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Profile of Students' Mental Model Change on Law Concepts Archimedes as Impact of Multi-Representation Approach

Profile of Students' Mental Model Change on Law Concepts Archimedes as Impact of Multi-Representation Approach

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Abstract. This paper outlined the results of an experimental study on the effects of multi-representation approach in learning Archimedes Law on students' mental model improvement. The multi-representation techniques implemented in the study were verbal, pictorial, mathematical, and graphical representations. Students' mental model was classified into three levels, i.e. scientific, synthetic, and initial levels, based on the students' level of understanding. The present study employed the pre-experimental methodology, using one group pretest-posttest design. The subject of the study was 32 eleventh grade students in a Public Senior High School in Riau Province. The research instrument included model mental test on hydrostatic pressure concept, in the form of essay test judged by experts. The findings showed that there was positive change in students' mental model, indicating that multi-representation approach was effective to improve students' mental model.

1. Introduction

Until today, Physics is still considered a difficult, tedious, and daunting subject in schools. Students believe that physics can only be understood by special people with natural gift of extraordinary intelligence. That is why most students dislike physics subject so much. It is widely known that this phenomenon occurred in almost all educational institution in Indonesia, from primary schools to universities. Therefore, the government and all elements of education process have a huge homework to solve this physics education issue [1].

In this regard, teachers has important role and responsibility; that is to develop physics learning as well as to improve its negative image in students' eyes. This is in line with Minister of Education and Culture's Regulation No. 65/2013 on Process Standards. The regulation stipulates that every educator in schools is responsible for formulating systematic and comprehensive lesson plans so that the learning process could be interactive, inspirational, fun, challenging, motivating students' active participation, and providing enough opportunities for students to develop their skills, creativity, and independency according to their own talent, interest, and physical and psychological development. To do so, teachers need to implement appropriate learning approach, among others, which may facilitate students to understand Physics concepts in a more fun and easier way [2].

The multi-representation approach could be implemented as an approach in Physics learning. Presenting various representations to instill a concept will facilitate students to develop scientific mental model of the concept. Heuvelen and Zou argued that when students learned using several types of representation, their comprehension increased [3].

Stages teach the concept of archimedes using multi-repetition approach can be done by conveying the legal understanding of archimedes verbally *"If an object is immersed in a liquid, it will receive a force called buoyant force (upward force) of the weight of the liquid it displaces"* then presents the physical phenomenon of a plastic ball dipped into water, then students are required to squeeze the ball into the water slowly while feeling the reaction of the ball as in figure 1.

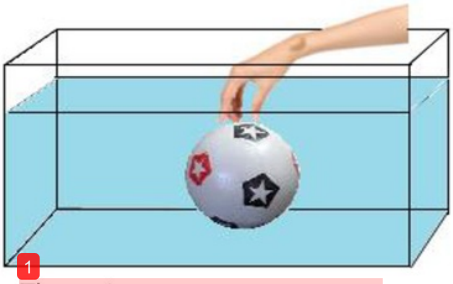

Figure 1. The plastic ball dipped in water

The upward force experienced by objects when in water is called the Archimedes style. The great style of Archimedes is formulated in terms of mathematical equations as follows.

$$F_a = \rho \, . \, g \, . \, V_{bc}$$

Information:

ρ : Mass of a liquid (kg/m^3)
g : Acceleration of gravity (10 m/s^2)
V_{bc} : Volume of dyed objects (m^3)

In addition, the material can also be presented in the form of pictures and graphs as in the figure 2 and 3 and its application in everyday life as in figure 4 so that students' understanding will be built intact to the concept delivered.

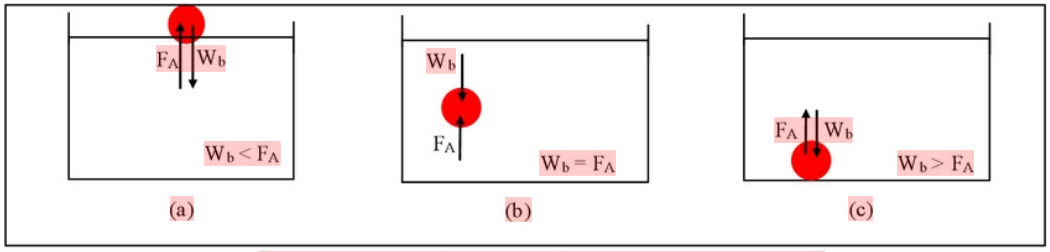

Figure 2. Position of the object (a) Floating, (b) Floating, (c) Sinking

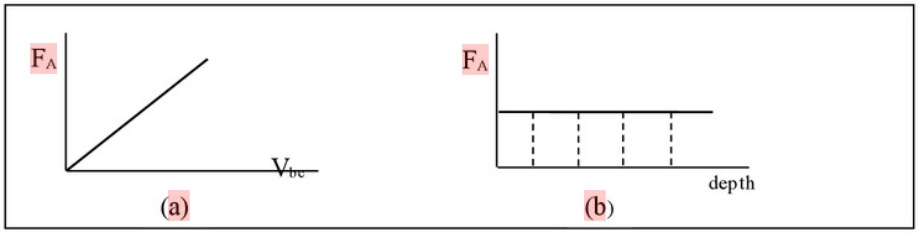

Figure 3. Graph (a) relationship Between buoyant force (FA) to the volume of dyed objects (b) relationship Between buoyant force (FA) to depth

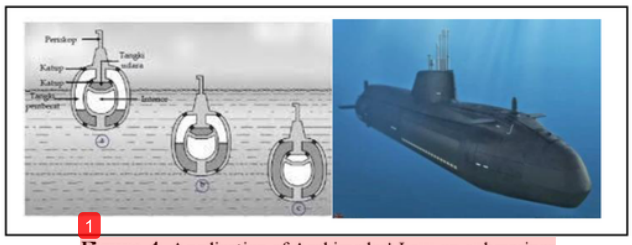

Figure 4. Application of Archimedes' Law on submarines

This was because each student had unique and specific skill that was more prominent than the other skills. Some students had more prominent verbal skill than spatial or quantitative skills, and vice versa [4]. Students should have scientific mental model of physics concepts. Developing mental model is the core of meaningful learning, in which student develop a mental model in his mind to un derstand and reason various micro and macro components of a system.

Mental model is interesting to study for two reasons. First, mental model affects cognitive function. Second, mental model may provide useful information for teachers and researchers of science education concerning students' conceptual structure [5].

This is in line with the findings of Supriyatman which stated that students' mental model profile could be used as an alternative of appropriate approach in teaching electricity and magnetic concepts [6]. Kurnaz found that students' mental model on solid friction concept was on scientific level (17.21%), synthetic level (56.28%) and initial level (26.51%). More than half of the students had synthetic level of mental model, nearly a quarter of them had initial mental model, and a fifth of the students had scientific mental model on solid friction concepts [7].

These previous studies provided information that many students still did not have scientific mental model, indicating that there was a problem in physics lessons they had received.

Among various researchers studying multi-representation approach in learning, and its effects on various learning aspects, was Sunyono they studied the effects of multi-representation approach implemented in teaching atomic structure concept on students' mental model [8]. Their statistical analysis result indicated that multi-representation approach in learning was more effective in developing students' mental model to comprehend atomic structure concepts, compared to conventional learning. Chittleborough and Treagust reported that students' mental model could be developed through interpretation, comprehension, and explanation of phenomenon for sub-micro representation [9]. However, most students preferred to use their mental model in simple representation phenomenon, for instance through suitable visualization for certain topic.

The present study was conducted to examine the implementation of multi-representation approach in Physics lessons in Senior High School. The primary aim was to see the effectiveness of this implementation in improving students' mental model. The problem was formulated in the following research question: "How is the effectiveness of multi-representation approach implementation in improving students' mental model on Archimedes Law concepts?"

This paper outlines the process and result of the study on multi-representation approach implementation in Physics learning and its effects on students' mental model improvement concerning Archimedes Law concepts.

2. Methodology

The methodology employed in the present study was quasi-experimental methodology with one-group pretest-posttest design. In this design, pre-test was first administered to the subjects, followed by a treatment of cooperative learning using multi-representation approach. Then, post-test was administered to measure the effect of multi-representation approach on students' mental model improvement on Archimedes Law. Pre-test and post-test results were then analyzed to find the answer to the research question. Figure 5 displays the research design implemented in this study.

	Pre-test	Treatment	Post-test
Subject	Test	Treatment of cooperative learning using multi-representation approach	Test

FIGURE 5. Research Design

The multi-representations implemented in discussing Archimedes Law concepts included verbal, pictorial, mathematical, and graphical representations. The subjects of this study were eleventh grade students in a Senior High School in Riau Province. Total population was 32 students. For data collecting purpose, a research instrument was constructed, i.e. a mental model test on Archimedes Law in the form of essay test. This instrument had been validated by experts and field-tested.

The effectiveness of multi-representation approach implementation in improving students' mental model on Archimedes Law was determined based on the percentage of students achieving ≥ 80 test score in a scale of 100, with the criteria shown in Table 1.

TABLE 1. Criteria of learning effectiveness (Source: A. Suhandi and F. C. Wibowo. 2012)

Number of students achieving ≥ 80 score	Learning effectiveness criteria
>75 %	High learning effectiveness
50% - 75%	Medium learning effectiveness
<50%	Low learning effectiveness

3. Result and Discussion

The diagram in Figure 6 displayed the percentage of students achieving each score range in mental model tests on Archimedes Law.

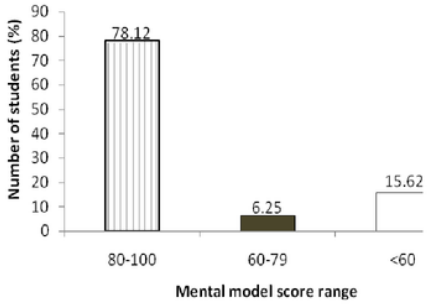

FIGURE 6. Bar diagram of students' percentage in achieving each score range in Archimedes Law mental model test.

Figure 6 showed that there were 78.12 % students (or 25 out of 32 students) achieving the 80-100 score range. This indicated that most students had good comprehension of the concepts in Archimedes Law. Figure 7 displayed students' percentage in each mental model level, based on pre-test and post-test result.

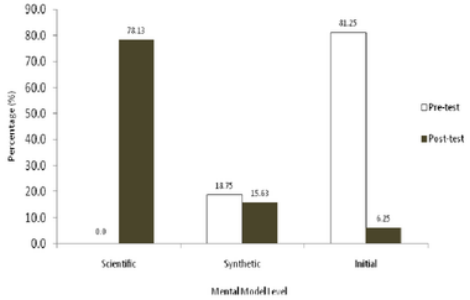

FIGURE 7. Bar diagram of students' percentage in each mental model level

Figure 7 showed that in the pretest, no student achieved scientific mental model level. However, post-test result indicated that 78.13% students managed to achieve scientific mental model. On synthetic level, there were 18.75% students in pre-test. This number decreased to 15.63% in the post-test result. Meanwhile, the 81.25% students achieving initial level in pre-test decreased to 6.25% in the post-test. This number indicated that students' mental model on Archimedes Law improved greatly. The high percentage of students achieving 80-100 score range on mental model test (Figure 6), and the high percentage of mental model level improvement (Figure 7), indicated that the multi-representation approach implemented in cooperative learning was highly effective in improving students' mental model on Archimedes Law.

This was understandable, considering that using various representations in explaining a concept would facilitate students' comprehension. When a student had not fully comprehend a concept explained using a representation, the use of another representation would reinforce the concept and help the student to understand. Therefore, students would have deep understanding [4]. This finding was in line with Mayer who stated that multi-representation could facilitate deep conceptual understanding construction [10]. Savinainen and Viiri argued that the use of several representation in teaching provided great benefits for students' deep conceptual understanding [11]. In regard to multi-representation function in learning, Ainsworth (Nieminen) stated that the implementation of multi-representation could complement other representations, limit other representations, and build comprehensive understanding [12].

4. Conclusion

Based on the findings and discussion, it could be concluded that multi-representation approach implemented in cooperative learning had quite high level of effectiveness in improving students' mental model on Archimedes Law. Therefore, the researcher recommended that multi-representation approach be implemented in Physics and other lessons.

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References

[1] M. Faizi 2012 *Ragam Metode Mengajarkan Eksakta Pada Murid*, 1st ed. Yogyakarta: DIVA Press.
[2] "Peraturan Menteri Pendidikan dan Kebudayaan Nomor 65 tahun 2013 tentan Standar Proses," 2013.
[3] A. Van Heuvelen and X. Zou 2001 "Multiple representations of work – energy processes Multiple representations of work – energy processes," *Am. J. Phys.*, vol. 69, no. 2, pp. 184–194.
[4] A. Suhandi and F. C. Wibowo 2012 "Pendekatan Multirepresentasi dalam Pembelajaran Usaha-Energi dan Dampak Terhadap Pemahaman Konsep," *J. Pendidik. Fis. Indones.*, vol. 8, pp. 1–7.
[5] L. A. R. Laliyo 2011 "Model Mental Siswa Dalam Memahami Perubahan Wujud Zat," *J. Penelit. dan Pendidik.*, vol. 8, no. 1, pp. 1–12.
[6] Supriyatman, A. Suhandi, A. Rusli and D. Rusdiana 2012 "The Profile of Student Physics Education Mental

Model in Electricity and Magnetism Concepts Using Problem Solving Test," *Int. Jounal Sci. Res.*, vol. 3, no. 8, pp. 2093–2097.

[7] M. A. Kurnaz 2015 "An Analysis of High School Students ' Mental Models of Solid Friction in Physics," *Educ. Sci. Theory Pract.*, vol. 15, no. 3, pp. 787–795.

[8] Sunyono, L. Yuanita and M. Ibrahim 2015 "Supporting Students in Learning with Multiple Representation to Improve Student Mental Models on Atomic Structure Concepts," *Sci. Educ. Int.*, vol. 26, no. 2, pp. 104–125.

[9] G. Chittleborough and D. F. Treagust 2007 "The modelling ability of non-major chemistry students and their understanding of the sub-microscopic level," *Educ. Res.*, vol. 8, no. 3, pp. 274–292.

[10] R. E. Mayer 2003 "The promise of multimedia learning : using the same instructional design methods across different media," *Learn. Instr.*, vol. 13, pp. 125–139.

[11] A. Savinainen and J. Viiri 2004 "A Case Study Evaluating Students Representational Coherence of Newtons First and Second Laws," *Proc. Phys. Educ. Res. Conf. 2003, AIP Conf. Proc. No. 720, Ed. by J. Marx. S. Franklin, K. Cummings (AIP, New York, 2004)*, no. 720, p. 77.

[12] P. Nieminen, A. Savinainen and J. Viiri 2010 "Force Concept Inventory-based multiple-choice test for investigating students ' representational consistency," *Phys. Rev. Spec. Top. - Phys. Educ. Reseach*, vol. 6, pp. 1–12.

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