

An Analysis of Critical Thinking Skills of Palembang City Junior High Schools Students in Science Material

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ABSTRACT

The aim of this study was to determine the Critical Thinking Skills of class IX Junior High School students in Palembang on science learning. The method used in this research was descriptive analysis. The instrument used was in the form of 20 questions of critical thinking skills on the material of motion and force as well as vibration and waves. Based on the analysis of the test results of Critical Thinking Skills, it was known that the critical thinking skills of students on vibration and wave material were still low, especially in the indicators of Critical Thinking Skills on strategies and tactics (43.2%). Critical Thinking Skills on the material of motion and Force were still low, especially on the Critical Thinking Skills indicator in making further explanations (31.2%). Based on the results of the analysis, it can be concluded that the students Critical Thinking Skills in the material of motion and force as well as vibration and wave are still low so that an effort is needed to develop students' Critical Thinking Skills in science material in school learning.

Keywords: An analysis, Critical thinking skills, Junior high school, Science material.

1. INTRODUCTION

The development of Critical Thinking Skills has become a major challenge in the 21st century. Critical Thinking Skills are reflective and reasoned thinking skills that are focused on making decisions to solve problems [1]. According to [2][3][4][5] Critical Thinking Skill is a very important ability for every individual in the 21st century. According to [6][7][8] [9] critical thinking skills have an important role to ensure successful learning. According to [10][11][12] critical thinking skills are important skills and have a major influence on learning and career.

In the revised Bloom's taxonomy, there are three indicators that can describe the level of critical thinking skills of students, they are analyzing, evaluating, and creating [13]. Meanwhile, according to [14] there are five indicators of critical thinking skills, they are elementary clarification, basic support, inference, advanced clarification, and strategies and tactics.

Critical Thinking Skills according to [15][16] and [17] can be developed through science learning. However, in reality Critical Thinking Skills have not been maximally developed by educators [18]. This can

be seen from the low average score of science in the results of the National Examination in 2019, which was 48.08 nationally and 46.74 at the Palembang city level [19]. Therefore, the Critical Thinking Skills of students still need improvement, especially in science learning in schools. This study aimed to determine the Critical Thinking Skills of Junior High School students in Palembang on the material of motion and vibration and waves. Based on data from Puspandik for motion material only 46,74% of student answered correctly. While in the material of vibration and wave only 33,61% of students answered correctly.

2. METHOD

This research is a quantitative study which used a multiple-choice written test instrument to determine the Critical Thinking Skills of students in the city of Palembang in science subject. Critical Thinking Skills test was made in the form of google form with a total of 20 multiple choice questions. Respondents in this study were 205 grade IX students in the 2020/2021 academic year of 7 schools. The Critical Thinking Skills indicator consists of five indicators proposed by Ennis. While the science materials being tested were motion and force as

well as vibration and waves. Students' answers were analyzed based on five indicators of critical thinking skills according to Ennis.

3. RESULT AND DISCUSSION

3.1. Vibration And Waves

In the material of vibration and waves, students' critical thinking skills on each indicator of critical thinking skills are shown in table 1.

Table 1. Students' Critical Thinking Skills on Vibration and Wave material

No	Critical Thinking Skills Indicator	Percentage
1	Elementary Clarification	62,90%
2	Basic Support	52,95%
3	Inference	47,80%
4	Advance Clarification	54,40%
5	Strategies and Tactics	43,20%

In each indicator of Critical Thinking Skills, students were given two questions related to vibration and wave material. In the first critical Thinking Skills Indicator, namely providing a simple explanation (elementary clarification), students were given two questions about the characteristics of a sound and the strength and weakness of a sound. Critical thinking skills test questions for students are shown in Figure 1.

5. Berikut ini pernyataan yang benar tentang gelombang bunyi adalah...
<input type="radio"/> gelombang bunyi disebabkan oleh benda yang bergetar <input type="radio"/> gelombang bunyi dapat merambat melalui ruang hampa <input type="radio"/> gelombang bunyi diudara adalah gelombang transversal <input type="radio"/> gelombang bunyi merambatkan partikel-partikel udara ke suatu tempat
9. Gerakan orang yang kaget karena tiba-tiba mendengar dentuman yang sangat keras merupakan gerak refleks, karena orang tersebut mendengar bunyi dengan.... yang besar
<input type="radio"/> intensitas <input type="radio"/> frekuensi <input type="radio"/> periode <input type="radio"/> panjang gelombang

Figure 1. Questions on the Indicator of Elementary Clarification.

In question number 5, students were asked to clarify the correct statements in the choices provided. To answer this question, students must understand the nature and characteristics of sound. Based on the results of the analysis of the students' answers, as many as 50.7% of students answered correctly, namely sound waves were caused by vibrating objects. Meanwhile, 22% answered that sound waves propagate air particles to a place. In question number 9, students were asked to clarify the cause of reflex motion due to a very loud bang. Based on the analysis of students' answers, it was

known that 75.1% of students answered correctly, namely intensity. Meanwhile, 18.5% of students stated that the sound strength was influenced by frequency. In fact, frequency affects the sound level. Based on the analysis of these two questions, it was known that 62.90% of students can apply critical thinking skills on the indicator of providing simple explanation (elementary clarification).

An indicator of critical thinking skills on building basic skills (basic support) was analyzed by asking two questions about four objects (P, Q, R, S) that vibrate with a certain period, and determine the time interval between visible lightning and the sound of lightning. Firstly, students were asked to compare the frequencies of four objects based on the period of the objects. In solving this problem, students need to know the relationship between period and frequency. Students must calculate the frequency of each object then make a comparison of each object. Students who were able to answer correctly on this question were only 45.4%, namely P:Q = 4:5. A total of 24.4% of students answered Q:R = 40:25. Students did not divide to get comparative numbers in accordance with mathematical rules. Whereas in the sixth question, students were asked to determine the time interval between when lightning was seen and the sound of lightning. As many as 60.5% of students answered correctly that the time interval between lightning and lightning was 4 seconds. To solve this problem, students must understand the relationship between distance, speed and time. In this question, 39.5% of students did not answer correctly. Based on the analysis of students' answers, it is known that there are 52.95% of students who have critical thinking skills on indicators of building basic skills (basic support).

In the indicator of critical thinking skills in concluding (inference) students were given two questions about four springs that vibrate for a certain time and determine how the bell in the hood will sound if the air in the hood is released. In the first question, students were asked to determine the same period of four springs that experience vibrations within a certain time. To answer this question, students need to understand the meaning of period and the relationship between the number of vibrations and time. To calculate the period of vibration, the using formula:

$$T = \frac{t}{n} \quad (1)$$

Based on the results of the analysis of students' answers, it was known that only 33.2% of students answered correctly, they were on spring I and III. This showed that students have not been able to makes conclusions from the results of the data analysis presented in this questions. In the second questions, students were asked to conclude the sound of the bell in

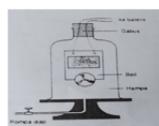
the hood If then the air in the lid was released until it ran out. As many as 62.4% of students answered correctly, namely the sound cannot propagate in a vacuum. This showed that students have been able to provide conclusions about the properties of sound from a sound phenomenon. Based on the results of the analysis of students' answers to the two questions, it was known that the critical thinking skills of students on the indicator of *inference* were still low, which was only 47.8%. The critical thinking skills test questions of inference are shown in Figure 2.

2. Perhatikan tabel berikut. Pegas yang memiliki periode yang sama ditunjukkan oleh nomor....

Pegas	Jumlah gelaran	Waktu (detik)
I	12	6
II	6	12
III	14	7
IV	20	5

- I dan II
- I dan III
- II dan IV
- III dan IV

10. Pada gambar di bawah ini dilukiskan sebuah bel listrik yang berada dalam sebuah sangkup yang tertutup. Kemudian bel dibungkus dan udara dalam sangkup dikeluaran. Setelah udara dari sangkup habis dikeluaran, bunyi bel listrik tidak terdengar lagi. Berdasarkan peristiwa itu dapat disimpulkan bahwa bunyi....



- tidak terjadi dalam ruang tertutup
- terbawa oleh udara keluar sangkup
- tidak dapat merambat dalam ruang hampa udara
- tidak dapat merambat melalui zat padat

Figure 2. Questions of Critical Thinking Skills on the Indicator of Inference.

On the indicators of critical thinking skills to make further explanations (*Advanced clarification*), students were asked to determine the speed of the wave propagation through the two corks moving up and down over the surface of the pool water and analyzing the type of sound if it is known that the sound propagation speed and its wavelength are known. There were two questions on the critical thinking skills indicator of *advanced clarification*. In the first question, students were asked to determine the speed of the wave surface of the pool through the events of two corks floating above the pool. To answer this question, students must understand very well about transverse waves and their characteristics. As many as 51.4% of students could answer correctly, namely 80 cm/s. This shows that students are able to identify and analyze questions well. Whereas in the second question students were asked to identify the type of sound based on its speed and wavelength. To answer this question correctly, students must first calculate the frequency of the wave and then identify the type of sound based on the frequency that has been obtained. By using the formula:

$$f = \frac{v}{\lambda} \quad (2)$$

the value of $f = 170,000$ Hz will be obtained. This means that the sound includes ultrasonic sounds that cannot be heard by human. From the results of the analysis of the students' answers, it was known that 50.7% of students answered correctly, namely the sound could not be heard because the sound was ultrasonic (the frequency was more than 20,000 Hz). Based on the results of the analysis of students' answers to these two questions, it is known that the critical thinking skills of students are still low, which was 54.40% on the indicators of making further explanations (*Advance clarification*).

In the indicators of *strategies and tactics* critical thinking skills, students were given two questions about transverse waves and sound utilization. In the first question students were asked to observe a transverse wave image and determine the amplitude, period, frequency, and speed of propagation of the waves. To correctly answer this question, students must understand the characteristics of the transverse wave well so that they can analyze the transverse wave image. Students who can answer correctly were only 29.80%. This shows that students have not been maximally able to apply Critical Thinking Skills on the indicator of *strategy and tactics*. Thus, it really needs to be trained and taught to students. According to [20] Critical Thinking Skills can be improved through interesting learning. In the second questions, students were asked to observe a Picture of the measurement of the seabed by utilizing the reflection of sound waves and determining the differences in ocean depth from two different position. To answer this questions correctly, students must first understand the use of sound reflection properly. Students must calculate the depth of the first position then calculate the depth in the second position using the formula:

$$s = \frac{vxt}{2} \quad (3)$$

On this question 50.70% of students answered correctly. Based on the results of the analysis of students' answers to the two questions, it is known that the critical thinking skills of students on the indicators of *strategy and tactics* are still low, i.e. 43.20%.

3.2. Motion And Force

The indicators of students critical thinking skills on the material of motion and force are shown in table 2. On the indicator of critical thinking skills in providing a simple explanation (*elementary clarification*), students were given two questions. On the first question, students were asked to determine the example of slowed down glbb (accelerated linear motion) and accelerated glbb that has been provided. In this question, students who answered correctly were only 27.8%. In order to answer this question, students must have a good understanding

about accelerated linear motion. Students still cannot distinguish slowed and accelerated glbb. In the second question, students were asked to observe the motion graph of an object and then determine the speed of the car. Based on the analysis of students' answers, it is known that 54.1% of students can answer correctly. Thus the critical thinking skills of students on indicators of providing simple explanations are still low, i.e. 40.95%.

Table 2. Students' Critical Thinking Skills on Motion and Force Material

No	Critical Thinking Skills on Motion and Force Material	Percentage
1	Elementary Clarification	40,95%
2	Basic Support	36,35%
3	Inference	42,20%
4	Advanced Clarification	31,20%
5	Strategies and Tactics	53,80%

On the indicator of critical thinking skills in building basic skills (*basic support*) students were given two questions about the motion of two moving objects in graphic form. Students were asked to determine the type of motion based on the graphic. As many as 37.10% of students can answer correctly. To answer this question, students must firstly understand the relationship between speed and time. In the second question, students were asked to analyze the motion of flying geckos. Students must analyze the motion of the flying bird and relate it to the concept of newton's third law. Based on the results of the analysis of students' answers, as many as 35.60% of students could answer correctly that the magnitude of the action and reaction forces between birds and air were the same but in opposite directions. Based on the results of the analysis on these two questions, students' critical thinking skills on the indicators of building basic skills were still low, i.e. 36.35%.

Students' Critical Thinking Skills on the indicator of *inference* were analyzed by giving two questions to students. On the first question, the students observed the oil drop pattern image then determined the type of motion that occurred. As many as 51.20% of students can answer correctly. To answer this question, students must firstly understand the types of motion of objects. In the second question, students were asked to analyze the events of moving objects and then stop. Students were asked to relate these events to Newton's laws. To answer this question, students must understand Newton's laws and their applications in everyday life. Students who answered correctly were only 33.20%. This shows that students have not been able to understand the examples and applications of Newton's laws in everyday life. Based on the results of the analysis of students' answers to these two questions, it

was known that the critical thinking skills of students on the indicator of *inference* were still low, i.e. 42.20%.

Students' Critical thinking skills on the indicator of making further explanations (*advanced clarification*) were still low, i.e. 31.20%. To find out critical thinking skills on this indicator, students were given two questions about Newton's I and II laws. In the first question, students were asked to observe a picture of 2 blocks on a smooth and rough surface. Students are asked to determine the ratio of forces that occur on the two surfaces. There were only 28.30% of students who can answer correctly. This shows that students do not understand well the concept of force on smooth and rough surfaces. Whereas in the second question, students were asked to predict the results of Newton's first law experiment by placing a glass on paper and then pulling it quickly. As many as 34.10% of students answered correctly. This shows that the critical thinking skills of students in Newton's law are still low. Based on the results of the analysis of students' answers to these two questions, it is known that the critical thinking skills of students on the indicator of making further explanations (*advanced clarification*) are still low, i.e. 31.2%. Questions to measure critical thinking skills on the indicator of *advanced clarification* are shown in Figure 3.

16. Perhatikan gambar berikut. Sebuah benda mempunyai bentuk, ukuran, dan massa yang sama. Jika permukaan pada gambar atas licin sedangkan pada gambar paling bawah kasar, maka perbandingan gaya yang dibutuhkan keduanya adalah....



- F1 < F2
- F1 > F2
- F1 = F2
- tidak bisa diprediksi

17. Sebuah gelas diletakkan diatas sebuah kertas HVS. Jika kemudian kertas ditarik dengan cepat pernyataan berikut yang benar adalah....

- gelas akan tetap berdiri karena mempertahankan kelembamannya
- gelas akan tetap berdiri karena memberikan gaya aksi yang sama dengan gaya yang diterima
- gelas akan robuh karena mengalami perubahan kelembaman
- gelas akan robuh karena mendapat gaya aksi dengan cepat

Figure 3. Questions of Critical Thinking Skills on the Indicator of Advanced Clarification.

On *strategies and tactics* indicator, students were asked two questions about acceleration and force on an object. In the first question, students were asked to analyze the acceleration of a car that was initially stationary and then began to move. To correctly answer this question, students must understand the concept of object motion well. The results of the analysis of students' answers showed that as many as 50.5% of students could answer correctly. Whereas in the second question, students were asked to observe force images on objects. Then the students determine one of the

forces on the object. To correctly answer this question, students must master the concept of addition and subtraction. Based on the results of the analysis of students' answers, it is known that 57.10% of students can answer correctly. This shows that the critical thinking skills of students on the indicator of *strategy and tactics* are still insufficient. Based on the analysis of the two questions, it is known that the critical thinking skills of students on the indicator of *strategy and tactics* are 53.8%.

4. CONCLUSION

Based on the results of the analysis in the discussion, it can be concluded that the critical thinking skills of students in the material of vibration and waves as well as motion and force are still low. In the material of vibration and waves, the lowest critical thinking skills of students were found in the *strategy and tactics* indicator, i.e., 43.20%. Meanwhile, the highest critical thinking skills of students were found in the Basic clarification indicator, which was 62.90%. In the material of motion and style, the lowest critical thinking skills of students were found in the indicator of making further explanations (*Advanced clarification*), i.e., 31.2%. Meanwhile, the highest critical thinking skills of students were found in the *strategy and tactics* indicator, i.e., 53.80%. Therefore, it really needs efforts or solutions to overcome these problems so that students' critical thinking skills in science material can be developed through the learning process at school.

ACKNOWLEDGMENTS

This research was funded by PNBP of Sriwijaya University in 2020 on Competitive Superior Grants.

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