness of the solution, and drawing conclusions from statements

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