The Influence of Using Momentum and Impulse Computer Simulation to Senior High School Students' Concept Mastery

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The Influence of Using Momentum and Impulse Computer Simulation to Senior High School Students' Concept Mastery

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Abstract. This research is based on students' lack of mastery of physics abstract concepts. Thus, this study aims to improve senior high school students' mastery of momentum and impulse concepts with the use of computer simulation. To achieve these objectives, the research method employed was pre experimental design with one group pre-test post-test. A total of 36 science students of grade 11 in one of public senior high school in Bandung became the sample in this study. The instruments utilized to determine the increase of students' concept mastery were pretest and posttest in the form of multiple choices. After using computer simulations in physics learning, students' mastery of momentum and impulse concept has increased as indicated by the normalized gain <g> of 0.64 with the medium category.

1. Introduction

Physics as a subject in the school is a branch of the natural sciences that can explain each natural phenomenon in daily life. This natural phenomenon can be described through a concept, theory and physics law so it can be accepted by human's brain. Learning physics means learning the nature along with the concepts within it. Those concepts can be concrete or abstract. "There are lots of physics concepts learnt in senior high school that involve abstract thinking level. Concept understanding is one of the key aspects in the learning process that involves this thinking level." [1]. Understanding the process of knowledge change is a central goal in study of development and education. Two conceptual types of knowledge that children acquire are conceptual understanding and procedural skill [2]. Therefore, conceptual understanding be able to change student's perception about the topic in physics motivated by a desire to change the prevalent passive teaching mode and to involve students in active learning enhanced by technology [3]. There is mean that to change understanding concept's student can be started with learning method in classroom. Instead of that, the ability to understand the concept is the purpose of physics learning in senior high school. This purpose is stated in Education Unit Level Curriculum (KTSP) that all students have the ability to comprehend physics knowledge, concept and principles [4]. To achieve that purpose, students are required to master physics concepts taught in school during learning process.

Concept is the ability to discriminate group of objects and generalize them by grouping the objects that have one or more similar characteristics. People who have concepts can abstract the objects encountered, so the objects are categorized into a certain group. Amien affirmed that concept is impression or idea based on relevant experience and can be generalized to form a concept [5]. Thus,

concept has a significant role in physics learning success because it is the foundation to learn natural phenomena.

Furthermore, the function of media in learning is to present and clarify the material. Media be able to make the things that can only be found outside the class be available inside the class. It even be able to decrease the deficiency of direct observation. The media that becomes wider and easier gives significant improvement in learning. Learning media has been developed from white board into poster that then turns into Overhead Projector (OHP) and advances into computer based media known as computer multimedia.

It is still hard to create ideal learning condition. Teachers frequently use conventional learning model that makes physics learning monotone, boring and less challenging for students. As the result, students pay less attention toward the information given by the teacher. Finally students have difficulties in understanding the concept taught by the teacher. Media is rarely used in the class and it is usually less heterogeneous. In a semester, teachers only use visual aids as learning media twice or three times. Teachers only use PowerPoint slide media that only presents picture and text. PowerPoint slide media made by the teachers seems to be monotone, less interactive, static, and it has not been employed optimally to explain physics concepts in the class. This type of learning process appears to be less optimum, hence students' lack of concept mastery. Moreover, Sudjana & Rivai asserted that the use of learning media is expected to improve the quality of teaching-learning process that can affect the quality of students' concept mastery [6].

Based on those elaborations, this research is intended to figure out the effects of impulse and momentum computer simulation towards students' concept mastery in learning physics.

2. Methods

This research was conducted by using pre experimental method with one group pre-test post-test design. The population was all students from grade XI-natural science in a senior high school in Bandung city in 2013/2014 academic year. By using cluster sampling technique, a class of grade XI-natural science was chosen out of six classes. Accordingly, the samples taken are the students of grade XI-Natural Science-6 as experimental class with 36 students.

The test instrument for concept mastery was in the form of 16 multiple choice test items with five choices for each question. This instrument measures students' concept mastery of impulse and momentum that consists of understanding (C2), applying (C3) and analyzing (C4) cognitive domains.

To find out the improvement of concept mastery, it is necessary to analyze pretest and posttest result. It was examined based on normalized gain scores. The score can be calculated by using the formula proposed by Hake [7] as below:

$$\langle g \rangle = \frac{S_{post} - S_{pre}}{S_{maks} - S_{pre}} \quad (1)$$

3. Findings and discussions

This research has been conducted with a simulation-based learning to enhance students' understanding of the concept of the material momentum and impulse. Momentum and impulse itself is a material with an abstract concept. Therefore, the use of simulation media aimed to understanding the concept can be maximized by good. In addition, the use of simulation media also plays a role so that students are not experiencing misconceptions about the concept of momentum and impulse. Learning results obtained are shown in Table 1 below:

Table 1. The Increase of Concept Mastery

Tes	Score				<g>	Category
	Ideal	Max.	Min.	Average		
Pretest	16	10	2	5.75	0.64	Medium
Posttest	16	16	3	12		

Based on Table 1, it can be observed that after using computer simulation in physics learning (treatment), students' concept mastery increased. It is proved by the posttest average score, 12 that is higher than pretest score, 5.75. The same thing is confirmed by normalized gain score which is 0.61 with medium category. These results prove that the use of simulation media can be used to increase students' understanding of the concept. In this study, in addition to the students can understand the concepts, students can practice their skills in finding out information using computer simulations media. Students can explore their curiosity will concept, students are able to discuss and exchange information on the concepts learned.

Concept mastery test consists of 16 multiple choice test items divided into three cognitive domains in which six questions for understanding (C2), four questions for applying (C3) and six questions for analyzing (C4). The improvement of concept mastery in each cognitive domain can be seen in test result of each question for each domain given during the pretest and posttest.

The comparison of pretest, posttest and normalized gain (<g>) average score for each cognitive domain can be observed in figure 1.

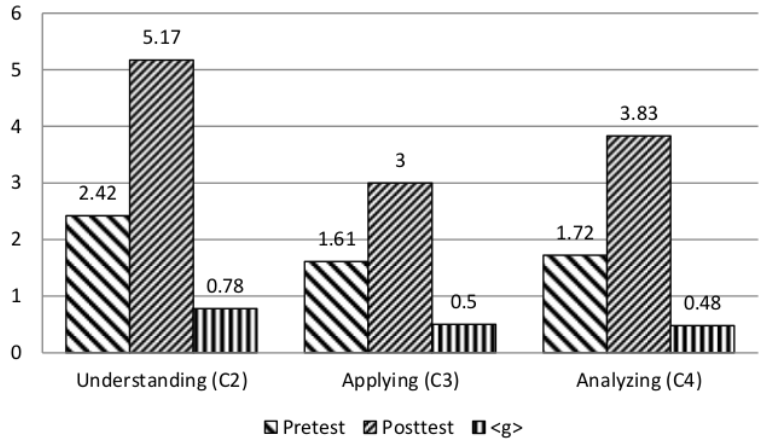

Figure 1. The increase of Concept Mastery in Each Cognitive Domain.

Based on Fig. 1, it is known that there is an increase of concept mastery in all cognitive domains. The highest increase takes place in understanding aspect (C2) with the score, 0.78 classified as high category. The reason is the posttest average score, 5.17 is higher than the pre-test average scores, 2.42. The improvement of concept mastery is also occurred in applying aspect (C3) with normalized gain <g> of 0.48 classified as medium category.

The increase of students' concept mastery of momentum and impulse was in medium category because they were new concepts introduced in senior high school level so the prerequisite concept should be mastered well by the students. Instead of that, momentum and impulse are abstract concepts. Students need to not only understand the concept but also have sufficient mathematic skill to solve the questions related to momentum and impulse. As proposed by Ellis & Turner [8] that "Mathematical relationships between science concepts make students' learning science a complex process". It means that the correlation between mathematic skill and science concept makes the learning process more complex. As the consequence, the average score of KKM (minimum completeness/competence criteria) during posttest is in average level with the score of 75.

If the increase of concept mastery is viewed from each cognitive domain including understanding (C2), applying (C3) and analyzing (C4), understanding aspect (C2) is the aspect with the highest increase of concept mastery with normalized gain score of 0.78 ranked as high category. The reason is

the questions in this aspect emphasize the concept understanding that relatively simple and easy. So, students can answer the questions in understanding aspect (C2) without any difficulties.
In applying aspect (C3) that is higher than understanding aspect (C2), the concept that should be comprehended by the students is more complex as well. Meanwhile, analyzing aspect (C4) is the highest aspect in this research and it involves Higher Order Thinking Skill Level. The concepts asked in this aspect are more complex than applying aspect (C3). In this research, concept which involves in aspect (C3) is momentum an impulse. Salmiza in his paper say that, "the most difficult questions (less than 20 students answered correctly) is questions related to the concept of ball movement on flat surfaces, whereas for form four science students, the most difficult question is related to the concept of conservation of energy and momentum" [9]. This means that concept of conservation energy and momentum is the highest aspect in Newtonian physics. Analyzing can be defined as solving question or problem into parts, types and patterns so its components will be clear.
In line with the elaboration above, the level of cognitive domain proposed by Bloom was described in the form of pyramid that shows higher level requires more complex thinking skill [10].

4. Conclusions

Based on research data, tabulation and analysis that had been conducted, it can be concluded that there is influence of using momentum and impulse computer simulation on senior high school students' concept mastery. There is an increase in momentum and impulse concept mastery in all cognitive domains after the implementation of computer simulation in physics learning. Those cognitive domains are understanding (C2) with <g> 0.78 high category, applying (C3) with <g> 0.5 medium category and analysing (C4) with <g> 0.48 medium category. Generally the mastery of momentum and impulse is improved with <g> 0.64 ranked as the medium category.

Acknowledgments

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