The Effectiveness of Using Multimedia in Teaching Physics to Gauge Student Learning Outcomes In The Senior High School in Indonesia

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***Abstract* -- Generally, one of the concepts of Physics that students have to master is straight-forward motion. This concept is commonly difficult to be comprehended by the students. One of the techniques to improve students' comprehension is by using interactive multimedia which can be used for autonomous learning. Hence, this study attempted to use interactive multimedia to improve student learning outcomes. This study aimed to figure out the effectiveness of using multimedia on 10th grade student learning outcomes about concepts of straight-forward motion in SMA Negeri 1 Semparuk, Indonesia. This study employs quantitative pre experimental method with one group pretest posttest design. 90 students were chosen through purposive sampling from three different classes. The data analysis shows that using multimedia improves student learning outcomes. The size effect of the outcomes is 0.82 which indicates significant improvement. Based on the findings, this study suggests that using multimedia is highly effective in improving student learning outcomes in Physics, particularly in straight-forward motion.**

***Keywords* — Multimedia, Effectiveness, Learning Outcomes, Physic, Straight-Forward Motion**

I. INTRODUCTION

Science is one of the subject matters that discusses various aspects of nature in scientific and systematic ways (Nora, 2015). In a senior high school level (SMA) in Indonesia, Physics become one of the sub subjects of science. "Physics is a study about material structures and its interactions to better understand the natural and artificial systems (technology)." (Sutrisno, Kresnadi, dan Kartono, 2007, p. 27).

One of the concepts of Physics that commonly exists in nature is kinematics straight motion. This concept is being taught in 10th grade of senior high school level. Straight-forward motion is an essential concept that must be mastered by students before continuing to learn the next concepts. According to Daniel (2004), concepts of 'kinematics' and 'dynamics' is the most problematic issues encountered by students in the late 1990s. This issue still occurs to this age, as reported by other scholars (Bollen, De Cock, Zuza, Guisasola & Kampen, 2016; Motlhabane, 2016), there are still many students fail to comprehend the concept of kinematics.

In order to ease student comprehension about the concept of straight-forward motion, multimedia is commonly used to motivate and stimulate students to learn. Lokas (2013) stated that the implementation of learning media should be able to encourage students to learn and to utilize their potential. However the results of Yeo et al (2004) suggest that, despite interactivity and animated graphics, interactive multimedia may not produce the desired outcome for students learning introductory physics concepts.

Learning media that incorporate concrete experience promote students to integrate their previous experiences, and therefore it enable to facilitate learning of abstract concepts (Smaldino, Sharon, Loether, & Russel, 2012). Based on the discussions that have been presented, then the aimed of this study is to prove the effectiveness of multimedia on learning physics.

II. LITERATURE REVIEW

Traditionally, science courses are taught deductively. The instructor first teaches students relevant theory and mathematical models, then moves on to textbook exercises. Often the only motivation students have to learn the material, beyond grades, is the vague promise that it will be important later in real life or in their careers (Prince & Felder, 2007). Dalacosta, Kamariotaki-Paparrigopoulou, Palyvos, and Spyrellis (2009) explain that one of the reasons why science is perceived as difficult by many students is that it is a-priori viewed as dealing with concepts which are often difficult to be explained and understood. Some students feel that they have to learn a lot of theory without ever considering how this theory might apply to the real world they are living in.

To date, teaching science becomes easier and more fun with the existence of multimedia. According to Issa, Mayer, Schuller, Wang, Shapiro, and DaRosa (2013), the term 'multimedia' refers to the presence of both visual material (i.e. static images such as illustrations or dynamic images such as animation) and verbal material (i.e. printed words or spoken words), which, in this context, are used to inform and explain new knowledge to learners.

Mayer (2011) stated that multimedia provides educators with a unique opportunity to control every second of instruction by way of planning and selecting the audio and visuals that a learner receives. Additionally, Pun (2014) points out that computers have appeared as powerful tools to facilitate science and help students and teachers understand the subject. Specifically, in teaching physic, Chen, Stelzer, and Gladding (2010) found that the use of multimedia has resulted in a large improvement in students' understanding physics concepts.

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Multimedia is an integration of text, audio, images, animation, music and/or video. The integration of these media promotes fun learning experiences among students (Apriyanti, Umar, & Tandililing, 2015). Besides multimedia can also presents information visually, auditory, and interactive thus it becomes effective in facilitating teaching and learning process. As cited in Computer Technology Research, “people able to remember 80% from what they see, hear, and do at the same time” (Munir, 2013: p.6). In terms of straight-forward motion, many samples of motions are difficult to observe because their rapid movement. However, with the use of multimedia, those motions can be played in a slow motion with the image captures in every change of motion, thus it can be observed repeatedly.

III. THE STUDY

Based on the elaboration above, it is essential to implement multimedia in Physics teaching and learning process and to gauge the effectiveness of its use. Thus this study is designed to figure out whether or not multimedia usage can significantly improve student learning outcomes. The level of effectiveness would be undertaken through pretest, treatment, and posttest .

The multimedia used in this study has been validated by media expert and Physics expert (i.e. Apriyanti et al., 2015). The content of this multimedia is about straight-forward motion and the measurement using conceptual test to figure out student learning (cognitive) outcomes.

IV. HYPOTHESES

The ‘null hypothesis’:
H_0: There is no significant difference in mean pre- and post test to figure out the effectiveness of using multimedia on 10th grade student learning outcomes about concepts of straight-forward motion in SMA Negeri 1 Semparuk, Indonesia.

V. METHODOLOGY

This study employed quantitative pre-experimental method with one group pretest and posttest design (Campbell & Stanley, 1963). The process of choosing the participants used purposive sampling technique (Arikunto, 2010). The sample was chosen from the recommendation by the Physics teachers, based on the previous students’ marks (i.e. vector concept). The Table 1 below shows the design for this present study.

TABLE I: ONE GROUP PRETEST POSTTEST DESIGN

Pretest	Action	Posttest
O_1	X	O_2

Annotation:
O_1 : Pretest before the treatment
O_2 : Posttest after the treatment
X : Treatment using multimedia

The participants were 90 high school students from three different classes (XD, XE, and XF). The data collection commenced in November 2016 in SMA Negeri 1 Semparuk. The data collection of this study used measurement technique. The instrument was conceptual test (i.e. multiple choices with alternative choices and open ended reasons) and open ended questions. The questions consist of pretest and posttest.

The pretest comprises 7 questions of multiple choices with 3 options and open ended reasons, and 3 open ended questions. The content of the test represents student comprehension about concept of straight-forward motion. The posttest comprises 7 questions of multiple choices with 3 options and open ended reasons, and 3 open ended questions which align with the pretest. The content of the test represents student comprehension about concept of straight-forward motion. With that being said, each question from pretest and posttest represents similar concepts. This instrument has been tested for its validity and reliability.

For the treatment, all classes were taught the same content and strategy using Microsoft PowerPoint through LCD projector. Learning Physics with this instructional medium is not only done by teachers, but students can also use it. It can happen due to the fact the medium contains instructions for use so that students can learn independently with it, both in and outsidex the classroom. They were given tests before (pretest) and and after (posttest) the intervention.

VI. DATA ANALYSIS

After collecting all data, the data then were entered and analyzed in SPSS software. Descriptive statistics were used to describe the means and standard deviations. Paired sample t-test was used to test the hypothesis.

In order to figure out the effectiveness of multimedia for straight-forward motion learning process among 10th grade students in SMA Negeri 1 Semparuk, we used Effect Size method.

The effect size can be figured by using the following *Cohen* formula (Dunst, Hamby, & Trivette, 2004, p.6):

$$d = \frac{M_{posttest} - M_{pretest}}{\sqrt{\frac{SD^2_{posttest} - SD^2_{pretest}}{2}}}$$

Annotation :
M = Mean score
SD= Standard Deviation

The *effect size* value *d* is determined by using the following *Cohen* criteria (table 2).

TABLE II: COHEN CRITERIA FOR EFFECT SIZE VALUE

Effect size	Interpretation
$d < 0.2$	No contribution
$0.2 < d < 0.5$	Low
$0.5 < d < 0.7$	Average
$d > 0.7$	High

VII. RESULTS

The difference between students' score from prestest and posttest, is shown based on mean scores of of the whole students in the classes.

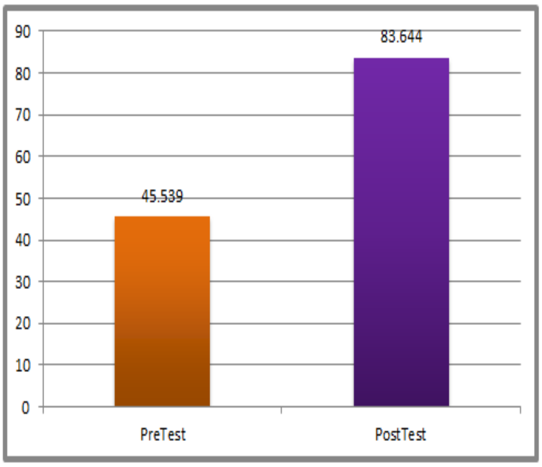

Fig. 1. Graphic of students' mean on pretest and posttest

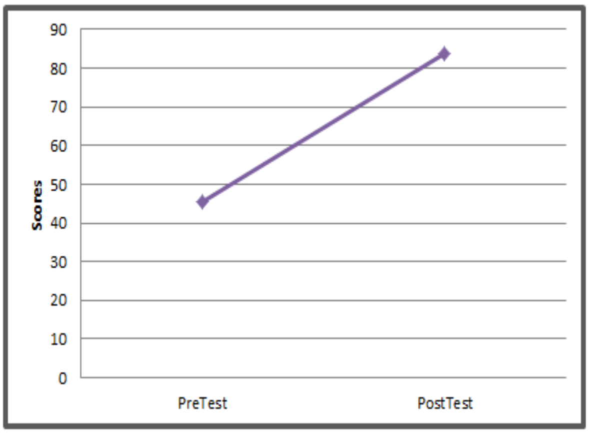

Fig. 2. Graphic of improvement on students' learning outcomes

TABLE 2: DESCRIPTIVE STATISTICS AND PAIRED SAMPLE CORRELATION

	Mean	N	Std. Deviation	Std. Error Mean
Pretest	45.539	90	12.5982	1.3280
Posttest	83.644	90	13.5657	1.4300

The table 1 above shows that the mean score of post-test is higher (83.644) than the pre-test (45.539). From the row t statistic in Table 2, t = -23.731, and p = 0.000. This results indicate that the null hypothesis is rejected, since $p < 0.05$. In other words, there is a strong evidence that the teaching intervention using multimedia improves students' marks.

TABLE 3: PAIRED SAMPLE T-TEST

			95% Confidence Interval of the Difference				
Mean	Std. Dev.	Std. Error Mean	Lower	Upper	1	df	Sig. (2-tailed)
-38.1056	15.2333	1.6057	-41.2961	-34.9150	-23.731	89	.000

The Effect Size result of student learning outcomes is 0.82 (based on calculation using *Cohen* formula). The result shows that the Effect Size is classified high.

VIII. DISCUSSION AND CONCLUSION

The multimedia used in this study was interactive and user friendly, thus students were able to use it autonomously. Moreover, this multimedia prioritized interaction between students and the media which contained learning steps, learning contents, and interactive questions. Hence, the students were able to comprehend the concepts in more meaningful way (Apriyanti et al., 2015; Isa, 2016).

Fig. 3. Screenshots of the multimedia used in the study

In the end of the lessons, the students undertook the test. Based on constructivist theory, drill and practice does not merely aimed to identify the quality of student comprehension (Muhith, 2007, p.77). The assessment of this study was aimed to re-explore the effectiveness of using multimedia in learning Physics, particularly in the concept of kinematics straight-forward.

In summary, this study showed that using multimedia in teaching physic can improve students' understanding about the materials being taught. This result is also aligned with some previous research about multimedia implementation in teaching science (e.g. Chen et al., 2010; Pun, 2014). Another study by Stelzer, Gladding, Mestre and Brookes (2009) also echoed similar findings, whereby students receiving the multimedia learning modules performed significantly better on both tests than the students experiencing the text-based presentations.

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