

ANALYSIS OF CRITICAL THINKING SKILLS OF JUNIOR HIGH SCHOOL STUDENTS ON VIBRATION AND WAVE MATERIALS

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Abstract. This research aimed to describe the critical thinking skills of junior high school students on vibration and wave materials. The method used in this research was descriptive quantitative. The subjects in this study were 32 students in the eighth grade of junior high school SMP Negeri 2 Purwosari, Indonesia. The sample consisted of 16 male and 16 female students under the purposive sampling technique. The data collection method used an essay question instrument to test critical thinking skills. The essay question instrument consisted of five indicators of critical thinking skills: giving simple explanations, building basic skills, concluding, making further explanations, and setting strategies and tactics. This research concludes that the average percentage of students' critical thinking skills indicators is 59.94%. The percentage results indicate that the critical thinking skills of students of SMP Negeri 2 Purwosari on vibration and wave materials are classified as less, following the benchmark reference assessment criteria. Based on gender, the results of critical thinking skills between female and male students are relatively the same.

Keywords: *Vibration and Waves, Critical Thinking, Science Learning*

INTRODUCTION

Seeing the condition of Indonesian society being hit by the COVID-19 pandemic impacts aspects of life, especially education. The impact of this field of education can be seen directly in the learning process that takes place. The learning process during the pandemic could not be carried out optimally [1]. Obstacles exist in the implementation of learning. For example, teachers have difficulty managing learning and focusing on completing the curriculum. At the same time, most parents of students are unable to accompany their children to study at home because they have to work [2].

To maintain the backwardness and learning gaps, the Ministry of Education and Culture issued an emergency curriculum (under special conditions) for educational units, essentially simplifying the national curriculum [3]. Based on the Joint Decree of 4 ministers on May 11, 2022, the learning process can be carried out face-to-face limited to 100% of students while still complying with health protocols for education units located in the PPKM level 1-2 area.

In the 21st century, knowledge is used as the main foundation of aspects of life, meaning that alternative efforts to meet the needs of life are mostly knowledge-based [4]. 21st-century skills are essential in teaching knowledge and understanding through performance [5]. Learning 21st-century skills is called 4C skills, namely critical thinking, collaboration, communication, and creativity [6]. One of the important 21st-century skills is critical thinking. Critical thinking skills need to be familiarized in learning so students can solve problems [7].

Critical thinking is a student's skill in analyzing and evaluating information so that the information can be used to draw valid conclusions [8]. Another sense

of critical thinking is to think logically and reflectively in determining what needs to be done. Lowering the student's concentration will reduce his enthusiasm for learning. Critical thinking is an important educational goal, so an understanding of the basic principles and criteria of critical thinking [9]. There are five indicators of critical thinking, including providing simple explanations, building basic skills, drawing conclusions, making further explanations, and arranging strategies and tactics [10]. In science learning, students with critical thinking skills can make careful considerations when deciding to accept or reject a statement [11].

A person needs critical thinking skills to be able to face problems in social and personal life. Based on research that has been carried out, the critical thinking skills of junior high school students are still low. Students' low critical thinking skills because students are not yet accustomed to active learning maximizes the potential of thinking [12]. In addition, the contributing factor to students' low thinking skills is that students rarely get questions to improve their critical thinking skills [13]. From the results of interviews with science teachers at SMP Negeri 2 Purwosari, students' critical thinking skills are considered very important. The learning carried out currently has carried out limited face-to-face learning for 100% of students while still complying with health protocols. The amount of learning time in each learning hour was reduced from the original 40 minutes to 30 minutes. It makes the learning carried out less than optimal.

Science learning in schools aims to provide students with understanding to overcome problems encountered in everyday life so that they

can be solved easily [14]. Science learning refers to building science students' character so they can solve problems [15]. Critical thinking skills are important in science learning to train students to solve problems and foster reasoning skills and objective thinking [16]. Selecting the appropriate material to practice critical thinking skills in science learning is necessary. Vibration and wave materials are very suitable because vibration and wave materials require students to think critically. One of the science materials related to reasoning is vibration and wave material because, in this material, students are required to connect between equations and concepts in everyday life [17]. For this reason, this study uses vibrational matter and waves [18].

In this study, researchers analyzed the critical thinking skills of junior high school students on vibration and wave material. Based on the explanation above, researchers are interested in conducting research with the title Analysis of Students' Critical Thinking Skills on Vibrational And Wave Material.

RESEARCH METHODS

This research was carried out at junior high school SMP Negeri 2 Purwosari in the even semester of the 2021/2022 academic year. This type of research is descriptive with a quantitative approach. Quantitative descriptive research serves to see, review, and describe hammering numbers and draw conclusions about them according to the phenomena that occur [19]. This method is appropriate to describe the critical thinking skills of junior high school students on vibration and wave material. The subjects in the study were class VIIIA students of SMP Negeri 2 Purwosari, as many as 32 students consisting of 16 female and 16 male students. The technique used in sampling is purposive sampling to determine classes by paying attention to the heterogeneous skills of students in one class and the consideration of science teachers.

Procedure

The data is in the form of the results of the student's critical thinking skills test, then analyzed based on the student's critical thinking skills indicators. The instruments used are adapted from [20]. The test results are then analyzed descriptively based on the results of the achievements of each indicator using the following formula:

$$\% \text{ Indicators} = \frac{\sum \text{Score Generation}}{\sum \text{Maximum Score}} \times 100\%$$

Instruments

The instruments in this study are: 1) Interview sheets to find student responses regarding critical thinking skills. 2) students' critical thinking skills question sheets are used for data collection. This question sheet answers ten essay questions that follow critical thinking indicators, namely providing simple

explanations, building basic skills, concluding, making further explanations, and arranging strategies and tactics [10].

Data Analysis

The results of the data analysis from the student's critical thinking skills test sheet were recapitulated using a benchmark reference assessment. Scores obtained from the results of the recap of the observation sheet into the critical thinking criteria, namely, students who get a score of 90-100 are categorized into the excellent category. Students who score 80-89 are categorized in the good category. Students who get a 60-79 are categorized into enough categories. Students who score 50-59 are categorized into the less category. Students with a score of less than 50 are categorized into the category of very less [21]. If the student's score is known, then the researcher analyzes the critical thinking skills possessed by the student.

RESULTS AND DISCUSSION

This study was conducted to describe the critical thinking skills of junior high school students on vibration and wave material. The critical thinking skills of junior high school students on vibration and wave materials can be seen based on the results of the critical thinking skills test sheet. Based on the results of the critical thinking skills question sheet, data on the percentage of students' critical thinking skills in each aspect of the indicators were obtained as in Table 1.

Table 1. Results of Students' Critical Thinking Skills on Each Aspect of the Indicators

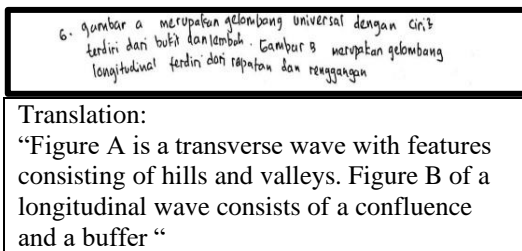
Critical Thinking Skills Indicators	Average	Criteria
Providing a Simple Explanation	66.41%	Enough
Building Basic Skills	57.81%	Less
Drawing Conclusions	57.03%	Less
Make A Further Explanation	58.59%	Less
Set Up Strategies And Tactics	59.38%	Less

Table 1 shows that the average percentage in the aspect of providing simple explanations of 66.41% classified as enough categories, aspects of building basic skills of 57.81% classified as fewer categories, aspects of drawing conclusions of 57.03% classified in the less category, aspects of making further explanations of 58.59% classified in the less category, and in the aspect of managing strategies and tactics as much as 59.38% classified as less. The details of students' critical thinking

skills for each aspect of the indicator can be seen based on the details and exposure as follows:

1. Provide a Simple Explanation

In the critical thinking skills indicator with the aspect of providing simple explanations, the results this indicator obtained the average student's skill in providing simple explanations was 66.41% which was classified as sufficient. Students can provide simple explanations, namely focusing on questions, analyzing arguments, and choosing relevant information. One of the essay test questions related to indicators provides this simple explanation, namely that two waves are provided, and students are expected to be able to distinguish between the characteristics of transversal waves and longitudinal waves. Overall, students are quite capable of distinguishing wave characteristics as expected. The following documentation of the results of the work of students of the good category on the indicator gives a simple explanation.



Translation:
 "Figure A is a transverse wave with features consisting of hills and valleys. Figure B of a longitudinal wave consists of a confluence and a buffer "

Figure 1. The results of the work of students of the category on the indicators give a simple explanation.

It can be seen that students in the high category have been able to write facts based on analysis that has been done appropriately. Students who fall into the less category can focus less on the questions and analyze them appropriately. Students can focus on the questions because students understand the discourse provided [22].

2. Building Basic Skills

In the critical thinking skills indicator with the aspect of building basic skills, the results obtained in this indicator, the average student's skills in building basic skills were 57.81% which is classified as a low category. Essay test questions related to this basic skill-building indicator are based on events that have been illustrated. Students are expected to be able to determine the frequency of vibrations in these events. From the research results, most students were less able to determine the frequency of vibrations in the question. It is because students' basic skills in calculating frequencies are lacking. Based on interviews with teachers, students' skills in understanding concepts are severely lacking. It

is because students, for approximately two years, carry out online learning. It is indirectly the impact of learning that used to be carried

$$F_A = \frac{n}{t} = \frac{5}{4} = 1,25 \text{ Hz}$$

$$F_B = \frac{n}{t} = \frac{5}{6} = 0,8 \text{ Hz}$$

out online [23]. It can be seen that the results of the work of the students of the category lack the indicators of building basic skills.

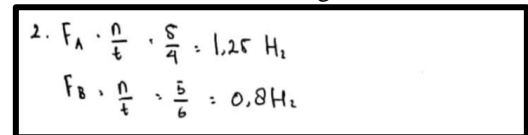
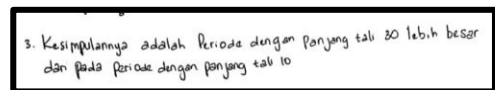


Figure 2. The results of the work of students category are less on the indicators of building basic skills

The results of student work with fewer categories only write down how to do it. Based on interviews with students with fewer categories, they do not understand the concept of vibration. Lack of mastery of concepts can hinder students' critical thinking. The results of women's critical thinking skills are better than men's [24]. Understanding a problem can affect theoretical knowledge and decision-making [25].

3. Drawing Conclusions

In the critical thinking skills indicator with the aspect of concluding, the results obtained in this indicator, the average student's skill in concluding was 57.03% which was classified as less. In this indicator, students are asked to analyze and make conclusions based on the provided practicum results table. From the research data obtained, most students are unable to make conclusions from the tables that have been provided. It can be seen that the results of the work students are lacking in the indicators of drawing the following conclusions.



Translation:
 The conclusion is that the period with a rope length of 30 is greater than the period with a rope length of 10.

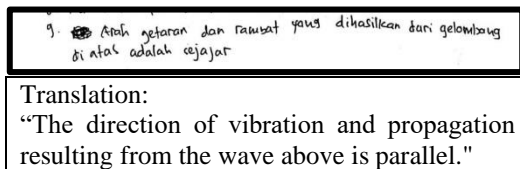
Figure 3. The results of the work of students category less on the indicators draw conclusions

The results of student work show that students do not understand the content of the table provided, so students have difficulty in making conclusions. Students' lack of

knowledge also makes the sentences made by students also not good. The low level of student analysis makes it difficult for students to make conclusions and prepare sentences [26]. Critical thinking skills can be trained through a learning process that invites students to make conclusions about concepts and skills in overcoming a problem [27].

4. Make A Further Explanation

In the indicators of critical thinking skills with aspects of making further explanations, the results obtained this indicator, the average skill of students in making further explanations was 58.59% which was classified as less. Students make advanced explanations of known phenomena in this indicator and develop their thinking skills. The problem related to this indicator is that students are expected to be able to analyze a wave and provide a more detailed explanation of the wave. The results of the work of students of the good category on the indicators explain further.



Translation:
 "The direction of vibration and propagation resulting from the wave above is parallel."

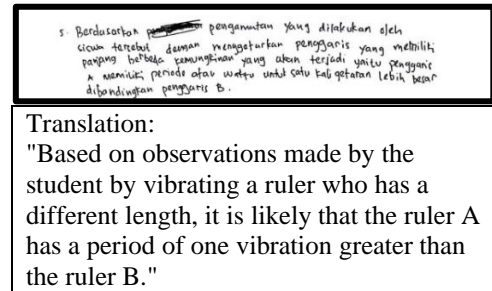
Figure 4. The results of the work of the student's category are good at making further explanations

Based on the results, in this case, students still lack in describing or providing more complex explanations related to existing phenomena. The lack of student skills in this indicator can be caused by students not mastering existing concepts to influence students' thinking. A person who cannot master the concept and lacks knowledge can then postpone his skills in critical thinking—one of the actions to improve students' thinking power through questions. Appropriate techniques for questioning between teachers and students can improve communication and provide interesting and meaningful learning [28]. The ability to think critically will develop well if students have deep, correct, and clear concepts [29].

5. Set Up Strategies And Tactics

In the fifth critical thinking skills indicator with aspects of regulating strategy and tactics, the results obtained in this indicator the average student's skill in managing strategies and tactics was 59.38%. In this indicator, students are expected to be able to make decisions to set strategies and tactics related to the phenomenon that will occur based on existing illustrations. The problem related to this indicator is that students are given problems and are expected to determine

the solution to existing problems. The results of student work with good categories on the indicators set strategies and tactics as follows.



Translation:
 "Based on observations made by the student by vibrating a ruler who has a different length, it is likely that the ruler A has a period of one vibration greater than the ruler B."

Figure 5. The results of the work of the student's category are good at making further explanations

In this case, students are not good at solving existing problems. The lack of students in terms of organizing and strategies and tactics can be caused because students are less able to concentrate, so they cannot give appropriate answers. Prameswari [30] argues that student education influences their critical thinking skills. If the student is in poor condition, the student's concentration and enthusiasm for learning will decrease.

The results of students' critical thinking skills obtained from the analysis of critical thinking skills indicators can be seen in Table 2.

Table 2. Results of Students' Critical Thinking Skills

No.	Criteria Assessment	Number of Students	Persentase
1	90-100 Excellent	0	0.00%
2	80-89 Good	4	12.50%
3	60-79 Enough	16	50.00%
4	50-59 Less	10	31.25%
5	≤50 Very Less	2	6.25%

Based on table 2. as a result, the critical thinking skills of students of SMP Negeri 2 Purwosari are classified as lacking. It is evidenced by the sample's average percentage of critical thinking skills of only 59.94%. Most students' critical thinking skills fall into the category of moderate. It is by Karim's research [31] states that the critical thinking skills of junior high school students are still low or undeveloped. Based on interviews with science teachers, the factor causing students' low critical thinking skills is that students rarely receive questions that hone their critical thinking skills. Therefore, students critical thinking skills at SMP Negeri 2 Purwosari are relatively low. Critical thinking skills require

practice questions to have them [12]. Critical thinking skills must be trained for students because by thinking critically, students can analyze problems to make choices and make smart conclusions. If students are trained to use thinking at a higher level, then students will get used to distinguish between knowledge and beliefs. One way to practice critical thinking skills is through learning. We must think more critically and evaluate problems using or adapting that knowledge and skills [32].

Critical thinking skills are very important in the learning process because students are appropriately trained in decision-making and different perspectives [13]. Based on interviews with teachers, the learning was less effective because the lesson time in each class was reduced due to limited face-to-face learning. It has a direct impact on students' critical thinking skills. Good learning should be learning that can encourage children to be creative, make students active in learning, achieve learning goals effectively, and walk in pleasant conditions. In this case, the right learning model needs to be selected to adjust to school conditions [33]. Teacher-led learning can shape students' critical thinking skills. Teacher-led learning can shape students' critical thinking skills. The selection of learning models and methods according to the conditions at school can maximize the skills that exist in students. It will improve students' critical thinking skills [12].

Results Students' critical thinking skills viewed by gender can be seen in Table 3. and Figure 6.

Table 3. Results of students' critical thinking skills based on gender

No.	Criteria Assessment	Number of Students		
		Female	Male	
1	90-100	Excellent	0	0
2	80-89	Good	3	1
3	60-79	Enough	8	8
4	50-59	Less	2	7
5	<50	Very Less	1	0
Rata-Rata Nilai			61.25	58.44

Table 3 shows that the results of critical thinking skills based on gender in each indicator in class VIII-A with a comparison of the number of male students, as many as 16 people, and women, as many as 16 people resulted in average critical thinking skills of female students of 61.25. The average score of thinking skills of male students was lower than that of female students at 58.44. The readiness of the students can influence differences in grade achievement. Based on the interviews with students, female students are superior in motivation and organization in learning. Women are better at identifying problems, providing reasons and opinions, providing statements and questions, explaining concepts, and making conclusions [34]. Results Students' critical thinking skills based on gender in each indicator can be seen in Figure 6.

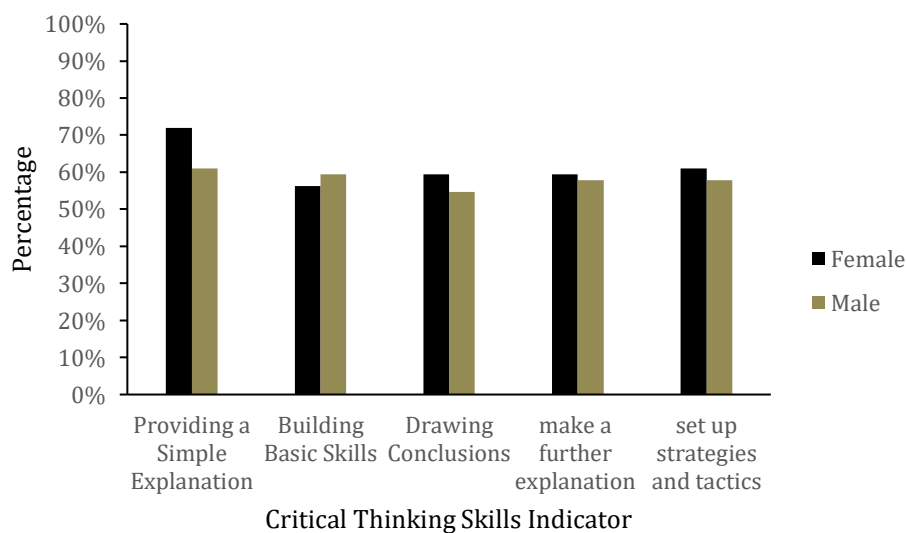


Figure 6. Diagram of critical thinking skills based on the gender of each indicator.

Analysis of students' critical thinking skills in each indicator is found in Figure 6. Critical thinking skills based on gender in each indicator in this study show that the critical thinking skills of female and male students are relatively the same. The indicator provides a simple explanation of the critical thinking skills of female students, which is 71.88%. For male

students, the critical thinking skills possessed in the indicators provide a simple explanation of 60.94%. It shows that almost all students can provide simple explanations regarding what is asked in the questions. Male and female students can show indicators of critical thinking by giving simple explanations [35]. On the indicator of building basic

skills, male students have critical thinking skills 59.38%. For women, the critical thinking skills possessed in this indicator are less than for male students, which is 56.25%. Based on the interview results, male students have difficulty constructing sentences and are more proficient in calculation and logic. Men are weak in language but excel in logic, science, and mathematics [25]. The cognitive abilities of men are better than those of [35]. In the indicators concluding, the critical thinking skills of female students amounted to 59.38%, and the thinking skills of male students to 54.69%. It shows that female students are better at concluding male students. It is supported by interviews with male students who state that they have difficulty expressing their opinions. Women are better able to express opinions to other people. Women are also superior to men in making conclusions [35]. Women can identify problems well, so it is easier to make conclusions [34]. In the indicators, the critical thinking skills of female students tend to be superior to male students, namely 59.38%, while male students are 57.81%. It is reinforced by interviews with male students who stated that they only briefly wrote down their opinions because the ability to process words was still lacking.

Usually, men only tend to write down things they consider important briefly because they don't like writing activities [36]. Male students tend to be better able to express reasons or supporters of the answers than female students. Women excel in the ability to induce and deduct, namely the ability to think logically [37]. In terms of setting strategies and tactics, the critical thinking ability of female students on this indicator amounted to 60.94%. The critical thinking skills of male students on this indicator amounted to 57.81%. It shows that women's critical thinking skills are superior to male students' critical thinking skills in managing strategies and tactics. The interview results show that female students can identify the problem well so they can make the right conclusions to solve the problem. Women are considered superior in identifying problems, providing statements, and being able to make conclusions [34].

CONCLUSION

Critical thinking skills are logical and reflective thinking skills in determining what needs to be done. The study was conducted using an essay test sheet with five indicators of students' critical thinking skills. Based on the results and discussion of research that has been carried out, the critical thinking skills possessed by class VIII-A students of SMP Negeri 2 Purwosari through a test sheet of 59.94%. This research proves that the critical thinking skills of junior high school students on vibration and wave materials are included in the category of not by the benchmark value of students' critical thinking skills. Reviewed by gender, the

critical thinking skills of male and female students are relatively the same. It is evidenced by the average value of students' critical thinking skills in each gender is not much different.

The advice that can be given is that there is a need for practice questions about deeper thinking to improve students' critical thinking skills, where limited face-to-face learning results in a lack of an optimal learning process. It impacts student collaboration skills, and research can be used as a reference for further research.

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