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ANALYSIS OF SCIENCE LITERATURE CAPABILITIES OF HIGH SCHOOL STUDENTS IN PHYSICS LEARNING DURING THE COVID-19 PANDEMIC ON STRAIGHT MOTION KINEMATICS MATERIALS

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Abstrak

Di Masa pandemi Covid-19, pembelajaran yang kurang optimal berdampak pada kemampuan literasi IPA siswa, berdasarkan penilaian yang dilakukan oleh PISA bahwa kemampuan literasi sains siswa Indonesia tergolong rendah. Oleh karena itu, diperlukan upaya untuk meningkatkan kemampuan literasi sains siswa.Tujuan penelitian ini untuk menganalisis kemampuan literasi sains siswa kelas X MIPA 1 dan X MIPA 2 SMA Negeri 1 Pangkalan Banteng pada materi kinematika gerak lurus untuk pembelajaran fisika pada masa pandemi covid-19. Penelitian ini termasuk dalam penelitian deskriptif kuantitatif. Teknik pengambilan sampel dalam penelitian ini adalah cluster random sampling. Sampel penelitian ini adalah 62 siswa yang berasal dari dua kelas yaitu X MIPA 1 dan X MIPA 2 SMA Negeri 1 Pangkalan Banteng. Teknik pengumpulan data dengan cara wawancara dan tes online dengan mengerjakan soal essay yang telah divalidasi oleh validator. Tingkat kemampuan literasi sains yang diukur adalah domain kompetensi. Dari hasil penelitian diketahui bahwa tingkat kemampuan literasi IPA siswa, khususnya pada materi kinematika gerak lurus tergolong "Rendah" dengan persentase 56%. Sehingga perlu adanya kegiatan seperti praktikum berbasis literasi sains yang dapat menarik rasa ingin tahu siswa dan memperkuat pemahaman siswa terhadap IPA kongkrit melalui eksperimen, meskipun pembelajaran dilakukan secara online.

Kata Kunci: Kemampuan Literasi Sains, Fisika, Pandemi Covid-19, Kinematika Gerak Lurus.

Abstract

During the Covid-19 pandemic, less than optimal learning had an impact on students' physical science literacy skills, especially based on an assessment conducted by PISA that Indonesian students' scientific literacy abilities were classified as low. Therefore, efforts are needed to improve students' scientific literacy skills.The purpose of this study was to analyze the scientific literacy skills of students of class X MIPA 1 and X MIPA 2 at SMA Negeri 1 Pangkalan Banteng on the material of straight motion kinematics for learning physics during the covid-19 pandemic. This research is included in quantitative descriptive research. The sampling technique of this research is cluster random sampling. The sample of this research is 62 students from two classes, namely X MIPA 1 and X MIPA 2 SMA Negeri 1 Pangkalan Banteng. Data collection techniques are by means of interviews and online tests by working on essay questions that have been validated by the validator. The level of scientific literacy ability that is measured is the domain of competence. From the results of the study, it was found that the level of physical science literacy skills of students, especially in straight motion kinematics material was classified as "Low" with a percentage of 56%. So, the need for activities such as scientific literacy-based practicums can attract students' curiosity and strengthen students' understanding of concrete science through an experiment, even though learning is done online.

Keywords: *Science Literacy Ability, Physics, Covid-19 Pandemic, Straight Motion Kinematics.*

INTRODUCTION

At this time the country of Indonesia is facing a pandemic of the corona virus or Covid-19 which has an impact on the weakening of the country's economy. This is because all community activities can no longer run normally, everything is done online, not least in the field of education. This online learning is considered not easy to accept on the subject of science(Naila & Khasna, 2021). Of course this will greatly affect the scientific literacy ability of students. We all know that scientific literacy knowledge is an important perspective that can be used as a challenge today whose ultimate goal is to experience the development of increasingly sophisticated technology.(Andini et al., 2020).

Every student must have scientific literacy skills because knowledge of scientific literacy is a very important ability in this 21st century (Pertiwi et al., 2018). As stated by(Konopko, 2015), climate literacy skills are one of 16 important skills in the 21st century that are recognized by the World Economic Forum. These skills aim to prepare individuals to face competition in the development of science and technology, besides that they can also prepare students' abilities for various challenges in the era of globalization.(Turiman et al., 2012). This is in line with what was stated by(Nofiana, 2017) that the key to success in facing challenges in the 21st century is "Science Literacy", because individuals who are scientifically literate are one of the Human Resources (HR) who can compete in the era of globalization and can prepare creative and innovative students by abilities and skills in their respective fields.

According to (OECD, 2015a)Scientific literacy is a person's ability to implement knowledge to solve problems related to science and technology in everyday life. Students will be involved in several discourses on science and technology so that these competencies are needed to design, evaluate and explain scientific research data and evidence. The American Association for the Advancement of Science (1990) argues that someone will be said to be literate if that person can relate science, mathematics and technology.

Program for International Student Assessment (PISA) is a study conducted to evaluate an education system followed by 70 countries. The scientific literacy ability of students in Indonesia is still very low. In 2015 PISA conducted an assessment of students' literacy skills which showed that Indonesian students only achieved a score of 403 from the OECD average score of 493(OECD, 2015b). Then in 2018, the results of the PISA assessment experienced a decline, from which Indonesian students initially scored 403 to 396 while the average score for OECD countries was 389.(OECD, 2019). The decline in students' scientific literacy skills is influenced by several factors, including learning models, teaching materials, teaching media, worksheets and scientific literacy-based evaluation tools.(A. Rusilowati et al., 2019). The factor that causes this to happen is because there are still several educational institutions in Indonesia that have not made updates to learning media and teaching methods. Scientific literacy ability can be measured based on 4 domains, namely; context, scientific competence, knowledge of science and attitudes towards science. The context domain includes the assessment of students' knowledge and competencies. In the domain of science competence includes students' ability to describe, design and evaluate scientific evidence and research data. The domain of scientific knowledge includes content, procedural, and epistemic knowledge. Then in the domain of showing students' interest in science, support for scientific research, and motivation to have responsibility for the environment(OECD, 2015a)

PISA has measured scientific literacy skills in the field of physics, which is a branch of science that can be analyzed for literacy (Nurwulandari, 2018). Developing abilities in the field of physics is one of the keys to the success of increasing students' abilities in adapting to changing times and entering the technological era (Indrawati, 2018). Therefore, the ability of scientific literacy in physics needs to be measured. Straight motion kinematics material is material that is included in the content of scientific literacy. According to the results of research conducted by(Amalia & Yulianti, 2018) get the result that the students' scientific literacy ability towards linear motion kinematics material is low.

Based on the results of the explanation above, this study aims to analyze the scientific literacy skills of high school students on the material of linear motion kinematics for learning physics during the covid-19 pandemic. The results of this study will be used as a guide for how to improve students' scientific literacy skills for learning physics during the covid-19 pandemic.

METHOD

This research is a quantitative descriptive research because this research describes systematically and structured on the whole object of research regarding students' scientific literacy skills. according to(Kriyantono, 2006) quantitative descriptive research is a research method that describes a problem whose results can be explained in a systematic and structured manner. Descriptive research can describe a phenomenon in a certain population. The data obtained will be processed and displayed based on real results.

The method used in taking the sample data is cluster random sampling. according to(Setiawan, 2005) explained that cluster random sampling is a sampling technique in which the population is divided into large population units.

The subjects used in this study were students of class X MIPA SMA Negeri 1 Pangkalan Banteng, Central Kalimantan. The sample of this study amounted to 62 people who were students from class X MIPA 1 and MIPA 2.

Research data collection techniques were carried out by tests and interviews. Interviews were conducted with physics teachers regarding the online learning process during the Covid-19 pandemic on physics learning. Then the test is carried out through Microsoft Office Forms.

The implementation of this research was in June 2021 where that time was the initial period of the Covid-19 pandemic.

In this study, the instrument used in the test was 6 essay questions that had been validated by the validator. Assessment of instrument validity was carried out by two lecturers of the Department of Physics, State University of Surabaya using numbers 1-5 for each aspect. The validity is assessed from several aspects, as shown in table 1 below.

Table 1. Aspects of Instrument Validation

No	Observed aspects
1	The suitability of the questions and questionnaires with the research objectives.
2	Clarity of instructions for working on questions and questionnaires.
3	Clarity of the meaning of the question
4	Possibility of questions and questionnaires can be resolved.
5	The suitability of the language used in the questions and questionnaires with the Indonesian language rules.
6	Sentence questions and questionnaires do not contain a double meaning.

The results of the validator's research are calculated using the following equation:

$$presentase : \frac{jumlah\ skor\ yang\ diperoleh}{jumlah\ skor\ maksimum} X\ 100\%$$

Questionnaires and response questionnaires are declared valid if the presentation of validity is 61% as shown in table 2.

Table 2. Interpretation of Scores

Percentage	Criteria
81% - 100%	Very Good / Very Valid
61% - 80%	Good / Valid
41% - 60%	Enough
21% - 40%	Not enough
0% - 20%	Very less

The essay questions used in the test are physics questions on linear motion kinematics material based on scientific literacy by adopting research (Siti Yulianti, 2020). Students' scientific literacy ability can be measured by analyzing the student's ability to each domain(Ani Rusilowati et al., 2016). In this study, the measured domain is the competence domain. The competence domain has indicators including; describe, design and evaluate scientific evidence and research data(OECD, 2015a)

In the data analysis using the percentage of the achievement of physical science literacy skills on each indicator. The category of interpretation of the score data is shown in table 3

Table 3. Category of Score Data Interpretation

Category	interval
Very high	85 - 100
Tall	76 - 85
Currently	60 -75
Low	55 - 59
Very low	<54

RESULTS AND DISCUSSION

This research has been conducted online to students of class X MIPA 1 and X MIPA 2 SMA Negeri 1 Pangkalan Banteng. This research was carried out in June 2021 with the aim of knowing the scientific literacy skills of high school students in straight-motion kinematics material for physics learning during the covid-19 pandemic, totaling 62 students for 2 classes.

This research is included in quantitative descriptive research. Data collection techniques used are interviews and tests. Interviews were conducted with physics teachers regarding the indirect learning process during the Covid-19 pandemic on physics learning. Then the test is carried out through Microsoft Office Forms. The instrument used in the test is 6 essay questions that have been validated by the validator. Below are the results of instrument validation from the validators:

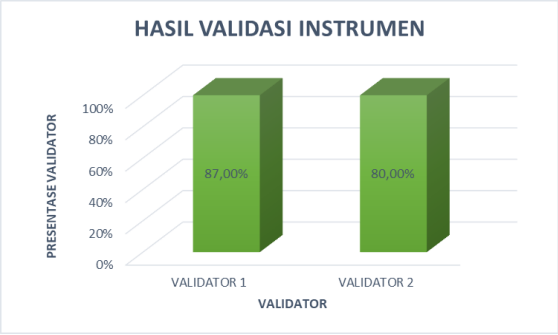


Figure 1. Instrument Validation Results.

Based on Figure 1 the results of instrument validation on validator 1 get a percentage of 87%, while in validator 2 get a percentage of 80% where the results of instrument validation get a valid category.

Based on the results of the data above, the physical literacy abilities of students in class X MIPA 1 and X MIPA 2 SMA Negeri 1 Pangkalan Banteng on the material of Straight Motion Kinematics are shown in the table below:

Table 4. Percentage of Physical Science Literacy Skills for Class X Mathematics and Natural Sciences at SMA Negeri 1 Pangkalan Banteng

No	Competency Indicator	Question Number	Results percentage (%)	Category
1	Explaining phenomena scientifically	1.4	55.50%	Low
2	Evaluating and designing scientific investigations	3.5	60.00%	Currently
3	Interpreting scientific data and evidence	2.6	52.20%	Low
Physical Science Literacy Ability Competency Domain			56.00%	Low

Based on table 4, the percentage level of physical science literacy ability for the entire domain is classified as "Low" with a percentage of 56%. Of the three indicators of evaluating and designing scientific research, the highest percentage is 60% which is included in the "Medium" category. Then the indicator explaining the phenomenon scientifically gets a percentage of 55.50%, namely in the "Low" category. Then the indicator of interpreting data and scientific evidence gets a percentage of 52.20% which is included in the "Low" category.

1. Explaining Phenomena Scientifically

Based on (OECD, 2015a)The indicator of Scientifically Explaining Phenomena has several specific indicators, namely 1) applying and remembering scientific knowledge. 2) identify, use, and produce clear representations. 3) make and justify the right hypothesis. 4) potential involvement of scientific knowledge to society. This indicator is found in numbers 1 and 4.

In number 1, it is hoped that students can provide a hypothesis from the explanation of the GLB event (Organized Straight Motion) on the following questions:

" Terdapat Mobil A dan Mobil B yang sedang bergerak lurus di sepanjang jalan tol, jalan tol tersebut memiliki batas kecepatan maksimum. Suatu saat mobil A dan Mobil B bergerak secara berdampingan (dengan kecepatan yang sama). Kemudian Mobil A bergerak dengan kecepatan yang laju mendahului Mobil B. setelah bergerak laju mendahului Mobil B, Mobil A dianggap melampaui batas maksimum kecepatan yang ada di jalan tol. Tidak disangka di deapan mereka terdapa polisi yang sedang bertugas. Sehingga Mobil A yang melampaui batas maksimum kecepatan terkena Razia polisi tersebut. Jika Mobil B berjalan dengan kecepatan tetap , apakah Mobil B juga melampaui batas kecepatan maksimum pada jalan tol dan terkena Razia dari polisi tersebut? Berikan pendapatmu".

In question number 1, most of the students gave a simple explanation. An example of a simple student answer is shown in the following picture.

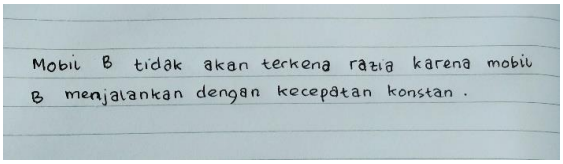


Figure 2. Example of Student Answer No. 1 With a Simple Answer.

Based on the results of student number 1's answer, out of 62 students there were only 7 students who managed to get a score of 7. Students who got a score of 7 were able to provide an appropriate explanation accompanied by supporting facts from the event.

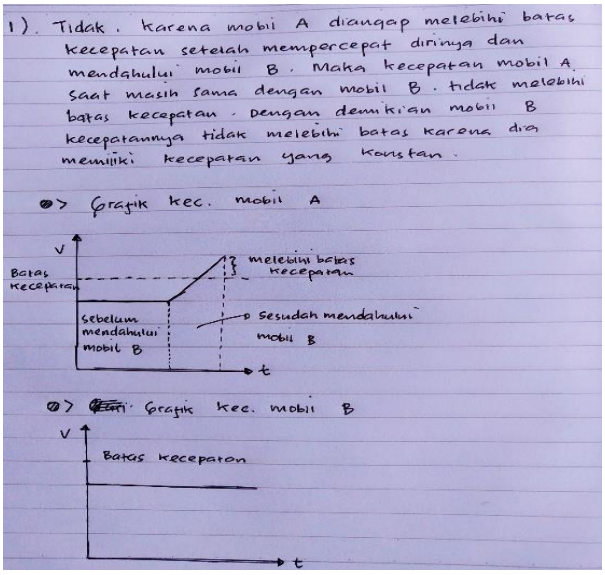


Figure 3. Example of Student Answer No. 1 which is more appropriate.

Then question number 4 is presented with experimental data and students are expected to be able

to provide hypotheses from the data. The data is shown in the image below.

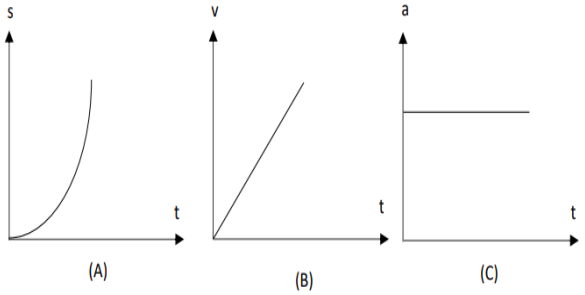


Figure 4. Graph of Problem No. 4.

Based on Figure 4, in the problem there are 3 graphs that illustrate the accelerated GLBB (Regular Changing Motion). Most students answered simply and incorrectly as shown in Figure 5. This can prove that students have not been able to identify, use and produce a clear representation. Students cannot distinguish the graph of s against t, v against t and a against t. As an example of student answers below.

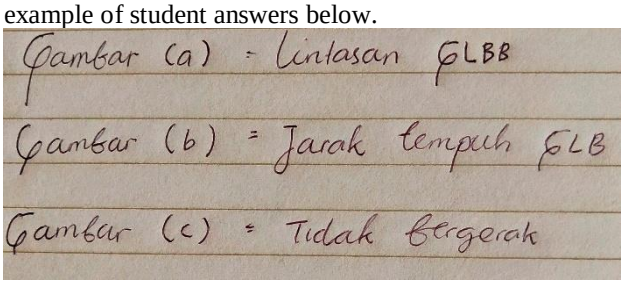
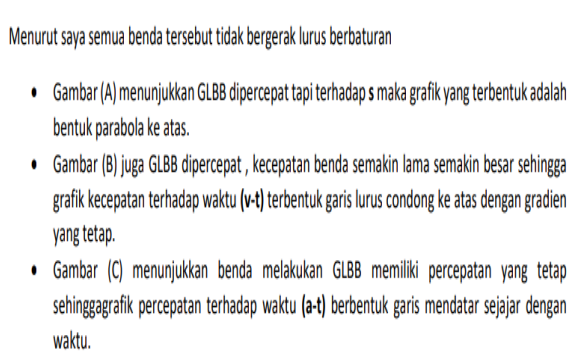


Figure 5. Example of Student Answer Number 4 which is not correct.

Among the 62 students who gave the hypothesis there were only 4 students who answered correctly to the 3 graphs. The following are examples of student answers who answered correctly.


Menurut saya semua benda tersebut tidak bergerak lurus berbaturan

- Gambar (A) menunjukkan GLBB dipercepat tapi terhadap **s** maka grafik yang terbentuk adalah bentuk parabola ke atas.
- Gambar (B) juga GLBB dipercepat , kecepatan benda semakin lama semakin besar sehingga grafik kecepatan terhadap waktu **(v-t)** terbentuk garis lurus condong ke atas dengan gradien yang tetap.
- Gambar (C) menunjukkan benda melakukan GLBB memiliki percepatan yang tetap sehinggagrafik percepatan terhadap waktu **(a-t)** berbentuk garis mendatar sejajar dengan waktu.

Figure 6. Example of Student Answer No. 4 Correct.

2. Evaluating and Designing Scientific Investigations

Based on (OECD, 2015a)in the domain indicator evaluating and designing scientific research has several indicators, namely; 1) Distinguishing questions that can be researched scientifically. 2) Identify the research question in a particular scientific study. 3) Evaluating questions that have been given scientifically. 4) Explain and evaluate what scientists use to ensure correctness and objectivity as well as general explanations. In this indicator there are numbers 3 and 5.

In question number 3, students are expected to be able to evaluate how to investigate the questions given scientifically to the combination of free fall motion and upper vertical motion as shown below.

Figure 7. Hysteria rides

Based on the picture above, most of the students gave a simple explanation regarding the event. the hysteria vehicle to reach the top requires a greater speed than when the hysteria vehicle descends, which is caused by the influence of gravity. Below are examples of student answers who answered simply.

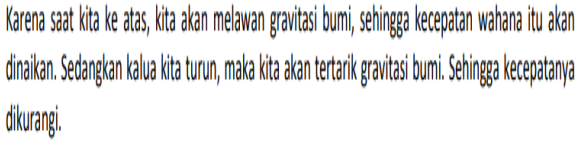

Karena saat kita ke atas, kita akan melawan gravitasi bumi, sehingga kecepatan wahana itu akan dinaikan. Sedangkan kalua kita turun, maka kita akan tertarik gravitasi bumi. Sehingga kecepatanya dikurangi.

Figure 8. Example of Student Answer No. 3 Simple.

Based on question number 3, out of 62 students who answered there were only 12 students who could answer correctly by providing explanations and facts that supported the event. Below is an example of the correct answer.

Karena Ketika wahana dilontarkan ke atas maka melawan gravitasi sehingga kecepatan lebih besar agar wahana dapat bergerak naik. Namun Ketika wahana dilontar ke bawah maka sesuai dengan arah gravitasi sehingga kecepatannya lebih kecil agar wahana tidak turun dengan cepat. Jika saat ke bawah kecepatannya sama dengan ke atas, maka wahana akan turun sangat cepat dan dapat membahayakan penumpang.

Figure 9. Example of Student Answer No. 3 Correct.

Then in question number 5 students are expected to be able to distinguish a question that is possible to be studied scientifically regarding the phenomenon of free fall motion. Problem number 5 shows the phenomenon when a piece of paper and a pencil are dropped at the same time and height, which one will fall to the floor first? Then if the piece of paper is clumped which one will fall first? Explain and why!

Based on question number 5 out of 62 students, most of the students answered that the pencil that would fall first was a pencil. The answer given is correct, but the reason given is incorrect. Below is an example of an incorrect student answer.

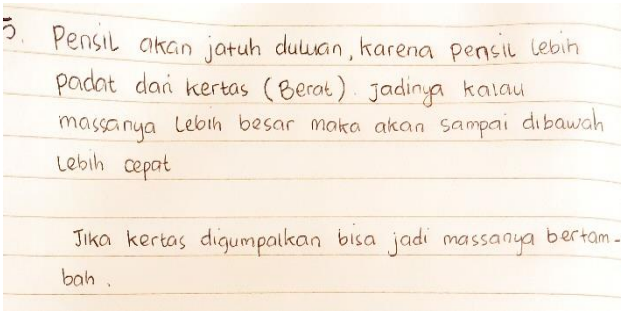


Figure 10. Example of Student Answer No. 5 which is less precise.

In this phenomenon, most students consider the event to be influenced by mass, the mass of a pencil is larger than that of a piece of paper. Meanwhile, in the event of free fall motion is not affected by mass(Firdaus et al., 2019).

In free fall motion, the event is influenced by air resistance. Then when students are given a comparison question, if a piece of paper is clumped which one will fall first? The student still answered the pencil that would fall first. While the correct answer is when a pencil and a piece of paper are clumped together and dropped at the same time and height, the pencil and the clump of paper will fall at the same time. This is because the air resistance that affects the two objects is small, when a sheet of paper is not clumped it is affected by large air resistance. In addition, there is a physical quantity that affects the event of free fall, namely the acceleration of gravity.

3. Interpreting Scientific Data and Evidence

Based on (OECD, 2015a)this indicator has several special indicators, namely; 1) Changing data from one representation to another. 2) Analyze and interpret data and draw appropriate conclusions. 3) Identify evidence and reasoning assumptions in science-related texts. 4) Distinguish an argument based on scientific evidence and one based on a consideration, 5) Evaluate arguments and scientific evidence from various sources. This indicator is found in questions 2 and 6.

In question number 2, students are given two events between the rotation of the earth and a train where students are expected to be able to identify evidence and reasoning assumptions in science-related texts. the earth rotates at a constant rate and we cannot feel the motion. While a moving train is usually exemplified in the GLB, this can mean that the speed of the train is constant, but when we board the train we can still feel that the train is moving. From the statements that have been given, most of the students answered the event because the earth has a much larger size than a train. From these answers indicate that students have not been able to identify evidence assumptions and reason well.

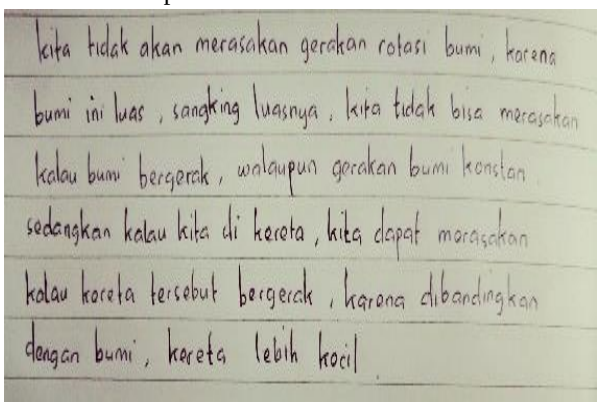


Figure 11. Example of Student Answer No. 2 which is not correct.

Furthermore, in question number 6, students are expected to be able to analyze the data and draw appropriate conclusions about the free fall motion. In question number 6, the event of a parachuting match is presented, in which participants open their parachutes with different heights. If it is associated with a free fall event, which participant will land first? From this incident, several students answered that the participant who would land first was the participant who opened his parachute first (with the highest height of the other participants). Based on these answers, students have not been able to interpret the event to be associated with the concept of free fall motion. Meanwhile, other students were able to answer correctly by answering the

participant who landed first was the participant who opened his parachute last (the participant with the lowest height than the other participants), but these students have not been able to apply the concept of free fall motion. Examples of student answers as shown below.

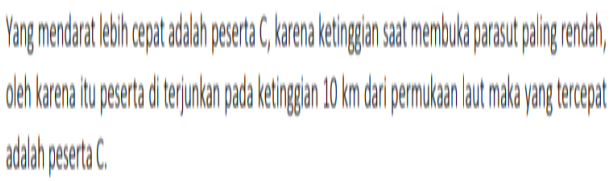


Figure 12. Example of Student Answer No. 6

The correct answer for this event is that when the participant jumps without opening the parachute, the participant is experiencing free fall motion, at that time the speed is very high. However, after the parachute is opened, there is an obstacle from the air that can affect the free fall motion, so that the speed of the parachutist decreases. From this event, it can be concluded that the participant who landed first was the last participant to open his parachute.

Based on the analysis of student answers and the data in table 3. The indicator that has the highest percentage is the indicator of evaluating and designing scientific research. The results of this study are in accordance with research conducted by(Alam et al., 2015). Meanwhile, indicators that have a "Low" category are indicators that explain phenomena scientifically and indicators that interpret scientific data and evidence. The low physical science literacy ability of students on this indicator is influenced by the inability of students to remember and apply scientific knowledge. From the results of this study in accordance with research conducted by(Utama et al., 2019)Furthermore, indicators that have a low category are indicators of interpreting data and scientific evidence. These results are in accordance with research conducted by(Merta et al., 2020). The cause of the low physical science literacy skills of students on indicators of interpreting data and scientific evidence is caused by the inability of students to analyze data to draw conclusions correctly.

Based on the analysis of the explanation, we can know that the scientific literacy ability of students in learning physics is in the "Low" category. The cause of the low literacy skills of physics is that students are still unfamiliar in solving physics problems based on scientific literacy. according to(Irwan, 2020)the ability to work on physics problems affects the level of students' understanding of physical science literacy, besides the lack of guidance in working on the questions also affects this. Meanwhile, according to(A Rusilowati et al., 2017) the lack of activities such as practicum and the low knowledge and technology of students can also affect the low literacy skills of students in physics.

Based on interviews that have been conducted with physics teachers, that at the time of indirect learning during the Covid-19 pandemic, no practicum activities were carried out in physics learning at all. Based on this, the cause of the low ability of physical science is online learning that is not appropriate, therefore it is necessary to redesign the learning process to improve students' physics science literacy.

according to(Yuliati, n.d.)To improve and build scientific literacy, teachers can apply learning that emphasizes students to be active in understanding and applying the concepts that have been studied in accordance with the problems that exist around them. Based on the results of research from(Sulsilah et al., 2019)the scientific approach also affects the improvement of students' scientific literacy skills. Then according to(Rahayuningtyas et al., 2019) in the exploration activities contained in the syntax of the scientific approach, practicum activities can be carried out to increase students' curiosity in increasing understanding of scientific literacy through an experiment.

CONCLUSION

Based on the results of the data analysis, it can be concluded that the scientific literacy ability of high school students during the Covid-19 pandemic is in the "Low" category. The factor causing the low scientific literacy ability of students during the Covid-19 pandemic is that no practical activities have been carried out, especially on the material of straight motion kinematics.So the need for practical activities to increase students' curiosity in increasing understanding of scientific literacy through an experiment, even though learning is done online. In addition, students are not used to working on physics problems based on scientific literacy.

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