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The effect of multiple media instruction in improving students' science process skill and achievement

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Abstract

Teaching using media is one of the most important components in the teaching and learning process. This research was conducted to investigate the effectiveness of various constructive teaching media in the science teaching and learning process to improve the student's science process skills (SPS) and science achievement in the Siak Sri Inderapura Secondary School, Riau Indonesia. Four modules were developed and eight multimedia teaching were carried out. This research employed *quasi-experiment* method with "non equivalent control group" design. Two treatment groups and one control group were involved in this research. The first treatment group used ICT module while the second treatment group used environmental module. The control group on the other hand used conventional teaching approaches. The study was conducted on 96 students in Siak Sri Inderapura Secondary School in Riau, Indonesia. The instruments used were Science Process Skills Test and Science Achievement Test. Data were analyzed descriptively, which later followed by subsequent inferential analysis using ANOVA and MANOVA test. The findings revealed that there were significant differences on the knowledge of SPS and Science achievement between students who underwent the ICT and environmental modules with the students who underwent conventional teaching strategies. Based on the findings, it can be concluded that the teaching and learning process using various constructive teaching media has significantly improved the SPS and Science achievement among students.

Keywords: Multiple media instruction ; science process skills (SPS); achievement.;

1. Introduction

The teaching of curriculum requires teachers to choose appropriate learning methods to engage students' active participation in learning especially in the aspect of mental and physical learning, social and biological that stresses on the understanding of concepts, completing questions and solving problems (Depdikbud, 2005). Therefore, to improve the teaching and learning process, we need to modify a varied range of educational media such as textbooks, television, props, specimens, photos, computer, even the environment itself. Media Teaching and Learning is one of the education components that have been included in the curriculum to achieve better teaching and learning (Siahaan, 2007).

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In the process of teaching and learning the subject of Biology which involves environmental skills, teachers are required to design attractive media and to implement it in their teaching not only in the classroom. Students are expected to understand the concept of the ecosystem. Therefore, various instructional media using ICT and environment modules to meet the demands of a broad learning environment is essential so that learning becomes interesting and meaningful for students (Triatmanto, 2009). The use of various instructional media and various activities in teaching and learning will allow the students to synthesise and collaborate the knowledge that will end up provide more easily understanding of the topics being learned among the students (Mc Clintock, 1992). Using a variety of instructional media can assist students' learning, thus improving students' knowledge and develop their attitudes and skills in Science.

1.1 Research Conceptual Framework

According to Razali (1994), the media is one of the aspects that need to be seriously considered in teaching and learning. It is important to attract students and increase the stimulus for more work and progress, other than reinforce or detection of a particular topic or topics presented by the teacher. This should improve the success of learning, and students' attitudes and their Science process skills. According to Kosasih (2007), teaching media can be divided into four types:

1. Graphic media such as pictures, photographs, graphics, charts, diagrams, cartoons, posters, and comics.
2. Three-dimensional solid model of the media in the form of sectional model, the model apartment, working models, and dioramas.
3. Media projectors such as slides, film strips, films, and OHP.
4. The environment.

Researchers distinguished the two types of instructional media as multimedia and the environment. Multimedia or ICT media combines graphics, three-dimensional media and media projectors. According to Von Wodtke (1993) Feldman (1994) and Salmiyati (2007), the interactive multimedia learning technology (ICT) presents a variety of media such as text, sound, graphics, animation, and video into the computer system. While Sudjana (2008) and Triatmanto (2009) stated that the environment is an innovative learning tools that are factual and can be obtained easily by the teachers from their school surrounding.

1.2 Research Objectives

The objective of this study is to evaluate the effectiveness of the use of Multi Media Teaching constructivist-based teaching and learning to enhance students' Science process skills and achievements.

2. Methodology

Campbell and Stanley (1963) reported that the quasi experimental method can be used to design a "non equivalent control group" to identify the Science process skills and increase student achievements. Table 1 illustrates the design.

Table 1. Design of the Treatment and Control Groups

Group	Pre-Test	Teaching Strategies	Post-Test
Treatment Group 1 (n=32)	O_1	X_1 (use of multimedia technology – ICT)	O_2
Treatment Group 2 (n=32)	O_3	X_2 (environment usage)	O_4
Control Group (n=32)	O_5	X_3 (Conventional strategy)	O_6

2.1 Sample and Population

The population of this study are Primary 1 students, from the state 11 High School in Riau Province. The samples were taken by using the purposive sampling and random sampling methods. Sampling method was aimed to determine the degree of school and school levels. While simple random method was to determine the group.

2.2 Research Instrument

In this study, there are two instruments which are Science Process Skills tests and Achievement tests. Construction of the questions in the SPS builds upon previous research by Rose (2004) and Rezba et al. (2003) and modified according to the degree and the ability of students. This test consists of 30 objective questions which includes five constructs, they are; the basic process skills: observing (K1), welding (k2), predicting (k3), communicating (K4) and inferencing (K5). The achievment test was developed by reasearchers and experts in science education based on the construct defined by Bloom's Taxonomy (Anderson & Krathwohl, 2001). A total of 30 questions consisting of 15 low level and 15 high-level questions were designed for this study. Researchers developed a variety of media and multimedia softwares of teaching modules which include: CD-ROM learning modules based on the environment, students' worksheet (CGI) and the Implementation Plan of Teaching .

3. Research Findings

3.1. Post Test Analysis of Science Process Skills Test

The post-test mean SPS score descriptive statistics is presented in Table 2.

Table 2. Mean Post-Test Scores on SPS

Group	N	Mean Score	Standard Deviation
Multimedia / ICT	32	81.36	5.00
Environment	32	79.79	6.04
Conventional	32	74.17	6.16

Table 2 above shows the mean or average test scores after the SPS was conducted. The ICT group (M=81.36, SD=5.00), the environmental group (M=79.79, SD=6:04) and conventional group (M=74.17, sd=6.16). Furthermore, inferential statistical analysis using ANOVA was carried out to determine differences in all three groups. Result of the one-way ANOVA can be seen in Table 3 below.

Table 3. ANOVA for Post-Test SPS

	Total square	Degrees of freedom	Mean square	F	Sig.
Between Groups	914.871	2	457.435	13.794	0.000
In Group	3084.124	93	33.163		
Total	3998.994	95			

Table 3 shows that there are significant differences ($p < 0.05$) in post-test mean score of science process skill under which the three groups F (2,93)=13,794, P=0.000. Next to be done is the post hoc Tukey test to compare the results in more detail. The result of *post hoc* Tukey test analysis shows that there are a significant differences M=5.63 and sig=0.001 ($P<0.05$) between the Enviromental groups and the Convensional group. There were also a significant differences between Convensional group and ICT group with the value of M=7.19 and sig=0.000 ($P<0.05$).

3.2. Post Test Analysis Achievement Tests

Descriptive statistics mean scores on achievement tests is shown in Table 4.

Table 4. Mean Scores on the Achievement of The Post Test

Group	N	Mean Score	Standard Deviation
Multimedia / ICT	32	80.00	6.64
Environment	32	76.77	7.69
Conventional	32	72.00	6.44

Table 5 above shows the mean achievement test scores after a lesson, the ICT group (M=80.00, SD=6.64), the environmental group (M=76.77, SD=7.69) and conventional (S=72.00, SD=6:44). Furthermore, inferential statistical analysis was conducted using ANOVA to determine differences in all three group. Results of one-way ANOVA is shown as Table 5 below.

Table 5. ANOVA Results for Performance Post-test

	Total square	Degrees of freedom	Mean square	F	Sig.
Between Groups	1017.745	2	508.872	10.551	0.000
In Group	4485.387	93	48.230		
Total	5503.132	95			

Table 6, shows that there are significant differences in mean scores of achievement tests of these three groups ($p < 0.05$). This means that there are significant differences between the achievement scores of ICT group and the environmental group and the conventional group. Subsequently, post hoc Tukey test was performed to see the differences in more detail. The result of post hoc Tukey test analysis is shown in Table 6 below.

Table 6. Post hoc Tukey Test Results for Post Test Achievement

Group (I)	Group (J)	Mean Difference (I-J)	Standard Error	Sig.
Conventional	Environment	-4.79256*	1.73620	0.019*
	ICT	-7.9172*	1.73620	0.000*
Environment	Conventional	4.79256*	1.73620	0.019*
	ICT	-3.1247	1.73620	0.175
ICT	Conventional	7.9172*	1.73620	0.000*
	Environment	3.1247	1.73620	0.175

From Table 6, we can conclude that the post hoc Turkey test conducted performance tests there were significant differences ($p<0.05$) between groups of ICT and the conventional group, and between environmental groups and conventional. There is not much significant difference ($p>0.05$) between the ICT group and the environment group. The achievement test conducted consists of two sub achievement of low-level questions (LQ) and high level questions (HQ).

Table 7. MANOVA Test Results for the Post Test for Group sub-achievement

Source	Total of Both Types III	Degree of Freedom	Mean squares	F	Sig.
Group					
LQ	808.433	2	404.217	3.731	0.028
HQ	1125.9	2	562.976	5.931	0.004

Based on Table 7, it shows the significant differences in groups based on LQ sub-achievement value and sig F = 3731 = 0028 (P <0.05) and significant differences are based on the sub-achievemen HQ with F = 5931, and sig = 0.004 (P <0.05). This means that there are differences in achievement test scores among low-level and high level in ICT group with the environmental and conventional group. Furthermore, the *post hoc Tukey* test was carried out to compare in more detail. The result of *post hoc Tukey* test analysis shows that there were a significant difference in sub-achievement LQ between the group that used ICT with Convensional group with the min=6.88 and sig=0.0026 (P<0.05). The result also shows the sub-achievement AT There are significant differences between groups that use ICT with use conventional learning with note differences mean = 8:33, and sig = 0.003 (P <0.05). whereas The result also shows that there is no significant difference between Environmental and Convensional group (P>0.05).

4. Discussion

The findings revealed that there are significant differences in the students' performance in SPS and Science achievement between those who undergo the ICT and environmental modules with those who undergo conventional teaching strategy. This finding is also consistent with a study conducted by Iwan (2005) that the students who were taught the ICT strategy are performed better than the students who studied with conventional strategies. The finding also revealed that the students who were studying the environment educations also shows improvement on their SPS performance. Sudjana (2008) and Soleh (2007), who were used the environment elements in teaching, shows that a more comprehensive set of activities enabling a verity of skills to be used such as observing, making enquiries, interviewing, proving and demonstrating, examining facts, which improved students' achievements. Learning environment is a rich source of learning experiences because of the diverse elements such as social environment and nature, which may be used for experiments. Students will be able to understand, appreciate and learn to love all aspects of life in its environment. This is also supported by Yustina (2010) who reported that students can improve their educational achievement and SPS skills if the students carry out experiments based on the environment issues. Besides, the learning based on the experiments activities in environmental issues will also helps in improving the understanding of the topic that being taught among the students.

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