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IMPROVING UNDERSTANDING PERFORMANCE OF STUDENTS WITH HEARING IMPAIRMENTS ON STATIC FLUID DENSITY THROUGH EXPERIMENTAL DEMONSTRATIONS

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Abstract

The purpose of this study was to improve students' understanding performance of static fluid density and to explain experimental demonstrations to students with hearing impairments. Results of this study show an increase in learning outcomes in understanding the theory of static fluid density, and students were more motivated and active during the learning process. In addition, students showed improvement in vocabulary, sentence composition, and understanding abstract concepts. This study used a single-subject approach, involving three students with hearing impairments in special high schools. The experimental demonstration provided a concrete and structured explanation of the density of fluids. The model show that each fluid has a different density (dishwashing liquid, water, and coconut oil). This method has an impact on new and meaningful learning experiences in learning abstract concepts in students with hearing impairments.

Keywords: Experiment demonstration, Special education, Static fluid density, Student with hearing impairment,

1. Introduction

Many studies on static fluid density have been conducted, including a learner-centered approach to teaching density and determining the density of the fluid using Roberval balance [1, 2]. A lot of media and methods have been conducted in order to find solutions in the teaching of static fluid. There have been many studies discussing the method, the media, and the evaluation of material density to high school students. However, it is difficult to find studies on how to teach density to students with hearing impairments at a high school level. Hearing impairment is a reduction in the ability to perceive sound which may range from slight inability to complete deafness [3]. Hearing loss happens to a person that not only it makes it difficult to communicate but also affects cognitive, behavioral, and so on because of the lack of information from the ear.

Learning about static fluid density is one of the difficult topics for students with hearing impairments. Density of an object does not depend on its size or shape in which "heavier" as applied to a substance is synonymous with "greater density" [4]. In physics, understanding and measuring density is an abstract concept to study [5] Learning science, especially physics, should not only emphasize mathematical skills, but should also concentrate on understanding physical phenomena [6].

Static fluid density material is described when an object is immersed in a liquid, there are three possibilities that occur, namely: sinking, buoyant, or floating. This situation occurs when the density of the liquid is less than the density of the object [7]. Based on the composition of the density, it is known that the density of coconut oil is more tenuous than water and dishwashing liquid. The difference in density causes the three liquids to remain separate because the denser the particle arrangement of a substance, the greater the density of the substance [8].

Teaching abstract concepts is a challenge for teachers when teaching students with hearing impairments. Different from other studies, the present study has its own novelty. There have been barely any studies on learning about density towards students with hearing impairments, teaching abstract concepts (material density) to students with hearing impairments, and that the demonstration experiments can increase learning motivation and understanding on density. Needless to say, the purpose of this study was to reveal and describe the experimental demonstration for students with hearing impairment in understanding static fluid density material.

2. Research Methods

2.1. Research subject

This study used a single subject approach on science topic on static fluid density to three students with hearing impairments. Generally, the average number of students with hearing impairment in special schools in Indonesia is five students in one class. Therefore, the number of subjects in this study were three high school students.

The materials used were dishwashing liquid produced by PT Unilever Indonesia Tbk, coconut oil produced by PT Barco, water, measuring cups, scales and stone. During the learning process, the teacher always paid attention to the direction of the face when delivering learning materials to the students with hearing impairments so that they were able to lip-read and try to listen to every word for those who had hearing impairments. In this way, the students were expected to be able to

understand the static fluid density materials. We used scores for the performance of the students, marking 1 for unable yet and 2 for able independently.

2.2. Teaching condition

Lessons were given five times and each meeting was 30 minutes and also conducted virtually. The demonstration of the density concept was given to students through short videos and images. In the learning video, there was a sign language interpreter who translated what the teacher taught. Subtitles were also added to the videos. The teacher also spoke loudly with clear articulation so that students were able to understand well. Measurement of students' understanding was carried out by pretest and posttest (paper test). Furthermore, to obtain data on students' cognitive, affective and psychomotor aspects, we used questionnaires and interviews.

2.3. Experimental demonstration procedure

Figure 1 explains how the experiment was carried.

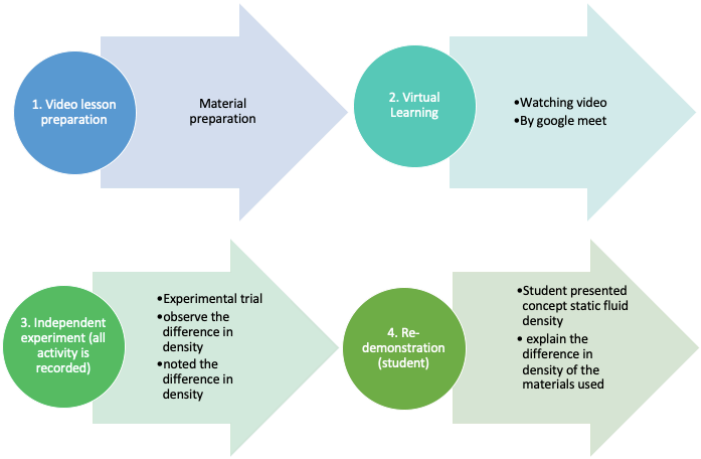

Fig. 1. Experimental procedure.

3. Result and Discussion

3.1. Experimental results

One of the quantities in the fluid is density, which is a measure of the density of an object [7]. The results of the experiment above show the difference in density between the three fluids tested. Dishwashing liquid has a density greater than water and coconut oil because dishwashing liquid has very dense particles. Besides, fluid viscosity affects the density [8]. Compared to water and coconut oil, dishwashing liquid is thicker, so it always occupies the bottom of the container.

Figure 2. shows the illustration of the experimental demonstration using several chemicals. Figures 2(a) to (d) are respectively water/coconut oil; water/dishwashing liquid; dishwashing liquid/coconut oil; and water/coconut oil/dishwashing liquid. The experiments were conducted by putting the chemicals into the system one by one. The results showed that different types of arrangements were obtained due to the density of the chemicals. The phenomena were then taught to students.

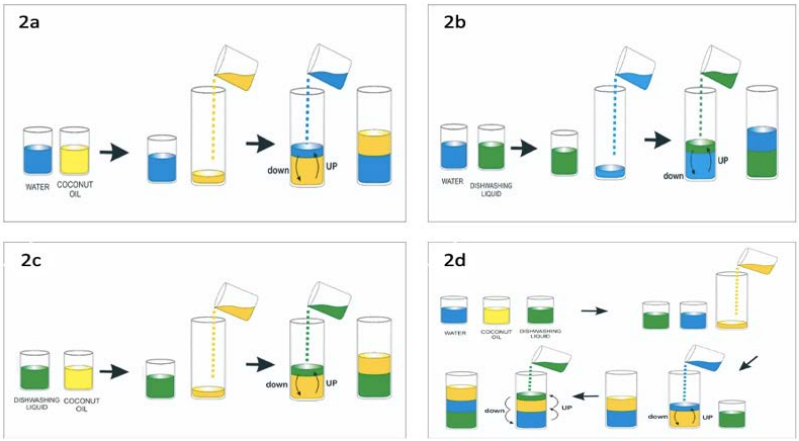

Fig. 2. Illustration of mixing chemical testing: (a) water/coconut oil; (b) water/dishwashing liquid; (c) dishwashing liquid/coconut oil; and (d) water/coconut oil/dishwashing liquid.

Figure 3. contains the photograph of images of mixing chemical testing, in which Figs. 3(a), (b), (c), and (d) are respectively water/coconut oil; water/dishwashing liquid; dishwashing liquid/coconut oil; and water/coconut oil/dishwashing liquid. As shown in the Figs, water does not mix with coconut oil. The density of water is 1,000 kg/m^3, while the density for coconut oil is 800 kg/m^3. This is in line with Fig. 3(b), where dishwashing liquid has a density of 1.110 kg/m^3, resulting it is in the bottom position of the container. Figure 3(c) describes the phenomenon of the difference in density of coconut oil and dishwashing liquid, with the greatest mass of dishwashing liquid. Figure 3(d) presents the density of the largest to lowest density in the order of dishwashing liquid, water, and coconut oil.

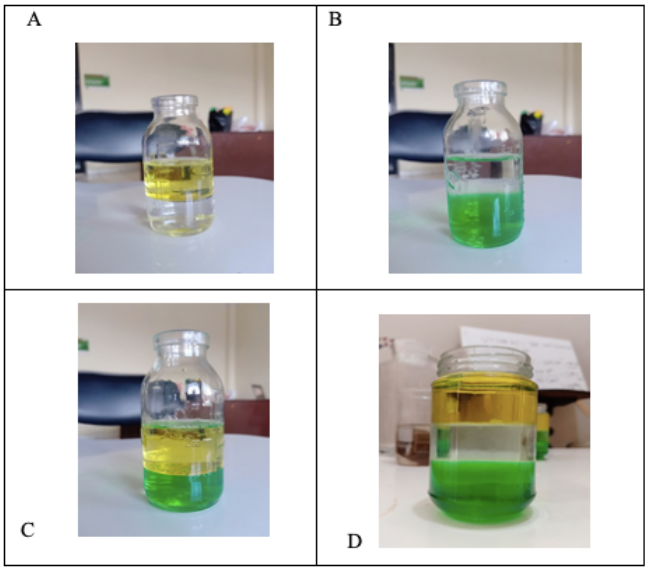

Fig. 3. The photograph of images of mixing chemical testing: (a)water/coconut oil; (b) water/dishwashing liquid; (c) dishwashing liquid/coconut oil; and (d) water/coconut oil/dishwashing liquid

3.2. Demographic data of student with hearing impairments

Table 1 shows the abilities of students including the cognitive, affective, and psychomotor abilities and their age ranges from 16-20 years old. During the learning process in the classroom, the students completed information about the needs and abilities of the students for the services to be provided [10]. The process of obtaining new information about the students requires a long process. It begins with the entry of information through sensory, followed by the process and storage of knowledge, producing knowledge, then a response [11]. Knowing students' abilities in cognitive, affective and psychomotor aspects is important in formulating learning methods that will be given to deaf students.

Knowing the cognitive, affective, and psychomotor abilities of deaf students before and after learning is very important. This process is called the ability and needs assessment [12]. In this study, two students still had hearing residue, and one student did not have hearing ability remaining. The cognitive domain ranks thinking skills according to the expected goals and the thought process describes the stages of thinking that deaf students must master to be able to apply theory into action [13]. The affective domain describes the ability of deaf students in the process of behavior, feelings, motivation, interests, and attitudes [14]. In connection with the demonstration experimental method given to them, good abilities are needed in preparation for learning, and these abilities can increase after learning is carried out. A meaningful learning experience needs to be given through structured preparation by knowing their cognitive, affective, and psychomotor aspects abilities.

Table 1. The ability of students with hearing impairments in cognitive, affective, and psychomotor aspects.

Aspects	Sub-aspects	Scores (%)					
		StA1	**St B1**	**St C1**	**St A2**	**St B2**	**St C2**
Cognitive	Knowledge	68.70	100.00	68.70	100.00	68.70	100.00
	Understanding	50.00	100.00	50.00	91.60	50.00	91.60
	Application	50.00	91.60	50.00	90.00	50.00	90.00
	Analysis	50.00	100.00	50.00	100.00	50.00	100.00
Affective	Acceptance	91.60	100.00	50.00	91.60	50.00	91.60
	Response	75.00	83.30	66.60	83.30	66.60	83.30
	Self-assessment	75.00	87.50	75.00	87.50	75.00	87.50
Psychomotor	Manage	75	87.50	50	87,.0	50	87.50
	Imitate	75	87.50	50	87.50	75	87.50
	Manipulate	50	75	50	75	50	87.50
	Experience	75	87.50	50	75	50	75
	Articulation	75	87.50	50	75	75	87.50

*A1, B1, C1= pretest score, A2, B2, C2: posttest score

Student A has better abilities in cognitive, affective and psychomotor aspects. The student uses the Indonesian national sign language (SIBI) and is also good at lipreading. Student B is able to use SIBI but is not fluent in lipreading and does not produce sound at all. In communicating, student C used his sign language instead of SIBI. Table 2. shows that the average ability of students in the sub-aspects of understanding is low because they have difficulty understanding

abstract things. First, student C showed a slight improvement by scoring 60 at the post-test. Student C also had no residual hearing. Second, students A and B still had a residual hearing. Both of them had good improvement in their scores. Student A was proficient in Indonesian Sign System.

Table 2. Analysis of the percentage of students' answer to the density of static fluid concept material being taught.

No.	Questions	Student A		Student B		Student C	
		Pre	Post	Pre	Post	Pre	Post
1	**What is a fluid?**	1	0	1	0	1	1
2	**Which of the following is a fluid?**	0	1	1	1	0	1
3	**Fluid is divided into two parts. What are they?**	1	0	1	0	1	1
4	**What is a static fluid?**	0	0	1	0	1	1
5	**What is density?**	1	1	0	1	0	0
6	**What is the difference between mass and density?**	0	1	1	1	1	0
7	**Is the density of dishwashing liquid and coconut oil different?**	0	1	1	1	0	0
8	**What happens when coconut oil and water put in the same container?**	0	1	0	1	0	1
9	**What happens if dishwashing liquid and coconut oil put in in the same tube?**	1	0	0	1	0	1
10	**When we put dishwashing liquid into water, why is it on the bottom?**	0	1	0	1	0	0
11	**When we put coconut oil and water into the same container, why is coconut oil on the top?**	1	1	1	1	0	1
12	**In physics, what formula is used to find the density of an object?**	1	1	0	1	1	1
13	**When the stone mass is 120 grams and put into 45 ml, it makes the measuring cup rises to 75 ml. Why?**	0	1	0	1	0	1
14	**A brass block is 8×5×2.5 cm. The brass block density is 8,400 kg / m^3, what is the mass of the block?**	0	1	0	1	0	1
15	**How much is the volume of aluminum in SI units! (density of aluminum is 2.5 g/m^3)**	0	1	0	1	1	1
Total Score		33.33	73.33	46.66	80	33.33	60

The results show that students have understood abstract concepts, even though it requires several repetitions. Current science teaching presents a range of difficulties for deaf students particularly when abstract concepts are delivered using a didactic approach with a reliance on textbooks [15]. Finding out whether students understand the sign language system that we use is important. Also, when writing on the board, it is best for the teacher not to speak while writing. Students with hearing impairment are called “visual learners” [16], therefore, talking face to face to the students help them reading the teacher's lips and articulation. The principle of learning for students with speech-language disorders is face direction when delivering material.

These individuals have hearing problems that are so severe that speech cannot be understood when it is transmitted through the ear [17]. Whereas hard-of-hearing individuals can still use the auditory channel as their major avenue for speech and language development, deaf individuals must rely on the visual channel [13]. Hearing barriers that are suffered by students with hearing impairment make it difficult for them to receive audio information. Therefore, video is one of the effective learning media for students with hearing impairments because it contains information visually.

Therefore, to provide an appropriate learning environment for students with hearing impairments, the social-emotional and academic impacts of educational settings on student with hearing impairments need to be examined [17]. The combination of internal and external self-motivation is very important in the learning process for students with hearing impairments. Self-concept is considered an important construct within education because of its links to students' motivation, achievement, confidence, and psychological well-being [18].

Motivation in interacting and learning can be well built by teachers through active interaction. The motivating factors in interaction between the instructor and the students with hearing impairment: getting immediate feedback, getting in touch with SMS, getting in touch with e-mail, and able to ask question and get answer whenever they want [19]. The teacher needs to find out the background that affects the low motivation of students, provide simple counseling if needed, and provide intense attention and guidance students rebuild their motivation.

4. Qualitative Analysis Results

The results of the students' pretest showed a very low understanding of density. When answering questions that are presented in google form, students' expressions are very confused, students tend to just shift their cell phone screen. The first 10 minutes they expressed anxiety and wanted to end the test. When asked "why is water at the bottom of the container, and coconut oil on top of the water? Student A answered confused using sign language, and students B and C did not answer at all.

During the demonstration experiment, the students became more motivated in learning, they began to understand one by one about density. The experimental process is a process undertaken by scientists and consists of elements of observing, asking questions, proposing explanations and hypotheses, designing and conducting experiments, analyzing data, drawing conclusions, and building models or theories [20]. Experiments help HI students understand the differences in density in the fluid, because the activities are structured and contain elements of fun activities. This method helps students develop their language skills by re-demonstrating the experimental activities they have done. The difference in the results obtained was also significant in terms of understanding the concept of density and students' cognitive, affective and psychomotor abilities (Tables 1 and 2).

5. Conclusion

Material density which is an abstract concept for students with hearing impairments has been taught through experimental demonstrations. The results show an increased understanding of density. Cognitive (understanding), affective (being active and motivated), and psychomotor (vocabulary articulation) aspects

also increased. Experimental demonstrations provided a concrete and structured explanation of the density of fluids. The model shows that each fluid had a different density (dishwashing liquid, water, and coconut oil). This method has an impact on new and meaningful learning experiences in learning abstract concepts in students with hearing impairments. This study was focused on finding new strategies to teach this new knowledge to students with hearing impairments. Thus, the ability of deaf students to receive static fluid density learning becomes our concern in the future.

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