

## e-AV BIOLOGY Courseware : a Model of Learning about Renewable Energy

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**Abstract.** Teaching and learning process was often faced with abstract subjects and it is out of the daily experience such as the process of biofuel production or renewable energy on industrial biotechnology field, which is one of subject unit in Biology. Therefore, this subject was difficult to be taught by teacher and difficult to be understood by student. In this research, biology especially renewable energy (the process of biofuel production) one of industrial biotechnology field was chosen because of many factors such as the production of biofuel needs long time, the process to produce biofuel is very complex and industrial biotechnology subject was difficult to be taught by teachers in the classroom. So they need the aids to explain biofuel in the classroom. The teachers' ability and competency are necessary to teach the Biology course to be more attractive and efficient. Visualization is one of the ways that can be done to concretize an abstract idea. e-Audio Visual Biology courseware (e-AV BIOLOGY) is one of the alternative aids to explain this course, so biology learning will be more interesting for the students. This paper considers the design and development of a web-based courseware for education of biology in Indonesia Senior High Schools. The new teaching media, namely e-AV BIOLOGY, had been developed as a teaching approach in science education. e-AV BIOLOGY had been developed with integrated and comprehensive Assignment, Quizzes, and Discussion Board for supporting the students' learning process. This research had examined the impact of e-Audio Visual Biology towards students' attitude, students' interest and learning outcomes in Indonesia Senior High Schools. The later part of this paper presents the evaluation data from a main research conducted with students at Senior High Schools in Semarang, Indonesia. The findings from the main research are also discussed.

### Introduction

In the last decade, the Information and Communication Technology (ICT) has influenced various aspect human daily lives such as in information feature, communication, business, education, etc. In the educational field, ICT can be used in the classroom to improve the quality of teaching and learning process [3]. The impact of ICT is highly dependent on how it is used. ICT can enhance teaching by enhancing what is already practiced and better ways of teaching and learning [3].

There are many learning approaches that can be explored through ICT such as project-based learning, learning object-orientation, self-directed learning, online collaborative learning, online discussion, multimedia-based learning, etc. For biology, multimedia-based learning can be used to transform abstract concepts to the 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-organism; to cope with space limitation, time and energy such as the process of production biofuel, therefore this subject will be more easier to teach by teachers and easy to understand by students.

Many students in Indonesia have difficulties to learn biology, they think that learning biology is just to memorize the subject. Hence, they found it is not interesting. According to [15], student had difficulties in learning some subjects and had no interest in the lesson because high school biology curriculum did not include subject matter relevant to daily live. This is in line with [18], that "Most

students are learning that the biology subject is a set of facts that are unrelated to the workings of the world and are simply to be memorized without understanding.” Their motivation to learn this subject was low. Hence, their daily test grade did not achieve the teachers’ standard grade [13].

The teachers must have ability to make learning atmosphere to be more interesting, so it will be enhanced students’ motivation and students’ interest. The teaching aids have been considered as an urgent necessity for the teacher to explain biology subject in the classroom. [14] stated that the roles of media in the teaching and learning process is teaching will be more attractive to the students so that learning motivation and students’ interest can be improved. e-Audio Visual biology media is one of the alternative aids to explain this course, so biology learning will be more interesting for the students.

This research had examined the impact of e-Audio Visual Biology to students’ attitude, students’ interest and learning outcomes in Indonesia Senior High Schools.

### **Issues of Senior High School Science Education**

The awareness of the education realm in Indonesia on the importance of the media in enhancing the teaching has been growing vastly. The management and provision of teaching aids has been considered as an urgent necessity for the teacher in classroom teaching process. Along with the development of communication technology, education and teaching activity process demand the diversity of education media.

In the teaching and learning process, the teaching media was not used optimally; it is caused by many factors such as: teacher difficulties to choose what media are suitable for the class necessity, the low teachers’ competency, and the low teachers’ knowledge of using the teaching media. Many teachers in Indonesia consider that teaching media can substitute the teacher, not as a teaching substitute [8]. This finding is not appropriate with the argument of [10], “computers as a tool to support learning but not as a replacement for traditional instruction”.

The advantages of the media in this research are emphasized more on the media used as instrument and materials in teaching activities ([5],[12],[16]):

1. To enhance the message in order to be less verbal.
2. To cope with space limitation, time and energy.
3. To enable the students to learn independently based on visual, auditory and kinaesthetical aptitude and ability.
4. To provide experience and generate similar perception.

Teaching learning process is often faced with abstract subjects and it is out of the daily experience such as the process of production biofuel on biotechnology field, it is one of subject unit in Biology. Therefore, this subject is difficult to be taught by teacher and difficult to be understood by student.

The teachers’ ability and competency are necessary to teach the Biology course to be more attractive and efficient. Nowadays, the teacher explains the course by verbal and writes it in the whiteboard. The students’ activity were listening, taking note and doing some assignments. The teacher gives them some assignments to memorize the lesson. This situation causes many students in Indonesia were not interested to learn Biology. Hence, their interest and motivation were low and their grade of biology subject did not achieve the teachers’ standard grade [13]. For enhancing students’ motivation and students’ interest on Biology subject, the teacher should change the way of teaching. The use of teaching media is one of the alternatives to attract students’ interest. According to the research carried out by [9] reveals that most of students reported that the moving image clarified or enhanced their understanding and attract their interest. It seems that through video, they understood the abstract process. Today, the internet makes this requirement (for being able to present the actual development of mitosis) even easier, making it accessible to all students.

In this research, biology especially biofuel one of biotechnology field was chosen because of many factors such as the production of biofuel needs long time, the process to produce biofuel is very complex and biotechnology subject is difficult to be taught by teachers in the classroom. So

they need the aids to explain biofuel in the classroom. Visualization is one of the ways that can be done to concretize an abstract idea. Previously, the visualization that has been used for teaching learning process was two dimensional picture or three dimensional model. Nowadays, in the information technology era, one of visualization media is digital based audio visual or e-audio visual. e-Audio Visual Biology (e-AV BIOLOGY) is one of the alternative aids to explain this course. So that the teaching and learning process in Senior High Schools of Indonesia would be improved.

Researchers ([1],[5],[6]) 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 will understand easily and better if they conduct it using body movement and practice (kinaesthetical). Learning activity is influenced mostly on the learning style and how to learn. Confucious cited in [4] 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, computer has fulfilled the requirements as media because of the abilities which are related to (1) video, (2) audio, (3) text, (4) graphic and (5) animation like what has been stated by the researchers above.

The concept of audiovisual and multimedia is important to define. The Audiovisual as one of multimedia component can be used for teaching and learning process. Didactical video or audiovisual is able to bring more multisensory and emotional experience to the students than textual information. On the other hand, paper based pedagogical materials, such as book or articles, could allow students to have deeper knowledge of the matter and could allow a more analytical approach to it. Multimedia materials in this study, in fact share characteristics of these two kinds of material. Firstly, they allow the inclusion of audiovisual content to educational materials. Secondly, they also allow the inclusion of textual information [2].

Multimedia material has another distinctive characteristic, it has 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 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 [2].

This research objective is to design and develop 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 are the facts that we are able to stimulate motion effects, modify sound and color, and we do not need any special prerequisites to operate them. With combination of various elements in teaching and learning process, teacher can realize learning atmosphere that use audio visual media. It can attract students' interest in learning and brace up student learning [7].

Unfortunately, some people may think that audio visual media making is something complicated and requires special skills and massive teamwork. Nowadays, Audio Visual Media is easily produced and published on the web and CD [11].

The reality today is not as bad as illustrated above. In line with the advancement of computer technology, audio visual production has emerged with practical offers and features. This matter is in line with [7] statement, which stated that the mushroom growth of computer technology in the aspect of vastly data processing, large of data store, availability of CD-ROM drive and camcorder make easily to produce CD-ROM multimedia use suitable software and hardware. Through these years, computer technology has contributed a lot related to its ability to be utilized optimally in teaching and learning process.

Based on these reasons, the design and development of e-Audio Visual biology teaching media for Senior High School Students in Indonesia are absolutely needed. We had cooperated with teachers to make the Biology Instructional Design and create e-Audio Visual biology teaching media which appropriate with curriculum, the learning theory and multimedia technology,

especially on biofuel or renewable energy so that the teachers can teach this subject effectively and will enhance students' attitude, and students' interest on Biology subject and for enhancing the learning outcomes.

### Problem Statements

1. The Traditional or Conventional of T&L Biology process in Indonesia causes low interest.
2. The Traditional or Conventional of T&L Biology process in Indonesia causes low learning outcomes.
3. Students' Achievements of Biology were not able to meet the teachers' standard grade.

### Research Questions

1. Whether e-Audio Visual Biology (e-AV BIOLOGY) can enhance the students' biology knowledge if compared with conventional teaching approach?
2. Whether e-Audio Visual Biology can enhance the students' attitude towards biology if compared with conventional teaching approach?
3. Whether e-Audio Visual Biology can enhance the students' interest towards biology if compared with conventional teaching approach?

### Design & Development of e-AV BIOLOGY as Web-Based Courseware for T&L Process

The teaching and learning process of Biology in Senior High School of Indonesia was tested using the e-AV BIOLOGY Framework. Website was used as the Multimedia technology to support the framework. The website included the interactive video about Biology contents, such as Industrial Biotechnology. e-AV BIOLOGY had been developed with integrated and comprehensive Assignment, Quizzes, and Discussion Modules for supporting the student learning process. e-AV BIOLOGY had been developed to be an innovative teaching media for Biology. The use of animations, motion images, and videos was intended to make a scientific phenomenon easily comprehended by students.

There are six features available in e-AV BIOLOGY courseware, as follows:

#### • e-AV Biology Home

This part aims to introduce students about the e-AV BIOLOGY. 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 continued by an information about e-AV BIOLOGY features.



Fig 1. e-AV BIOLOGY Home

#### • Videos

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



Fig 2. e-AV BIOLOGY Videos

• Lesson & Assignment



Fig 3. Some Sample Videos of Renewable Energy

• Quizzes

This part aims to test the learner’s understanding through a set of multiple choice questions. The questions are taken from the Lesson Module in the respective session.

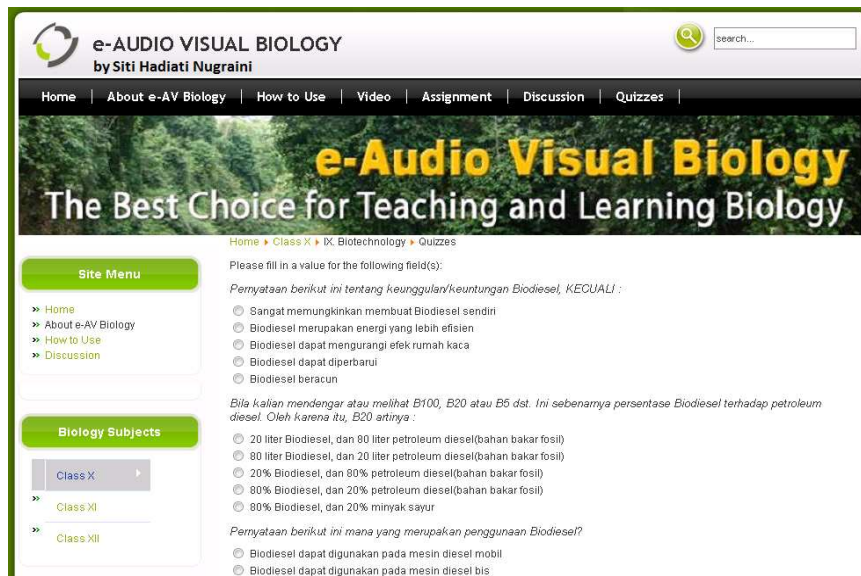


Fig 4. e-AV BIOLOGY Quizzes

- Discussion Board

This part facilitates the students to share the knowledge in the relevant content. The discussion board tries to improve the workgroup brainstorming skill as part of problem solving process.

## Methods

The study was carried out at 3 RSBI schools (International Schools of Indonesian Government) in Semarang as a population schools for this study. One school have been selected as a pilot study, and 2 schools have been selected for the main research. A quasi-experimental approach of study was conducted in two selective International schools of year 2011, which equipped with computer laboratory and Internet access was available in these schools. Lessons were carried, with the implementation of two teaching strategies, normal teaching and learning through e-AV Biology. Two phases of data collection were carried out by using Instruments of Students Knowledge, Attitude and Interest towards Biology Course. All of the instruments have been pilot tested. Data analysis tools used to compare means is SPSS, Independent t-Test.

## Results & Discussions

**RQ1** : Whether e-Audio Visual Biology (e-AV BIOLOGY) can enhance the students' biology knowledge if compared with conventional teaching approach?

The e-AV BIOLOGY with individual learning strategy in T&L Biology can enhance students' knowledge, and it is able to help students in the class experiments to reach the standard biology marks of teachers [7]. We can see the findings in Table 1. and Table 2., and Fig. 5.

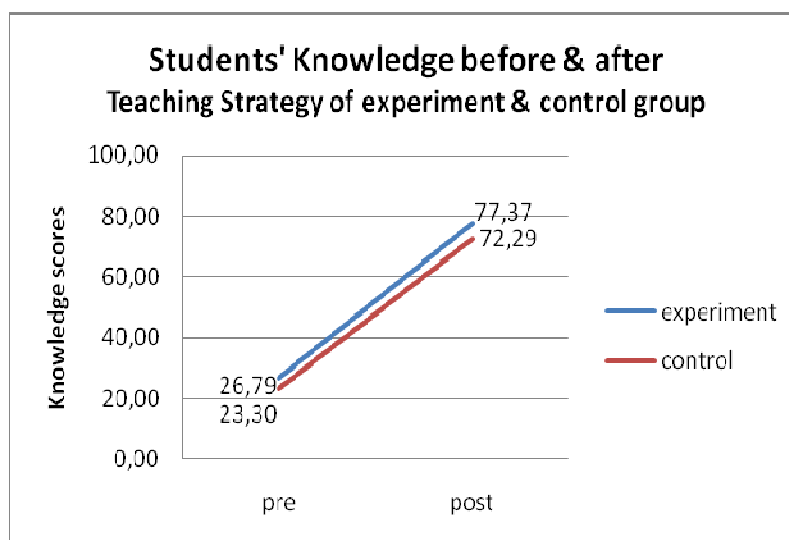
**Tabel 1. Group Statistics of students' biology knowledge before and after teaching strategy**

	group	Mean	Std. Deviation	Std. Error Mean
knowledge before	Experiment <sup>a</sup>	26.79	13.812	1.221
	Control <sup>b</sup>	23.30	15.305	1.353
knowledge after	Experiment <sup>a</sup>	77.37	10.853	.959
	Control <sup>b</sup>	72.29	11.795	1.043

**Tabel 2. Independent Samples t-Test of students’ biology knowledge before and after teaching strategy**

	t-test for Equality of Means			
	t	df	Sig. (2-tailed)	Mean Difference
knowledge before	1.916	251.370	.056*	3.492
knowledge after	3.584	254	.000*	5.078

Note : n = 256, <sup>a</sup> n = 128, <sup>b</sup> n = 128, \* Significant at p < .05  
Likert Scale 1: Strongly Disagree, 2: Disagree, 3: Undecided, 4: Agree, 5: Strongly Agree



**Fig. 5 Students’ biology knowledge before and after implementation of the teaching strategy**

Findings :

1. The p-value of ‘knowledge before’ is 0.056, therefore, the difference between the two means score is ‘not statistically significantly’ different from zero at p < .05. This means there is no different significant on students’ biology ‘knowledge before’ conducting e-AV BIOLOGY teaching strategy between experiment and control group.
2. The p-value of ‘knowledge after’ is 0.000, therefore, the difference between the two means score is ‘statistically significantly’ different from zero at p < .05. This means there is any different significant on students’ biology ‘knowledge after’ conducting e-AV BIOLOGY teaching strategy between experiment and control group.

**RQ2:** Whether e-Audio Visual Biology (e-AV BIOLOGY) can enhance the students’ attitude towards biology if compared with conventional teaching approach?

The e-AV Biology with individual learning strategy in T&L Biology can enhance students’ attitude in experiment group. We can see the findings in Table 3., Table 4. and Fig. 6.

**Table 3. Group Statistics of Students’ Attitude towards Biology Contents**

	Group	Mean	Std. Deviation	Std. Error Mean
Attitude before	Experiment <sup>a</sup>	3.45	.30293	.02678
	Control <sup>b</sup>	3.42	.39616	.03502
Attitude after	Experiment <sup>a</sup>	4.21	.36405	.03218
	Control <sup>b</sup>	3.97	.43601	.03854

**Table 4. Independent Samples t-Test of Students' Attitude towards Biology**

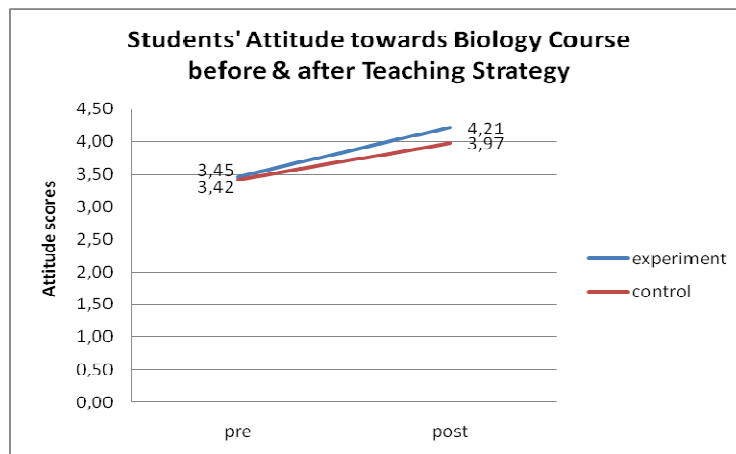
	t-test for Equality of Means			
	t	df	Sig. (2-tailed)	Mean Difference
Attitude before	.573	237.679	.567*	.02527
Attitude after	4.889	254	.000*	.24544

Note : n = 256, <sup>a</sup>n = 128, <sup>b</sup>n = 128, \* Significant at p < .05

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

#### Findings :

1. The p-value of 'attitude before' is 0.567, therefore, the difference between the two means score is 'not statistically significantly' different from zero at p < .05. This means there is no different significant on students' attitude towards Biology Course before conducting e-AV BIOLOGY between experiment and control group.
2. The p-value of 'attitude after' is 0.000, therefore, the difference between the two means score is 'statistically significantly' different from zero at p < .05. This means there is any different significant on students' attitude towards Biology Course after conducting e-AV BIOLOGY teaching strategy between experiment and control group.

**Fig. 6 Students' attitude towards biology contents of experiment and control group**

**RQ3:** Whether e-Audio Visual Biology (e-AV BIOLOGY) can improve the students' interest towards biology if compared with conventional teaching approach?

The e-AV BIOLOGY with individual learning strategy in T&L Biology can enhance students' interest towards biology in experiment group, this is in line with [14], they stated that the roles of media in the teaching and learning process is teaching will be more attractive to the students so that learning motivation and students' interest can be improved. According to the research carried out by [9] reveals that most of students reported that the moving image clarified or enhanced their understanding and attract their interest. It seems that through video, they understood the abstract process. We can see the findings in Table 5., Table 6, and Fig. 7.

**Table 5. Group Statistics of Students' Interest towards Biology**

	group	Mean	Std. Deviation	Std. Error Mean
Interest before	Experiment <sup>a</sup>	3.40	.35588	.03146
	Control <sup>b</sup>	3.42	.39293	.03473
Interest after	Experiment <sup>a</sup>	4.49	.42727	.03777
	Control <sup>b</sup>	4.24	.46601	.04119



**Table 6. Independent Samples t-Test of Students' Interest towards Biology Contents**

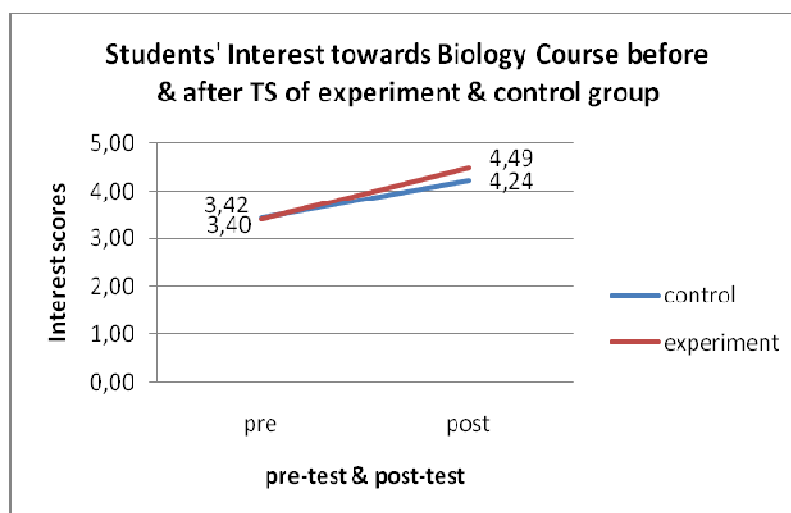
	t-test for Equality of Means			
	t	df	Sig. (2-tailed)	Mean Difference
Interest before	.417	254	.677*	.01953
Interest after	4.502	254	.000*	.25156

Note : n = 256, <sup>a</sup>n = 128, <sup>b</sup>n = 128, \* Significant at p < .05

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

#### Findings :

1. The p-value of 'interest before' is 0.677 , therefore, the difference between the two means score is 'not statistically significantly' different from zero at p < .05. This means there is no different significant on students' interest towards Biology Course before conducting e-AV BIOLOGY teaching strategy between experiment and control group.
2. The p-value of 'interest after' is 0.000 , therefore, the difference between the two means score is 'statistically significantly' different from zero at p < .05. This means there is any different significant on students' interest towards Biology Course after conducting e-AV BIOLOGY teaching strategy between experiment and control group.



**Fig. 7 Students' interest towards biology contents of experiment and control group**

#### Conclusions

This work presents a courseware for designing educational audio visual applications that intends to set a bridge between instructional and hypermedia aspects. Audio and Visual media was defined in the courseware as educational applications in hypermedia environments. The contribution that we have at this point is to propose the multimedia courseware for Biology Teaching and Learning media using the e-Learning method to deal with the explained educational problem in Indonesia. e-Audio Visual Biology website (e-AV BIOLOGY) have designed and developed, consisting some videos such as renewal energy (biofuel sources, biofuel production and biofuel usage). The advantages of the courseware of e-AV BIOLOGY design are expected to increase the Teaching and Learning quality in Senior High School, especially in Biology content. e-AV BIOLOGY had been developed with integrated and comprehensive Assignment, Quizzes, and Discussion Board for supporting the student learning process. The result of the main research data analysis shows that students' attitude, interest and knowledge was increased after using e-AV BIOLOGY courseware.

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