

IMPACT OF E-AV BIOLOGY WEBSITE FOR LEARNING ABOUT RENEWABLE ENERGY

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ABSTRACT

This paper considers the design and development of a Website for Biology in senior high schools in Indonesia. The teaching media, namely e-AV Biology, was developed with the main features of video lessons and other features in supporting the students' learning process. Some video lessons describe the production process of Biofuel or Renewable Energy on the field of Biotechnology Industrial, which is one of the subjects that students and teachers find it difficult to learn and explain. The process of it is very complex. It needs longer time. There is a need of aiding the explanation of biofuel production process in the classroom. One of the alternative aids to clarify this subject is e-AV Biology Website, so the atmosphere for learning Biology more attractive to students. This study examined the impact of e-AV Biology towards the concerned students' reception of knowledge and interest of high and low achievers. A total of 256 high school students participated in quasi-experiment of year 2011 with the intervention of two different ways of teaching, one with fully media instruction using e-AV Biology and another one the traditional manner of teaching. The last part of this paper presents the evaluation of the impact of the teaching media, which indicates that students' knowledge reception and interest of high and low achievers were improved after using e-AV Biology, with special mention of the fact that their interest have shown an obvious improvement.

Keywords: e-Audio Visual, Biology, Renewable Energy, Learning Impact

INTRODUCTION

Many students in Indonesia have difficulties in learning Biology. They think that learning Biology simply involves memorizing the contents of the subject and regurgitate them during their examinations. According to Tekkaya, Ozkan and Sungur (2001), students have difficulties in learning Biology and have no interest in the lesson due to the irrelevancy of the subject with the daily experiences. Students' motivation to learn this subject was low; because their Biology marks often did not achieve the school standard score for Biology which should be 75 percentages for international schools (Setiawan, 2008).

Teachers must have the ability to induce a more conducive learning atmosphere for Biology, making them more motivated and eager to learn. The teaching aids have been considered an urgent necessity for teachers to explain crucial concepts of Biology in the classroom. Sudjana et al. (2005) stated that the role of teaching media intrigues the students, and have been found able to improve students' motivation and interest. Many researches on teaching media have claimed that the media usage improves the students' learning capacity, especially the Audio Visual media. According to the research which was carried out by Prinou et al. (2003), it reveals that most of students reported that the moving image clarified or enhanced their understanding and managed to pique their interest. It seems that through video, they are able to understand abstract processes. The use of educational technology in teaching of science increased the students' interest to be high achievers in the experimental group (Suleman et al., 2011). According to the research which was carried out by Ossai-Ugbah et al. (2012, p.220), it reveals that "Majority of the respondents (37%, 74 out of 200) confirmed that Audio-Visuals made learning easier and more interesting".

In line with the advancement of computer technology, Audio Visual production has emerged with practical offers and features. This matter is in line with How (2000, p.57), which stated that “The mushroom growth of computer technology in the aspect of vast data processing, large data storage, availability of CD-ROM drive and camcorder renders producing audiovisual content more easier and faster” (can be uploaded on YouTube and other site, even the regional video site).

PURPOSE

This study is carried out to examine the impact of e-AV Biology teaching media on students’ knowledge and interest at Senior High Schools In Indonesia.

The researcher had designed and developed Biology teaching media, especially e-Audio Visual media as one of the alternatives in teaching innovation. e-Audio Visual teaching media is chosen because of the strength of Audio Visual media in stimulating motion effects as well as modifying sound and colour. We do not need any special prerequisites to operate them. With a combination of various elements in teaching and learning process, the teacher can realize an engaging learning atmosphere by using Audio Visual media. It can attract the students’ interest in learning and brace up student learning (How, 2000).

Based on these reasons, the design and development of e-AV Biology teaching media for Senior High School students in Indonesia is needed. The first author had cooperated with teachers to make the Biology Instructional Design and to create e-AV Biology teaching media. This medium is appropriate with Indonesian science curriculum, supported by multimedia learning theory and an instructional design framework, especially on Biofuel or Renewable Energy, in which case teachers can teach this subject effectively and also enhance students’ interest and learning outcomes.

Renewable energy is a current topic of Biology education in Indonesia, which has gained much attention among environment-conscious scientists. This area of content should be implicated students in order to improve their understanding and awareness of bio-energy such as biomass, biodiesel and biofuel.

RESEARCH QUESTIONS

This study addresses the following research questions, mainly concerning the impact of teaching media on learning outcomes such as knowledge, attitude changed and interest improved.

1. Does e-AV Biology able to affect the Students’ Biology Knowledge of high achievers if compared with conventional teaching approach?
2. Does e-AV Biology able to affect the Students’ Biology Knowledge of low achievers if compared with conventional teaching approach?
3. Does e-AV Biology able to improve the Students’ Interest towards Biology of high achievers if compared with conventional teaching approach?
4. Does e-AV Biology able to improve the Students’ Interest towards Biology of low achievers if compared with conventional teaching approach?

IMPACT OF TEACHING MEDIA

ICT can be used in education to improve the quality of teaching and learning processes (Balanskat et al., 2007). The impact of ICT is highly dependent on how it is used. The impact of a specific ICT application or device depends on the capacity of the teacher to exploit it efficiently for pedagogical purposes.

There are many learning approaches that can be explored through ICT, such as project-based learning, object-orientated learning, self-directed learning, online collaborative learning, online discussion, multimedia-based learning, etc. In the case of Biology, multimedia-based learning can be used to transform abstract concepts to more concrete ones, such as the blood circulatory system; to replace rare and dangerous objects which should be brought to the classrooms; to display objects which can hardly be seen by our senses, such as micro-organisms; to cope with limitations on space, time and energy such as the process of production biofuel, and many more. Through multimedia, this subject will be made easier for teachers to teach and for students to learn.

The advantages of the media used in this research as an instrument in teaching activities are emphasized (Eisner, 1994; Thomson et al., 1996):

1. To enhance the message while being less verbal.
2. To cope with limitations on space, time and energy.
3. To enable the students to learn independently based on visual, auditory and kina esthetical aptitude and ability.
4. To provide experience and generate similar perception.

ISSUES OF THE USE OF MEDIA AIDS IN SCIENCE EDUCATION

In the education of science in Indonesia, the awareness of the importance of teaching media in enhancing teaching has been growing vastly. The management and provision of teaching aids has been considered an urgent necessity. Along with the development of communication technology, education and teaching processes demand diversity in teaching media. However, in the current science education, the teaching media is not used optimally; it is caused by many factors such as: teachers' difficulties in choosing what media are suitable for the class, the low competency and knowledge among teachers to employ media. Many teachers thought that teaching media can substitute teachers, as a replacement for traditional instruction (Perdana, 2008); however, Richard et al. (2000) argued that teaching media, such as computers, is a tool to support learning but not as a replacement for traditional instruction.

The teachers' ability and competency are necessary in teaching the Biology more effectively to students. Often the teacher explains the course verbally and writes it on the whiteboard. The students' activities include listening, taking notes and doing assignments. The teacher gives them some assignments to memorize the lesson. This situation causes many students in Indonesia to be less interested in learning Biology. Hence, their interest and motivation are low and their marks of Biology subject do not achieve the school's standard Biology marks (Setiawan, 2008). In enhancing students' motivation and students' interest in Biology, the use of teaching media is one of the alternatives to raise students' interest. According to the research carried out by Prinou et al. (2003), it reveals that most of students reported that the moving image clarified or enhanced their understanding and attracted their interest. Through video, they understood abstract processes. Today, the internet makes the delivery of video easier, and accessible to many students.

MULTIMEDIA WITH INTERACTIVITY

The Audio Visual is one of the popular multimedia components in education. Didactical video or Audio Visual is able to give a multisensory aspect to the learning experience to students than textual information. On the other hand, paper based pedagogical materials, such as books or articles, could allow students to think and analyse the content provided. Multimedia materials in this study presented in a Website can bring the two kinds of material together. Firstly, it allows the inclusion of Audio-Visual content into the array of educational materials. Secondly, it also allows the inclusion of textual information (Amatller & Simo, 2007).

Multimedia material has another distinctive characteristic: it allows interaction. Students can interact with the information in different ways. The access to information could be done in multiple ways, different items could be connected according to students' interest and the practice and simulation of complex processes such as the processes of production biofuel is made possible. All the characteristics are not only the result of technological possibilities; they are also opportunities for constructivism based pedagogic materials (Amatller and Simo, 2007).

Gardner (1993) and Eisner (1994) found out that there are many ways for students in processing unique information. Some of them can easily process visual information, some of them can be helped with voice or sound (auditorial), and the rest using body movement and practice (kina-esthetical). Learning activity is influenced mostly by the learning style and procedure. Confucious was cited by De Porter et al. (2007) explain that 10 % information is absorbed from what we read, 20% from what we hear, 30% from what we see, 50% from what we see and hear, 70% from what we say, 90% from what we do and say. In line with this, the computer fulfils the requirements of being an efficient teaching tool due to its technical aspects pertaining to (1) video, (2) audio, (3) text, (4) graphic and (5) animation like what has been stated by the researchers above. Nowadays, Audio Visual Media is easily produced and published on the web and CD (Romero et al., 2008).

DESIGN AND DEVELOPMENT OF E-AV BIOLOGY WEBSITE

The teaching and learning process of Biology in Senior High Schools of Indonesia was tested using the e-AV Biology instructional design framework adapted from Armani's Integrated Framework (2004). Armani proposed three levels of design consideration, namely The Educational Context Level, The Requirements Level and The Design Level. We adapted from Armani's Framework and developed four main levels of guiding the design and development, namely The Educational Context Level, the Requirements Level, the Design Level, and the Learning Outcomes Level. The Learning Outcome Level emphasizes on knowledge, attitude changed and interest improved in the subject matter, in this case Biology.

A Website was used as the Multimedia technology to support the framework. The website includes the interactive video about Biology contents, such as Biotechnology. e-AV Biology had been developed with integrated and comprehensive video lessons, and other features supporting the student learning process. The use

of animations, motion images, and videos was intended to render a scientific phenomenon and process to be easily comprehended by students.

There are some features to aid teaching and learning, available in e-AV Biology Website, as follows:

- **Home Page of e-AV Biology**

This part aims to introduce students to the e-AV Biology Website. It starts with a description of how-to-use and register to become users of the e-AV Biology, followed by a short description of e-AV Biology menu and other e-AV Biology features.

- **Video Lessons**

This part contains various videos concerning biofuel sources, biofuel production and biofuel usage (in Indonesian and English). Students were provided with content in the form of audios, videos and animation that enables them to explore e-AV Biology Website more enthusiastically. The integration of various media elements such as diagrams, audio, video and animation in this part adds more value to the website.



Fig 1.e-AV Biology Videos

- **The Main Lessons**

This part contains articles and textual information related to Biology for the benefit of all students in Indonesia. It provides the materials for students needed to understand core concepts of the subject more easily.



Fig 2. Sample of e-AV Biology Lesson for Indonesian Students



Fig 3. Some Sample Videos of Renewable Energy within the Geographical Context for Indonesian Students

• **Other Features**

This part facilitates students to share the knowledge in the relevant context, for example assignments, quizzes and discussion board.

METHODS

The study was carried out at three International schools by the government in Semarang, a district in Indonesia which has connections to Jardiknas (The Educational Network had developed by Indonesian Government). One school had been selected as a pilot study, and two schools have been selected for the main research. A quasi-experimental design research was applied in two selective International schools of year 2011. Those schools were selected because they were equipped with computer laboratory and Internet access. The first step of the experiment was to seek approval from school science teachers and the headmaster. The next step was to provide lessons to the intended group of students in two ways of teaching strategies, normal teaching and learning through the e-AV Biology Website. The students have done their activities individually in the Teaching and Learning through the e-AV Biology Website. The students were required to view some videos about Industrial Biotechnology especially Renewable Energy such as ‘Video of Renewable Energy on Biosolar’, ‘Video of Renewable Energy source of Jatropa Curcas L’, ‘Video of Renewable Energy of Jatropa Oil Production’ and ‘Video of Renewable Energy of Sunflower Oil Production’, etc. The conventional teaching approach was the normal teaching using textbook, charts with a teacher in front of the class. Both ways of teaching covered the same area of content and lesson objectives.

A total of 256 students were involved in this study, aged 14-16, and the majority of them were Tenth Grade students. They were selected from 2 schools, 2 classes for experiment group and another two classes for control group in each school. The students had been divided into 2 groups based on their Biology marks from the teacher database. The high achievers of students have Biology marks ≥ 75 , while low achievers have Biology marks < 75 . Two phases of data collection were conducted by using Instrument A (Student Attitude, Interest

towards Biology, Perception and Perceived Effectiveness toward Biology Teaching Media), Instrument B which is Test of Knowledge and Instrument C (Overall Feedback of e-AV Biology Website). All of the instruments have been pilot tested and improved based on the feedback given by students, teachers and research methodology experts, in terms of its clarity of words, and accuracy of content scope, especially for the internal and external validity of the instruments to measure the dimensions of the experiment (knowledge and interest) by the Biology Content expert, the educational and instructional media experts.

Social science software package SPSS ver. 17.0 was used to analyse data, and t-Test was used for comparing mean scores of two groups. Since level of achievement prior to the experiment is believed to be a factor to influence the results of experiment, students with high achievement in their Biology marks were separated from the low achievement group for the main analysis.

FINDINGS AND DISCUSSIONS

The dimensions of Knowledge and Interest were tested of normality, which indicated normal and its graph were normally distributed. The findings of the impact of e-AV Biology Website for knowledge and interest in Renewable Energy were presented and explained in the following sections:

IMPACT OF KNOWLEDGE FOR HIGH ACHIEVERS

e-AV Biology with individual learning strategy in Teaching and Learning Biology was able to considerably enhance students' Biology knowledge compared to the conventional teaching approach. e-AV Biology with individual learning strategy in Teaching and Learning Biology. It was able to affects students' knowledge in experiment group, and it was able to help students in the class experiments reach the standard Biology marks of teachers. The overall score of test on knowledge of Biology for experiment group (post- test) was able to reach the standard of Biology marks which is 75. Puspita et al. (2008, p.442) stated that "The illustration animation (dynamic) with audio in Teaching and Learning Biology was effective and efficient to improve the concept control of student, and it was able to help students in the class experiments to reach the standard of Biology marks".

Table 1 shows the mean scores of the high achievers in Biology knowledge for the experiment group and the control group in the pre-test. Their mean scores were 28.43 and 25.41 respectively. Descriptively, the experiment group obtain a higher mean score pre-test compared to the control group; however, there is no significant difference in the mean score pre-test between the two groups at the p-value = .141 ($p > .05$).

Table 1 also shows the mean scores of the high achievers in Biology knowledge for the experiment group and the control group in the post-test. Their mean scores were 77.46 and 72.96 respectively. Descriptively, the experiment group obtain a higher mean score post-test compared to the control group. The result shows that there is a significant difference on Biology knowledge post-test between the two groups at p-value = .005 ($p < .05$). Thus, there is an indication that the e-AV Biology teaching strategy benefits the high achievers.

Table 1: Independent Samples t-Test of Biology knowledge for High Achievers

	Group	Mean	SD	Std. Error Mean	t-Test for Equality of Means			
					t	df	Sig.(2-tailed)	Mean Difference
Knowledge pretest	experiment high ^a	28.43	14.228	1.409	1.479	203	.141	3.024
	control high ^b	25.41	15.019	1.480				
Knowledge posttest	experiment high ^a	77.46	10.910	1.080	2.859	203	.005*	4.500
	control high ^b	72.96	11.608	1.144				

Note :^an = 102, ^bn = 103, * Significant at $p < .05$

Fig. 4 shows the graph of interaction for the mean scores of the high achievers between the experiment group and the control group. It shows the control group with a lower score of Biology knowledge pre-test, also obtain a lower score of Biology knowledge post-test compared to the experimental group; however, the lower score in pre-test of the control group is not significantly different from the experiment group as shown in Table 1. Thus, the results interpret that the significant difference is contributed from the higher score post-test of the experiment group.

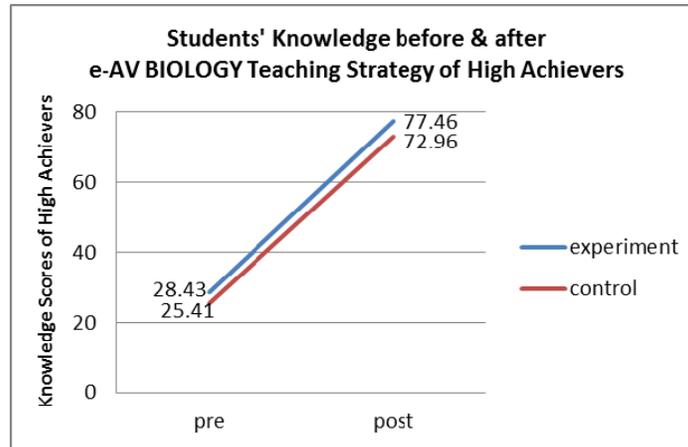


Fig. 4 High Achievers' Knowledge Before & After Teaching Strategy

Impact of Knowledge for Low Achievers

The use of e-AV Biology Website in Teaching and Learning Biology can affect students' knowledge in experiment group of students' academic low achievement, and it is able to reach the standard marks in experiment low group of 77.00.

Table 2: Independent Samples t-Test of Knowledge for Low Achievers

	Group	Mean	SD	Std. Error Mean	t-Test for Equality of Means			
					T	df	Sig.(2-tailed)	Mean Difference
Knowledge pretest	experiment low ^a	20.35	9.851	1.932	1.739	49	.088	5.746
	control low ^b	14.60	13.528	2.706				
Knowledge posttest	experiment low ^a	77.00	10.830	2.124	2.298	49	.026*	7.480
	control low ^b	69.52	12.393	2.479				

Note : an = 26, bn = 25, * Significant at p < .05

Table 2. shows the mean scores of the low achievers in Biology knowledge for the experiment group and the control group in the pre-test. Their mean scores were 20.35 and 14.60 respectively. Descriptively, the experiment group obtained a higher mean score in the pre-test compared to the control group; however, there is no significant difference in the mean score pre-test between the two groups at the p-value = .088 (p > .05). Table 2. also shows the mean scores of the low achievers in Biology knowledge for the experiment group and the control group in the post-test. Their mean scores were 77.00 and 69.52 respectively. Descriptively, the experiment group obtained a higher mean score post-test compare to the control group. The result shows that there is a significant difference on Biology knowledge post-test between the two groups at p-value = .026 (p < .05). Thus, there is an indication that the e-AV Biology teaching strategy benefits the low achievers. Figure 6. Shows Low Achievers' of Knowledge Before and After e-AV Biology Teaching Strategy. Fig. 5. Shows Low Achievers' of Students' Knowledge towards Biology.

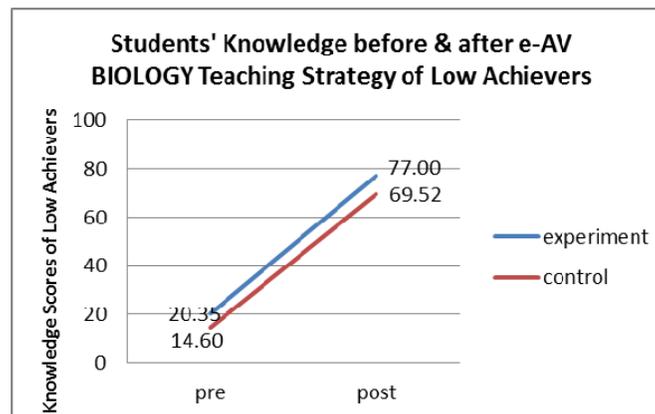


Fig. 5 Low Achievers' of Knowledge Before and After e-AV Biology Teaching Strategy

IMPACT OF STUDENTS' INTEREST TOWARDS BIOLOGY CONTENTS OF HIGH ACHIEVERS'

e-AV Biology with individual learning strategy in Teaching and Learning Biology was able to improve the students' interest towards Biology in high achievers of experiment group more significantly in comparison to conventional teaching approach. This is in line with Sudjana et al. (2005) stating that the role of media in the teaching and learning process is rendering the learning process to be more appealing to the students in order to raise significantly their motivation to learn. The research carried out by Prinou et al. (2003), it reveals that most of the students reported that moving images clarified or enhanced their understanding and piqued their interest. It seems that through video, they are able to understand abstract processes. Table 3. shows the mean scores of high achievers in students' interest for experiment group and control group in the pre-test. Their mean scores were 3.41 and 3.44 respectively. Descriptively, the control group obtain a higher mean scores in the pre-test compare to the experiment group, however, there is no significant difference on the mean scores in the pre-test between the two groups at p-value = .512 ($p > .05$).

Table 3: Independent Samples t-Test of High Achievers Students' Interest towards Biology

	Group	Mean	SD	Std. Error Mean	t-Test for Equality of Means			
					t	df	Sig.(2-tailed)	Mean Diff.
Interest pretest	experiment high ^a	3.41	.36587	.03382	-.657	230	.512	-.03320
	control high ^b	3.44	.40347	.03762				
Interest posttest	experiment high ^a	4.06	.36519	.03376	4.374	230	.000*	.21780
	control high ^b	3.84	.39295	.03664				

Note :an = 117, bn = 115, * Significant at $p < .05$

Table 3. also shows the mean scores of high achievers of students' interest for experiment and control group in the post-test. Their mean scores were 4.06 and 3.84 respectively. Descriptively, the experiment group obtains a higher mean score in the post-test compare to the control group. The result shows that there is a significant difference on students' interest in the post-test between the two groups at p-value = .000 ($p < .05$). Thus, there is an indication that the e-AV Biology teaching strategy has benefits to interest of the experiment group of high achievers. Fig. 6. Shows High Achievers' of Students' Interest towards Biology.

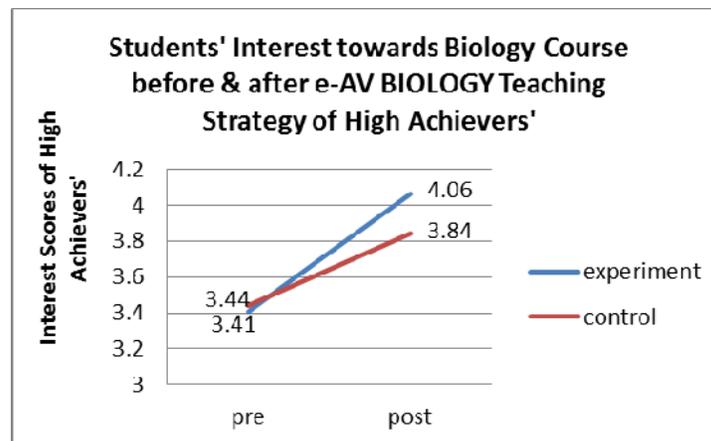


Fig. 6. High Achievers' of Students' Interest towards Biology

Impact of Students' Interest towards Biology Contents of Low Achievers'

Table 4. shows the mean scores of low achievers in students' interest for experiment group and control group in the pre-test. Their mean scores were 3.33 and 3.24 respectively. Descriptively, the experiment group obtain a higher mean scores in the pre-test compare to the control group, however, there is no significant difference on the mean scores in the pre-test between the two groups at p-value = .336 ($p > .05$).

Table 4: Independent Samples t-Test of Low Achievers Students' Interest towards Biology

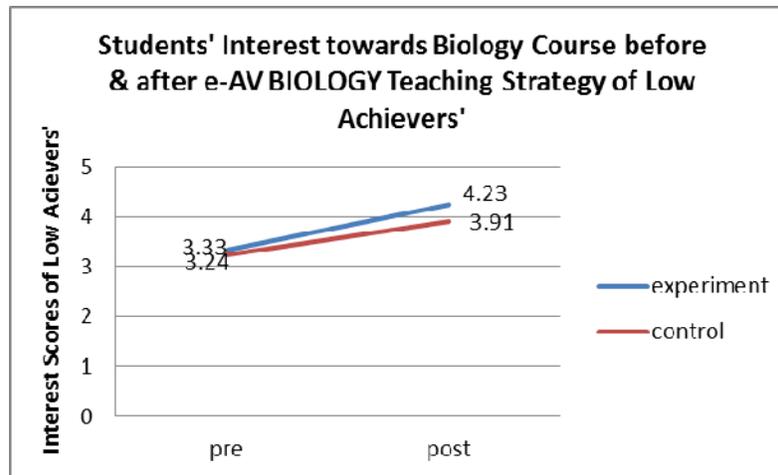
	Group	Mean	SD	Std. Error Mean	t-Test for Equality of Means			
					t	Df	Sig. (2-tailed)	Mean Diff.
Interest pretest	experiment low ^a	3.33	.22361	.06742	.984	22	.336	.08974
	control low ^b	3.24	.22169	.06149				
Interest posttest	experiment low ^a	4.23	.18668	.05629	2.993	19.649	.007*	.31702
	control low ^b	3.91	.32358	.08974				

Note : an = 11, bn = 13

Likert Scale 1: Strongly Disagree, 2: Disagree, 3: Undecided, 4: Agree, 5: Strongly Agree

* Significant at $p < .05$

Table 4. also shows the mean scores of low achievers of students' interest for experiment and control group in the post-test. Their mean scores were 4.23 and 3.91 respectively. Descriptively, the experiment group obtains a higher mean score in the post-test compare to the control group. The result shows that there is a significant difference on students' interest in the post-test between the two groups at p -value = .007 ($p < .05$). Thus, there is an indication that the e-AV Biology teaching strategy has benefits to interest of the experiment group of low achievers. Fig. 7. Shows Low Achievers' of Students' Interest towards Biology.


Fig. 7. Low Achievers' of Students' Interest towards Biology

DISCUSSIONS

This work presents a study of the impact of Audio Visual teaching media through e-AV Biology. This study was conducted due to the increasing challenge of teaching an abstract subject, and the importance of the topic of renewable energy. Audio and Visual media was incorporated as the key component in e-learning website based on Instructional Design.

The results of the change of Attitude and Interest are more obvious compared to the change of Knowledge. This could be due to a more reinforced acceptance of students toward teaching media based on Interest, which subsequently brings an impact on their Attitude as well. They have more interest in media for their learning experience, and have changed their attitude toward the subject itself after using it. Mainly, this could be due to the scarce usage of video media delivered through a website, and they felt it useful and interesting. Having said that, the students' knowledge level has also increased with a small significance result.

Students' Knowledge

The students' knowledge especially in the bioenergy was low. It was able to improve due to the use of e-AV Biology Website, this is in line with the increase in students' interest. Students' knowledge level has also increased with a small significance result. Figure 6 shows the graph of interaction for the mean scores of the low achievers between the experiment group and the control group. It shows the control group with a lower score of Biology knowledge pre-test, also obtain a lower score of Biology knowledge post-test compare to the experimental group, however, the lower score in pre-test of the control group is not significant different from the experiment group as shown in Table 3. Thus, the results interpret that the significant difference is contributed from the higher score in the post-test from the experiment group. More importantly, the low achievers were able

to score the targeted score at 77.00 after using e-AV Biology teaching strategy. This indicates that teaching and learning using e-AV Biology Website with individual teaching strategy was useful for the students to improve their Biology marks better than the standard Biology marks of schools, not only for high achievers but also for low achievers.

Students' Interest

While students' interest was initially low, after the implementation of e-AV Biology Website their interest to the Biology subjects was improved. Actually, students like Biology subjects, but specifically on the particular matter Biotechnology such as Biotechnology Industrial or Renewable Energy students find it difficult to understand. Hence, students' interest was decreased. After the e-learning model using e-AV Biology Website individually, the result was positive. It indicates that the media has influenced the students to have positive interest in Biology.

CONCLUSION

The study of the impact of e-AV Biology Website indicated that students of experiment group of high and low achievers show significantly better knowledge and interest as compare to the control group on post-test.

The e-AV Biology with individual learning strategy in Teaching and Learning Biology can affects students' knowledge if compared with conventional teaching approach, and it is able to help students in the class experiments to reach the standard Biology marks of schools.

Students' knowledge level has also increased with a small significance result. Teaching and learning using e-AV Biology Website with individual teaching strategy was useful for the students to improve their Biology marks better than the standard Biology marks of schools, not only for high achievers but also for low achievers in experiment group.

LIMITATIONS AND FUTURE RESEARCH

The limitation of this study is mainly due to: (1) a short time frame of conducting the study and the impact on knowledge gain has not shown much significance. (2) The research is only conducted in one of the major cities in Indonesia, (3) the research sample is limited to International Schools by the Indonesian Government.

The contribution of the study is to propose the e-Learning Website design and development for Indonesia Senior High Schools to address the problem faced in Biology education. e-AV Biology website will be further developed to include more videos related to different topics of Biology since generally students are able to accept it as perceived it as useful to improve their interest and attitude toward Biology.

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