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TEACHING SOUND REFLECTION BY USING SOLID OBJECTS AS A REFLECTIVE MEDIUM FOR STUDENTS WITH DEAF AND HARD OF HEARING

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Abstract

The purpose of this research was to discover the sound reflection material teaching to students who are deaf or hard of hearing by using solid objects as the reflection medium. The experimental method (pre-and post-test design) was used towards seven students who are deaf or hard of hearing ranging in age from 14 to 21 years. The oral method and experimental demonstration were used to deliver materials on sound reflection. The findings demonstrated that the material on sound reflection could be taught to students who are deaf or hard of hearing. Despite their inability to hear optimally, they understand that sound can be reflected and that there are factors that influence it. The ability of the teacher to explain the material and direct students when carrying out sound reflection experiments using tubes, classroom walls as reflective media, and sound level meters to measure the intensity of the sound source and the intensity of the reflected sound influences students' success in mastering the material. This success is greatly aided by their ability to read lip movements and perceive sounds.

Keywords: Deaf, Hard of hearing, Reflective medium, Sound reflection.

1. Introduction

Humans cannot be separated from the sounds around them in everyday life, both the sounds of human conversation and the sounds of objects. Recognizing the existence of sound is essential for all humans because sound alerts us to our surroundings. Hearing impairment, on the other hand, results in limited access, which can cause discomfort in the environment [1]. Hearing loss makes it difficult to understand spoken language and can limit a child's ability to learn and speak [2]. There are numerous definitions and classifications of hearing loss. However, in general, hearing impairment is classified as deaf or hard of hearing. Deafness refers to the inability to hear any sound, whereas hard of hearing refers to the ability to hear some sounds [3].

Students who are deaf or hard of hearing must be aware of their surroundings, as well as the sounds of equipment such as radios, music, alarms, ovens, running faucets, printers, and other devices. These things are unquestionably related to auditory awareness. Listening exercises can help. Students who are deaf or hard of hearing require listening practice to improve their listening and communication skills [4]. The hearing skills of students who are deaf or hard of hearing include integrated abilities in the areas of detection, discrimination, identification, and understanding of sound [5]. Sound properties awareness is one of the materials used in hearing training. Sound requires a medium to propagate, it can be refracted, and it can be reflected. Reflected sound is the sound produced by the reflection of a sound wave. When a sound wave strikes the surface of a hard medium, it returns to the original medium at the same angle. Reflected sound is classified into three types which are reflected sound that amplifies the original sound, reverberation, and echo.

Several studies on teaching sound to students have revealed that students have some misconceptions about sound transmission. Students are unaware that sound is heard due to reflection, and they are also unaware that when sound is transmitted, particles transfer energy in the medium by vibrating [6]. Other studies have concluded that conceptual change in sound occurs slowly and gradually, rather than as a sudden transfer of concepts [7]. Teachers use a variety of methods to improve students' understanding of sound, including written responses and oral presentations [8]. Students benefit from the implementation of a process-oriented integrated STEM design [9]. Several applications that can detect and identify what sounds are occurring and provide audio awareness for the deaf have been developed to improve sound comprehension for students who are deaf or hard of hearing [10]. According to the findings of several studies, there has been no research that discusses how to introduce sound and sound properties to students who are deaf or hard of hearing, particularly sound reflection material.

The purpose of this research was to discover how to teach sound reflection material (as one of the properties of sound) to students who are deaf or hard of hearing by using solid objects as a reflection medium. The properties of sound need to be taught to Deaf and Hard of Hearing students as the basis for hearing exercises. The experimental method (pre-and post-test design) was used on seven students who are deaf or hard of hearing and attend a special school for the deaf. The oral method and experimental demonstration were used to deliver materials on sound reflection. The difficult subject matter can be taught to students who are deaf or hard of hearing by utilizing the delivery method (combination of speaking,

repetition, and listening), a combination of demonstration experiments, and the most efficient modification of strategies and media [11-13].

2. Method

This study included seven students who are deaf or hard of hearing ranging in age from 14 to 21 years. They are students from the Junior High School and the Senior High School of special school. This study employed an experimental design (pre- and post-testing) in the absence of a control group. The pretest-treatment-posttest design was used in this study. Students were given an initial test, then the material on sound reflection, and finally a final test when the treatment was completed. Students who were chosen as subjects had good sound detection abilities, allowing them to be given sound reflection material.

This research was carried out in four stages: 1) asking students several questions about understanding sound and sound reflection, 2) students were shown an example of how the process of making a sound was carried out, 3) students then conducted their sound reflection experiments using the equipment provided, and 4) students were given a post-test to assess students' understanding of the material that had been delivered. All information about data comprehension was graded on a scale of 0 (do not know) to 1 (know). The assessment of the student's attitude toward the presence of a reflected sound was given 0 (no), 1 (undecided), and 2 (yes). Students' attitudes were assessed through oral responses and expressions.

Students were asked to answer 10 questions to collect data on their understanding of the material. During the delivery of the material, the researchers observed students' attitudes and expressions when a reflected sound was produced. 4 indicators will be used to observe student attitudes. In this sound reflection experiment, the distance between the end of the pipe and the reflected medium was varied as follows: 1) 10 cm, 2) 20 cm, and 3) 30 cm. It is conducted to instil the idea that the distance between the tip of the pipe and the reflected medium influences the strength of the reflected sound. Figure 1 depicts an illustration of this activity.

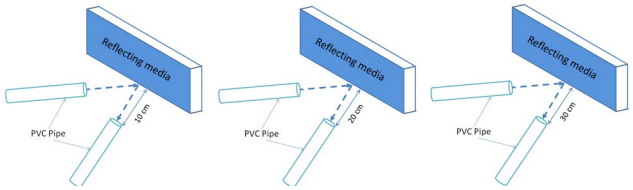

Fig. 1. Illustration of the distance between the pipe and the reflecting medium.

3. Result and Discussion

3.1. Student's demographic data

This study included seven students who are deaf or hard of hearing ranging in age from 14 to 21 years. Student A is a 20-year-old female with a 70-degree hearing loss and has good sound perception skills. She is capable of detecting, identifying, and distinguishing sounds. In Math, student A got 92 and science 85. Student B is a 17-year-old male with a hearing loss of 65 decibels. He got 86 in Maths and 85 in science. In terms of sound perception ability, student B can detect, identify, and

distinguish sounds. Student C is a 21-year-old male with a hearing loss of 60 decibels and got 86 in Maths and 80 in science. Student C, like students A and B, has good sound perception skills. Student D is a 16-year-old male with a 75-degree hearing loss. Has a good sense of hearing. Student D understands the direction of the sound, the source of the sound, and how to pronounce simple words and sentences. Student D got an 85 in Maths and a 77.5 in science. Student E is a 15-year-old male with a hearing loss of 75 decibels and got 86 in Maths and 83 in science. Student E can recognize the direction of the sound, the source of the sound, and pronounce simple words and sentences. Student F, a 16-year-old female with a hearing loss of 80 decibels. She got 84.6 in Maths and 82 in science. Student E can recognize the direction of the sound, the source of the sound, and pronounce simple words and sentences. Student G is a 14-year-old female with a hearing loss of 85 decibels and got 76 in Maths and 78 in science. Student G has good sound perception skills.

Students' scores in math and science are needed to know how students' abilities in these two subjects are because students' abilities in math and science will greatly support the implementation of sound reflection experiments. Sound reflection material is one of the topics in science subjects. Mathematical skills are needed in carrying out this sound reflection experiment. For example, in setting up a series of tools to be used in a sound reflection experiment, students must measure the exact distance and angle of the PVC pipe. All the students use total communication at school which means they use both oral communication and sign language. In Indonesia, there are two types of sign language which are Indonesian Sign Language known as *Bisindo* and Indonesian Sign Language System or *Sibi*. At school, students use *Sibi* and outside school they use *Bisindo.*

3.2. Experiment result

Sound is a longitudinal wave that travels through the air until it is detected by the listener's receptors. Vibrating objects can generate sound. Sound can be reflected, which is one of its properties (sound reflection). Sound reflection occurs when sound propagates in one medium, strikes the surface of another medium, and bounces back in another or the original direction. The law of sound reflection is the incident sound, the normal line, and the reflected sound lie in the same plane. The incidence angle equals the reflection angle (see Fig. 2).

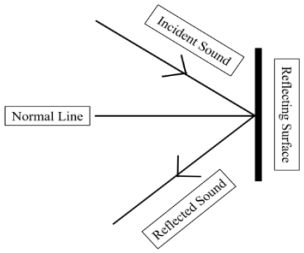

Fig. 2. The law of sound reflection.

The angle of incidence is the angle formed by the incident and normal sounds. The angle of reflection is the difference between the reflected and normal sound. The normal line is the perpendicular line of the reflected plane through the incident

sound's falling point [14]. If the reflected wall is close to the sound source, the reflected sound can amplify the original sound.

3.3. Teaching process

Teaching the concept of sound reflection to students who are deaf or hard of hearing requires special consideration, specifically selecting the appropriate strategies and media to ensure that the material is understood by the students. The experimentation strategy was chosen so that students who are deaf or hard of hearing could gain first-hand experience with the sound reflection process. The classroom wall serves as a reflective medium, and two PVC pipes with a length of 50 cm and a diameter of 2 inches are used. The alarm clock is chosen as the sound source. A sound level meter is required to measure the intensity of sound and can also be used to indicate that sound is present when the numbers on the sound level meter screen move.

The steps in the process of the sound reflection experiment are as follow:

(i) Set up the equipment to be used in a quiet or soundproof room.
(ii) Explain to students the function of each tool.
(iii) Explain the process of the experiment.
(iv) Turn on the alarm clock and ask the student to detect that there is a sound produced by the alarm clock.
(v) Put the student's ear on the end of the pipe that has the sound level meter.
(vi) Ask the student if she/he can hear the reflected sound at the end of the pipe with the sound level meter on it.
(vii) The student can detect sound by looking at the sound level meter. If the sound level meter moves, this indicates that there is sound.
(viii) Do experiments A and B alternately. Experiment A will produce a reflected sound. Experiment B does not produce a reflected sound. Explain to students why this can happen ,see Fig. 3.
(ix) When students conduct these experiments, pay close attention to their facial expressions.

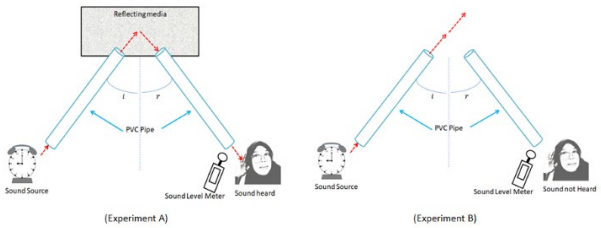

Fig. 3. The process of sound reflection experiment, using the classroom wall as a reflecting medium (Experiment A) and the process of sound monitoring experiment, without using reflected media (Experiment B).

3.4. Sound reflection taught to subjects

Table 1 shows the student's understanding of sound reflection before and after the activity. Before the activity, all students received 0 on all questions. Students did not understand the concept of sound reflection. Following the completion of the

sound reflection experiment, students' understanding of the concept of sound reflection improved.

After the activity, students A, B and C got 1 for questions 1, 2, 3, 4, 5, 6, and 7. And 0 for question 8. Students A, B, and C understood that if the sound source was at the end of the pipe, the subject understands that sound could be reflected, that the cause of sound could be reflected, that the cause of the frequency produced was weak and some were strong, and that the size of the two pipes and the angle must be the same. Students were also aware that if there was no reflective medium, the reflected sound could not be heard. However, students are still unsure about understanding the frequency of the sound source before and after the reflection process. Students D and E, after the activity, got 1 for questions 1, 2, 3, 4, and 7. However, they got 0 for the question "Why must the two pipes have the same size?", "Why must the angles of the two pipes be the same?" and the question "Is the frequency of the sound source as strong as the frequency produced". Students D and E responded hesitantly, stating that they did not know. Students F and G, could understand the questions about "Can sound be heard at the end of the pipe?", "Can sound be reflected?", " What causes reflected sound?", and the question " Why is the sound not heard if there is no reflecting medium?" Both students were unaware of the relationship between sound reflection and frequency, pipe size, and pipe angle.

Table 1. Comparison of subject.

Question	Student													
	A		B		C		D		E		F		G	
	W0	W	W0	W	W0	W	W0	W	W0	W	W0	W	W0	W
Can a sound be heard at the end of the pipe?	0	1	0	1	0	1	0	1	0	1	0	1	0	1
Can sound be reflected?	0	1	0	1	0	1	0	1	0	1	0	1	0	1
What causes reflected sound?	0	1	0	1	0	1	0	1	0	1	0	1	0	1
What causes the resulting frequency to be weak and some are strong?	0	1	0	1	0	1	0	1	0	1	0	0	0	0
Why must the two pipes have the same size?	0	1	0	1	0	1	0	0	0	0	0	0	0	0
Why must the angles of the two pipes be the same?	0	1	0	1	0	1	0	0	0	0	0	0	0	0
Why is the sound not heard if there is no reflecting medium?	0	1	0	1	0	1	0	1	0	1	0	1	0	1
Is the frequency of the sound source the same as the frequency produced after the reflection process?	0	0	0	0	0	0	0	0	0	0	0	0	0	0

3.5. Student's sound awareness

Table 2 describes students' attitudes and expressions when there was a reflected sound produced during the delivery of the material. For all items observed, students A, B, C, D, and E displayed attitudes and expressions with a value of 2. Table 2 describes students' attitudes and expressions when a reflected sound was produced

during material delivery. Students A, B, C, D, and E displayed attitudes or expressions with a value of 2 for all items observed. Students F and G only received 2 on two items, which are paying attention when the material was delivered and following instructions during the experiment. Students got 1 for showing a doubtful expression when detecting the presence of a reflected sound when there were reflective media and realizing that there was no sound when there was no reflected medium. This is because the level of hearing loss is quite severe.

Table 2. Student's sound awareness.

Things to observe	Subject						
	A	**B**	**C**	**D**	**E**	**F**	**G**
Students pay attention when the material is delivered	2	2	2	2	2	2	2
Students follow instructions during the experiment	2	2	2	2	2	2	2
Students can identify the presence of a reflected sound when there is a reflected medium	2	2	2	2	2	1	1
Students know that there is no sound when there is no reflected medium	2	2	2	2	2	1	1

4. Conclusion

Based on the findings of this study, it is possible to conclude that the material on sound reflection can be applied to students who are deaf or hard of hearing, even if they have hearing loss. Using appropriate methods and media for students who are deaf or hard of hearing, a simple experiment allows material (which requires hearing) to be taught to students who are deaf or hard of hearing. The teacher's ability to explain the material and direct students when carrying out sound reflection experiments using PVC tubes/pipes, solid objects (in this case, the classroom wall) as a reflecting medium, and a sound level meter to measure the intensity of the sound source and the intensity of the reflected sound influences students' mastery of the material. The ability to read lip movements and perceive sounds, which they already have, are very helpful in this success. This sound reflection experiment, if repeated regularly, can train students' auditory awareness. It is hoped that more research on sound reflection will be conducted on students who are deaf or hard of hearing in the future so that students can continue to improve their sound abilities.

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