Fostering Science Process Skills and Improving Achievement Through The Use Of Multiple Media

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Submission date: 08-May-2020 04:53PM (UTC+0800)

Submission ID: 1319299271

File name: Jurnal_3._Kamisah,_Rian,_FOSTERING_SCIENCE.pdf (699.77K)

Word count: 6627

Character count: 36341

JOURNAL OF BALTIC SCIENCE EDUCATION

ISSN 1648-3898

FOSTERING SCIENCE PROCESS SKILLS AND IMPROVING ACHIEVEMENT THROUGH THE USE OF MULTIPLE MEDIA

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Abstract. *The study focuses on how best to foster the science process skills and improving achievement of secondary schools students in Riau Indonesia. This research used a quasi-experiment method which involved two experimental groups and one control group. The first experimental group used an environment learning module based on Information Communication Technology (ICT), whilst the second experimental group used the environmental module without ICT. The third group went through the teaching and learning process using conventional methods. The instruments used were the Science Process Skills test and students' achievement test. Analysis of the findings was done descriptively followed by subsequent inferential analysis using ANOVA and MANOVA tests. It was found that there exist significant differences in science process skills and achievement between the two experimental groups and the conventional group. Based on the findings, it is suggested that science teachers need to be adroit in varying their teaching approaches as well as orientating themselves in using ICT in their teaching.*

Key words: *information communication technology, science process skills, science teaching and learning*

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Introduction

The curriculum requirements of Biology Education in Indonesia emphasize the need for conceptual understanding, thinking and problem solving skills. Teachers need to choose and use teaching methods that would actively involve the students mentally, physically and even socially (Depdikbud, 2005). To meet the demands and current needs of the Biology education curriculum various teaching mediums are used - text books, television programmes, specimens, pictures, computers and also the environment itself. The success of a teaching plan depends on the proccess of the teaching and learning itself; students, teachers, the curriculum, teaching methods, fascilities and infrastructure as well as the teaching and learning medium (Hassard, 2005) are all important factors.

Yustina and Vebrianto (2009) when looking at the process of learning Biology in Indonesia found that teachers were more inclined to explain and provide information regarding the phenomenon and concepts in Biology verbally and not through real life observation, having a tendency to explain topics, provide samples of questions, and give exercises. In daily practice, teachers did not give the opportunity to the students to observe their surroundings in order to show the biological phenomenon, nor to see the basic concepts through instructional media and observation. Student's responses towards this teaching is primarily in the form of revising information given by the teacher. Teachers are primarily "subject matter oriented only", focusing on the discussion of content without the consideration of students learning (Depdikbud, 2005; Suryawati, Osman & Meerah, 2010; Yustina, Osman & Meerah, 2011). Here the learning process focuses on the teacher, while the student's science skills and attitude are not given the opportunity to develop. Teachers also pay less attention to the opportunity for students to interact directly with the object they are learning about. Because of that, teachers function as the provider of information, and students as the recipients of information.

In this research the implementation of the teaching and learning process specifically for the subject of Biology, which is related to the environment, demand teacher's skills in preparing various interesting instructional media which when implemented is not limited in the classroom. Using various instructional mediums in teaching and learning activities enables the teacher to synthesize information so that students are able to understand and learn more effectively (Mc Clintock, 1992; Dow, 2010). Students are better able to grasp the concept of the ecosystem through direct experience rather then relying on imagination and reading alone. Thus, the use of various instructional mediums, specifically ICT and direct experience with the environment are expected to make learning more interesting and meaningful to most students.

Analysis of literature in environmental education has shown much research has been done to determine the effectiveness of using ICT in improving student's achievement (Dow, 2010; Chuang & Yang, 2005; McLaughlin & Arbeider, 2008). This is because the use of interactive multimedia in learning creates a more student centered learning environment. Students are also entertained and relaxed when using ICT resulting in a better understanding of what they are learning and enhances student's science process skills (Chuang & Yang, 2005; McLaughlin & Arbeider, 2008; Knighton & Smoak, 2009; 2005; McLaughlin & Arbeider, 2008; Knighton & Smoak, 2009; Rohaida & Kamariah, 2005).

In addition to ICT integrated teaching appealing and meaningful learning experiences can also be created through interaction with the learners' surroundings. By exposing the students to the actual environment, both outside the classroom and in the science lab, students are able to observe and relate these findings to their learning process. This method is meaningful because students are exposed to actual experience and therefore it is more realistic. Teaching and learning about the environment doesn't require a long period of time, aguably one or two hours of learning is adequate depending on what is being learnt and how it was learnt (Brody, 2005; George & Glasgow, 2002; Barak, 2007).

It could therefore be concluded that instructional media is an important component in the process of teaching and learning. Additionally, the use of various instructional mediums is hoped to assist students in learning actively in order to understand concepts, shape their scientific attitude as well as developing their science skills.

Instructional Medium

According to Razali (1994) instructional medium is one of the tools that is required to strengthen the teaching and learning process. This is crucial in capturing student's interest and increasing their motivation to persevere and succeed as well as strengthening their understanding of the topic taught by the teacher (Tutwiler, Lin & Chang, 2012). Kosasih and Angkowo (2007) suggest that instructional medium is divided into four types: i) Graphic media such as pictures, photographs, graphics, charts, diagram, cartoon, posters, and comics. ii) Three dimensional medium in the form of models, iii) Projector medium such as slide, films and OHP; and iv) The Environment as a learning medium.

Von (1993) and Koesnandar (2006) state that interactive multimedia technology includes many types of media such as text, audio, graphic, animation, and video which are incorporated in the computer system. In this study, the researcher defines instructional medium as multimedia and the environment. According to Feldman (1994), multimedia is the manipulation and integration of various mediums like data, text, graphic, video and sound within a digital environment and for this study multimedia or ICT combines graphic medium, three-dimensional medium and projector. The second medium is learning based on the environment which is an innovative and factual resource and a variation of teaching style could be practiced by a teacher using the school surroundings (George & Glasgow, 2002; Barak, 2007).

In Indonesia's junior high schools Environmental Education is a part of Biology curriculum. Biology relates to learning about the environment and the surrounding in a systematic way. Within the context of competency-based curriculum, one of the competencies applied in Biology is the understanding of the natural phenomenon through observation and experiments in order to cultivate a scientific attitude and science process skills. In a curriculum that stresses competency achievement student's aims and achievements are summarized by their competency level. Thus, it could therefore be argued that a person who is competent in a certain field would not only process the knowledge but would be able to understand and appreciate the subject as well as manifest it in their daily behavior (Sanjaya, 2006).

Constructivism as an Important Element in Media Design

Constructivism is part of a body of educational theory that teachers use as a guide to develop challenging and effective teaching and learning for their students. In the context of constructivism, the teacher should provide a solution and act as facilitator taking into account the social climate of the class in order to develop the class curriculum. Teachers also need to design learning situations and make appropriate rules of construction (Moustafa, Assaraf & Eshach, 2012).

According to Briner (1999), constructivist learning is based on the active participation of students in problem-solving and critical thinking in a learning activity. This means that students construct their own knowledge by testing ideas and knowledge-based methods with their own past experiences and apply it to new situations by integrating the newly acquired knowledge with existing knowledge. McBrien and Brandt (1997) state that learning was where individual students acquire knowledge of a process based on the experience of receiving information from external sources. This means that teachers no longer act as an active provider of information but must facilitate and supervise. Robottom (2004) found that learning by using constructivist thought appropriate to use in the learning environment enhanced the understanding and involvement of students as well as developing a variety of skills, including the science process skills. In this study, researchers developed a variety of constructivist-based instructional media. It is hoped that by using a constructivist learning theory and its instructional media the science process skills and student achievement of students in an Indonesian school can be enhanced.

Science Process Skills as Outcomes in Science Learning

Science process skills are intellectual skills and can be practiced, learned and developed by children through the learning process (Balfakiha, 2010) making the student better able to meet the challenges of the 21st century. A local study conducted in primary schools by Rohaida and Kamariah (2005) found that the analysis of verbal and non-verbal data revealed that there are several factors that influence the acquisition of science process skills: (1) web-based instructional materials, (2) the physical laboratory, (3) the role of teachers and (4) readiness of students. Other research also indicates that the teaching and learning of science process skills is best done using teaching media in this study the researchers developed teaching aids with multimedia and environmental experts in the form of ICT software and modules based on the environment.

Many studies have been carried out to measure the effectiveness of multimedia technology (ICT) and environmental modules, both in Indonesia or abroad, but most only reach level usability and knowledge of concepts; in practice science process skills were rarely measured (Chuang & Yang, 2005; Dillon, 2003; Bartosh, 2003; Tutwiler et al., 2012). In this study the researchers conduct a study to compare the two treatment groups with a control group to measure achievement and science process skills. This research is carried out to see the effectiveness of using constructivist multiple teaching media in the teaching and learning process in order to improve science process skills and ahievement. Specifically, the research objectives are as follows:

1. To determine the differences in the effectiveness of multiple teaching media towards the student's science skills process; and
2. To determine the differences in the effectiveness of multiple teaching media towards student's achievement.

Research Methodology

Research Design

With reference to Campbell and Stanley (1963), this research employs a quasi-experiment with non equivalent control group design to determine the increase in science process skills and differences in the student's achievement. Table 1 illustrates the research design as implemented in this study.

Table 1. Non equivalent control design.

Group	Pre-Test	Teaching Strategy	Post Test
Experimental Group 1	O_1	X_1 (Multimedia (ICT))	O_2
Experimental Group 2	O_3	X_2 (Environment)	O_4
Control Group	O_5	X_3 (Conventional method)	O_6

There are three groups involved in this study; the first experimental group using multimedia technology (ICT), the second experimental group using the natural surroundings (environment) and the third control group was taught using conventional teaching strategies. Just like the two experimental groups, the third group was given the same pre science process skills test before the intervention strategies and after that the three groups were given a post-test which were analyzed to see the distinction between groups with respect to dependent variables as measured in the study.

The Sample

The population of this research is made up of Standard One *(aged 13)* students from junior high schools in Riau, Indonesia. The research sample was taken in two stages; firstly, schools were selected based on random selection by taking into consideration of all junior high schools in Riau. Secondly, after the schools have been selected the experiment and control groups were also randomly selected. Finally a total of 96 first year students were chosen consisting of three groups; 32 students in the first treatment group used ICT, 32 students in the second treatment group used the environment, and 32 students in the control group with used coventional methods in the teaching and learning of Biology.

The Instrument

Science Process Skills (SPS)

The construction of SPS test is based on previous researches by Rose, Abdul, Lilia and Siti (2004) and Rezba, Sprague and Fiel (2003) but which have been modified based on the level and ability of the students. The test consisted of 30 questions covering five basic process skills constructs which are; observation (S1), classifying (S2), predicting (S3), communication (S4) and inference (S5).

The researchers cooperated with Biology subject matter experts to revise the instruments in order to obtain comments regarding the content such as the clarity of the questions, overlapping or confusion of the sentences and test format. Based on the feedback given, the researcher made a few changes to match the Indonesian Biology Curriculum and a pilot test was conducted to determine the reliability of the instrument. The feedbacks received from the pilot study were analyzed and the Cronbach Alpha obtained from each SPS construct were 0.8 for observation and classifying skills, 0.70 for predicting skills, 0.79 for communication skills and 0.71 for inference skills

Achievement Test

The achievement test was developed by researchers and Biology subject matter experts. By referring to Bloom's Taxonomy of Learning Domains (Anderson, David & Krathwohl, 2001), a total of 30 objective questions were produced consisting of 15 lower level questions (LL) and 15 higher level questions (HL). The Kuder Richardson (KR20) reliability of the achievement test is 0.68 for low level questions and 0.63 for high level questions. According to Best and Khan (1986), even though there are no limitations that could be used to determine the reliability coefficient of a research instrument, they recommend a reliability coefficient of more than 0.60 to be used to determine the reliability of any research instruments.

Environmental Multimedia Software and Teaching Module

The multimedia content developed for the first experimental group contained six components within its structure as shown in Figure 1 and Figure 2. These are:

1. Learning objectives
2. Instructional manual
3. Materials
4. Conclusion (reinforcement)
5. Quizzes
6. Glossary
7. Games.

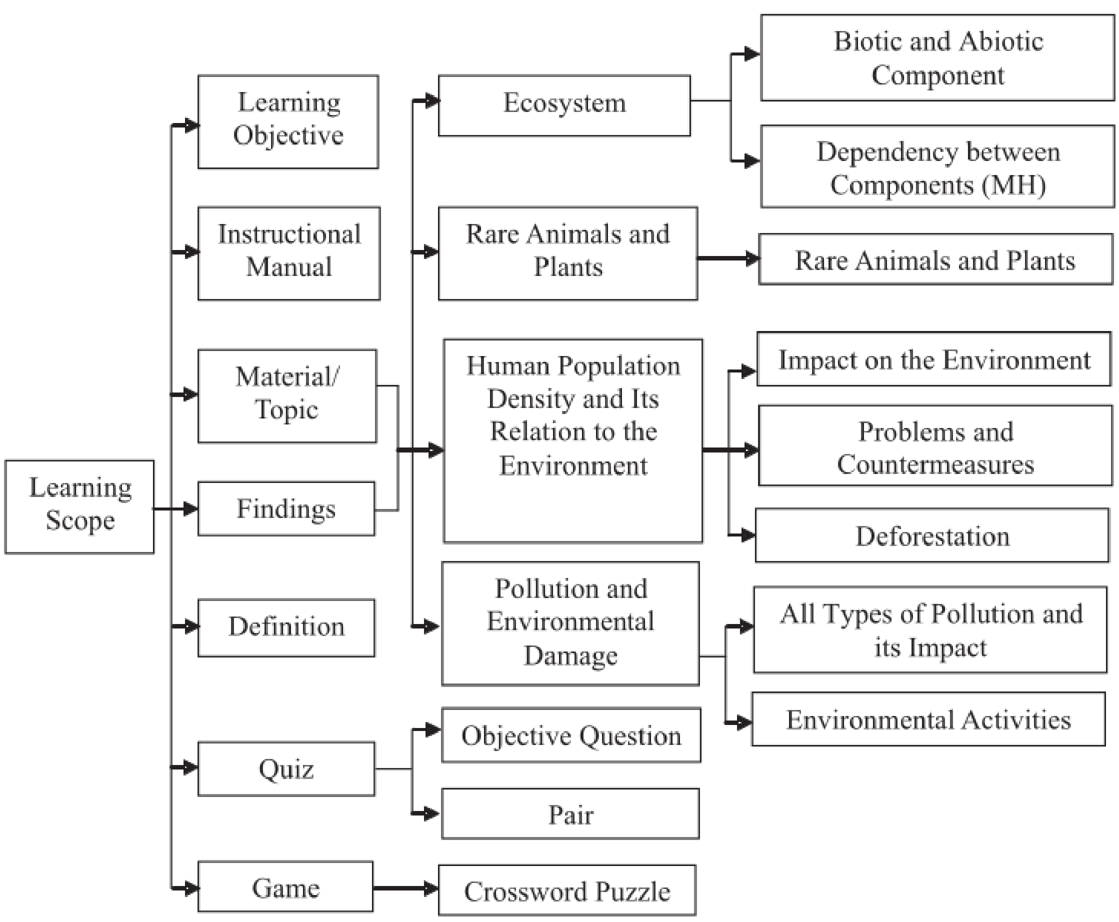

Figure 1: Multimedia development framework (ICT).

Journal of Baltic Science Education, Vol. 12, No. 2, 2013
ISSN 1648–3898

Figure 2: **Main menu.**

The content structure for the development of the environment based module is shown in Figure 3 below. On the other hand, the second experimental group underwent truly environmental learning experience while the control group learnt the same topic using conventional teaching methodology.

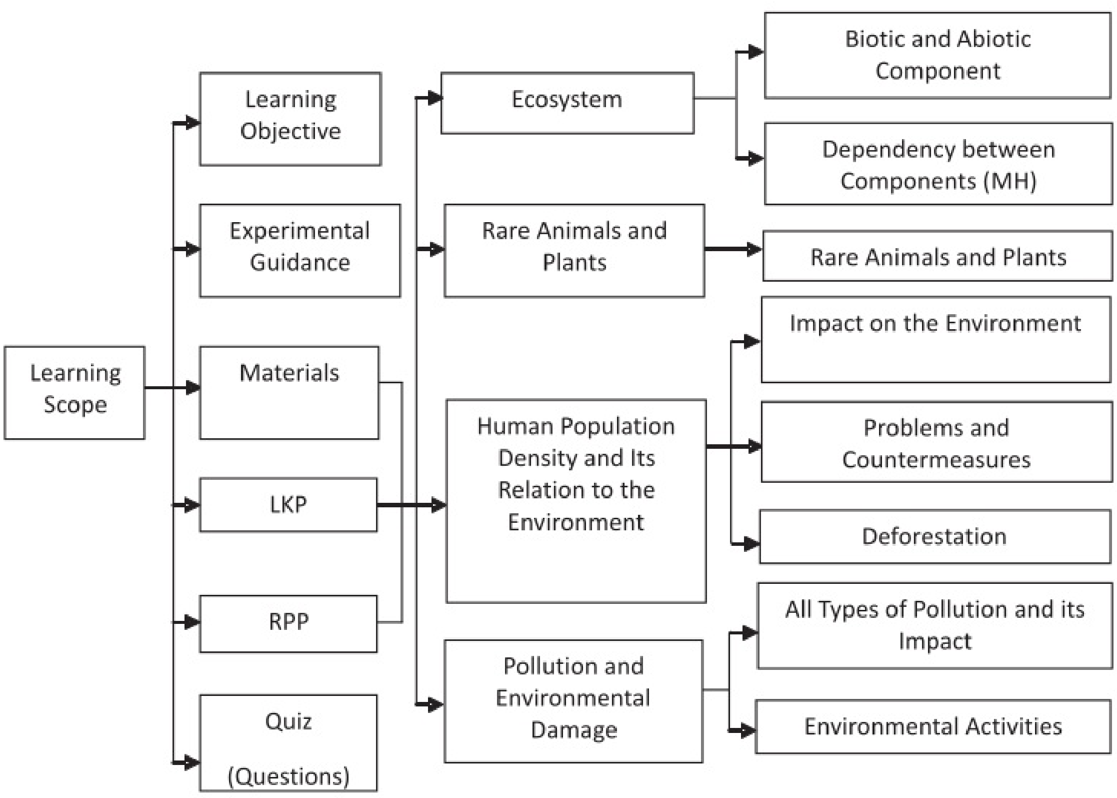

Figure 3: **Environment based module developmental framework.**

Journal of Baltic Science Education, Vol. 12, No. 2, 2013
ISSN 1648–3898

Statistical Analysis

This study employed both descriptive and inferential statistical analysis. The former is used to summarise the science process skills and students' score in the pre-test as well as post-test. The latter is then used to determine whether there exist differences in the effectiveness of multiple teaching media towards the student's science skills process; and to determine whether there exist differences in the effectiveness of multiple teaching media towards student's achievement. Mainly the analysis involved were Analysis of Variance (ANOVA) and Multivariate Analysis of Variance (MANOVA).

Results of Research

Science Process Skills

Descriptive statistical analysis of mean score of the Science Process Skills (SPS) pre-test are summarized in Table 2

Table 2. Descriptive mean scores of science process skills.

Groups	N	Mean Score	Standard Deviation
Multimedia / ICT	32	56.15	8.64
Environment	32	60.10	8.98
Conventional	32	58.85	10.46

Table 2 shows that the mean scores for the SPS test before intervention has been carried out are similar, indicating that there is no significant difference in the ability of the three groups. An analysis of the ANOVA test, illustrated in Table 3, shows that before any intervention was carried out the student's science process skills are at the same level. Scientific processing skills, as well as non-significant differences ($F(2,93) = 1.485$, $p = 0.232$) among the students in the three groups, lead to a conclusion that all of the students are homogenous prior to any intervention of the present study.

Table 3. Results of ANOVA science process skills test.

	Total square	Degree of freedom	Mean square	F	Sig.
Between groups	262.042	2	131.021	1.48	0.232
Within groups	8204.722	93	88.223		
Total	8466.764	95			

Science Process Skills Post Test

The findings of the descriptive analysis of the Science Process Skills post test are summarized in Table 4 below.

Table 4. Mean score of science process skills post test.

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

ISSN 1648–3898

Inferential statistical analysis was carried out to identify if there exist significant differences between groups (see Table 5).

Table 5. ANOVA test for SPS post test.

	Total square	Degree of freedom	Mean square	F	Sig.
Between Groups	914.871	2	457.435	13.794	0.000
Within groups	3084.124	93	33.163		
Total	3998.994	95			

Table 5 indicates that there are significant differences ($p<0.05$) to the mean score of the SPS post test based on all three groups which is $F(2, 93) = 13.794$, $p = 0.000$. A post-hoc Tukey test was thus necessary in order to see the differences in greater detail. The result of the *post- hoc* Tukey test is as shown in Table 6.

Table 6. The *post-hoc* Tukey test for SPS post test.

Group (I)	Group (J)	Mean Difference (I-J)	Standard Deviation	Sig.
Conventional	Environmental	-5.6256*	1.43967	0.001*
	ICT	-7.1887*	1.43967	0.000*
Environmental	Conventional	5.6256*	1.43967	0.001*
	ICT	-1.5631	1.43967	0.525
ICT	Conventional	7.1887*	1.43967	0.000*
	Environmental	1.531	1.43967	0.525

The result of the *post-hoc* Tukey test shown in Table 6 indicate significant difference ($p <0.05$) between the environmental and the conventional groups with mean difference of 5.63. There is also significant difference in mean score between the ICT and the conventional groups at 7.19. However, between the ICT and the environmental group, there was no significant difference ($p>0.05$) with mean difference of only 1.56.

In this research the SPS includes five sub-SPS' which are observing (S1), classifying (S2), predicting (S3), communicating (S4) data inference (S5). The descriptive statistical analysis was carried out to determine the mean score and the standard deviation of the sub-SPS for each group. The results of the descriptive analysis are shown in Table 7 below.

Table 7. Descriptive mean score of sub-SPS post test for each group.

	Group (J)	N	Mean Score	Standard Deviation
Observing (S 1)	ICT	32	84.3750	11.92682
	Environmental	32	80.7292	14.11002
	Conventional	32	80.7292	14.11002
Classifying (S 2)	ICT	32	76.5625	16.85877
	Environmental	32	82.8125	13.03729
	Conventional	32	70.3125	15.10677
Predicting (S 3)	ICT	32	81.2500	15.11604
	Environmental	32	74.4792	16.38710
	Conventional	32	66.6667	19.39959

	Group (J)	N	Mean Score	Standard Deviation
Communicating (S 4)	ICT	32	80.2083	14.31688
	Environment	32	74.4792	16.38710
	Conventional	32	76.5625	19.28051
Inference (S 5)	ICT	32	84.4653	15.22678
	Environmental	32	86.4583	13.67669
	Conventional	32	76.5625	15.18074

Table 7 shows that the ICT treatment group is more proficient at sub-SPS observing, predicting and communicating compared to the environmental and conventional groups. The environmental treatment group, however, is better at classifying and inference compared to the ICT and conventional groups. In sub-SPS communication it was found that the conventional group performed better than the environmental group. Therefore, it could be summarized that the treatment group out-performed the control group in almost all sub-SPS that have been analyzed. Subsequent to that, inferential statistical analysis was carried out using Multivariate Analysis of Variance (MANOVA) in order to find the differences in each of the student's sub-SPS based on groups. A result of MANOVA analysis is as succinctly described in Table 8 below.

Table 8. MANOVA test for Sub-SPS post test for each group.

Source	SubSPS	Total of Both Types III	Degree of freedom	Mean square	F	Sig.
Group	Observing	283.565	2	141.782	0.787	0.458
	Classifying	2500.000	2	1250.000	5.495	0.006*
	Predicting	3408.565	2	1704.282	5.854	0.004*
	Communicating	538.194	2	269.097	0.955	0.389
	Inferencing	1741.898	2	870.949	4.024	0.021*

Table 8 shows a significant difference between groups in classifying, predicting, and inference. However, there are no significant differences in observing and communication skills and it can be concluded that three out of the five sub-SPS demonstrate significant differences. A post-hoc Tukey test will have to be carried out to futher identify the source of such differences and the results are shown in Table 9 below.

Table 9. Result of post-hoc Tukey test on Sub-SPS post test.

Dependent Variable	(I) Group	(J) Group	Differences Mean (I-J)	Standard Error	Sig.
Classifying	Conventional	Environmental	-12.500*	3.77051	0.004*
		ICT	-6.2500	3.77051	0.227
	Environment	Conventional	12.500*	3.77051	0.004*
		ICT	6.2500	3.77051	0.227
	ICT	Conventional	6.2500	3.77051	0.227
		Environmental	-6.2500	3.77051	0.227
Predicting	Conventional	Environmental	7.8125	4.26560	0.165
		ICT	-14.583*	4.26560	0.003*
	Environment	Conventional	7.8125	4.26560	0.165
		ICT	-6.7708	4.26560	0.256
	ICT	Conventional	14.583*	4.26560	0.003*
		Environmental	6.7708	4.26560	0.256

Journal of Baltic Science Education, Vol. 12, No. 2, 2013
ISSN 1648–3898

Dependent Variable	(I) Group	(J) Group	Differences Mean (I-J)	Standard Error	Sig.
Inferences	Conventional	Environmental	-9.8958*	3.67809	0.023*
		ICT	-7.8125	3.67809	0.090
	Environment	Conventional	9.8958*	3.67809	0.023*
		ICT	2.0833	3.67809	0.838
	ICT	Conventional	7.8125	3.67809	0.090
		Environmental	-2.0833	3.67809	0.838

Based on Table 9, it could be summarized that three out of five sub-SPS (classifying, predicting and inference) show significant differences. In classifying and inference, the environmental treatment group performed significantly better than the ICT treatment group and the conventional control group. On the other hand, the ICT treatment group are better in predicting. This means the treatment groups (ICT and environmental) performed significantly better than the control (conventional) group.

Achievement

Descriptive statistical analysis of the achievement test mean score can be seen in Table 10 below.

Table 10. Mean score of achievement post test based on groups.

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

Furthermore, inferential statistical analysis was carried out using ANOVA to determine the differences for the three group. Table 11 below shows the results of the one-way ANOVA test.

Table 11. ANOVA test results for achievement post test.

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

Based on Table 11, it could be inferred that there are significant differences ($p<0.05$) in the mean score of achievement test between the three groups ($F(2,93) = 10.551$, $p = 0.000$). As a result of the results in Table 11, a *post-hoc* Tukey test was carried out to explore the differences in greater detail and the results are shown in Table 12 below.

Table 12. Result of *post-hoc* Tukey test on post achievement.

Group (I)	Group (J)	Mean Differences (I-J)	Standard Error	Sig.
Conventional	Environmental	-4.79256*	1.73620	0.019*
	ICT	-7.9172*	1.73620	0.000*
Environmental	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

The post-hoc Tukey test on achievement (Table 12) indicates significant difference ($p<0.05$) between ICT group and the conventional group but there are no significant differences ($p>0.05$) between the ICT and the environmental group. The outcome of MANOVA test can be seen in Table 13.

Table 13. Result of MANOVA test of sub-achievement post test for groups.

Source	Total of Both Types III	Degree of freedom	Mean square	F	Sig.
Group					
LL	808.433	2	404.217	3.731	0.028
HL	1125.9	2	562.976	5.931	0.004

Table 13 shows significant group differences based on sub-achievement low level questions (LL) ($F= 3.731$ and sig= 0.028 ($p<0.05$)) and high level questions (HL) ($F= 5.931$ and sig= 0.004 ($p<0.05$)). These results indicate that the differences in the mean score of achievement test in the lower and higher level between the ICT and environmental groups on the one hand and the conventional group. A further *post-hoc* Tukey test must be carried out to determine the differences in detail and the result are shown in Table 14 below.

Table 14. Result of *post-hoc* Tukey test on sub achievement post test.

Dependable Variable	(I) Group	(J) Group	Differences Mean (I-J)	Standard Error	Sig.
Low Level Questions (LL)	Conventional	Environmental	-5.0006	2.60214	0.138
		ICT	-6.8753(*)	2.60214	0.026*
	Environmental	Conventional	-5.0006	2.60214	0.138
		ICT	-1.8747	2.60214	0.752
	ICT	Conventional	6.8753(*)	2.60214	0.026*
		Environmental	1.8747	2.60214	0.752
	Conventional	Environmental	-5.0000--	2.43578	0.106
		ICT	8.3334(*)	2.43578	0.003*
Higher Level Ques-tions (HL)	Environmental	Conventional	-5.0000	2.43578	0.106
		ICT	-3.3334	2.43578	0.362
	ICT	Conventional	8.3334(*)	2.43578	0.003*
		Environmental	3.3334	2.43578	0.362

As indicated earlier, the LL and HL scores are better in the ICT group than either the environmental treatment group or the conventional group. Based on the overall mean for both sub-achievement scores (LL and HL), it was found that students in the ICT and environmental treatment group scored significantly better than their counterparts in the control group. Result of post-hoc Tukey analysis further confirm that the overall differences as shown in the LL and HL scores are due to differences between the ICT and environmental groups.

ISSN 1648–3898

Discussion

The findings of this research shows that students who were taught using the ICT and environment strategies obtain better results in the SPS and achievement test compared to students taught using the conventional strategy. These findings are parallel to research done by Chien and Chang (2012), Rohaida and Kamariah (2005) who found that student's SPS improves with the use of ICT. However, learning using the environment is also highly recommended in teaching and learning as also stated by Brody (2005) and Moustafa et al. (2012). It is recommended that where possible teachers should use the environment itself as a learning resource. By putting them in that kind of learning environment, student's activities become more comprehensive and active because it can be carried out in many ways such as observing, questioning, interviewing, proving, demonstrating and fact testing resulting in improved science process skills and their overall understanding of the topic being taught. George and Glasgow (2002) noted that learning through the environment is a rich learning experience that includes the social environment, both natural and man-made, and can be creatively used for nurturing science process skills as well as manipulative skills (George & Glasgow, 2002). Arguably, such kind of learning environment provide access for students to understand better the different aspects of life that exist in their surroundings, improve their skills and develop an appreciation of the environment. This is supported by Dillon (2003) in his research where students were found to improve their performance through experiments carried out in their surroundings, which led to improvement of many skills, including the ones listed in SPS, which resulted in student's better understanding of the scientific concepts being taught.

In addition, the increased score of the ICT group in this research is due to the inclusion of music, animation, video narration (in text) quizzes and exercises and is in line with Chuang and Yang's (2005) and Knighton and Smoak (2009) research where it was found that learning with multimedia could increase achievement score. The improvements in scores could also be due to the software design and teaching module which lead to a more effective teaching and learning process. Indirectly, this leads to the improvement of student's comprehension during the teaching and learning process.

The element of music in ICT acts as a stimulant to cognitive development and emotional intelligence. This is supported by Sadiman (2009) who stated that the function of music in multimedia is to create emphasis, variation and the right atmosphere. The study shows that music could provide rich stimulants for all aspects of cognitive and emotional intelligence.

Tapilouw (2007) stated that animation is essential in multimedia in order to visualize abstract concepts, which are difficult to create in the class-room. Russel, Netherwood and Robinson (2004) added that animation in multimedia for the teaching of biology is suitable in helping students to understand abstract concepts as well as attract student's attention in learning abstract concepts rather than presenting the abstract concepts conventionally. In this research the software is also equipped with narration. Text is in the form of speech or writing, which is intended to convey or explain the events and developments from time to time. This improves student's understanding leading them to higher achievements. Meanwhile, learning through the environment creates a direct learning experience through observation and experiments (Ramsey & Hungerford, 1989). Learning through observation and experiment increases a student's curiosity, strengthens their knowledge, as well as increase their understanding. This concurs with Alessi and Trollip (1991) who stated that learning does not only happen through observing but also when a student actively carries out the experiments. This encourages individuals to learn actively, cultivate different skills and leads to a better understanding of concepts.

Furthermore, results also show that exercises that were provided to the ICT and environment students could improve student's memory (Dow, 2010). This is supported by Ismail (2002), who stated that a person was able to retain 90% of what they read, hear, see, articulate and practice at the same time. The software that was developed fulfilled these criteria as it contains elements such as text, graphics, video, audio and animation which are presented simultaneously. Meanwhile, the use of the environment encourages students to be more confident in the experiment processes based on what they have observed.

Conclusions

The findings of this research confirm the significant effect of teaching with ICT and environment towards the development of science process skills and student's achievement within the context of Biology learning. The findings are significant to those who are directly involved in Biology teaching, especially to those who are facing with the problem of selecting the appropriate teaching approach which not only improve students' performance but also improving their science process skills. This study has also shown that ICT based learning environment is suitable learning activities which require lower order mental processing as well as higher order tasks. Nevertheless, in ensuring effective ICT based teaching and learning, it is therefore suggested that the next step is to identify the right mechanism to determine the level of readiness of teachers and students in order to utilise the approach that has been highlighted in this research and proven to be effective.

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Received: *November 06, 2012*

Accepted: *February 20, 2013*

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