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Identification of Students' Misconceptions in Junior High Schools Accredited A using the Three Tier Test Instrument in Science Learning

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Abstract: The study aims to analyze the student's misconception profile and determine the percentage of misconceptions of class VIII students on vibration, wave, and sound material. The research subjects were 159 students in three accredited A secondary schools during the full 2022–2023 semester. This research method is descriptive quantitative. Data collection method using a diagnostic test with a three-tier test. The three-tier test of 16 questions developed by Muhammad Ainal Yaqin and Linda Rahayuningsih was then modified by researchers with a reliability of 0.94 (very high). The three-tier test instrument consists of three tiers the first level is multiple choice, the second level is a choice of reasons for the first level, and the third level is a question of the level of confidence in the first and second levels. The result of the study was a student's misunderstanding of the vibration indicator being in the low category, whereas the wave magnitude indicator, wave movement, rapid wave retardation, medium sound retardance, and sound wave are in the medium category. The study concluded that the percentage of high school students in Koto Tangah district who suffered from misconceptions of vibration, wave, and sound material was 44% in the medium category.

Keywords: Misconception; Sound; Three tier test; Vibration; Waves

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.

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 plays a role in the development of sciences and technologies that help people live a better life (Haerunnisa et al., 2022). Knowledge is an important thing that focuses on problems. The more knowledge students have, the easier it is for students to dig information so that student curiosity can be increased. Physical learning is not a lesson of fiction, but lessons that require students to understand concepts and apply concepts (Sari, 2015). This view is supported by Haliza et al. (2022) which states that learning IPA in learning not only memorizes but the theory of students should also be involved in a science process that transcends concepts.

Every student has the ability to master concepts (Astuti, 2017). Concepts are one of the initial knowledge that students must have because concepts are the basis

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for formulating the following principles. Students' science concepts in the teaching and learning process can be seen by evaluating the results (Juliani et al., 2021). Conceptual mastery is acquired by students by understanding concepts after learning activities. According to Dahar (2011), Concept is an abstract represented by a class of objects, events, activities, or relationships that have the same attributes. Based on such descriptions it can be concluded that the concept is an information that has the same characteristics (Bayuni et al., 2018).

Understanding concepts is important for everyone (Bayuni et al., 2018). The purpose of understanding concepts was to organize and organize information and provide a higher level of thinking (Rusli et al., 2016). It is always relevant to the educational objectives in the curriculum at every level of education. Teachers and students have the ability to master concepts. Learning material concepts are interrelated so that students can understand other concepts if students understand one concept correctly. However, errors in understanding one concept will affect the understanding of another concept (Mukhlisa, 2021). According to the opinion Nisa et al. (2022), in the subsequent learning process, wrong concepts can interfere with student understanding of the concept. Student errors cannot be eliminated but can be reduced. The common problem of learning IPA is the many misunderstandings experienced by students or called misconceptions (Rahmah et al., 2017).

Misconception is an inconsistency in the student's understanding of the correct scientific idea (Gurel et al., 2015). Supported by the Maison opinion that misconceptions are interpretations of ideas that don't align with the scientific understanding or understanding of experts (Maison et al., 2020). Misconceptions can also cause students to be left behind in learning in class (Rokhim et al., 2023). According to the opinion Suparno (2013), misconception occurs when a student has a misunderstanding of a subject based on scientific principles. Misconceptions that occur in students are one of the main factors that students fail to understand concepts. Therefore, it is very important for teachers to distinguish between misconceptive students and students who do not understand the concept because misconcept cannot be changed, so it is harder to correct a student who does not understand a concept, and both require different learning approaches (Peşman et al., 2010). Teachers of science play an important role in identifying and addressing student misconceptions (Qian et al., 2017). Students' understanding of a concept that does not match the scientific concept accepted by experts can lead to misconception (Zayyinah et al., 2018).

Student misconceptions are difficult to identify with traditional methods (Rismaningsih et al., 2022). One way to identify student misconception is by using a diagnostic test (Ratman et al., 2022). A diagnostic test tool is a type of tool that detects student mistakes to be used as a material for improvement in learning on that material (Rokhim et al., 2023). A diagnostic test is a test that is used to determine the strengths and weaknesses of students in the learning process. There are several kinds of double-optional diagnostic tests that can be used for identifying students' misconceptions, namely one-tier, two-tier, three-tier, and four-tier (Rusilowati, 2015). The Three Tier Diagnostic Test gives students the opportunity to choose a single level of confidence in choosing answers and reasons for each item of the question.

The Three Tier Test can be used as a self-assessment for students because students' weaknesses can be found and corrected to improve students' understanding of ideas (Prodjosantoso et al., 2019). Three Level Test can help students find the truth and reason behind the information presented so that students can solve problems using the information accompanied with the right reason. The results of the three-tier test can be utilized as a basis for planning further action against students. One of the physics materials that can be tested misconceptions are vibration material, waves, and sounds because this material is very close to everyday life. Misconception in vibration, wave, and sound material experienced by students, namely: vibration concepts 26.39%, medium sound slowdown concepts 23.15%, and wave thunderbolt concepts 54.94% (Christiani et al., 2021).

This is due to the presence of preconceptions that are not in line with the concepts of the experts as well as learning assessments that are used in the form of one-tier double-selection tests and screening tests so that they are not able to measure the understanding of the student's concepts. Important misconception analysis is carried out so that the indicators of achievement of competence can be achieved to the maximum and as a reflection of teachers in improving student understanding of materials taught. The aim of the study is to analyze the student malconception profile and determine the percentage of student misconcept in the material of vibrations, waves, and sounds.

New in this study is the identification of student misconceptions in three schools preventing first accredited A students who are in the same district using the Three Tier Test instrument. The results obtained are the student level of misconception accompanied by the student's confidence level. The level of confidence is an important factor in improving student learning (Wang et al., 2018). The Three Level Test instrument gives researchers an understanding of student reasoning beyond student responses, thus providing false positive and false negative estimates without conducting advanced interviews (Peşman et al., 2010).

Method

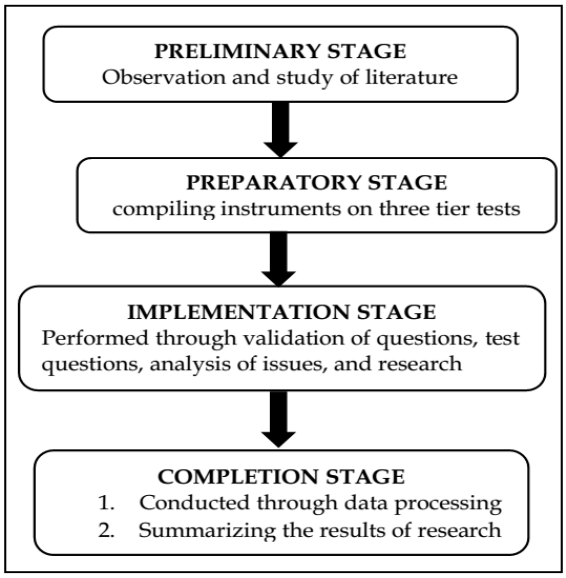


Figure 1. Stages of Research

Research design and method should be clearly defined**.** This method of research is quantitative descriptive. The study was conducted in June 2023. The subject of the study is a student in the first three preventive schools accredited A with a sample of 159 students. The data collection method uses a diagnostic test with a double-optional instrument Three Tier Test. The 16 questions developed by Muhammad Ainal Yaqin and Linda Rahayuningsih were then modified by the researchers with a reliability of 0.94 (very high). The three-tier test instrument consists of three tiers: the first level is multiple choice, the second level is a choice of reasons for the first level, and the third level is a question of the level of confidence in the first and second levels (Yang et al., 2019). The research process is carried out through four stages: initiation, preparation, implementation, and completion.

Data collected is then analyzed descriptively with the following steps. Group the test results according to the category of the level of understanding that has been modified, namely:

Table 1. Category Three Tier Test ((Istiyani et al., 2018))

First Tier	Second Tier	Third Tier	Category
Correct	Correct	Sure	Understand the concept
Correct	Correct	Not Sure	Guessing
Correct	Incorrect	Sure	Misconception (false positive)
Correct	Incorrect	Not Sure	Not understand the concept
Incorrect	Correct	Sure	Misconception (false negative)
Incorrect	Correct	Not Sure	Not understand the concept
Incorrect	Incorrect	Sure	Misconception (pure)
Incorrect	Incorrect	Not Sure	Not understand the concept

Count the percentage of students who understand concepts, guess, misconceptions (false positive), do not understand the concept, false negative, and pure misconception.

$$P = \frac{s}{Js} \times 100\% \quad (1)$$

(Gurel et al., 2015)

Information:

P = Percentage of students in each group (understood concepts, guessed, false positive, did not understand concepts and false negative, and misconceptions)

s = number of students per group category

J_s = Total number of students participating in the test

Make a recapitulation of the average percentage of student misconceptions. Groups the average percentage of misconception based on Table 2.

Table 2. Indicators of the Degree of Classification of Misconceptions

(%)	Category Misconceptions
0 < M ≤ 30	Low
30 < M ≤ 60	Medium
60 < M ≤ 100	High

Description: M = Misconception

(Istighfarin et al., 2015)

Identify students who have misconception answers. Concludes the data processing results by describing the percentage of misconceptions obtained

Result and Discussion

Result

The results of the descriptive analysis of three-stage diagnostic tests on vibration, wave, and sound material are presented in Table 3.

Table 3. Average Percentage of Student Misconceptions on Each Indicator

Related Concepts	Question Number	Category Student Misconceptions (%)		
		False Positive	False Negative	Pure Misconception
Vibration	1	4	0	0
	2	8	7	26
	3	2	11	30
		4	6	18
Wave magnitude	4	22	6	25
	5	15	7	25
		19	7	25
Wave movement	6	7	10	42
	7	8	8	42

Related Concepts	Question Number	Category Student Misconceptions (%)		
		False Positive	False Negative	Pure Misconception
		7	9	42
Rapid	8	34	14	14
Wave Slope	9	9	9	35
	10	9	7	36
	11	35	2	4
		22	8	22
Medium	12	16	1	8
Sound	13	18	4	15
Restriction		17	3	11
Sound	14	8	3	12
waves	15	31	6	25
	16	4	16	19
		14	9	19
		13.83	7	22.83

The percentage of misconceptions on vibration material, waves, and noise on each indicator and its categorization can be seen in Table 4.

Table 4. Categories Percentage Misconceptions of Students Based on Indicators

Related Concepts	Percentage Misconceptions (%)	Category
Vibration	29	Low
Wave magnitude	50	Medium
Wave movement	58	Medium
Rapid Wave Slope	52	Medium
Medium Sound Restriction	31	Medium
Sound waves	42	Medium
$\bar{X}$	44	Medium

Discussion

Concept of Vibration

The concept of vibration consists of the definition of the vibration, the change in the length of the rope with respect to the frequency and period of the vibratory band, and the mass of the band with regard to the period of vibrations. The level of understanding of the concept of vibration can be seen in Figure 2.

Based on Figure 2 it is known that students understand the concept on question number 1 as much as 96% of the definition of vibration. Question number 1 is shown in Figure 3.

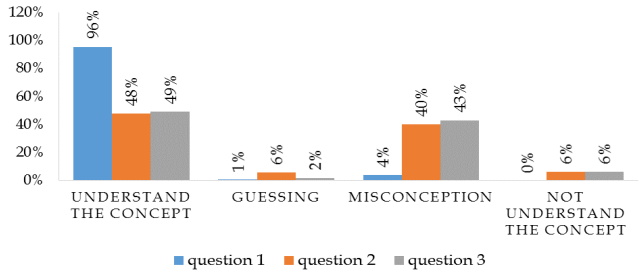
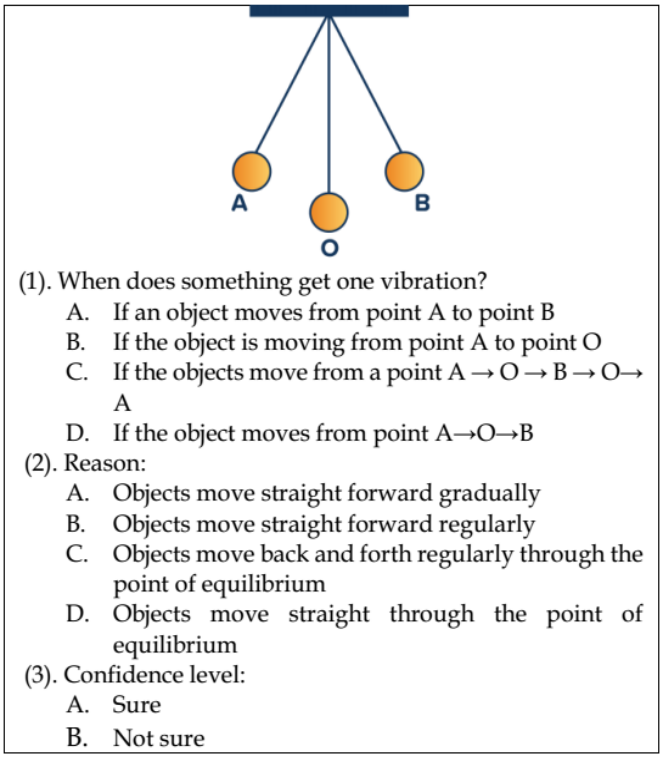


Figure 2. Percentage of level of understanding of the concept of vibration



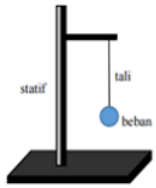
(1). When does something get one vibration?
- A. If an object moves from point A to point B
- B. If the object is moving from point A to point O
- C. If the objects move from a point A → O → B → O→ A
- D. If the object moves from point A→O→B

(2). Reason:
- A. Objects move straight forward gradually
- B. Objects move straight forward regularly
- C. Objects move back and forth regularly through the point of equilibrium
- D. Objects move straight through the point of equilibrium

(3). Confidence level:
- A. Sure
- B. Not sure

Figure 3. Question number 1

Given a "Simple Band" experiment with one end of the rope tied to the stativ and the other end loaded (M1) like in the picture!



(1). If the load is replaced with a mass of M2 (M1 is smaller than M2), while the rope length and the angle of rotation are 10°. Then the resulting period of vibration...
- A. Bigger than before
- B. Smaller than before
- C. Constant
- D. Constant change

(2). Reason:
- A. The mass affects the period of vibration, the larger the mass of the bandol then the longer the period or the time it takes for a single vibration the longer
- B. The mass does not affect the period of vibration because what affects the period is the length of the rope
- C. The mass affects the period of vibration, the larger the mass of the bandol then the period is faster or the time it takes for a single vibration is smaller

(3). Confidence level:
- A. Sure
- B. Not sure

Figure 4. Question number 3 (Yaqin, 2018)

The misconceptions identified on the vibration concept indicator are the number 3 issues that gain the greatest misconception of 43% of the bandol mass against the period of bandol vibration. Question number 3 is shown in Figure 4.

Question number 3 aims to determine the period of vibration that is produced if the bulk mass changes. The misconceptions experienced by the student on the indicator of the vibration concept, among other things, determine the influence of the mass on the period. The student assumes that the change in bulk massa influences the bulking period. This student's concept does not conform to the scientific theory that the length of the rope and gravitational acceleration influence the period and frequency of vibrations. The true concept is that the changes in bulking mass have no influence on bulk vibration periods (Serway et al., 2009).

Concept of Wave Magnitude

The concept of wave magnitude consists of a wave chart against the wavelength of the wave and the movement of the particles on the rod. The level of understanding of the concept of wavelenght can be seen in Figure 5.

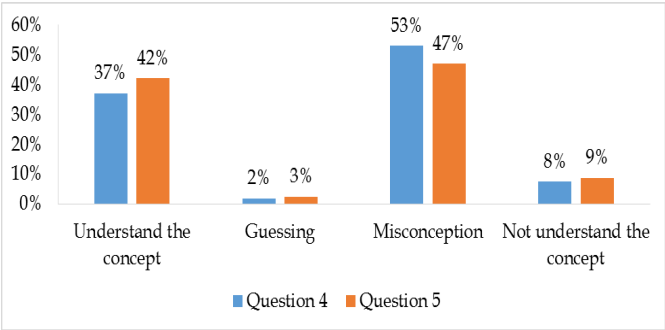
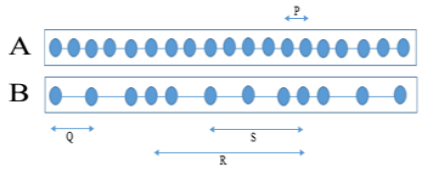


Figure 5. Percentage of understanding of the concept of the big wave

Based on Figure 5, it is found that students understand the concept of question number 5 as 42% of the movement of particles on the rod. Question number 5 is shown in Figure 6.

Question 4 identified a student misconception of 53% with regard to the wave chart with respect to distance. Question No. 4 is shown as in Figure 7. Question number 4 aims to determine the definition of wavelengths. The misconceptions experienced by students on the concept of wave magnitude indicators among other things identify the wave length. The student assumes that the wavelength measured from the wave peak to the sequential wave peaks is called the wavlength. The student's concept does not conform to the scientific concept. The true concept is that the longitude of the waves is the distance between two sequential peaks of waves (Sudiro, 2020).

Look at the diagram below!



(1). Figure A is a diagram of the movement of particles at the time the rod is given no disturbance and Figure B is the movement diagram for particles inside the rod which is given distortion from the left side so that the particle moves to the right. The movement of the particles can be identified using the letters indicated. The wavelength indicated by the arrow line...

A. P
B. Q
C. R
D. S

(2). Reason:

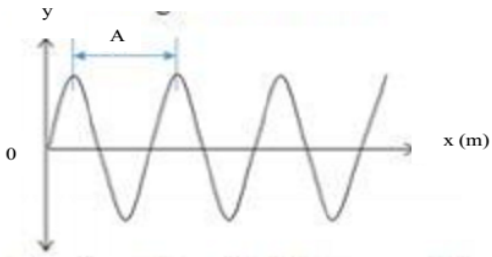
A. Maximum deviation of particle movement
B. Distance from the center of the scratch to the centre of the stitch
C. The distance between two particles in an uninterrupted condition
D. Distance of the center of the scratch to the centre of the sequence of scratches

(3). Confidence level:

A. Sure
B. Not sure

Figure 6. Question number 5 (Yaqin, 2018)

Look at the graph below!



(1). The letter A on the chart above shows...

A. Period
B. Frequency
C. Wavelength
D. Wave deviation

(2). Reason:

A. Distance between two consecutive wave peaks
B. Wave deviation measured from the wave peak to the consecutive
C. The time it takes to form one wave
D. The number of waves formed in a second

(3). Confidence level:

A. Sure
B. Not sure

Figure 7. Question number 4 (Yaqin, 2018)

Concept of Wave Movement

The concept of wave movement consists of the event of a beam floating in sea water and the influence of waves on the movement of objects. The level of understanding of the concept of wave magnitude can be seen in Figure 8.

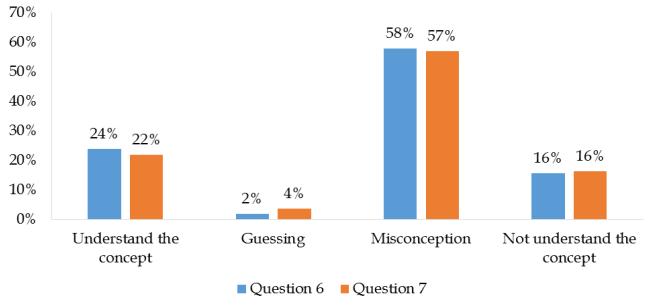


Figure 8. Percentage level of understanding concept of wave movement

Based on Figure 8, it is known that students understand the concept of question number 6 as 24% about the event of a beam floating in the sea water. Question number 6 is shown in Figure 9.

Look at the picture below!

(1). The picture above is an illustration of the event of a beam floating in the sea. If the beam is exposed to waves and there are no other factors affecting the movement of the beams. Then the...

A. The beam vibrates to the right and to the left andins its position
B. It vibrates up and down and keeps a distance from its initial position
C. The beam moves away from its initial position in the direction of movement of the object in the same direction as the wave movement
D. The beam moves away from its initial position in the direction of object movement in the opposite direction of wave movement

(2). Reason:

A. The wave carries energy from one place to another
B. The wave vibrates its medium
C. Wave moves matter so that the medium particles are pushed in all directions from the source of wave
D. Waves move energy by vibrating the medium, not moving the matter

(3). Confidence level:

A. Sure
B. Not sure

Figure 9. Question number 6 (Yaqin, 2018)

The student's misconception is to determine the direction of the wave movement. The student assumes that the beam moves away from its initial position in the direction in which the object moves in its direction. The reason is that matter is moved by waves so that the medium particles are pushed in all directions from the source of waves. The students' concept is not consistent with the scientific concept. The true concept is that a beam vibrates up and down and keeps a distance from its starting position because the energy is transferred by the waves by vibrating the medium instead of moving the matter (Serway et al., 2009).

Concepts of Rapid Wave Slope

The concept of rapid wave retardation is about the influence of the mass of the rope on the speed of the wave and the velocity of a wave on the distance and time of the wavelength. The level of understanding of the concept of wave magnitude can be seen in Figure 10.

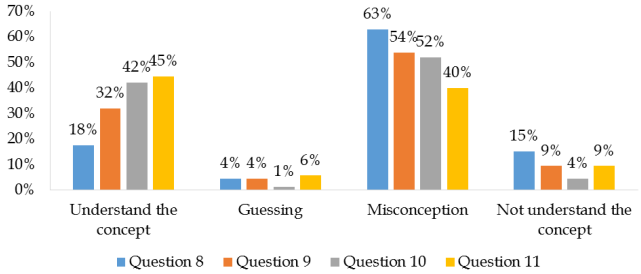
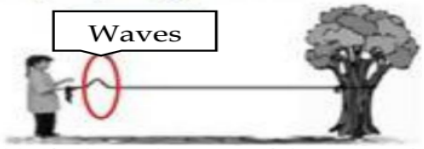


Figure 10. Percentage level of understanding concepts of rapid wave slope

Based on Figure 10, it is found that students understand the concept of the question number 11 as 45% about the rapid decline of a wave against the distance and time of the wave. Question number 11 is shown in Figure 11.

Tika performs an activity to determine the difference between the length of a rope and the speed of a wave. Tika holds one end of the rope, and the other end is tied to a tree rod. Then Tika touches the end of a string that he holds to form waves that slide toward the ends of ropes that are stuck on the tree rod, as in the following picture!



(1). If Tikains the strain of the rope and wants to make the waves reach the tree faster, then the most appropriate statement is...

A. Tika replaces the rope with a shorter rope so that Tika's position is closer to the tree
B. Tika replaces the rope with a longer rope so that Tika's position is further away from the tree
C. Tika replaces the rope with a shorter rope so that Tika's position is further away from the tree
D. Tika replaces the rope with a longer rope so that Tika's position is closer to the tree

(2). Reason:

A. If the voltage of the rope is fixed, the wire is shortened, then the mass of the string is also decreased and the weight of the type of rope (μ) remains, so the wave speed is constant. Because the wavelength is shorter than before, the time it takes for the waves to reach the end of the thread is faster than before.
B. If the rope is extended, then the string-type mass (μ) becomes smaller so that the wave is slowing faster than before and the wavelength is faster
C. If the rope is shortened the wave is shrunk so that the wavelength is shorter than before. The time it takes for the waves to move faster, because the wavelength is shorter than before.

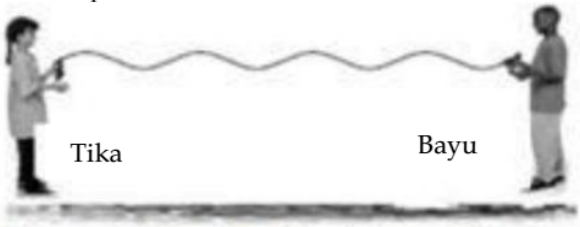
(3). Confidence level:

A. Sure
B. Not sure

Figure 11. Question number 11 (Yaqin, 2018)

The misconceptions identified in the concept indicator of wave speed is the number 8 issue that obtains the greatest misconception of 63% about the influence of the mass of the rope on the wave velocity. The issue number 8 is shown as shown in Figure 12.

Tika and Bayu hold the rope at both ends. Tika repeatedly taps the ropes at one end of the ropet so that the direction of the strap shakes up and down and the straps of the string leads to Bayu while Bayuins the ends that he holds stable, as in the picture!



(1). If the Tika touch is strengthened so that its amplitude increases, but the wave frequency and tension of the rope is fixed, then the resulting wave rapidly contracts...

A. Faster than ever
B. Slower than ever
C. Constant
D. Constant change

(2). Reason:

A. The voltage of the rope is fixed, the mass of the type of rope stable, then the speed of the wave stable
B. The frequency is fixed then the energy of the wave stays fixed so that the rapid wave deceleration stays.
C. λ=v/f, based on the formula, the amplitude does not affect the rapid wave retardation.

(3). Confidence level:

A. Sure
B. Not sure

Figure 12. Question number 8 (Yaqin, 2018)

Question number 8 is intended to determine the speed of a wave. The student's misconception on the concept of a quick wave indicator is that the formula λ=v/f explains that the wave speed is not influenced by the amplitude. The concept of the student is not consistent with the scientific concept. The true concept is that a speed of wave slow is affected by the type of voltage and mass. So a fast wave rate is constant when the voltage of a rope and the mass of the rope type are also fixed (Sudiro, 2020).

Concept of Medium Sound Restriction

The question of the concept of rapid wave contraction is about solid matter as a medium of sound contraction. The level of understanding of the notion of wave magnitude can be seen in Figure 13.

Based on Figure 13, it is known that students understand the concept of question number 12 as 70% of solid matter as a medium of sound interference. Question number 12 is shown in Figure 14.

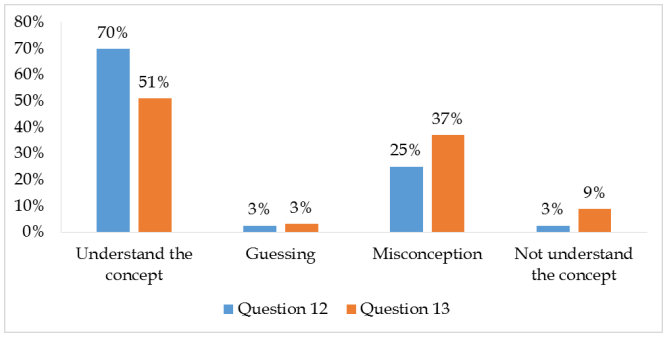
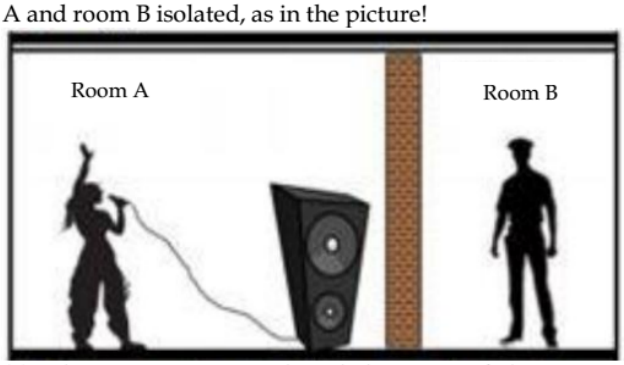


Figure 13. Percentage level of understanding of the concept of medium sound restriction

A woman is singing using a loudspeaker in room A bounded by a wall with a room next to it (room B) and room A and room B isolated, as in the picture!



(1). The man in room B heard the voice of the woman singing in room A. The statement was...

A. True
B. False

(2). Reason:

A. The sound is only transmitted through the air because there is a wall, so the sound is blocked by the wall
B. The wall reflects the sound so that the man can't hear the voice of the woman singing in room A
C. The sound went through the air, and there was a gap between the rooms A and B, so that the man in the room B heard the woman singing
D. The sound of the loudspeaker in room A shall be partly reflected by the wall, and partly clung to the wall; so that the man who is in room B shall hear the woman singing in the room A

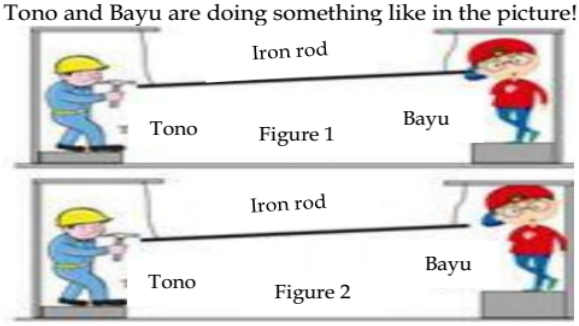
(3). Confidence level:

A. Sure
B. Not sure

Figure 14. Question number 12 (Yaqin, 2018)

The misconceptions identified on the noise retardation medium concept indicator are the number 13 issue that gained the greatest misconception of 37% of solid as sound retarding medium. Question number 13 is shown as shown in Figure 15.

Tono and Bayu are doing something like in the picture!



(1). In this activity, Bayu's ears are approached with the tip of the iron rod (Figure 1) at one end of the Iron rod there is Tono who is preparing to hit the Iron Rod with a hammer. Then Tono hits the Iron Ball with one stroke. In the second activity (Figure2) Bayu distances his ear from the tip, then Tono strikes the Ironball with one knock. The most appropriate statement for these two activities is...

A. Bayu didn't hear the sound of the iron rod that Tono hit
B. Bayu heard the sound of the iron rod that Tono hit through the air and through the steel rod
C. Bayu heard the sound of the iron rod hit by Tono through the air
D. Bayu didn't clearly hear the sound of the iron rod that Tono hit

(2). Reason:

A. The iron rod is a medium that can slow down sound. The energy on the sound is transferred as the energy of the vibration on the particles of the iron rod
B. The resulting sound passes through the air, so the iron rod does not affect the sound retardation. The air particles vibrated when the sound crashed in the air while the iron-barrel-building particles did not vibrate
C. The sound that creeps through the iron rod is heard more clearly than it creeps in the air because the arrangement of iron rod particles is closer than the air and the closer the arrangements of particles of a medium, the faster the sound creeps.

(3). Confidence level:

A. Sure
B. Not sure

Figure 15. Question number 13 (Yaqin, 2018)

The student's misconception on the noise retardation medium indicator is that solid particles cannot delay sound. The concept is not consistent with the scientific concept. The true concept is that sound can pass through several media, such as solid, liquid, and gas (Purba, 2021). This is because sound is a mechanical wave that requires a medium in its intersection. The speed of energy transfer in the medium is influenced by the density of the medium. Large density medium causes the speed of the sound retreat to get faster and faster. Based on the media's successive speeds of solid substances, liquid substances and gases.

Concept of Sound Waves

The concept of sound waves is about the influence of the medium density on the rapid decline of sound. The level of understanding of the concept of sound waves can be seen in Figure 16.

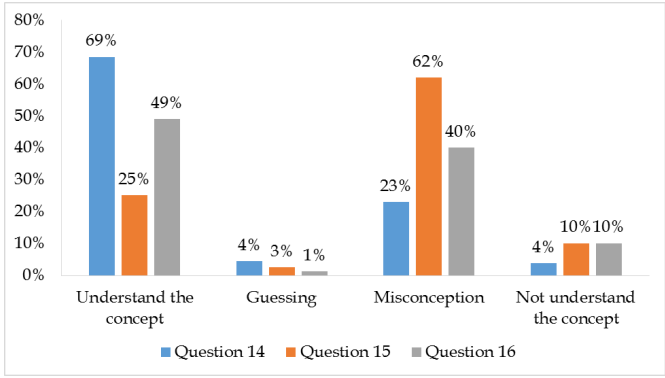


Figure 16. Percentage of understanding of sound wave concepts

Based on Figure 16, it was found that students understood the concept on question number 14 by 69% about the influence of medium density on rapid sound retardation. Question number 14 is shown in Figure 17.

(1). Tania plays the song on her personal phone with the same volume, when at night the sound of the song is clearer than during the day. Based on these observations, it can be concluded that...

A. The air density at night is stronger than during the day
B. The air density at night is closer than during the day
C. The air density at night is the same as the density during the day
D. The air waves slow down faster during the day than at night

(2) Reason:

A. The closer the medium to the sound, the faster the sound slows.
B. The louder the medium of sound, the faster the sound slows
C. The air is the best medium of sound at night
D. The air is the medium of bad noise during the day

(3). Confidence level:

A. Sure
B. Not sure

Figure 17. Question number 14 (Rahayuningsih, 2021)

The misconception identified on the sound wave concept indicator is the number 15 question that obtains the greatest misconception of 62% about solid matter as a sound suppression medium. Question number 15 is shown as in Figure 18.

Question number 15 aims to determine the sound that is heard when the airspace increases. The misconception experienced by students on the sound wave concept indicator is that small airspaces result in lower sound. The student's concepts do not match the scientific concepts. The true concept is that large airspaces result in lower sound (Desstya et al., 2020). It's because the distance between the scratches is increasing.

(1). Luna wanted to make an orange ice cream in a steak for her friends, she made an oregano ice cream from the mineral water in a large bottle poured into the steak.When the water is poured out, there's a sound of "gluuug... gluuug..." until the water in the big bottle is exhausted. When the bottle becomes empty the loud sound will...

A. Sounded louder than the previous sound
B. Sounds lower than the previous sound
C. Sounds the same as before
D. No more sound

(2) Reason:

A. As the water flows out, the air space inside the bottle increases, resulting in a widening of the gap between the scratches
B. As the water flows out, the air space within the bottle decreases so that the distance between the scratches gets closer
C. As the water flows out, the noise crashes through the bottle and the air, increasing the frequency of the sound
D. The less water the lower the frequency of sound

(3). Confidence level:

A. Sure
B. Not sure

Figure 18. Question number 15 (Rahayuningsih, 2021)

Conclusion

Conclusions can be drawn based on research and discussion. The result of the study was a student's misunderstanding of the vibration indicator being in the low category, whereas the wave magnitude indicator, wave movement, rapid wave retardation, medium sound retardance, and sound wave are in the medium category. The study concluded that the percentage of high school students in Koto Tangah district who suffered from misconceptions of vibration, wave, and sound material was 44% 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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