

# Misconception Analisis of Junior High School Student in Lareh Sago Halaban Distrit on Vibration, Wave and Sound Materials Using the Four Tier Test Instrument

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**Abstract:** The purpose to analyse the student's misconception profile and determine the percentage of misconceptions of class VIII students on vibration, wave, and sound material. The research subjects 78 students in two accereditated A secondary schools during the full 2023-2024 semester. The research method is descriptive quantitative. Data collection method using a diagnostic test with a four tier test of 21 questions developed by Merry Christiani and Vindy Utami Karomah was the modified by researchers with reliability of 0,86 (very high). The four tier test instrument consists of four levels. At the first level, there are multiple choice questions with four answer choices. The second level includes students' confidence in answering the first level questions. The third level is related to the reasons behind the answers students choose at the first level. Finally, the fourth level includes students' beliefs regarding the reasons for the answers at the third level. The results of the research show that the profile of students' misconceptions is on the indicators of the concept of vibration, the concept of amplitude and deviation, the concept of period, the concept of vibration frequency, the relationship between frequency and period, the basic concept of waves, the concept of sound and frequency, the sound propagation medium and the relationship between periods, frequency and wavelength. speed, is in the medium category while the creepage concept indicator is high. The conclusion of the research results is that the misconception of junior high school students in Lareh Sago Halaban District regarding vibration, wave and sound material using the Four Tier Test instrument is 55% in the medium category

**Keywords:** Four tier test; Misconception; Sound; Vibration; Wave

## Introduction

Education is an effort to enhance the ability of students through guidance, learning, and training activities (Mu'arikha et al., 2021). Education is not just a process of exchange of information but education also includes student understanding of the concepts taught, because concepts can shape student thinking (Hairy et al., 2018). Student thinking must be equipped with maximum competence so that students can compete well in the world of education. Competence is grounded by knowledge that works to improve student thinking.

Therefore, a concept is needed so that student thinking is in line with scientific concepts that have been studied by experts (Leonard et al., 2014).

Learning is an action carried out deliberately, directed and with clear objectives by an individual or group of individuals, such as teachers or textbook authors, to ensure that other people, including students, gain meaningful experiences (Arif, 2020). In the learning process, you must seek the truth to achieve appropriate learning atmosphere and curriculum (Wirda et al., 2020). The curriculum is a series of lessons designed to achieve educational targets in line with Republic of Indonesia Constitution Number 20 of 2023. The provides freedom

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to students, teachers and schools to choose learning methods that suit the students (Kemdikbud, 2022). The Merdeka Curriculum is a learning program that aims to ensure that students can prioritize competencies with in-depth intracurricular learning and that students have enough time to understand concepts. Understanding concepts is a thinking ability that students must have during the learning process, so that students can apply this knowledge in dealing with situations or problems that arise in the school environment (Ariani, 2020).

The concept of IPA is very important for students in learning because it contains a variety of natural phenomena associated with life activity (Kurniasih, 2018). One of the most important areas of science and technology is physics (Utami et al., 2023). Physical science significantly contributes to the advancement of various sciences and technologies that enhance people's quality of life (Haerunnisa et al., 2022). Knowledge plays a crucial role in addressing issues. The more knowledge students acquire, the easier it becomes for them to gather information, thereby boosting their curiosity (Mutia Liza et al., 2016). Learning physical science involves comprehending and applying concepts, rather than dealing with fictional narratives (Sari, 2015). This perspective is reinforced by Zulfira et al. (2024), who emphasize that science education should not only focus on memorization but also engage students in scientific processes that go beyond mere concepts.

Every student has the potential to master concepts (Astuti, 2017). Concepts form the foundational knowledge that students need, serving as the basis for developing further principles. Students' understanding of scientific concepts during the teaching and learning process can be assessed by evaluating their performance (Maison et al., 2021). Mastery of these concepts is achieved through comprehension gained during learning activities. Dahar (2011) defines a concept as an abstract idea represented by a category of objects, events, activities, or relationships that share common attributes. From these descriptions, it can be concluded that a concept is information characterized by similar attributes (Bayuni et al., 2018).

Understanding concepts is crucial for everyone (Bayuni et al., 2018). The aim of grasping concepts is to organize information and facilitate higher-level thinking (Hasnawati et al., 2022). This is consistently aligned with the educational objectives at all levels of education. Both teachers and students can master concepts. The interconnectedness of learning materials means that understanding one concept correctly helps students grasp other related concepts, while errors in understanding can impact comprehension of subsequent concepts (Mukhlisa, 2021). According to Nisa et al. (2022), incorrect concepts can disrupt students' understanding during the learning process.

While student errors can't be entirely eradicated, they can be minimized. A common issue in science education is the prevalence of misconceptions, which are misunderstandings of scientific ideas (Afriwardani et al., 2023). Misconceptions are interpretations that deviate from scientific understanding (Gurel et al., 2015) and can hinder classroom learning (Rokhim et al., 2023). Suparno (2013) states that misconceptions occur when students misunderstand a subject based on scientific principles. Misconceptions that occur in students are the main factor that occurs in students understanding concepts (Putri et al., 2020). Misconceptions are a major obstacle to students' understanding of concepts, making it essential for teachers to differentiate between students who hold misconceptions and those who simply lack understanding (Umardianti et al., 2023). Misconceptions are harder to correct and require different educational approaches (Peşman & Eryilmaz, 2010). Science teachers play a vital role in identifying and addressing these misconceptions (Qian & Lehman, 2017).

Students' misunderstandings, which deviate from scientifically accepted concepts, can lead to misconceptions (Zayyinah et al., 2018). Traditional methods often fail to identify these misconceptions (Rismaningsih & Nurhafasari, 2022). Diagnostic tests, which detect student errors for improvement purposes, are one effective method for identifying misconceptions (Rahmadani et al., 2023). These tests assess students' strengths and weaknesses in the learning process. There are several types of diagnostic tests, including one-tier, two-tier, three-tier, and four-tier tests, with the Three-Tier Diagnostic Test allowing students to express their confidence in their answers and reasoning (Rusilowati, 2015).

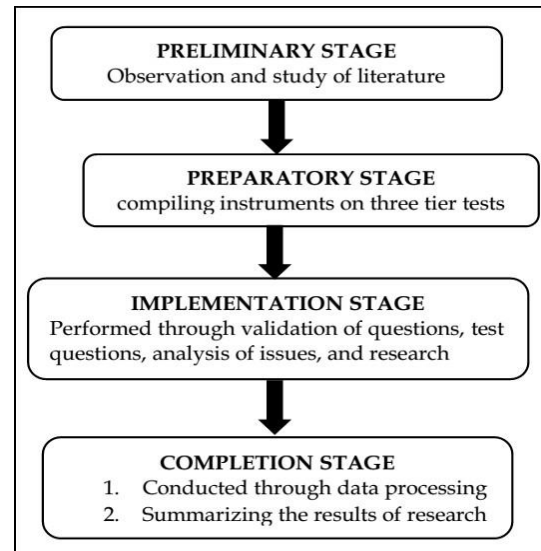
The four-level Diagnostic Test provides students with the opportunity to choose answers with a level of confidence and reason as well as with a level of confidence, where this four-level test is a refinement of the three-level test, for example, if a student is "sure" about the answer at the main question level. and "not sure" about the answer at the level of reasoning in this four-level test, researchers can determine "lack of knowledge" for that item (Gurel et al., 2015).

The results of the four levels of tests can be used as a basis for planning further actions for students. One of the physical materials that can be tested for misconceptions is the material of vibrations, waves and sound because these materials are very close to everyday life (Thompson & Logue, 2006). Misconceptions regarding vibration, wave and sound material experienced by students are: the concept of vibration 26.39%, the concept of moderate sound propagation 23.15%, and the concept of lightning waves 54.94% (Christiani et al., 2021). And the misconceptions identified in Lareh Sago Halaban sub-district regarding

vibrations, waves and sounds in general were 44% in the medium category (Sari, 2015).

This result was caused by students misunderstanding of the expert's concept and the learning assessment used was one-level multiple choice test so that it could not measure students understanding (Pratiwi et al., 2023). Misconceptions analysis is important so that competency achievement indicators can be achieved optimally and as a teacher's image in increasing students' understanding. The aim of the research is to analyze students' misconception profiles and determine the percentage of students' misconceptions regarding vibrations, waves and sound. What is new about this research is the identification of students' misconceptions in two schools which prevents misconceptions from occurring District using the Four Level Test instrument. The results obtained are the level of student misconceptions accompanied by student self-confidence. The level of student self- confidence is an important factor in improving student learning. The Four Tier Test instrument provides researchers with an understanding of student reasoning beyond student responses, thereby providing estimates of false positives and false negatives (Gurel et al., 2015).

**Method**



**Figure 1.** Research Stage

The colleted data was then analyzed descriptively with the following steps. Group the test results according to the modified level of understanding categories, namely:

**Table 1.** Four Tier Test Categories (Gurel et al., 2015)

First Tier	Second Tier	Third Tier	Four Tier	Category
Correct	Sure	Correct	Sure	Scientific conception
Correct	Sure	Sure	Not sure	Lack of knowledge
Correct	Not Sure	Sure	Sure	Lack of knowledge
Correct	Not Sure	Sure	Not Sure	Lack of knowledge
Correct	Sure	Incorrect	Sure	False positive
Correct	Sure	Incorrect	Not Sure	Lack of knowledge
Correct	Not Sure	Incorrect	Sure	Lack of knowledge
Correct	Not Sure	Incorrect	Not Sure	Lack of knowledge
Incorrect	Sure	Correct	Sure	False negative
Incorrect	Sure	Correct	Not sure	Lack of knowledge
Incorrect	Not sure	Correct	Sure	Lack of knowledge
Incorrect	Not sure	Correct	Not sure	Lack of knowledge
Incorrect	Sure	Incorrect	Sure	Misconception
Incorrect	Sure	Incorrect	Not sure	Lack of knowledge
Incorrect	Not sure	Incorrect	Sure	Lack of knowledge

Calculate the percentage of students who understand the concept, misconceptions, false positives, false negatives, do not understand the concept and pure misconceptions.

$$P = \frac{s}{j} \times 100 \tag{1}$$

(Gurel et al., 2015)

Information:

*P* =percentage of students in each group (unnderstnding the concept, false positives, false negatives, and not understanding the concept and misconceptions)

*S* =number of students per group category

*J* =number of studentd who excel in the test

Make a recapitulation of the average percentage of student misconceptions. Grouping the average percentage of misconceptions based on table 2.

**Table 2.** Indicators of Degree of Misconceptions Classification (Maison et al., 2021)

Percentage	Category
0-30%	Low
31%-60%	Medium

## Result and Discussion

The results of the descriptive of the four tier diagnostic test on vibration, wave and sound materials are presented in the table 3.

**Table 3.** Category Four Tier Teset (Gurel et al., 2015)

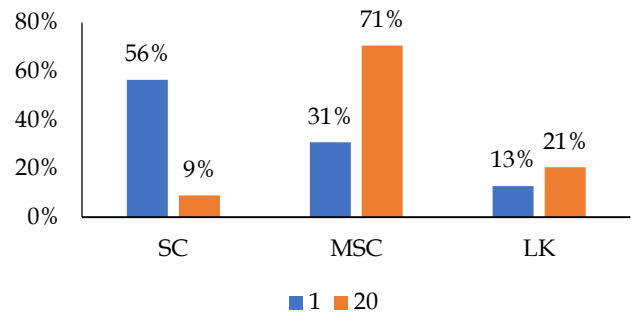
Related concepts	Question number	MSC Category (%)		
		FP	FN	MSC
Analyze the concept of vibration	1	10	10	10
	20	10	26	35
Analyzing amplitude and deviation	2	13	10	9
Analyzing periode	3	17	21	21
Analyzing sound propagation	5	14	10	37
Analyzing vibration frequency	21	4	26	31
Frequency and period relationship	4	1	17	46
Basic wave concepts	6	18	13	24
	7	24	1	40
Sound and frequency concepts	8	10	12	21
	9	22	14	21
	10	10	9	38
Sound propagation medium	11	5	35	23
	13	9	13	38
	14	9	15	28
Relationship between period, frequency, wavelength and speed	15	14	13	19
	16	5	23	14
	17	10	31	24
	19	22	10	14
	12	6	13	51

The percentage of misconceptions about vibrations, waves and sound in each indicator and category can be seen in table 4.

**Table 4.** Average Percentage of Student Misconceptions Each Indikator

Related Concepts	MSC (%)	Category
Concepts vibration	50	Medium
Concepts amplitude and deviation	32	Medium
Concepts period	57	Medium
Concepts propagation sound	61	High
Concepts frequency vibration	60	Medium
Concepts frequency and period	56	Medium
Concepts base wave	59	Medium
Concepts sound and frequency	53	Medium
Propagation medium sound	51	Medium
Connection period , frequency long wave and speed	60	Medium

The concept of vibration consists of the meaning of vibration, changes in the length of the rope relative to the frequency and period of vibration. The level of understanding of the vibration concept can be seen in Figure 2.



**Figure 2.** Percentage level of understanding of the concept of vibration

Based on picture number 2, it is known that students understand the concept in question number 1 as much as 56% of the meaning of vibration. The misconceptions identified in question number 1 were 31%. In question number 20, misconceptions were 71%.

The misconception identified in the vibration concept indicator is question number 20 which has the greatest misconception, namely 71% of the period when pendulum A is bigger than pendulum B. Question 20 is shown in figure 3.

20. Look at the picture below!

(1) There are two penders with the same period. If the two penders are swung by the angles of the deviation of  $10^\circ$ , then what happens to both pendulum after being swung simultaneously is ...

- Pendulum A frequency is smaller than the pendulum frequency B
- Pendulum A period is smaller than the pendulum period B
- Pendulum A frequency is greater than pendulum B
- Pendulum A period is greater than the pendulum period B

(2) Level of confidence

- Sure
- Not sure

(3) Which is the reason for your answer?

- The longer the rope, the greater the vibration period, so that the greater the frequency of vibration
- The longer the rope, the greater the vibration period, so the smaller the frequency of vibration
- The longer the rope, the smaller the vibration period, so that the greater the frequency of vibration
- The longer the rope, the smaller the vibration period, so that the vibration frequency is small

(4) Level of confidence

- Sure
- Not sure

**Figure 3.** Question number 20 (Christiani et al., 2021)



Question number 20 aims to determine the period of vibrations produced if the rope has different lengths. The misconceptions that students experience are indicators of the concept of vibration, including determining the effect of string length on period. Students assume that the difference in strings has no effect, but students assume that the longer the string, the period is smaller than the period of a pendulum that has a short string. Draft these students are not in accordance with scientific theory.

The actual concept Mathematically it can be formulated as:

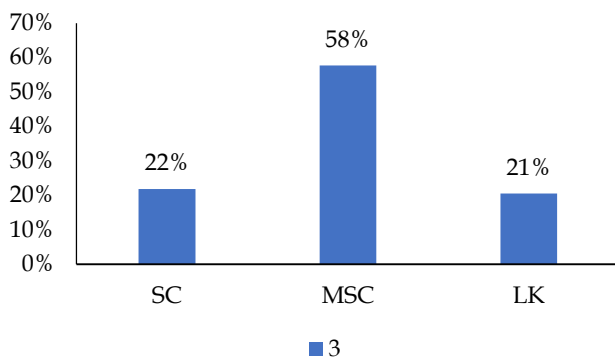
$$T = 2\pi \sqrt{\frac{L}{g}} \text{ and } f = \frac{1}{T} = \frac{1}{2\pi} \sqrt{\frac{g}{L}}$$

Description: Rope length(L), Gravitational acceleration(g), Period (T)= time required to carry out one complete vibration, Frequency (f)= the number of vibrations that occur per unit second.

Based on the pendulum period formula, the period has three things that influence the size of the period, namely the constant value of 20 (Nasukha, 2020).

*Period Concept*

The concept of period is the time required for an object to make one vibration. The level of understanding of the period concept can be seen in Figure 4.



**Figure 4.** Percentage of understanding the concept of period

Based on the picture, it is known that students understand the concept of question number 3 by 22% of the pendulum swing period. Question number 3 is shown in image number 6. The misconceptions identified in question number 3 were 58%.

The misconception identified in indicator 3 is that students think that the swing period of the pendulum is 0.01. Because the participants do not yet understand that one vibration, namely from point A, will return to point A. In accordance with the scientific concept that period

is the time required for an object to move through one full vibration (Nasukha, 2020).

3. Consider the following picture!

(1) The time needed to take A-B is 0.05 seconds. The swing period is ...  
 a. 0.05 s  
 b. 0.1 s  
 c. 0.2 s  
 d. 0.4 s

(2) Are you sure of your answer?  
 a. Sure  
 b. Not sure

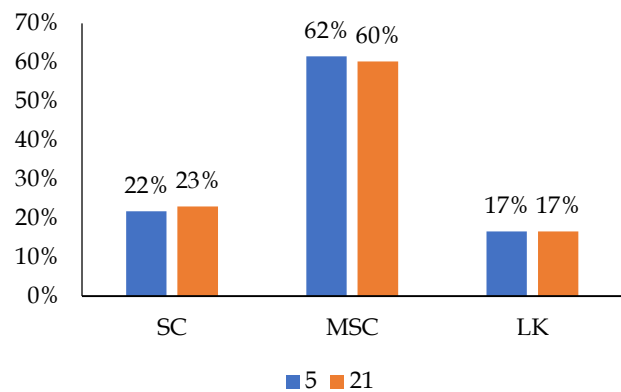
(3) Which is the reason for your answer?  
 a. The period is the time required for take ¼ vibration  
 b. The period is the time required for take ½ vibration  
 c. Period is the time needed to take one vibration  
 d. The period is the time needed from

(4) Are you sure about your reason?  
 a. Sure  
 b. Not sure

**Figure 5.** Question number 3 (Karomah, 2021)

*Sound Propagation Concept*

The concept of sound propagation concerns the incident of two children screaming at the same friend. And Rudi heard the sound of an ambulance at the bus stop. Level of understanding of the concept of sound propagation. The level of understanding of the concept of sound propagation can be seen in Figure 6.



**Figure 6.** Percentage of understanding the concept of sound propagation

Based on Figure 7, it is known that students understand the concept of sound propagation by 22% in

the event of two children shouting at their friends at the same distance. 23% of cases occurred when Rudi heard two ambulances sounding their sirens. Misconceptions experienced by students regarding number questions were 62%. The misconception that occurred in question number 21 was 60%.

21. Rudi was waiting for the bus at the bus stop, then two ambulances came and stopped in front of the bus stop, both ambulances sounded identical sirens. The siren volume of ambulance A is greater than ambulance B.

(1) Comparison of the frequency and amplitude of ambulance A and ambulance B sirens is...

- The frequency and amplitude of the ambulance siren A and the ambulance siren B are the same
- The frequency and amplitude of ambulance A's siren is less than ambulance B's siren
- The frequency and amplitude of ambulance A's siren is greater than ambulance B's siren
- The frequency and amplitude of the siren are the same and the amplitude of ambulance A's siren is greater than ambulance B's siren

(2) Level of confidence

- Sure
- Not sure

(3) Which is the reason for your answer?

- The statement that two sirens are identical indicates that the frequency and amplitude of both sound sources are the same
- The statement that the two ambulances stopped at the same location shows the same amplitude, while the frequency shows the weak loudness of the sound
- Amplitude shows the loudness and lowness of a sound, while frequency shows the pitch of a sound
- Frequency indicates the loudness and weakness of the sound while amplitude indicates the pitch of the sound

(4) Level of confidence

- Sure
- Not sure

Figure 7. Question number (Karomah, 2021)

Students' misunderstandings in determining the frequency and amplitude of ambulances A and B are the same, because they both travel through the medium of propagation, namely air. Students' concepts do not match scientific concepts. The actual concept is that amplitude indicates how loud or weak a sound is, while frequency indicates how high and low the tone is. The strength and weakness of a sound depends on its amplitude (Serway & Jewett, 2008).

*Vibration Frequency Concept*

The concept of vibration frequency is about two swings played by two children who have different body weights. In question number six, it is about what is the vibration frequency if the pitch fork vibrates 3000 times

in 2 minutes. The level of understanding of the concept of vibration frequency can be seen in Figure 8.

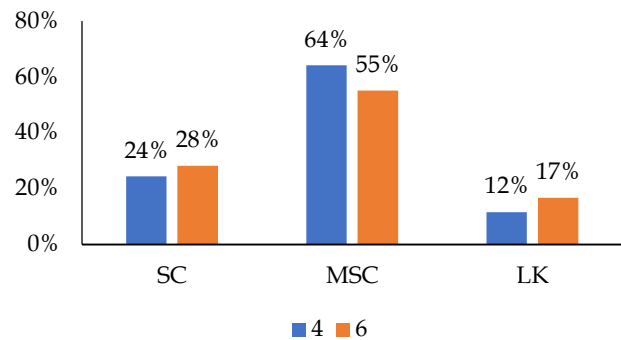


Figure 8. Level of understanding of the concept of vibration frequency

Based on Figure 8, it is known that students understand the concept of question number 4 by 24% regarding mass influencing swing vibrations. In question number 6, 28% is about what is the frequency of the tuning fork.

4. Pay attention to the picture below!

(1) Andi and Banu are in an identical swing. Andi's weight was twice heavier than Banu. If both of them pull the swing with the same distance then released to start swinging, what will happen?

- The swing climbed by Andi produced a vibration frequency twice as big as Banu
- The swing that banu is riding in produces a vibration frequency twice as much as Andi
- The swing that banu is riding in produces a frequency of vibration twice as smaller than Andi
- The swing that Andi and ban will produce the same frequency

(2) Are you sure of your answer?

- Sure
- Not sure

(3) Which is the reason for your answer?

- The mass does not affect the big the small frequency of vibration
- The greater the mass of an object, then The resulting frequency will be increasingly big
- The smaller the mass of an object, then The resulting frequency will be increasingly big
- The smaller the mass of an object, then The resulting frequency will be increasingly small

(4) Are you sure about your reason?

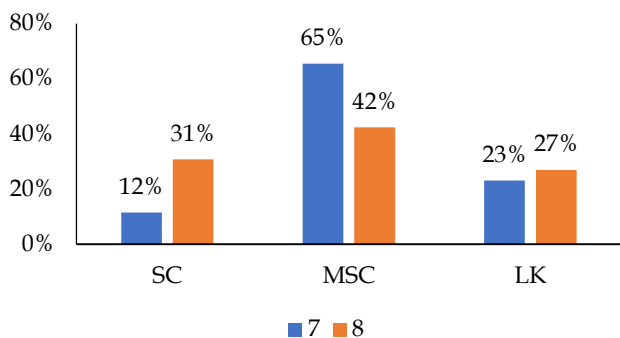
- Sure
- Not sure

Figure 9. Question number 4 (Christiani et al., 2021)

In terms of frequency and vibration indicators, students who experienced misconceptions in question number 4 were 64%, in question 6 it was 55%. The student's misunderstanding in Figure 9, question number 4, is regarding the vibration frequency. The vibration frequency of the swing that is ridden by one of the children whose weight is twice the weight of his friend will produce a vibration frequency that is twice the weight of his friend. The student's concept is no less accurate than the actual concept. The actual concept is that the swing that both children ride produces the same frequency, because mass does not affect the size of the vibration frequency (Nasukha, 2020).

*Frequency and Period Relationship*

The relationship between frequency and period is found in questions number 7 and 8. Question number 7 is related to a pendulum that has moved to produce a frequency of 50 Hz, the size of the pendulum's period. Then in question number 8 there are pictures of several types of pendulums with strings of different lengths, then you are asked which pendulum has the smallest frequency and the largest period. The level of understanding regarding the concept of the relationship between frequency and period can be seen in Figure 10.



**Figure 10.** Level of understanding of the concept of frequency and period relationship

Based on Figure 10, it is known that 12% of students understand the concept of question number 7 and 31% of students understand question number 8. Frequency and period relationship concept indicators. The highest misconception occurred in number 7 at 65%. In question 8, the misconceptions that occurred were 42%.

The students' misunderstanding in question number 7 regarding the period they got from the known question was 25 s. Students' concepts do not match scientific concepts. The actual concept is to use a formula to find the period, namely  $T = \frac{1}{f}$  (Nasukha, 2020) the vibration frequency of an object is inversely proportional to the period required for the object to vibrate.

7. It is known that the frequency of a pendulum moving in 2 minutes is 50 Hz.

(1) The size of the pendulum period is....

- 0.02
- 0.04 s
- 25 s
- 50 s

(2) Are you sure about your answer?

- Sure
- Not sure

(3) Which is the reason for your answer?

- The frequency of an object vibrates equal to the period of vibration of the object
- The period of vibration of an object is equal to half of the frequency produced
- The magnitude of the vibration frequency of an object is directly proportional to the period it takes an object to vibrate
- The frequency of vibration of an object is inversely proportional to the period required for the object to vibrate

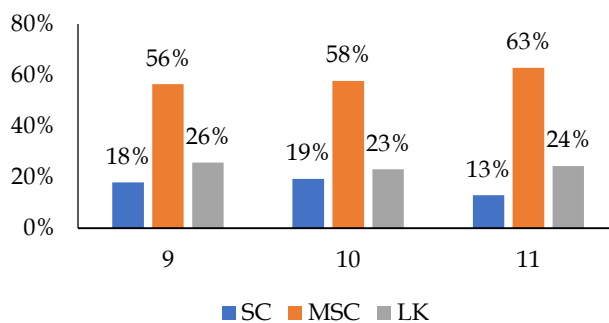
(4) Are you sure about your reasons?

- Sure
- Not sure

**Figure 11.** Question number 7 (Karomah, 2021)

*Basic Wave Concepts*

The basic concept of waves is question number 9, question 10 and question 11. Question number 9 is related to transverse waves, question 10 is about correct statements regarding waves and question 11 is about wavelength. The level of students' understanding can be seen in Figure 13.



**Figure 12.** Level of understanding of basic wave concepts

Based on Figure 13, it is known that 18% of students understand the concept of question number 9, 19% for question 10 and 13% for question 11. The highest misconception was in question 10 at 58%.

The student's misunderstanding in question number 10 is related to the correct statement, namely that the student considers I to be a wave if it passes through point abcdefg, on the grounds that the number of waves is the number of hills and valleys produced. Students' concepts do not match scientific concepts. The

actual concept is that I waves consist of I hills and I valleys (Christiani et al., 2021).

10. Look at the picture below

(1) The following statement is correct...

- 1 wave if it passes through points a-b-c-d-e-f-g
- The distance between points a and g is the furthest deviation
- The distance between points a and e is the length of one wave
- The number of waves that occur is 3

(2) Are you sure about your answer?

- Sure
- Not sure

(3) Which is the reason for your answer?

- One wave only consists of one hill or one valley
- The farthest deviation is the distance between 1 hill and 1 valley
- The length of one wave is the distance between two adjacent wave peaks
- The number of waves is the number of hills and valleys produced

(4) Are you sure about your reasons?

- Sure
- Not sure

Figure 13. Question number 10 (Christiani et al., 2021)

Sound and Frequency Concepts

The concept of sound and frequency is question number 13, question 14 and question 15. Question number 13 is related to the nature of sound, question 14 is about the frequency of sounds produced by guitar strings and question 15 is related to the source. The level of students' understanding can be seen in figure 14.

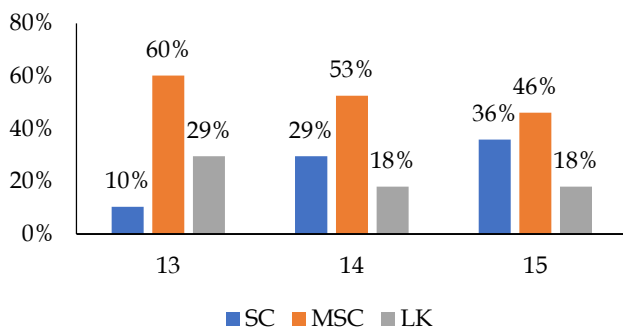


Figure 14. Level of understanding of sound and frequency concepts

Based on Figure 15, it is known that 10% of students understand the concept of question 13, 29% in question 14 and 36% in question 15.

13. Sound is a form of wave that propagates.

(1) The following are the properties of sound, except...

- Can be reflected
- Including longitudinal waves
- Including transverse waves
- Including mechanical waves

(2) Are you sure about your answer?

- Sure
- Not sure

(3) Which is the reason for your answer?

- Sound cannot be reflected because of sound propagate in all directions
- Sound propagates do not require a medium
- The direction of sound propagation is perpendicular to the direction of the sound source
- Sound is a longitudinal wave because the direction of sound propagation is parallel to the direction of sound propagation

(4) Are you sure about your reasons?

- Sure
- Not sure

Figure 15. Question number 13 (Karomah, 2021)

Students misunderstanding in question number 13 is a statement that is not a sound characteristic. Students assume that what is not part of the nature of sound is that sound can be reflected, students' scientific concepts are not the same as actual scientific concepts. The actual scientific concept, namely transverse waves, is not included in the properties of sound because the direction of sound propagation is perpendicular to the direction of the sound source (Malau, 2018).

Concepts Sound Propagation Medium

The concept of a sound propagation medium is found in number 16, question 17 and question 19. Question 16 is about the speed of sound propagation, question 17 is related to the correct statement about the speed of sound propagation and question 19 is related to examples of sounds. The level of students' understanding of the concept of sound propagation medium can be seen in Figure 17.

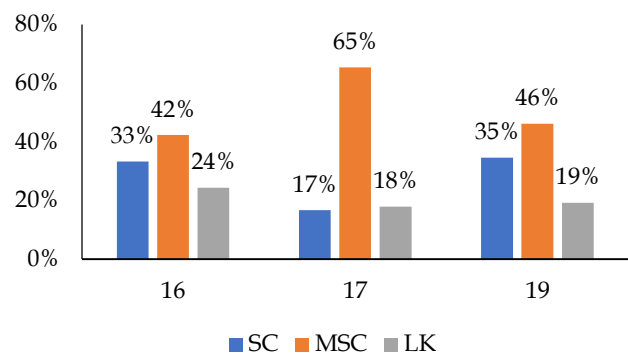


Figure 16. Level of understanding of the concept of sound propagation medium



Based on Figure 16, it is known that 33% of students understand question number 16. 17% of students understood question number 17 and 35% of students understood question number 19.

17. Pay attention to the following table!

Medium	Jarak (m)	Cepat rambat / bunyi
Udara (0°C)	250	331
Udara (15°C)	250	340
Air (25°C)	250	1490
Besi (20°C)	250	5130

(1) The following statements are correct according to the table above, except...

- The speed of sound propagation is influenced by the type of medium
- The speed of sound propagation is influenced by temperature
- The speed of sound is affected by distance
- The speed of sound is affected by the medium and distance

(2) Are you sure about your answer?

- Sure
- Not sure

(3) Which is the reason for your answer?

- The closer the distance between particles, the greater the speed of sound propagation at the same distance
- The closer the distance between particles, the smaller the speed of sound propagation at the same distance
- The higher the temperature, the smaller the speed of sound over the same distance
- The longer the travel time, the greater the wave propagation speed over the same distance

(4) Are you sure about your reasons?

- Sure
- Not sure

Figure 17. Question number 17 (Karomah, 2021)

Student's misunderstandings in question number 17 relate to the correct statement in the answer. Students assume that the speed of sound propagation is influenced by the type of medium. Students' scientific concepts are not the same as the correct scientific concepts according to experts. The correct concept is that the speed of sound propagation is influenced by distance because the closer the distance between particles, the greater the speed of sound propagation at the same distance (Nurhayati, 2018).

*The Concept of the Relationship between Period, Frequency, Wavelength and Speed*

The concept of the relationship between wavelength frequency period and speed is contained in number 12 and question number 18. Question number 12 is related to the ratio of wavelengths and question number 18 is related to sound wavelengths.

Based on picture number 19 in question number 12, there are 10% of students who understand the concept

and in question number 18, 31% of students understand the concept.

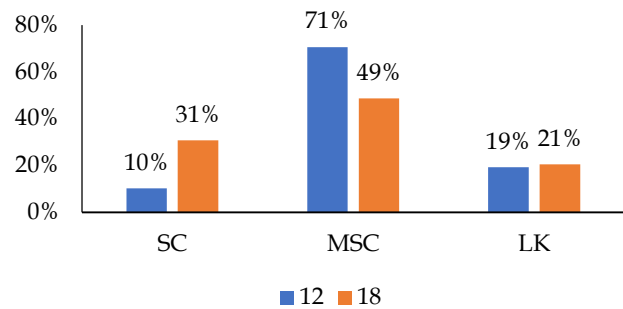


Figure 18. Level of understanding of the relationship between wavelength frequency period and speed

12. Two waves propagate at the same speed. If the frequencies of the first and second waves are 3 Hz and 5 Hz respectively, then the wavelength ratio between the first and second waves is....

- 3 : 5
- 5 : 3
- 1 : 3
- 3 : 1

(2) Are you sure about your answer?

- Sure
- Not sure

(3) Which is the reason for your answer?

- The greater the frequency of a wave, the greater the wavelength
- The greater the frequency of a wave, the smaller the wavelength
- The greater the wave frequency, the smaller the wave propagation speed
- Wavelength is affected by frequency but not affected by wave propagation speed

(4) Are you sure about your reasons?

- Sure
- Not sure

Figure 19. Question number 12 (Karomah, 2021)

The students' misunderstanding in question number 12 was that the wavelength ratio between the first and second waves was 3:5, with the reason being that the greater the wave frequency, the smaller the wave propagation speed. Students' concepts do not match the actual concept. The actual concept is that the longer the frequency of a wave, the smaller the wavelength (Serway & Jewett, 2008).

**Conclusion**

Based on the research and discussion, the conclusion is that the results of research on students' misunderstanding of the indicators of the concept of vibration, the concept of amplitude and deviation, the

concept of period, the concept of frequency and period the basic concept of waves, the concept of sound and frequency, and the medium and propagation of sound, are in the low category. , while the indicators for the concept of sound propagation, the concept of vibration frequency and period relationship, wavelength frequency and speed are in the medium category. The results of the research concluded that the percentage of students in Lareh Sago Halaban District who experienced misconceptions about vibration, wave and sound science subjects was 55% in the medium category.

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The authors declare that there is no conflict of interest in the publication of this article.

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