

## The Effects of *Science-On-Web* Learning Media on Junior High School Students' Learning Independency Levels and Learning Outcomes

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### ABSTRACT

This research aimed to examine the effects of science-on-web learning media on grade 8 students' learning independency levels and learning outcomes of 'excretion system' topic. Through a quasi-experimental research method within non-equivalent control group design, 70 grade 8 students drawn from Tanjungpinang, Indonesia participated in the study. Pretest and posttest were carried out before and after the teaching intervention. Two intact groups were assigned as the experimental and control classes (35 by 35). The experimental class was exposed to the science-on-web learning media, while the control one was instructed through the electronic module. Data were collected through a learning independency observation sheet and a learning outcomes test. This research showed that the experimental class significantly performed better at learning independency levels and learning outcomes than the control one.

**Keywords:** Learning independency, learning media, learning outcomes, science-on-web.

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### INTRODUCTION

Information and communication technology (ICT) has dramatically been improving in this globalized era. ICT aspects include such digital media tools as computer, laptop, internet and smartphone. Computer and internet contribute a great educational advantage to learning. Thus, teacher should encourage students to utilize computer and internet as important tools to support education, improve knowledge, broaden the opportunities and empower a better qualified life.



Schools, as social institutions, play an important role in changing people's lives. Hence, schools purpose to equip students with challenging any rapid change. That is, ICT facilities in schools enable students to actively and independently achieve learning. Further, teachers need to have these skills to improve and use learning media. Arsyad (2014) and Sadiman et al. (2017) state that media, which acts as a tool to deliver learning messages from sender to receiver, stimulates student's mind, emotion, attention and passion to the learning process. These experts' arguments imply that using the appropriate learning media affords students to build a better understanding of science and triggers their learning motivation to achieve learning goals.

One of the learning media is computer-based-multimedia that Indonesian in junior high school students are familiar with. While choosing appropriate learning media, students' characteristics, learning trends and challenges should be taken into consideration. For example; an audio visual media on website, which is accessible at any time by using computer, laptop, notebook or smartphone, meets their characteristics. In view of Rusman (2013), the object and interactive-computer-based media are the best resources for communication purposes/needs. These types of learning not only focus on media or objects, but also encourage students to actively interact with the media or peers.

Yen, Tuan, & Liao (2011), who conducted a web-based research, found that web-based learning made a significantly higher contribution to learning outcomes and assisted students in accomplishing a better understanding of the topic. Similarly, Shih et al. (2010) depicted that web-based learning media gave an opportunity for students to improve student's knowledge and self-regulated learning. Therefore, it is believed that the use of *science-on-web* learning media in form of HTML may create a funny and interesting learning environment for classical or individual (independent) learning.

The 'Excretion System' topic has its own characteristics in that it links structural, functional, procedural features of daily live to health of kidney, liver, lung and skin. The excretion system is an intangible topic to help students visualize and understand it via an interesting learning media. Web-based science learning media (*science-on-web*) has a potential to enable them to visualize the excretion concept.

As a new learning environment, web users can design and use web pages to get any help and information on the Internet. For instance; some students use websites to visualize any phenomenon or example (Donovan & Nakhleh, 2001). Therefore, web pages can be used to attain learning processes.

HTML (Hyper Text Markup Language), which is a programming language to create web pages, contains easy accessible information for people (Curran Bond, & Fisher, 2012). The newest HTML version is HTML5 that many browsers in computer and mobile devices have supported (Baker, 2014; Chen et al., 2013). HTML5 contains texts, static graphics and dynamic graphics (e.g., animation), hyper textual and graphical links. HTML5 can also be inserted within other programming languages (e.g., Java script, Java and CSS3) to design more interactive web pages (Garaizar, Vadillo & López-De-Ipiña. 2014; Sikos, 2011).

HTML5, which has an advantage not to need a special compiler, such as Fortran and Delphi, simply calls such browsers as Google Chrome, Mozilla Firefox and Microsoft Internet Explorer. Also, HTML5 particularly does not need an external plug-in program ( i.e., Adobe Flash) to display audio and video contents (Curran et al. 2012; Lubbers et al., 2011). In other word, HTML5 has been designed as an independent device.

Shih et al. (2010) describe self-regulated learning as a four-attribute learning process:

- (1) *Intrinsically or self-motivated: Self-regulated learners tend to maintain learning behavior with a very strong motivation. Learners can raise this motivation through some practices, such as setting learning goals.*

- (2) *Planned or automatized: Self-regulated learners are apt to use some strategies along with their learning processes, including both cognitive and self-regulated strategies. Generally, learners improve their learning performance when using self-regulated strategies rather than cognitive strategies. Self-regulated strategies contain goal-setting, goal-planning, organization, transition, exercise, and so on. A self-regulated learner needs to effectively use self-regulated strategies for his/her learning.*
- (3) *Self-aware of performance outcomes: Throughout the learning process, self-regulated learners sharpen their self-awareness of learning behaviors. To approach an ideal outcome, self-regulated learners should be aware of their own learning qualities, and change their behaviors or strategies correspondingly.*
- (4) *Environmentally/socially sensitive and resourceful: The learning environment(s) and resources affect one's learning pattern. Self-regulated learners have better skills in seeking learning resources or support. With such ability, they should arrange the environmental conditions and search for other resources effectively (p. 87).*

Benson & Voller (1997) state that self-regulated learning fully depends on student's own performances (e.g., learning and applying skills; practicing individual responsibility as an outcome of self-regulated learning; and determining their own learning paths).

Learning independence, as a learning process, affords students to plan, monitor and manage their own learning (Marini & Boruchovitch, 2014). Tsai, Hsu, & Tseng (2013) state that self-regulated learning, which refers to metacognitive, motivation and behavior processes, enables students to focus on and control their own learning. Metacognitive process includes managing and designing learning, while motivation process incorporates self-evaluation. Further, behavior process contains to choose, set up and create the best learning environment (Wan, Compeau, & Haggerty, 2012). Moreover, a self-regulated learning activity connects learning environment to learning outcomes (Pintrich & Zusho, 2002; Schunk, 2005). Motivation, as an important aspect of self-regulated learning, will trigger student's learning enthusiasm (Bharathi, 2014; Marini & Boruchovitch, 2014; Zimmerman, 2008). Overall, learning independence, as a self-regulated learning activity, not only makes students responsible for their learning processes but also possesses their own study initiatives, self-confidence and a high learning motivation.

The European Union (EU) (2015) implies that learning outcomes mean student's competency/achievement level via measurement and assessment. Learning outcomes includes such statements as what a learner knows, understands and does during a learning process. Kennedy, Hyland, & Ryan (2006) describe learning outcomes as a student's mastery level at learning process.

UNESCO (2015) sees learning outcomes as students' educational knowledge, attitudes, values, and skills. This means that learning includes three main learning domains (i.e., cognitive, affective, and behavior) (Grabau & Ma, 2017; Økland, 2012).

A learning outcome consists of students' learning efforts/performances (i.e., doing, knowing and understanding the targeted issues) in the end of learning period (Brooks et al., 2014). In a similar vein, Adam and Expert (2008) claim that students will gain some knowledge after their involvement with learning process. Hamalik (2011) considers a learning outcome as a learning achievement indicating student's behavioral change. This research aimed to examine the effects of science-on-web learning media on grade 8 students' learning independency levels and learning outcomes of in the 'excretion system' topic. Because science on-web learning media visualizes the concept of excretion, it supports student learning independency. Students can use science-on-web learning media via the guide instructions existing on the media independently. In brief, this study hypothesized that

science-on-web learning media would increase grade 8 students' learning independency levels and learning outcomes.

## METHODS

Through a quasi-experimental method within nonequivalent control-group design, pre-test and post-test were carried out before and after the teaching intervention (see Table 1).

**Table 1.** An outline of the quasi experimental research design

Group	Pretest	Treatment	Posttest
Experimental	T1	X1	T2
Control	T1	X2	T2

T1: Pre-test, T2: Post-test, X1: Science-on-web learning media, X2: Electronic module learning media

The use of science-on-web, which was offline, and CD format for enriched materials, enabled students to independently play at anytime and anywhere. The science-on-web, which was developed via HTML5, included animations and other visualization objects for the 'excretion system' topic. The electronic module learning media involved power points, videos and multimedia.

The sample of the research comprised of 70 grade 8 students drawn from a Junior High School 5 in the state of Tanjungpinang, Indonesia. Two intact groups were assigned as the experimental (17 boys and 18 girls in class VIII E) and control (15 boys and 20 girls in class VIII D).

### a) Data Collection Instruments

To collect data, a learning independence observation sheet and a multiple-choice test were exploited. The learning independence observation sheet was used to measure students' learning independence levels, while the objective test was employed to measure their learning outcomes.

### b) Learning Independence Observation Sheet

Content and construct validity of a 4-point learning independence observation sheet was ensured by an expert. There were five observed aspects, i.e., responsibility, learning initiative, dependence on other people, self-confidence and learning motivation. These aspects reflecting learning independence were converted into 11 indicators.

### c) Multiple-Choice Test

A 30-item multiple choice test was administered as a pre-test and post-test. An expert, whose research interests covered excretion system topic, construction, language and culture, validated the test. The test was pilot-tested with 35 junior high school students, who had already learnt about the topic under investigation. The results of Pearson Product Moment Correlation ( $r_{xy}$ ) were compared with  $r$  product moment ( $r_{tab}$ ) value. If  $r_{xy}$  is larger than  $r_{tab}$ , a significant correlation emerges and makes the item valid. That is, 22 out of 30 items were valid since  $r_{xy}$  value was larger than  $r_{tab}$ , i.e.  $r_{xy} > 0.339$ . The reliability of learning outcome items was measured using Kuder-Richardson's formulae, named  $\alpha$ -20's coefficient (Mardapi, 2008). Reliability value was found to be 0.788 meaning a high reliability.

#### d) Data Analysis

The students' learning outcome scores to pre-test and post-test were analyzed through gain standard. Meanwhile, their learning independence scores to every observation sheet were also analyzed by using gain standard. Improvement criteria of normalized gain scores are summarized in Table 2 (Hake, 1998).

**Table 2.** *Improvement criteria of normalized gain score*

No	Normalized Gain Score	Criteria
1	$g \geq 0.70$	High
2	$0.70 > g \geq 0.30$	Intermediate
3	$g < 0.30$	Low

After meeting prerequisite tests, i.e. normality test and similarity of variant covariant matrices test, effectiveness of science-on-web learning media was tested through *One-way* Manova Hotelling's  $T^2$ . Hypothesis of the current study were as follows:

- $H_0$  : There is no statistically significant difference between mean scores of the experimental (science-on-web learning media) and control (electronic module media) groups' learning independency levels and learning outcomes.
- $H_a$  : There is a statistically significant difference between mean scores of the experimental (science-on-web learning media) and control (electronic module media) groups' learning independency levels and learning outcomes.

## FINDINGS

Multivariate normality test indicated a statistically significant value between the experiment and the control class ( $p < 0.05$ ). This means that the data were distributed multivariate normally. The variant covariant matrices similarity test showed a statistically significant value of 0.193, which was higher than 0.05. This depicts that the experimental and control groups' variant covariant matrices were the same.

After fulfilling the prerequisite tests, i.e., multivariate normality test and homogeneity test, Manova test were performed by using SPSS 23<sup>TM</sup>. The results of hypothetical Manova test are outlined in Table 3.

**Table 3.** *The results of hypothetical Manova test*

Effect	Value	Sig.	Conclusion
Hotelling's Trace	0.119	0.023	$H_0$ rejected

#### a) An Improvement in Student's Learning Independency

Two observers observed every lesson by help of the learning independency observation sheet. Any improvement in student's learning independency level was determined their scores to three lessons. Hence, their gain values were calculated to make a comparison. The results of learning independency levels are presented in Table 4.

**Table 4.** Mean scores of student's learning independency levels

Class	Average Value			Gain
	Lesson 1	2	3	
Experimental	67.50	75.49	79.94	0,37
Control	62.56	69.71	73.54	0,29

### b) An Improvement in Student's Learning Outcomes

The students' learning outcome scores to pre-test and post-test are displayed in Table 5.

**Table 5.** Mean scores of the experimental and control groups' learning outcome scores to pretest and posttest

Class	Average Value		<g>
	Pretest	Posttest	
Experimental	42.8	80.5	0.66
Control	41.5	76.4	0.59

## DISCUSSION and CONCLUSION

As seen from Table 3, because the significance value was less than 0.05, i.e., 0.023,  $H_0$  was rejected, indicating significant difference of learning independency levels and learning outcomes between the experimental and control groups. This means that science-on-web learning media effectively improved the students' learning independency levels and learning outcomes. This result is in a harmony with previous studies indicating that web-based learning improves learning independence (Shih et al., 2010) and learning outcomes (Yen et al 2010). Similarly, Chang (2005), who implemented web-based learning, found that the web-based learning developed the students' learning independence in terms of responsibility and confidence. Chang (2005) also addressed that web-based learning helped them understand the learning material. Robin Kay (2014) also elicited that the students' learning outcomes of natural science lessons significantly increased with web-based learning. This shows that media-assisted learning activities provided opportunities for students to develop knowledge and independent learning. It showed that the students with web-based learning performed better at understanding the related concept than those with direct learning.

As can be seen from Table 4, the experiment group's average values ranged from 67.50 (first lesson) to 79.94 (third lesson). The gain value (0.37) of the experimental group showed an intermediate category. The control group's average values were between 62.56 (first lesson) and 73.54 (third lesson). The gain value (0.29) of the control group revealed a low category. These values showed that the experimental group (science-on-web learning media) had a higher learning independency than that of the control one.

A significant improvement in the experimental group's learning independency may result from features of science-on-web media (e.g., interesting learning media and new technology). That is, these features may have enhanced their learning interest and motivation. This is in a parallel with the result of Nafidi et al. (2017), who drew out a strong learning motivation as an output of the use of computer simulation. This also means that an advanced technology (i.e., science-on-web learning media) empowers student's self-regulated learning (Winters, Greene, & Costich, 2008) and enables students to have a higher independency level (Wang & Wu, 2008). These findings are also in line with those of Chen (2009), Shih et al. (2010) and Lee & Tsai (2011) reporting that web-based self-regulated learning significantly improved student's self-study capability.

As observed in Table 5, mean scores of the experimental group's learning outcomes were 42.8 in pre-test and 80.5 in post-test. Gain value (0.66) of the experimental group

indicated an intermediate category. Meanwhile, mean scores of the control group were 41.5 in pre-test and 76.4 in post-test. Gain value (0.59) revealed an intermediate category. These results showed that the experimental group's (science-on-web learning media) learning outcomes possessed a better improvement than did the control one.

A better improvement in the experimental group's learning outcomes of the 'excretion system' topic may stem from features of science-on-web learning media (e.g., a clearly interesting visualization of the topic). This is in line with the results of Frailich, Kesner & Hofstein (2007), who found that students with web-based chemistry animation and visualization had a better conceptual understanding than those with regular intervention. Similarly, Kusairi, Alfad & Zulaikah (2016) found that web-based learning media was effective in improving students' conceptual understanding. In addition, an improvement in students' learning outcomes is consistent with the results of Kay (2014) reporting that web-based- science learning significantly improved students' learning outcomes.

The use of technology in class, such as web-based-learning media, provides a proper learning process for students and positively affects their learning outcomes (Zimmerman & Tsikalas, 2005). As a matter of fact, Yektyastuti and Ikhsan (2016) found that using android software media improved students' cognitive learning outcomes.

The results of the study showed that the value of learning independence had a correlation with learning outcomes. That is, an increase in student learning independence also improved learning outcomes (Zheng, Li, & Chen, 2016). The relationship between learning independency level and learning outcomes supports the results of Uçar and Sungur (2017) addressing that students with a high independency level had good learning outcomes. The results of the current study indicated that science-on-web learning media of the 'Excretion System' topic might be used as an alternative approach to improve junior high school students' independency levels and learning outcomes.

It can be concluded that science-on-web learning media has a potential to improve junior high school students' learning independency levels and learning outcomes. Thus, the current study recommends that science-on-web learning media be implemented in schools to support their science learning independency and science learning outcomes.

## **Suggestions**

The availability of wide coverage of internet connection in schools and supporting infrastructures for online learning in Indonesia can assist students to improve their learning independency levels. This fact may contribute to success of education program in 4.0 industrial revolution era in Indonesia. Given the results of the current study, it suggests that science teachers and students should use science-on-web learning media as a medium to accomplish natural science learning. Future studies ought to develop similar science learning media/materials, and integrated into various learning strategies for better learning outcomes.

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