Identifying the Misconception of Sound Concepts among Grade V Students at SDN 192 Pekanbaru

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Abstract. The present study was carried out to identify the misconception of sound properties among elementary school students. Conducted through descriptive quantitative, there were 69 students of fifth grade of Public Elementary School 192 Pekanbaru as the chosen sample. The instrument used was a Four Tier Test diagnostic test and interviews related to misconceptions. Based on the results obtained in this line of study, it was figured out that the level of students' understanding on the sound characteristics was 56.16%. The results of this study indicated that the causes of misconceptions in students come from the students' understanding, low student retention, wrong intuitions, teacher learning methods, and reference books.

Keywords: misconceptions, sound characteristics, four tier tests

1. Introduction

Nowadays, misconception is one of the most widely studied areas, especially in science [1], [2], [3]. Science education has a crucial role in the development of a critical society in the era of rapidly changing technology [4],[5]. And therefore, it cannot be denied that technology has a close relationship with science considering that technology is the application of science. In addition, according to Hermita [4] science education is one of important subjects to be instilled for students, because through science learning students can understand the surrounding environment and be able to solve the problems they encounter related to science learning. Science has different characteristics from other knowledge, in science, then, the empirically direct observation of nature is important. Thus science education plays an important role in preparing superior human resources and possessing both soft skills and hard skills.

To prepare superior human resources and possess these skills, competent educators are highly necessary because during the learning process in the classroom teachers have notably important role in facilitating students in gaining as much knowledge as possible from various learning resources. Yet the facts found in the field in science learning, teachers do not provide opportunities for students to receive knowledge from various sources, however only from the teacher centered view. This causes misunderstandings and misconceptions among the students.

According to Hermita [3] misconceptions are resistant to new knowledge or concepts, this becomes an obstacle for students in learning and makes insights that are not meaningful to students in some scientific concepts. And therefore, during the learning process students are not able to understand the concepts they learn and learning objectives will not be achieved. For such obvious reason, misconceptions that occur in students shall be addressed immediately.

Misconceptions that occur in students can be caused by students' initial knowledge, daily experiences, and language, culture, teachers, textbooks and teaching methods [2]. Based on the causes
of misconceptions, it is probable that misconceptions can occur at all levels of education and at any concept in science, for example at the elementary school level, misconceptions can occur at the concept of voice transmission [7] and at the concept of water change [8]. Whereas in high school misconceptions occur in the concept of chemical bonds [9] and the concept of classification of matter and its changes [10, 11]. And in Higher Education misconceptions occur in the concept of birds [12] and the concept of static electricity [2]. With the occurrence of misconceptions at all levels of education, it is necessary to do remediation and detection of misconceptions early on students.

Detection that can be conducted to overcome misconceptions that occur in students can use diagnostic instruments such as four tier test [1], [7]. This four-tier test is a refinement of the existing three-tier test [2]. Three tier test which is also the development of two tier tests [6] at the first level is an objective problem with four answer choices, the second level is the belief in the choice of answers at the first level and at the third level is the reason for choosing answers at the first level. And in the four tier test added the level of confidence in choosing reasons that are at the third level.

2. Methodology

2.1 Research methods
To investigate the matter, the present study utilized descriptive research with a quantitative approach. Thus, the results of this study are descriptions of the quantity of students who experience misconceptions on the material of sound properties. The population in this study was grade V students at SD Negeri 192 Pekanbaru. The data collection technique in this study is total sampling which means that the number of samples is equal to the total population. The numbers of samples in this study were 69 students. The sample was given a diagnostic test in the form of a four tier test.

2.2 Data analysis technique
The research instrument in this study was a four tier diagnostic test instrument in the form of multiple choice questions with 15 questions. The results of students’ answers on the test instruments were then analyzed using Table 1 and grouped in the concepts of conceptual understanding (CU), not understanding concepts (NUC), misconceptions (M) and error (E).

| Tier 1 | Tier 2 | Tier 3 | Tier 4 | Category |
|--------|--------|--------|--------|----------|
| Correct| Sure   | Correct| Sure   | Understand the concept |
| Correct| Sure   | Correct| Not sure| Not understand the concept |
| Correct| Not sure| Correct| Sure   |
| Correct| Not sure| Correct| Not sure| |
| Correct| Not sure| Incorrect| Not sure| |
| Incorrect| Sure | Correct| Not sure| |
| Incorrect| Sure | Incorrect| Not sure| |
| Incorrect| Not sure| Correct| Not sure| |
| Incorrect| Not sure| Incorrect| Not sure| |
| Correct| Sure | Incorrect| Sure | Misconception |
| Correct| Not sure| Incorrect| Sure | |
| Salah| Sure | Incorrect| Sure | |
| Salah| Not sure| Incorrect| Sure | |
| Incorrect| Sure | Correct| Sure | Error |
3. Results and Discussion
Misconceptions about the material of sound properties occur in several concepts. The following is the distribution of the form of misconceptions of sound characteristics as in Table 2 below:

| Concept Number | Concept                                | Misconception                                                      |
|----------------|----------------------------------------|-------------------------------------------------------------------|
| Concept 1      | Reflection on sound waves               | Noises are always heard in every room                             |
| Concept 2      | Diffraction or flexing in sound waves   | TV sound that lights up in the living room is only heard in the room|
| Concept 3      | Refraction or refraction on sound waves | The sound will be louder during the day than at night              |
| Concept 4      | Interference or fusion of sound waves   | Musical instruments played simultaneously will produce different frequencies and amplitudes |
| Concept 5      | Resonance in sound waves                | The sound produced by a musical instrument comes from a closed hole|
| Concept 6      | Animals that use sound waves as a navigation tool | Bats can move at night using their eyes.                         |
| Concept 7      | Changes in sound frequency due to a moving sound source | The sound of sirens heard from vehicles such as ambulances has the same frequency when we hear it |
| Concept 8      | Sound produced due to differences in air pressure | The sound of a balloon bursting comes from the hole in the balloon |

Based on the results of students' answers on the four-tier test instrument and analysed using the four-tier-test decision, a description of the percentage of students who misconceptions of the material sound characteristics is presented as shown in Figure 1 below:

![Figure 1. Percentage of students' understanding of the concept of sound properties](image)

Based on the level of misconception of 56.16%, Figure 2 displayed the percentage of students who experience misconceptions of each concept on the concept of sound properties.
Thus it can be seen that students experience the highest percentage of misconceptions in concept 8 which means that there are 45 out of 69 students who experience misconceptions in this concept. The following Figure 3 presents the answers of students who experience misconceptions (M) based on the four tier test answer category on concept 8.

In concept 8 about the sound produced due to differences in air pressure, all students who experienced misconceptions with the number of 45 students in tier 3 namely the reasons for choosing tier 1 had the wrong answer and in tier 4 namely the level of confidence in choosing tier 3 all also answered confidently. Hence, based on the answers of these students, it can be seen that students do not recognize the reasons for choosing answers to the tier 1. This is caused by the lack of information obtained by students about the concept. This is because teachers who act as people who transfer knowledge to their students do not have good knowledge about the concepts taught to students and teachers also do not optimize their ability to teach as using appropriate teaching methods.

Furthermore student retention [12] is low, this can be seen in interviews that have been conducted on students who experience misconceptions that they cannot remember what material they has learned and students’ feelings are wrong because of this answer can be seen that most students answer by guessing because they don't know the reason for choosing the answer.

Based on the description above in the process of learning science it is better to approach the scientific process and method, and in turns, students understand what they are learning so that learning becomes meaningful to students so as to reduce misunderstandings that occur in students.
4. Conclusion
Based on results of the identification and analysis of student misconception data on the concept of sound changes, it can be concluded that there is a misconception among grade V students at SD 192 Pekanbaru with a percentage of 56.16%.

Students experience the greatest misconception with a percentage of 65.22% in concept 8 on the sound changes produced due to differences in air pressure. The student's answer to this concept is that the sound produced by a balloon blown to burst is due to a hole in the balloon. Moreover, concept 6 with a percentage of 60.86% of animals that use sound waves as a navigation tool. The student answers to this concept that bats are like other animals that see by using their eyes to find out where prey or objects are around.

Reference
[1] Hermita N, Alpusari M, Noviana E, Kurniawan O, Widyanthi A and Suhandi A 2019 A Study of Prospective Primary School Teachers’ Alternatif Conception in Heat and Temperature Journal of Physics: Conference Series 1351
[2] Hermita N, Suhandi A, Syaodih E, Samsudin A, Isjoni, Johan H and Safitri D 2017 Constructing and Implementing a Four Tier Test about Static Electricity to Diagnose Pre-service Elementary School Teacher’ Misconceptions Journal of Physics: Conference Series 895
[3] Hermita N, Suhandi A, Syaodih E, Samsudin A, Marhadi H, Sapriadi S and Wibowo F C 2018 Level conceptual change pre-service elementary teachers on electric current conceptions through visual multimedia supported concept Journal of Physics: Conference Series 1013
[4] Azriani N, Islami N, Hermita N, Nor M, Syaodih E, Handayani H and Samsudin A 2019 Implementing inquiry learning model to improve primary school students’ critical thinking on earth and universe concept Journal of Physics: Conference 1227
[5] Hermita N, Dewi R, Alpusari M, Noviana E, Kurniawan O, Antosa Z and Putra E D 2019 Improvement of Elementary School Critical Thinking Skills Through the POE Learning Model (Predict-Observe-Explain) on Natural Resource Material Journal of Physics: Conference Series 1351
[6] Sozen M and Mualla B 2011 Determining the misconceptions of primary school students related to sound transmission through drawing Procedia Social and Behavioral Sciences 15 1060-1066
[7] Boo K H 2006 Primary science assessment item setters’ misconceptions concerning the state changes of water Asia-Pacific Forum on Science Learning and Teaching 7(1)
[8] Ozmen H 2004 Some Student Misconceptions in Chemistry: A Literature Review of Chemical Bonding Journal of Science Education and Technology 13(2) 147-155
[9] Cahyanto M, Ashadi A and Saputro S 2019 An analysis of gender difference on students’ misconceptions in learning the material classification and its changes Jurnal Inovasi Pendidikan IPA 5(2) 157-167
[10] Cardak O 2009 Science students’ misconceptions about birds scientific Research and Essay 4(2) 1518-1522
[11] Ridzuan R, and Iksan ZH 2017 The Effectiveness of Using Coloured Blocks in Teaching the Concept of Balancing Chemical Equation in Chemistry Journal of Educational Sciences 1(1) 45-55
[12] Burke A 2019 Student Retention Models in Higher Education: A Literature Review American Association of Collegiate Registrars and Admissions Officers