ELECTRONIC VERSUS PRINTED BOOK: COMPARISON STUDY ON THE EFFECTIVITY OF SENIOR HIGH SCHOOL PHYSICS BOOK

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ABSTRACT

This study aims to examine the effectiveness of senior high school physics book, interactive electronic and printed, viewed from the difference of gender and material characteristics. The research method used Quasi Experimental Design with Non-Equivalent posttest-pretest control group design type. Data were collected through physics test result from six senior high schools in Lampung Province, Lampung, Indonesia and analyzed by Anova and multiple comparison to determine the differences in learning outcomes (effectivity) and interaction between interactive electronic and printed, gender, and material characteristics. The results showed that there are differences learning outcomes caused by interactive electronic and printed physics book ($p=0.000<0.05$), learning outcomes using interactive electronic books are better than using printed books for both male and female students, gender differences do not affect physics learning outcomes for both electronic interactive and printed books ($p=0.963>0.05$). There is no interaction between electronic interactive and printed books and gender ($p= 0.298>0.05$). There are differences in learning outcomes caused by physical material characteristics ($p= 0.000< 0.05$). The conclusion was that the high school interactive physics electronic book is effectively used as a learning resource for both male and female students.

Keywords: effectiveness interactive electronic book; gender; physics material characteristics

INTRODUCTION

Many factors can affect student' physics learning outcome, for example learning resources, material characteristics, students' experience, motivation, teaching method, and the initial competence of students (Hänze & Berger, 2007; Haycock, 2007). Commonly, schools use printed books as a learning resources which have been recommended from the Center of Curriculum and Books (Pusat Kurikulum dan Perbukuan), Ministry of Education and Culture. These books have been subject to content conformity with the existing curriculum. However, there has not been any research or study on the conformity of the format and its form .

Government recommends electronic school books for use in schools and purchase copyright from authors. By this way, anyone can print and reproduce the book at the maximum price set by the government. Beside that, students are allowed to download these books in pdf format and use it as learning resources without paying (Andina, 2011). This policy will certainly help students in providing a good and affordable learning resource.

But the question is, why the average Indonesian student learning outcomes is still relatively low (data from PISA/Programme for International Student Assessment score). The data concludes the average score of Indonesia science literacy in 2015 was 403, and it belogs to rank 62 of 70 countries participant, while another ASEAN countries such as Vietnam is in the 8th rank and Thailand in the 54th. Further analysis of PISA in Indonesia, obtained the fact of the average future career field Indonesian children in science is 15.3% (boys 8.6%, girls 22.1%). Index of learning science motivation is 0.65, whereas the average OECD is 0.02. besides that, the difference of learning science motivation between boys and girls is -0.06. This means that Indonesian girls enjoy learning science more than boys (OECD, 2015). This fact must be followed up with various studies that lead to increasein learning outcomes, of of them is concern in book form which become the main source of learning.

The use of learning resourcesbecome one factorwhich can influence the learning outcomes.Therefore, as the development of science and technology in the world, requires educators/teachers to modify the learning resource in the form of printed into unprinted. One of the most unprinted learning resource is an electronic-basedbook.Throughout the literature review, electronic-based books have been defined and described in numerous ways. Most research on

electronic-based books defines them as texts that are digital and accessed via electronic screens. There are two formats in which electronic-based books. These are page fidelity and reflow-able digital electronic-based books (Jeong, 2012; Chesser, 2011; Salmon, 2014). Beside that, many researchs in higher education has focused primarily upon faculty and student prefrences of e-textbook formats (Margolin et al., 2013; Kim & Kim, 2013; Robinson, 2011; Jamali et al., 2010; Woody et al., 2010, Kang et al., 2009)

By using electronic-based books, many physical process can be easily understood and visualized by students. Electronic based-book belongs to interactive book, because written in many kinds of colour, some illustrations have a moving, sounds, animation, video, and film (Holaday et al., 2013; Ambarwati & Suyatna, 2018; Suyatna et al, 2018). Electronic books are developed by using software, for example Learning Content Development Sytem (LCDS). By using interactive book, students are able to study by themselves, anywhere and anytime. In order to accommodate it, the interactive book must be created and designed to accommodate it. In preparing interactive book required an adequate supporting knowledge, especially in operating equipment such as computers, video cameras, and photo cameras. Such kinds of book are important to be developed in many kinds of subject, for example physics.

Perhaps, through the use of LCDS-based learning module facilitates physics teacher in delivering physics concept, escpecially for an abstract concept. So it can improve students in understanding physics. Because the LCDS-based learning module is able to engage students to be active through the discovery process, and trigger the mindset of students in conceptualization (Nuralinda, 2017). Books developed using the LCDS are also attractive, easy to use, useful, and effective in improving student learning outcomes (Aulia et al., 2017) .

Five kinds of the use of computer in learning process are drill and practice, tutorial program, demonstration, simulation, and instructional games (Hoseth & McLure, 2012; Reynolds, 2011).The overall use of computer programs above, can be seen in an LCDS-based book. LCDS makes it easy to publish e-learning with customizable content, interactive activities, quizzes, games, animations, videos, and other multimedia (Aremu, 2013).The LCDS application has several advantages, among them: (1) developing and publishing content quickly, timely and relevant, (2) delivering Web content in accordance with SCORM 1.2 and can be hosted in a learning management system, (3) upload or publish existing content; (4) create rich e-learning content based on Silverlight easily; (5) develop training structures and easily reorganize at any time; (6) develop learning books equipped with animation, images, videos, and interactive questions (Iqbal, 2011).

Personality and motivation play important roles in explaining sex differences in school attainment (Steinmayr & Spinath, 2008). According to Huang et al.(2017) male and female are motivated differently when reconstructing their identities, female is more focused on highlighting the physical situation, while male emphasize on their achievement. At the age of 14-17 years began to emerge characteristics typical of male and female, namely the nature of passive-accept for female and the active doing for male. Therefore, the appearance of male's behavior seems more intense and explosive. female's behavior seems more controlled by feelings and tied to family traditions and rules (Kartono, 2017). Yukselturk & Bulut (2009) analyzed gender differences in self-regulated learning components, motivational beliefs and achievement in self-regulated online learning environment. The results showed that test anxiety explained a large number of variants in female student achievement and two variables (self-efficacy for learning and performance, and task scores) explained a large number of variants in male student achievement. It was also found that there were no statistically significant mean differences between motivational beliefs, self-regulated learning variables and achievement in gender programming. Besides that, Female students also have higher levels of test anxiety than male. It causes the lower course grades for female participants (Chinet al, 2017). They also suggested that the relationship between gender and negative affect may be a significant indicator of an individual's predisposition towards high test anxiety and poor course grades. Further added by the study of Yang et al.,(2011), male students are spending more effort than female in online learning while female expend more energy than male on face-to-face learning. There are gender differences to emotional intelligence in some specific aspects (Lopez-Zafra, et al., 2012). Based on the above description, it can be concluded that gender and the utilization of learning resources is one of the factors that influence student learning outcomes. Therefore, every teacher in the school should have the ability to handle gender differences through the use of interactive learning resources, one of them through the interactive electronic learning of physics. In addition, it is also important to know whether interactive electronic books are suitable as a learning resources to present different physics learning materials.

Based on the explanation above, this study aims to examine the effectiveness of interactive electronic books of physics in terms of differences in format, gender, and material characteristics.

METHODS

The population of this study was all students of grade XI Senior High School in Lampung Province, Indonesia, year 2016/2017. The sample chosen by purposive sampling as many as 12 equivalent classes. The first six classes study physics with a source of learning, interactive electronic books. Each class studies a different topic, namely: Elasticity and Hooke's Law; Kinematic; Simple Harmonic Motion; Heat; Impulse and Momentum, Work and Energy. The second six

classes study physics with learning resources, printed book published by physics book published by Center of Curriculum and Books, Ministry of Education and Culture. The learning approach of all classes uses a scientific approach.

To examine the differences in student learning outcomes caused by differences in the books form, gender, and the interaction between book form and gender, using factorial design (Table 1).

Table 1. Factorial design (2x2)

Attribute		Book Form		
		E-book Interactive (EBI)	Printed Book (PB)	Total
Gender	Male (M)	M-EBI	M-PB	M
	Female (F)	F-EBI	F-PB	F
Total		EBI	PB	

In this design, before treatment all of the classes were given pretest and posttest after treatment. The instrument for pretest and posttest were in form of multiple choices which was consisted of 10 items for each different material, so the whole test questions are 60 items.

The instrument has average Normalized Gain of pre and post test score used the formula (Marx & Cummings, 2007). It was the difference of posttest and pretest score divided by the difference maximum score and pretest score.

A two-way anova is useful when we desire to compare the effect of multiple levels of two factors and have multiple observations at each level (Wobbrock et al, 2011). In this study, two-way anova was used to examine the differences in learning outcomes caused by differences in book form (electronic interactive and printed), gender differences (male and female) and the interaction between book form and gender. One-way anova test was conducted to examine the differences in learning outcomes caused by differences in the physics of interactive electronic books. The multiple comparison test was conducted to determine the physics material that led to different learning outcomes.

RESULT AND DISCUSSION

This research was preceded by the development of LCDS-based interactive electronic books for the material: Elasticity and Hooke's Law, Heat, Kinematics, Simple Harmonic Motion, Impulse and Momentum, and Work and Energy for high school students. In the experiment class, students used offline LCDS-based interactive electronic book. Students were required to acces menus, did the simulation, played video, and did interactive test as an excercises. Meanwile, in the control class, teacher taught the materials and student did the excercises in printed physics book. The result of data analysis of student learning outcome in each material and gender is shown in Table 2.

Table 2. Student' learning outcome in each material and gender

Material	student learning outcomes			
	Male (M)	Female (F)	Difference (M-F)	Total
Elasticity and Hooke's Law	80.83	73.33	7.50	75.83
Kinematic	80.00	75.83	4.17	78.00
Simple Harmonic Motion	73.75	66.82	6.93	68.67
Heat	83.56	80.83	2.72	81.88
Impulse and Momentum	74.67	70.94	3.73	72.74
Work and Energy	85.38	90.63	-5.24	88.28
Total Average	79.70	76.40	3.30	77.57

Table 3. Two-way Anova Analysis of Book Form and Gender

Source	Type III Sum of Squares	df	Mean Square	F	p
Corrected Model	1.094[a]	3	0.365	17.660	0.000
Intercept	12.876	1	12.876	623.290	0.000
Book Form	0.884	1	0.884	42.801	0.000
Gender	4.431E-5	1	4.431E-5	0.002	0.963
Book Form*Gender	0.023	1	0.023	1.101	0.298

Two-way anova test results are presented in Table 3. The results of the difference between the mean n-gain between students (both male and female) using an interactive electronic book with students using printed books obtained p = 0.000 less than α = 0.05. It means there is an average difference of n-gain between students who studied physics by using interactive electronic and printed books.

Student learning outcome by using interactive electronic book is higher than printed book. This finding also confirm the research result of Rockinson-Szapkiw et al. (2012), students who chose e-textbooks for their education courses had

significantly higher perceived affective learning and psychomotor learning than students who chose to use traditional print textbooks.This acquisition is possible because an interactive electronic book is equipped with an animated physical phenomenon for moving objects such as motion kinematics material shown in the example of straight irregular motion, accelerated motion, parabolic motion. Object movement can be evaluated directly any time. Similarly, in simple harmonic motion learning material, there is an example of simple harmonic motion. Through this animation, students are able to differentiate between it is clear that the difference between the harmonic and non-harmonic motion. In the matterial of impulse and momentum it is shown how the impulse causes a change in momentum. In other materials also provided a practical simulation. These findings are supported by other research results, including the effects of dynamic visualization. Dynamic visualization for moving objects is better than static visualization so that students' learning outcomes on this matter get better (Suyatna, et al., 2017; Chesser, 2011). This acquisition is supported by research results Suyatna et al. (2017) which shows the average of N-gain of student learning outcome moving image-assisted is higher than static object.

Media that integrates a combination of digital text, graphics, animation, and sound in physics learning can attract sight, stimulate student learning motivation and produce effective physics learning (Higgins et al., 2018; Faulconer et al., 2018). According to Lin (2009), animation was created to convey the concept of change and was considered effective in expressing the process. The results of the study support the findings that student's learning outcomes whose learning process is supported by interactive electronic books equipped with animation and simulation of physics laboratory is better than printed book.The result of physics learning using interactive e-book is higher than using printed book can be caused by printed book in Indonesia generally do not contain guidance to carry out experiment. Bancong and Song (2018) analyzed 30 physics textbooks from Grades 10 to 12 which are widely used both by teachers and students. The results showed that majority of physics textbooks did not mention about thought experiments. Only 6 physics textbooks presented thought experiments at a satisfactory level.

LCDS software as a system developer content of electronic learning materials very support the arrangement and completeness of teaching materials. Through the LCDS can be displayed text, images, animation, video, experiment simulation, and quiz, both online and offline. Experimental simulations contained in interactive electronic books strongly support problem-solving abilities. This is supported by the results of Gunawan et al. (2017) and Ebied & Rahman (2015). According to Sjarif et al. (2016) the use of integrated modules using interactive lectures and workshops can improve students' understanding and skills.

Based on two-way anova analysis (Table 3), gender differences did not give significant differences in student learning outcomes. The average n-gain of male students' learning outcomes was not significantly different at the 95% confidence level compared to the n-gain average of female students' learning outcomes, both in students using interactive electronic books and printed physics books ($p = 0.963 > 0.05$). Male students study physics as well as female students. Although there is a difference in science-learning motivation between boys and girls, where Indonesian girls enjoy learning science more than boys (OECD, 2015), but the interaction between male and female students during the classroom learning process has been reducing the difference. This finding is different from the results of research Fitrialisma et al. (2016), student learning outcomes and students' learning on physics that occurs in male students is better if compared with learning outcomes and activities in female students. This research was conducted on boarding school, where the class of male students was separated with the female students class so that during the learning process, there was no interaction between male and female students. However, this finding also confirm the research result of Hoogerheide et al. (2016) which conclude that gender does not affect learning outcomes, but may influence affective aspects of learning.

The result of two-way anova analysis on the interaction between book format and gender resulted in sig value or probability $p = 0.298 > 0.05$. It shows that there is no interaction between book form and gender. Thus, both male and female students can use electronic book formats or printed books. The results showed that students physics learning outcomes would be better if their learning was supported by interactive electronic books, both for male and female students, when compared by using physics printed book.

The results of one-way ANOVA analysis show that there are differences in learning outcomes seen from the characteristics of physical material (Table 4).

Table 4. One-way Anova analysis for interaction between different physics learning material and students learning outcome

Source	Type III Sum of Squares	df	Mean Square	F	p
Corrected Model	8380.64[a]	11	761.877	7.730	0.000
Intercept	1022761.44	1	1022761.44	10376.81	0.000
Material Characteristic	5746.701	5	1149.340	11.661	0.000
Error	16952.688	172	98.562		
Total	135644.64	184			
Corrected Total	25333.333	183			

a. R Squared = .331 (Adjusted R Squared = .288)

Further analysis to see an increase in the average learning outcomes in different physics material, multiple comparison analysis was used (Table 5). Based on the results in Table 5, there are different pysics learning outcomes in Elasticity and Hooke's Law materials. Elasticity and Hooke's Law with Work and Energy; Motion Kinematics with simple harmonic motion; Motion Kinematicswith Work and Energy; Simple harmonic motion with Heat; Simple harmonic motion with Work and Energy; Heat with Impulse and Momentum;Impulse and Momentumwith Work and Energy. Overall, there are seven pairs of different learning outcomes that occur. The differnce can be evaluated on the mean difference.

Students learning outcome Work and Energy is higher than Elasticity and Hooke's Law materials. The concept of elastic modulus is still considered difficult by the students because it involves abstract concepts and is difficult to visualize. In contrast to the concept of Work and Energy, the example can be found their daily life. So, it is easy to visualize and simulated. The Kinematics material is easier than the Harmonic Motion material. Although both topics are easy to visualize, but Kinematics materials are easier to represent in various forms.

Table 5. Result of Students Learning Outcome by Using Multiple Comparison Test in Different Learning Materials

(I) MK	(J) MK	Mean Difference	p
EHL	K	-2.1697	0.966
	SHM	7.1637	0.063
	H	-6.0504	0.127
	IM	3.0884	0.829
	WE	-12.4455*	0.000
K	SHM	9.3333*	0.008
	H	-3.8808	0.648
	IM	5.2581	0.364
	WE	-10.2759*	0.003
SHM	H	-13.2141*	0.000
	IM	-4.0753	0.598
	WE	-19.6092*	0.000
H	IM	9.1388*	0.002
	WE	-6.3951	0.096
IM	WE	-15.5339*	0.000

*) significant different at 95%
EHL is Elasticity and Hooke's Law, K is Kinematic, SHM is Simple Harmonic Motion, H is Heat, IM is Impuls and Momentum, WE isWork and Energy

The Heat material is felt more easily than simple harmonic motion because the concept of Heat more often encountered by students in everyday life. The average difference in learning outcomes for each of the physical material topics can be due to differences in material characteristics, and can also be attributed to differences in the quality of the development of interactive electronic books. A good interactive electronic book should have several criteria including the concept, principles, formulas, laws systematically arranged and supported by images, animations, videos, experimental simulations of interest and interactive exercise questions.

It can not be denied that each of physics material has a different level of difficulty. There are several materials that can be directly observed, done and learned in the learning so that students are easier to understand and apply them. However, some other materials are difficult to be understood because students can do experiment directly in learning process. Although already using computer-based learning media, there is still a side where students have to imagine what happens. Students' abilities in these matters vary with different effects on their capabilities and ultimately affect their learning outcomes.

3 CONCLUSION

Based on the results and discussions, it can be concluded that there are differences in physics learning outcome caused by different book forms. Student learning outcomes using interactive electronic books are higher than printed books. Meanwhile, there is no difference in the average of physics learning outcomes caused by gender both in experimen and control class. Male students' learning outcomes were not significantly different from female students. Besides that, here is no interaction between interactive electronic book form with gender in terms of student physics learning outcomes, but there is a difference in physics learning outcomes caused by the different characteristics of interactive electronic book material. These also indicate that interactive electronic books are feasible as a learning resources to present different physics learning materials.

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