

Analysis of the Difficulty of Understanding the Concepts of Vibration and Waves of Students Junior High School

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ABSTRACT

This research starts from the problem of low student physics learning outcomes. This is because students have difficulty understanding the concept, because it is also necessary to analyze the difficulties. The purpose of this study was to find out what forms of difficulties were experienced by students at each stage of students' abilities in understanding the concepts of vibration and waves, which difficulties at which stages of student ability were most dominantly experienced by students in the concept of vibrations and waves, and difficulties experienced by students in solving math problems. The subjects of this study were 32 students of class VIII SMP Negeri 2 Way Seputih to determine the sample using the cluster random sampling method. based on the analysis it can be concluded that the forms of difficulties experienced by students at the student's ability stage, the most dominant difficulty is at the C6 stage with a percentage of 100%, and the percentage of difficulties experienced by students in working on calculation questions is 60%. It can be seen the forms of difficulties experienced by students, so to overcome these difficulties the teacher should familiarize students more with solving their respective practice questions, especially questions of understanding and application.

Keywords: *learning difficulties, conceptual understanding, physics.*

INTRODUCTION

Education is the process of transferring knowledge, understanding, and appreciation. Education is one of the efforts or ways to education a nation's future generations to conceive knowledge and technology and skills that might prepare them to live among the society (Arwudarachman, et al., 2015). Education is a crucial thing, education also creates knowledgeable and broad-minded generations with the help of technological growth (Arwudarachman, et al., 2015; Yaumi, 2018; Aththibby, et al, 2022). Learning is an interaction process of students with teachers and learning sources in a learning environment. Learning is a support given by educators to create a process of knowledge acquisition, mastery of skills and characters, and an establishment of attitude and trust in students. Learning activities are arranged to help individuals to have capabilities and competencies deliberately designed to facilitate the course of active and efficient learning process in students (Pribadi in Hadi, 2016).

Physics is one of the branches of science or natural science which studies about natural phenomena using scientific methods acquired from studies or outcome of thoughts. Teaching materials are a set of learning materials based on the curriculum used in an effort to achieve the pre-determined standard of basic competencies

(Lestari, 2013). Teaching materials which are designed comprehensively—in the sense that there are elements of media and adequate teaching materials—will affect the learning atmosphere, causing the ongoing learning process in students to be more optimal. In principle, module is a teaching material arranged systematically with a language that is easy to understand by students in accordance with their ages and levels of knowledge, so they can learn independently with a minimum support or guidance from teachers (Prastowo, 2015). Module is a self-instructional learning material which only contains one learning subject. Module might create a learning process to be more interesting, more interactive, and capable of giving messages in a learning material, can be in the form of facts, concepts, and procedures.

The utilization of media is aimed to motivate students. The media used must have requirements and criteria to be compatible with the learning purposes. Learning media are media used frequently during the learning process as the conveyor of messages between teachers and students to achieve teaching purposes (Mais, 2018). Virtual laboratory can be defined as a laboratory that might embody abstract concepts into visualization with the support of technology. Substantiated by the statement of (Rosdiana, et al., 2019), it is stated that virtual laboratory allows students to learn comfortably because the instruments and materials are simulated into a computer to make them less dangerous. The calculation results of experiment data that use virtual laboratory are more valid and proper, therefore, it will be easier to understand the presented concepts.

MATERIALS & METHODS

This research is a descriptive qualitative research, which is a type of research conducted to analyze students' understanding difficulties in class VIII vibration and wave material, without making changes, additions or manipulation of existing data. In this

study, we wanted to analyze the difficulties experienced by students in understanding the concept of the subject matter of vibrations and waves in class VIII students of SMP Negeri 2 Way Seputih, Central Lampung.

The sample in this study was taken based on the cluster random sampling technique, namely the sampling technique by means of 5 classes, 1 class was taken as the sample. Sampling of 1 class was carried out randomly because researchers considered all populations to be the same or homogeneous. Write down the class names on a piece of paper then roll and shuffle it until 1 class is selected as the sample.

This study used an essay test instrument which was arranged based on the material that had been taught to measure the assessment of the cognitive domain. To obtain valid and reliable data measurement results, expert tests and field tests were carried out first to determine the level of validity and reliability of measuring instruments. After the necessary data is collected through the test method then the data is analyzed. Data analysis was carried out by presenting data and drawing conclusions.

RESULT

Every learning activity will produce changes in oneself which include cognitive, affective and psychomotor aspects (Bukhteeva et.al., 2019; Savall et.al., 2019). The term achievement according to various sources is interpreted as evidence of the success achieved from the activities that have been carried out. The domain includes the ability to restate concepts or principles that have been learned, which relate to thinking skills, competence to acquire knowledge, recognition, understanding, conceptualization, determination and reasoning. Forms of difficulties experienced by students at each stage of ability to solve vibration and wave problems (Sopandi, Permanasari & Pursitasari, 2022; Afifah & Ellianawati, 2019).

Table 1. Forms of Difficulties Experienced by Students at Each Stage of Students' Ability to Solve Vibration and Wave Problems.

No	Ability stage	Form of difficulty	Percentage of forms of difficulties experienced by students (%)	Average (%)
1.	C1	Students have difficulty remembering the meaning of vibration and waves. a. Students have difficulty in remembering the notion of vibration b. Students have difficulty in remembering the notion of waves	75 100	87,5
2.	C2	Students experience difficulties in explaining the meaning of the frequency and period of a vibration and its units a. Students have difficulty in describing the frequency of vibrations. b. Students experience difficulties in explaining the frequency unit of a vibration c. Students have difficulty in describing the period of a vibration. d. Students experience difficulties in explaining the unit period of a vibration. e. Students experience difficulties in distinguishing the types of waves based on the propagation medium	44 3 44 9 100	40
3.	C3	Students experience difficulties in determining the formula for calculating the period of a vibration and the speed of wave propagation and its units: a. Students have difficulty in determining known quantities. b. Students have difficulty in applying the formula to calculate the period of a vibration. c. Students have difficulty in using units of a quantity. d. Students have difficulty remembering and writing down the formula for calculating the speed of wave propagation.	19 22 100 41	45
4.	C4	Students experience difficulties in analyzing questions on the vibration sub-material.	50	50
5.	C5	Students experience difficulties in measuring the frequency of vibrations, the number of vibrations and the frequency of waves.	47	47
6.	C6	Students experience difficulties in clarifying the number of vibrations shown in the picture and looking for periods and frequencies or vibrations.	100	100

From table 1. it can be seen the forms of difficulties experienced by students at each stage of student ability, the most dominant difficulties experienced by students, and the percentage of student difficulties in solving calculation questions.

1. Ability stage C1

At the ability stage C1, the percentage of students who experience errors/difficulties in each form of error is:

- Students have difficulty remembering the meaning of vibration is 75%. This difficulty is in question number 1.
- Students have difficulty remembering the meaning of the wave is 100%. This difficulty is found in question number 7.

Thus, the average percentage of errors/difficulties in understanding the concepts of Vibrations and Waves

experienced by students at stage C1 is 87.5%. The dominant difficulty experienced by students at the C1 ability stage, namely in question no 7, is that students have difficulty remembering the meaning of waves, namely with a percentage of 100%.

Students have difficulty remembering the meaning of vibration as requested in the problem. This form of error/difficulty occurred in question no 1 (Figure 1). In this question students were asked to explain the meaning of vibration. The form of the student's answer that describes this situation is:

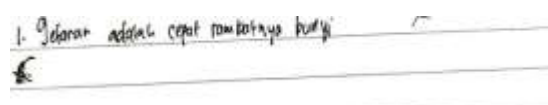


Figure 1. Student's Answer Questions 1

The correct answer to this question is: vibration is the periodic back and forth movement of an object through an equilibrium point. The difficulties experienced by students were caused by students not being able to recall the concepts/material that had been presented by the teacher. The percentage of the number of students who experienced this error/difficulty was 75%, namely 24 students. The difficulties experienced by students were caused by students not being able to recall the concepts/material that had been presented by the teacher. The percentage of the number of students who experienced this error/difficulty was 100%, namely 32 students.

2. ability stage C2

At the C2 ability stage, the percentage of students who experience difficulties in each form of difficulty is:

- a. Students experience difficulties in explaining the meaning of the frequency of a vibration. The percentage of students who experience these difficulties is 44%. This difficulty is found in question number 2.
- b. Students experience difficulties in explaining the unit of frequency. The percentage of students who experience these difficulties is 3%. This difficulty is found in question number 2.
- c. Students experience difficulties in explaining the meaning of the period of a vibration. The percentage of students who experience these difficulties is 44%. This difficulty is found in question number 2.
- d. Students experience difficulties in explaining the unit of the period. The percentage of students who experience these difficulties is 9%. This difficulty is found in question number 2.
- e. Students experience difficulties in distinguishing the types of waves based on the propagation medium. The percentage of students who experience these difficulties is 100%. This difficulty is found in question number 8.

Thus, the average percentage of difficulties in understanding the concept of Vibration and Waves experienced by students at the C2 level is 40%. The dominant difficulty experienced by students at the C2 ability stage occurred in question no. 8, namely students having difficulty distinguishing the types of waves based on the propagation medium, namely with a percentage of 100%.

3. ability stage C3

At the C3 ability stage the percentage of students who experience difficulties in each form of difficulty is:

- a. Students have difficulty in determining the amount that is known. The percentage of students who experience these difficulties is 19%. This difficulty is found in question number 3.
- b. Students experience difficulties in applying the formula to find the period of a vibration. The percentage of students who experience these difficulties is 22%. This difficulty is found in question number 3.
- c. Students experience difficulties in using units of a quantity. The percentage of students who experience these difficulties is 100%. This difficulty is found in question number 3.
- d. Students do not know the formula used to find the speed of wave propagation. The percentage of students who experience these difficulties is 41%. This difficulty is found in question number 9.

Thus, the average percentage of difficulties in understanding the concept of Vibrations and Waves experienced by students at the C3 stage is 45%. The dominant difficulty experienced by students at the C3 ability stage occurred in question no 3, namely students having difficulty using units of a quantity, namely with a percentage of 100%.

4. ability stage C4

At this level, students are asked to decompose information into several parts, find assumptions, and distinguish opinions and facts and find causal relationships. At the

C4 ability stage there is question no 4, students experience difficulty in analyzing questions on the vibration sub-material with a percentage of 50%.

5. ability stage C5

At this level, synthesis is defined as the ability to produce and combine elements to form a unique structure. This capability can be in the form of producing unique communications, complete plans or activities, and abstract sets of relationships. At this level, students are required to produce their own hypothesis or theory by combining various sciences and knowledge. At the C5 stage of ability found in questions no. 5 and 10, students have difficulty in measuring the frequency of vibrations, the number of vibrations and the frequency of waves with a percentage of 47%.

Students experience difficulties in choosing the formula to be used. This form of difficulty occurs in questions no. 5 and 10. In question no. 5 students are asked to count the frequency of vibrations and the number of vibrations. The form of the student's answer that describes this situation is:

The image shows a student's handwritten solution for question 5. The text is written on lined paper and includes the following:

S. ADIKOT $T : \frac{1}{2}$ detik : 0,5 s
 $n : 300$ kali : 300 s
Ditanya $F \dots ?$
Jawab $F : T \cdot n$
 $: 0,5 \cdot 300$
 $: 150 \text{ Hz}$

Figure 2. student's answer questions 5

The percentage of students who experience this difficulty is as much as 100%, namely 32 students. In problem no 10 students are asked to calculate the frequency of the wave. The percentage of students who experience this difficulty is as much as 31%, namely 10 students.

6. ability level C6.

At the C6 ability stage found in question no 6, students have difficulty clarifying the number of vibrations shown in the picture

and looking for the period and frequency of a vibration. The percentage of students who have difficulty at this level of ability is 100%. The forms of difficulties experienced by students at this stage of ability are:

- 1) Students have difficulty writing down known quantities.
- 2) Students have difficulty in choosing the formula used.
- 3) Students do not use the completion stage properly.
- 4) Students have difficulty in writing units.

These forms of difficulty occur because students pay less attention to the teacher's explanation of the concept of vibration and waves, students also do not understand the movement for one full vibration. In this problem, to solve it, first write down what quantities are known, namely by reading the pictures in the problem. Students have difficulty reading pictures so students have difficulty writing down known quantities and resulting in difficulties in solving this problem.

The forms of difficulties experienced by students in solving calculation questions are:

- 1) Students have difficulty writing down known quantities.
- 2) Students have difficulty in converting units.
- 3) Students have difficulty in choosing the formula used.
- 4) Students do not use the completion stage properly.
- 5) Students have difficulty in writing units.

These forms of errors are found in questions no. 4, 5, 6, and 10. In question no. 4 students are expected to calculate the number of vibrations, the percentage of students who experience this difficulty is as much as 50%. Problem no 5 students are asked to calculate the frequency and period of a vibration, the percentage of students who experience this difficulty is 74%. Question no 6 students are asked to calculate the frequency and period of a vibration from reading the pictures in the problem, the percentage of students who experience this difficulty is 100%. In

question no 10 students were asked to calculate the frequency of the waves, the percentage of students who experienced difficulties was 14%. So the average percentage of students who have difficulty solving math problems is 60%.

Understanding a physics concept is closely related to solving calculation problems. The concept of physics in this study is the concept of vibration and waves. This can be seen from the results of student tests on questions no. 4, 5, 6, and 10. Questions no. 4, 5, and 6 are included in the vibration sub-chapter, and question no. 10 is included in the wave sub-chapter. In the vibration sub-chapter (questions no. 4, 5, and 6) students are asked to count the number of vibrations, vibration frequency and period of vibration, and in the wave sub-chapter (question no. 10) students are asked to count the frequency of a wave, but in answering the calculation questions In this case, students experience difficulties, namely that students have difficulty writing down known quantities, difficulties in converting units, and students do not know what formula to use in solving the problem. The difficulties experienced by students in solving math problems were caused by students not understanding the material presented by the subject teacher, besides that students were also not careful in carrying out mathematical arithmetic operations. So understanding the concept of physics has something to do with solving math problems. If students do not understand the concept, students will have difficulty solving math problems on that material. For example, in question no 10, if students do not understand the meaning of frequency, period, wavelength and wave speed, then students do not know what quantities are known and what formula is used, so students will have difficulty solving problem no 10, namely calculating wave frequency. Therefore, understanding a concept is very important in solving math problems.

CONCLUSION

The most dominant difficulty experienced by students in understanding the concept of

vibration and waves is at the stage of C6 ability. The percentage of difficulties experienced by students at the C6 stage is 100%. Percentage of students who have difficulty working on calculation questions. Many students experience difficulties in solving math problems with a percentage of 60%. The link between understanding the concept and solving calculation questions is that understanding the concept becomes the basis for solving calculation questions. If students do not understand certain concepts (vibrations and waves) then these students will experience difficulties in solving math problems related to these concepts (vibrations and waves).

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