

Renewable Energy in Education for Biology Distance learning using e-AV Biology Courseware

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Abstract

Information and communication technology (ICT) has influenced various aspects of human life such as access to information, communication, business, and education. It is recognized that the quality of teaching and learning can be enhanced by using ICT in education. The context of Biology education in Indonesia shows that the students' motivation in learning this subject is considered low. Moreover, students' interest in the lesson was considered low, due to the subject irrelevancy, lack of daily experiences with Biology and monotonous teaching method. This research explored to overcome the common problem faced by the Indonesian Senior High School students in learning Biology especially Renewable Energy. There were two groups involved in this experiment, namely: T0 and T1. The first group (T0) was assigned as the control group and the second group (T1) was assigned to the experiment group. Two objectives were identified, firstly to examine the impact on learning outcomes when the e-AV Biology Courseware is used as a teaching medium. Secondly, it examined the overall feedback of the e-AV Biology Courseware. The findings of research indicated that the e-AV Biology Courseware was able to help students to understand more about the Biology subject, especially Renewable Energy topic, compared to the conventional ways of teaching. The research suggested two key contributions. The first contribution was the design and development of an e-Learning website for Indonesian Senior High Schools, secondly by using e-AV Biology Courseware.

Keywords: Renewable Energy, Biology, Education, Learning Model.

1.1 Introduction

Over the last decade, information and communication technology (ICT) has influenced various aspects of human daily life such as access to information, communication, business, and education, among others. The quality of teaching and learning can be enhanced by using ICT in education (Kiptalam & Rodrigues, 2010). The impact of ICT in the teaching and learning process depends 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. Since ICT can enhance teaching and improve the teaching and learning process, it is important that all students receive training in ICT (Ribeiro, Moreira, & Almeida, 2010).

Many learning approaches can be explored through ICT such as project-based learning, learning object-orientation, self-directed learning, online discussion, multimedia-based learning, and more. In Biology, multimedia-based learning can be used to transform abstract concepts, such as the blood circulatory system, into more concrete ones; to replace rare and dangerous objects which would otherwise need to be brought into classrooms; to display objects such as micro-organisms, which are invisible to the human eye. Also to overcome limitations of space, time and energy in the teaching of complicated processes such as the production of biodiesel, thereby enabling subjects to be taught by teachers and understood by students more easily. Many students in Indonesia have difficulties in learning Biology, and they think that Biology learning simply involves memorizing certain facts (Setiawan, 2008). There are some topics in Biology that students have particular difficulty in learning, such as cell division, chromosomes and the concept of energy (Tekkaya, Ozkan, & Sungur, 2001).

The main reasons for this are the nature of the topic itself, the teacher's style of teaching, the students' styles of learning and study habits, the negative feelings and attitudes of students toward the topic, and a lack of resources. To overcome these difficulties and make students' Biology learning more attractive, it has been suggested that teachers adopt various strategies such as teaching Biology through the use of visual aids, which is believed to be one way of making Biology learning more attractive. However, students find it difficult to learn Biology and have no interest in the lessons because the subject is irrelevant to their daily experiences (Cimer, 2012). Students' motivation to learn this subject is still low in Indonesia, which has resulted in their Biology marks not achieving the standard pass mark of 68 percent set by the Indonesian Ministry of Education (Setiawan, 2008; The Indonesian Ministry of National Education, 2003). Teachers must have the ability to foster a more conducive learning environment for Biology, which will make students more motivated and eager to learn, which in turn will increase students' knowledge.

The teaching media has been considered to be an urgent necessity as this can help teachers to better explain crucial concepts of Biology in the classroom. Sudjana and Ahmad (2005) state that teaching media could be used to improve students' motivation and interest, and indeed, many researchers on teaching media (Ogochukwu, 2010; Ossai-Ugbah, Ogunrombi, & Ameh, 2012; Suleman, Aslam, Sarwar, Shakir, & Hussain, 2011) claim that the use of media, and especially audiovisual (AV) media, improves students' learning capacity. Unfortunately, some people think that AV media is complicated and requires special skills and a massive amount of teamwork. However, nowadays, AV media can be produced and published easily on the web and on compact disc (CD) (Romero & Centellas, 2008). Teachers can produce AV media on their desktop and share it with their students through web-based technology. In line with the advancements in computer technology, the production of audiovisual has emerged with offers practical features. Audiovisual is a form of multimedia that has many advantages as follows (Ogochukwu, 2010):

- a. Learners can access many kinds of widely available information using multimedia.
- b. Utilizing multimedia in the classroom make students enjoys attending classes and they find these classes more interesting.
- c. Multimedia offers remarkable opportunities and challenges for teaching science.
- d. Educators can use multimedia as a new technology in order to enhance teaching styles.

The availability of the CD-ROM drive and camcorder makes the production of CD-ROM multimedia an easier task than ever before. Recently, computer technology has contributed a lot to the optimization of the teaching and learning process. Not only is it easier and faster to produce AV content, it can be uploaded on YouTube and other sites, and even on regional video sites. This research focuses on investigating the impact of the e-Audiovisual Biology (the e-AV Biology) Website, which is developed in this research to explain Biology in such a way that makes learning the subject interesting for students. This research examines the impact of the e-AV Biology Courseware on students' knowledge of Biology, attitude toward Biology, and interest in Biology. It also examines its impact on students' perception of AV media and the perceived effectiveness of AV media for teaching and learning Biology in Indonesian Senior High Schools. A research of the impact of this type of teaching medium in the Indonesian context is currently lacking and therefore this research is conducted to address a gap in knowledge (Perdana, 2008; Puspita, Widodo, & Hidayat, 2008).

1.2 The Teaching and Learning Context in Indonesian Senior High Schools

This section describes the current teaching and learning context in Indonesian Senior High Schools, government policy and technology in schools, and the roles and issues related to the use of teaching media in education. Currently, the teaching and learning system in Indonesia is still classic or traditional.

In a classroom, there are 32 to 40 students with one teacher. This makes the classroom a noisy place and results in the students' concentration being low. In Indonesian Senior High Schools, many teachers are still using the conventional methods for teaching and learning, i.e. teachers are the focal point of learning in the classroom. According to Setiawan (2008), Biology teachers in Indonesia are still using a monotonous teaching method, namely, the lecture, which is followed by giving students some examples and exercises, or some assignments. Senior High Schools in Indonesia have 12 classrooms for each Grade [Grade X, Grade XI, and Grade XII] which is grouped into Science (Biology, Chemistry, and Physics) and Social. Examinations are held twice in each academic year, in the middle and at the end of the year. Generally, teaching and learning involve the transfer of knowledge from the teacher to the students.

The methods used to acquire knowledge are listening, taking notes and doing assignments, which constitute a traditional teaching method that is popular in the Indonesian education system. Students may obtain lower learning outcomes due to a mismatch of teaching and learning styles in traditional teaching. For instance, one of the traditional teaching elements in the classroom is lecturing in a teacher-centered environment, in which students have to perform some activities such as listening to the teacher in the classroom and taking notes. However, sometimes students make mistakes because they are too busy writing down the information that is presented by teacher. This teaching and learning culture makes students passive and they can become bored because the subjects are not interesting. The participation of Indonesian students in the teaching and learning process is low (Setiawan, 2008). In addition, the teaching system is not optimal because technology is not used in the teaching and learning process, which is due to the low level of teachers' competency or capability, especially in the use of teaching media (Perdana, 2008).

1.3 Problem Statement

Based on the reasons described in the background, the problem statement of this research can be stated as follows:

1. The traditional or conventional style of teaching and learning Biology in Indonesia causes low interest.
2. The traditional or conventional style of teaching and learning Biology in Indonesia causes low learning outcomes.

1.4 Aim of Research

The research will recommend an improved model of the e-AV Biology Courseware for Indonesian Senior High Schools.

1.5 Research Questions

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

1. How is the impact in learning when the e-AV Biology Courseware was used for teaching Renewable Energy?
2. What would be the students' feedback in terms of the usefulness, video contents, and learning impact of the e-AV Biology Courseware and what improvements to the design of the e-AV Biology Courseware are suggested by students?

1.6 The Objectives of Research

Teaching Biology through media is designed and developed by the researcher, namely e-Audiovisual Biology media (the e-AV Biology Courseware) as one of the alternatives in teaching innovation. Audiovisual teaching media is chosen because of the strength of audiovisual media. In fact that the researcher is able to stimulate motion effects, modify sound and color, and also learners do not need any special prerequisites to operate it. By combination of various elements in teaching and learning process, teacher can realize that learning atmosphere that use audiovisual media can attract students' interest in learning (Ogochukwu, 2010). Based on these reasons, the design and development of e-AV Biology teaching media for Senior High School Students in Indonesia are needed. The researcher cooperated with teachers to make the Biology Instructional Design and to create the e-AV Biology teaching media which appropriate with Indonesian science curriculum, supported by multimedia learning theory and an instructional design namely Integrated Teaching and Learning Framework, so that the teachers can teach Biology subject effectively and improve students' attitude and interest in Biology. Besides that, it is also enhancing their learning outcomes. The e-AV Biology is one of the alternative teaching media to explain Biology course. Hence, the teaching and learning process in Indonesian Senior High Schools will improve. Renewable energy is a current topic of Biology education in Indonesia, which should be taught to students and should improve their understanding and awareness of bio energy such as biomass, biodiesel and biofuel.

This area of contents was concluded in Biology curriculum of Indonesian Senior High Schools in the fifth competency standard about Biotechnology. Biotechnology as a part of Biology subject is learned in the tenth grade of senior high school, it is determined by the fifth Competency Standard, which states that: “The Students are able to explain about Biotechnology - the principles, roles and its implications for sciences, environment, technology and society” (The Indonesian Ministry of National Education, 2003), and renewable energy has gained much attention from the green scientists.

The following are the objectives of research to support the aim:

1. To examine the impact in learning when the e-AV Biology Courseware was used for teaching Renewable Energy.
2. To examine the overall feedback of the e-AV Biology Courseware in terms of the usefulness, video contents, and learning impact of the e-AV Biology Courseware and the improvement of the e-AV Biology design.

1.7 Significance of the Study

Significance of the study can be formulated as follows:

1. Providing e-Learning (the e-AV Biology Courseware) as a tool to enhance students’ attitude and interest in Biology, particularly in Renewable Energy topic (Biodiesel Sources, Production and Biodiesel Usage).
2. Providing an alternative teaching and learning tool (teaching media) for educators.

1.8 Scope of the Study

Scope of the study can be stated as follows:

1. This research focuses primarily on high school students of the International School in Semarang, Indonesia.
2. This research focuses primarily on the individual learning of Biology using the e-AV Biology Courseware.
3. This research focuses primarily on one of subject matter in Biology, namely Renewable Energy (Biodiesel Sources, Biodiesel Production and Use of Biodiesel).

2.1 Instructional Design with Multimedia

The word teaching comes from the word instruction, which is widely used in the world. Cognitive holistic psychology has affected this term. Student is a source of the instructional learning activities. Besides, the term is also affected the development of technology, by facilitating the students to use of various media for learning something. Media used include print materials, television, internet, image and audio, etc. This is an aspect of supporting the changing role of teachers from learning resources to be facilitators of the teaching and learning process. This matter is in line with Gagne (2005), which stated that Instruction is a part of teaching, and as the consequences, students can learn something by utilizing the facilities and resources that are designed and arranged by teachers, it is the role of the teachers in student-centered learning.

2.2 Research Methodology

2.2.1 Selection of Population and Sample Schools

The population for this research comprises all first-year students of RSBI public daily schools, including International Schools of the Indonesian Government in Semarang. Semarang was considered ideal for this research because it is one of the main regions in Indonesia and The National Education Network (Jardiknas), which was built from 2004 to 2007 for the realization of ICT, has been implemented in this region. Purposive sampling with some criteria was used to select the population and sample used in this research because time and resources were too limited for random sampling and the necessary information is held by only certain members of the community, these are the first-year students of international schools run by the Indonesian Government (Tongco, 2007). A quasi-experimental approach was applied in two selective International Schools in 2011. Those schools were specifically selected because of some reasons or criteria. These criteria were essential in order to obtain a homogeneous sample. International Schools of Indonesia Government in Semarang were selected, from which 1 school was selected as the pilot study and 2 schools were selected as the main research. All of sample schools have 1152 students of the tenth grade, from which about 256 students selected as a sample in the main research.

2.2.2 Selection of Participants

The participants in this research consist of students’ participants and teachers’ participants.

Students' participants

A total of 256 students involved in this research, range of age were 14 to 16, and majority of them were the tenth grade students. They were selected from 2 schools of their existing classes with natural setting or existing arrangement of class. For each school, 2 classes for experiment group and another two classes for control group. Out of these two main groups (experiment and control), the students were largely divided into two sub category for each the experiment and control group. The students divided into two groups based on their Biology marks from teacher database, which are high and low achievers of Biology marks. The high achievers of students have Biology marks ≥ 75 , while low achievers have Biology marks < 75 . The school standard of Biology marks of International schools is 75. There were 36 classes in respective schools; ('tenth grade' of the each school have 12 regular classes). 4 (four) classes were selected as a sample in this research, for each school. 2 (two) classes were selected as the control group and 2 classes were selected as experiment group. All of the student's participants were selected from 'Tenth Grade', namely Class 1. Each class consists of 32 students' participants. Natural setting of students in the respective class or quasi experimental design was used for the main research.

Teachers' participants

All of the Biology teachers in the sample schools, especially in the selected classes were participated in this research. The first step of the experiment was to seek approval from school science teachers and 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 Courseware. The students did their activity individually in the Teaching and learning through the e-AV Biology Courseware. 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 *Jatropha Curcas L*', 'Video of Renewable Energy of *Jatropha Oil Production*' and 'Video of Renewable Energy of *Sunflower Oil Production*', etc. The conventional teaching approach was the normal teaching using textbook, charts and teacher explained in front of the class while students listen to the lectures or lessons. Both way of teaching covered the same content area or lesson objectives.

2.2.3 Data Collection, Instruments and Methods

The data collections methods used in this research are described below.

Interview

The interview is undertaken by communicating directly with or interrogating the respondents in order to get a detailed understanding of the problems being investigated. In this research, the interview was conducted face-to-face between the researcher and the participants in Senior High Schools. Interviews took place before and after the pilot study and the main study. The duration of each interview was approximately 60–90 minutes. The interviews were conducted in person with a group of students by making a tape recording and transcribing the results of the interviews. The interviewees consisted of the entire group of participants.

Documentation

Theoretical background information was collected from a review of the literature related to the teaching system in Senior High Schools and the literature related to the problem investigated.

Direct Observation or Field Research

The researcher observed directly the process of Biology teaching and learning in Senior High Schools over an eight-week period prior to the implementation of the e-AV Biology Courseware in the computer laboratory and classroom. The aim of this element of the data collection was to study the real-world situation of teaching and learning Biology in Senior High Schools and acquire knowledge of relevant data and documents. The kind of data observed during this field research included Biology marks and the high and low achievement ratings of students, the demographic information, and documentation in the computer laboratory and equipment in the schools studied.

2.2.4 Research Instruments

Quantitative data were collected by giving a survey questionnaire to the participants both before and after the experiment was implemented in the classroom (Luen, Fook, & Yong, 2012). A pre-survey questionnaire and pre-test of knowledge were completed by the participants before implementation of the e-AV Biology Courseware in the computer laboratory. A post-survey questionnaire and post-test of knowledge were completed by the participants after implementation of the e-AV Biology Courseware.

The questionnaire was developed based on a five-point Likert scale and a review of the questionnaires were used in the literature that are relevant to this research, specifically the Overall Feedback Questionnaire of the e-AV Biology Courseware based on 46 items.

3.1 Design and Development of the e-AV Biology Courseware

This section describes the e-AV Biology Courseware that was developed as an alternative strategy for the teaching and learning of Biology in Indonesian Senior High Schools. The first step in designing and developing the e-AV Biology Courseware was to prepare the main lessons (biodiesel sources, biodiesel production and biodiesel usage) and the videos for inclusion in the e-AV Biology Courseware. Using some software, videos about renewable energy were developed. The next step was to prepare the databases for the data storage requirement of the e-AV Biology Courseware. The databases were developed using MySQL. The third step was to design the e-AV Biology Courseware by using Joomla and some modules of Joomla. Finally, the e-AV Biology Courseware was ready to be uploaded as an e-Learning tool for Biology so that it could be accessed by students, particularly in Indonesia, to support the teaching and learning of Biology.

3.2 The e-AV Biology Courseware for Teaching and Learning Biology

The teaching and learning process of Biology in Indonesian Senior High Schools was tested using the e-AV Biology Courseware as the multimedia technology to support the e-AV Biology framework. The website included the interactive video lessons about Biology contents, such as Renewable Energy (biodiesel sources, biodiesel production, and biodiesel usage). The e-AV Biology Courseware was developed in an integrated way by combining comprehensive main lessons, video lessons, and other features, for supporting the student learning process. The e-AV Biology Courseware was developed to be an innovative Biology teaching media. The use of animations, motion images, and videos were intended to make a scientific phenomenon more easily comprehended by students. There are some features available in the e-AV Biology Courseware, as follows:

1. The e-AV Biology Home Page
2. Main Lessons
3. Video Lessons
4. Others Features

3.3 General Features of the e-AV Biology Courseware

The e-AV Biology Courseware consists of six features namely e-A Biology Home Page, Main Lessons, Video Lessons (Indonesian, English), Assignment, Quizzes and Discussion Board.

The e-AV Biology Home Page

This part aims to introduce students about the e-AV Biology Courseware. 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 the e-AV Biology menu and continued by information about the e-AV Biology features. Figure 1 shows the e-AV Biology Home Page.

Menu

Figure 2 shows menus available in the e-AV Biology Courseware which are main menu and pull down menu. The main menu consists of menu Home, about the e-AV Biology, How to Use, Video, Assignment, Discussion and Quizzes. In the pull down menu of Biology Subject, students can select subject of each class namely Class X, Class XI and Class XII.

Main Lessons

This part contains articles related to Biology. It provides the materials for students to learn more easily. Figure 3 to 6 shows Main Lesson about 'Biodiesel Production Process' in Indonesian.

From this Lessons features, students able to learn 'Trans-esterification Process', which is one of the chemical processes to produce Biodiesel, not only from text or article but also from video lessons.

Videos (Indonesian, English)

This part contains various videos such as biodiesel sources, biodiesel production and biodiesel usage (in Indonesian and English). Figure 3 to 6 shows Video Lessons about 'Renewable Energy'.

- Video Lesson 1 → Biofuel sources videos consist of 5 video lessons which are :
 - a. 'Video of Differences Biodiesel and Biofuel, length: 03.17 minutes'.
 - b. 'Video of Sources of biodiesel production, length: 02.17 minutes'.

- c. 'Video of renewable energy source of Jatropha Curcas L (Jarak Pagar), length: 1.58 minutes'.
- d. 'Video of renewable energy source of sunflower, length: 04.19 minutes'.
- e. 'Video of renewable energy source of palm plantation, length: 05.06 minutes'.
- Video Lesson 2 → Biodiesel production videos consist of 5 video lessons which are :
 - a. 'Video of Jatropha oil production, length: 02.34 minutes'.
 - b. 'Video of sunflower oil, length: 02.40 minutes'.
 - c. 'Video of trans-esterification process, length: 03.06 minutes'.
 - d. 'Video of biodiesel production process, length: 07.24 minutes'.
 - e. 'Video of diagram of biodiesel production process, length: 02.15 minutes'.
- Video Lesson 3 → Biosolar usage video consist of 1 video lesson which is :
 - 'Video of biosolar usages, length: 2.33 minutes'

Students were provided some content of Biology in the form of audios, videos and animation that allow them to explore the e-AV Biology Courseware. The integration of various media elements such as diagrams, audio and video in this section adds more value to this web-based courseware. Figure 1 to 8 shows some sample videos of renewable energy within the geographical context for Indonesian students with duration variation from 1.5 minutes to 2.5 minutes.

Other Features

This part facilitates students to share the knowledge in the relevant content, for example assignments, quizzes and discussion board. Feature such as individual quizzes was incorporated in the experiment of this research. Other features are not tested as it is not the focal concepts of this research.

1. Assignments

This part aims to test the learner’s understanding through a set of open ended questions. The questions were taken from the lesson module in the respective session. Figure 7 shows the e-AV Biology assignments.

2. Quizzes

This part aims to test the learner’s understanding through a set of multiple choice questions. The questions were taken from the lesson module in the respective session. Figure 8 shows the e-AV Biology quizzes.

3. Discussion Board

This part facilitates the students to share the knowledge in the relevant content.



Figure 1: The e-AV Biology Home Page



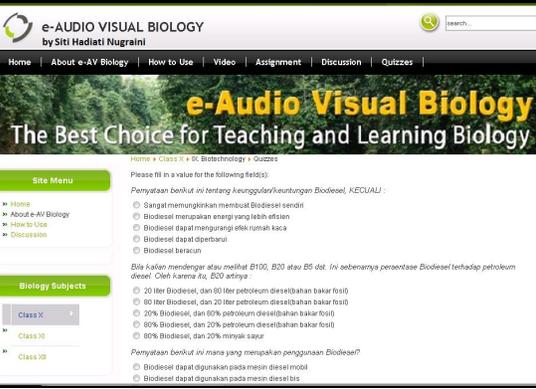
Figure 2: The e-AV Biology Menu



Figure 3: Video of Renewable Energy Source of



Figure 4: Video of Renewable Energy of Jatropha

<p>Jatropha Curcas L, length: 1.58 minutes</p> 	<p>Oil Production, length: 2.33 minutes.</p> 
<p>Figure 5: Video of Renewable Energy of Sunflower Oil, length: 2.40 minutes</p>	<p>Figure 6: Video of Renewable Energy on Biosolar Usages, length: 2.33 minutes</p>
 <p>Figure 7: The e-AV Biology Assignments</p>	 <p>Figure 8: the e-AV Biology Quizzes</p>

4.1 Results of Overall Feedback Survey in the e-AV Biology Courseware

Research Question: What is the students' feedback in terms of the usefulness of the video contents, and learning impact of the e-AV Biology Courseware and what improvements to the design of the e-AV Biology Courseware are suggested by the students?

This section present the results of the survey conducted to gain feedback on the e-AV Biology Courseware from the student participants of the experiment group after they had used the e-AV Biology Courseware for their individual learning. They had reported about Feedback of Usefulness of the e-AV Biology Courseware, Video Contents in the e-AV Biology Courseware, and Feedback of The Learning Impact of the e-AV Biology Courseware. The survey results indicated that majority of the students respont positively (agree and strongly agree) for overall feedback of the e-AV Biology Courseware. The data had been collected from results of the questionnaires. Mostly descriptive findings are presented to highlight popular items and also to notice which items are less agreed or more agreed by students. A mean score more than 4.0 with low standard deviation value indicates that the items were agreed and strongly agreed by students, and also many of them were sharing the similar feedback on the scale of 5 or 4 (agreement). These items will be mentioned and discussed in the following sections. Likewise, for items with mean scores near to 3 indicated that the items were not agreed nor disagreed by students, it indicates indecisive opinion by students for those items or other words a mixture of opinions of agree and disagree by the group of students collectively. Majority of the items draw favorable agreement by most of the students, with mean scores value ranging from 3.22 to 4.78 and the standard deviations value around .42.

A. Students' Feedback on the Usefulness of the e-AV Biology Courseware

Table 1 shows the results of the students' feedback on the usefulness of the e-AV Biology Courseware. The table shows that the majority of the students gave a positive response to the usefulness of the e-AV Biology Courseware, with an aggregated mean value of 4.50, and standard deviations ranging from .496 to .790. In the table, the percentage of agreement and disagreement is represented by '%' whiles the 'number of students' is represented by 'n'.

'Positive Response/Agreement' indicates that the students *agree* and *strongly agree* with the statements, while 'Negative Response/Disagreement' indicates that the students *disagree* and *strongly disagree* with the statements.

Table 1: Usefulness of the e-AV Biology Courseware

Items	Statements	Agreement (%) (n)	Undecided (%) (n)	Disagreement (%) (n)	Mean	Aggregated Mean
q1	The e-AV Biology Courseware is useful for learning	100% (121) (56%*, 44% **)	0%	0%	4.562	4.50
q2	The e-AV Biology Courseware is informative	92% (111)	8% (10)	0%	4.380	
q3	The e-AV Biology Courseware is easy to use	88% (106)	9% (11)	3% (4)	4.421	
q4	The contents of the e-AV Biology Courseware is easy to understand	94% (114)	6% (7)	0%	4.653	
q5	If I do not understand the lesson in the e-AV Biology I should repeat it again	87% (105)	12% (15)	1% (1)	4.578	
q6	I could watch the tutorial or lesson in the e-AV Biology at any time.	86% (105)	12% (14)	2% (2)	4.388	
q7	The information in the e-AV Biology was presented in an attractive way.	93% (112)	7% (9)	0%	4.529	

Note : n = 121

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

Agreement = *strongly agree* and *agree*, * = *strongly agree*, ** = *agree*

Disagreement = *disagree* and *strongly disagree*

Items q1, q4, q5 and q7 had higher mean scores (mean ≥ 4.0) with low standard deviation scores (SD ≤ 0.8), which means that these items have low variability. This indicates that the students agreed and strongly agreed with these items, and also many of them gave a similar feedback score of 5 or 4 (agreement). The table shows that the majority of the students gave a positive response regarding the usefulness of the e-AV Biology Courseware for their learning. From question 1 we can see that 44% (53 out of 121) of the respondents 'strongly agree' with the usefulness of the e-AV Biology Courseware for learning, while 56% (68 out of 121) 'agree' and zero respondents gave a negative response. It was also the opinion of 92% of the respondents that the e-AV Biology Courseware was informative, while 8% of the respondents were undecided about whether or not the e-AV Biology Courseware was informative (question 2). The results also show that 88% of the respondents gave a positive response about the ease of use of the e-AV Biology Courseware, while 9% were undecided and 3% gave a negative response (question 3). In addition, 94% of the students responded positively that the contents of the e-AV Biology Courseware were easy to understand, while 6% of them were undecided (question 4).

B. Students' Feedback of Video Contents in the e-AV Biology Courseware

Table 2 shows the Students' Feedback of Video Contents in the e-AV Biology Courseware. The table shows that majority of the students have a positive response to Video Contents in the e-AV Biology Courseware, with aggregate mean value = 4.35, and standard deviations around.53.

Table 2: Feedback of Video Contents

Items	Statements	Agreement (%) (n)	Undecided (%) (n)	Disagreement (%) (n)	Mean	Aggregated Mean
q8	Video contents of the e-AV Biology are useful to learn Biology	98% (119)	2% (2)	0% (0)	4.554	4.35
q9	I am interested in using the video contents of Biology	77% (93)	20% (24)	3% (4)	4.207	
q10	Video contents of the e-AV Biology are suitable for Biology courses	97% (117)	3% (4)	0% (0)	4.562	
q11	I am satisfied with the video contents for learning Biology	82% (99)	12% (15)	6% (7)	4.314	
q12	The Video contents are attractive	89% (107)	9% (11)	2% (3)	4.421	
q13	The Video contents can increase my ability to learn Biology	92% (112)	6% (7)	2% (2)	4.471	
q14	The Video contents can motivate me to learn Biology more	82% (100)	17% (20)	1% (1)	4.430	
q15	The sequence of video contents are easy to follow	87% (105)	11% (13)	2% (3)	4.595	
q16	The Video contents allow me to clarify my misconception in Biology	77% (94)	21% (25)	2% (2)	4.331	
q17	The background music is attractive, the background music is appropriately used.	54% (65)	38% (46)	8% (10)	3.868	
q18	The background music is distracting	17% (20)	18% (22)	65% (79)	3.893	
q19	Video content can explain abstract concepts clearly	86% (104)	13% (16)	1% (1)	4.562	

Note : n = 121

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

Agreement = *agree* and *strongly agree*

Disagreement = *disagree* and *strongly disagree*

Students' feedback to Video Contents of the e-AV Biology Courseware indicated that item q8, q10, q15, and q19 shows higher mean scores (mean ≥ 4.35) with low standard deviation scores ($SD \leq 0.8$), which mean that the items have low variability of the feedback from students. Many of them agreed and strongly agreed that Video Contents of the e-AV Biology were useful to learn Biology, it was suitable for Biology, the sequence of Video Contents were easy to follow, and Video Contents can explain abstract concepts clearly. From question 8 (q8) we can see that 98% of the respondents had a positive response about the suitability of Video contents in the e-AV Biology Courseware for learning Biology, while 2% of the respondents undecided. In the opinion of 77% of the respondents, they felt interested in using the video contents of the e-AV Biology Courseware, 20% of the respondents were undecided whether they felt interested in using the video contents of the e-AV Biology Courseware or not, while 20% of respondents had negative response (question 9).

The table also shows that 97% of respondents had positive response about Video contents of the e-AV Biology were suitable for Biology courses, while 3% were undecided (question 10). In addition, 82% of the students respond positively that they were satisfied with the video contents for learning Biology, while 12% of the students were undecided whether they were satisfied with the video contents for learning Biology or not, and 6% of respondents had negative response (question 11). The results also show that 89% of the respondents had positive response that the video contents of the e-AV Biology Courseware were attractive, while 9% were undecided, and 2% had negative response (question 12). From question 13 we can see that 92% of the students had positive response that the video contents can increase their ability to learn Biology, 6% were undecided, while 2% had negative response. Also, 82% of the students reported that the video contents can motivate them to learn Biology more, while 17% of the students undecided, and 1% of respondents have negative response (question 14). From question 15 (q15) we can see that majority of the students had a positive response to the sequence of video contents, as easy to follow, 87% of the respondents had positive response that the sequence of video contents were easy to follow, while 11% of the respondents were undecided, and 2% of respondents had negative response.

C. Students' Feedback of the Learning Impact of the e-AV Biology Courseware

The table 3 Shows that majority of the students have a positive response to the Learning Impact of the e-AV Biology Courseware, with aggregate mean value = 4.27, and the standard deviations around 0.42. Students' feedback on the Learning Impact of the e-AV Biology indicated that item q33, q35, q43, and q46 shows higher mean scores (mean ≥ 4.27) with low standard deviation scores (SD ≤ 0.8), which mean that the items have low variability of the feedback from students.

Many of students agreed and strongly agreed that they were motivated to learn Biology using the e-AV Biology Courseware because the contents were able to attract students' attention. The e-AV Biology has positive impact on students' learning of Biology. Students did not feel bored studying Biology with the the e-AV Biology Courseware. The e-AV Biology Courseware has shortened students' learning time on a particular topic of Biology, and students' knowledge was improved by the e-AV Biology Courseware. From question 33 (q33) we can see that 87% of the respondents had a strongly positive response that they were motivated to learn Biology using the e-AV Biology Courseware because the contents were able to attract their attention, and 12% of the respondents were undecided, while 1% of the respondents had a negative response.

Table 3: Feedback of Learning Impact

Items	Statements	Agreement (%) (n)	Undecided (%) (n)	Disagreement (%) (n)	Mean	Aggregated Mean
q33	I am motivated to learn Biology using the e-AV Biology because the contents are able to attract my attention	87% (105)	12% (15)	1% (1)	4.578	4.27
q34	My motivation will be decreased after using the e-AV Biology for several times	20% (24)	15% (18)	65%(79)	3.876	
q35	The e-AV Biology has positive impact on my learning of Biology	98% (119)	2% (2)	0% (0)	4.777	
q36	I have interest to use the e-AV Biology during the learning of Biology	84% (102)	14% (17)	2% (2)	4.488	
q37	The e-AV Biology is more efficient than the conventional teaching of Biology	73% (88)	26% (32)	1% (1)	4.223	
q38	Learning through the e-AV Biology is more effective than the conventional learning of Biology.	73% (88)	25% (31)	2% (2)	4.273	
q39	I wish the e-AV Biology could be used in the teaching of Biology	86% (104)	9% (11)	5% (6)	4.446	
q40	I can learn Biology with the the e-AV Biology alone	69% (84)	25% (30)	6% (7)	4.231	
q41	I do not feel bored studying Biology with the e-AV Biology	70% (85)	15% (18)	15% (18)	4.149	
q42	Biology textbook makes me feel bored	48% (58)	24% (29)	28% (34)	3.223	
q43	The e-AV Biology has shortened my learning time on a particular topic of Biology courses.	84% (102)	16% (19)	0% (0)	4.512	
q44	My interest in Biology was increased by the e-AV Biology.	75% (91)	23% (28)	2% (2)	4.380	
q45	The e-AV Biology was effective in helping me learn the material.	92% (111)	8% (10)	0% (0)	4.008	
q46	My knowledge was improved by the e-AV Biology.	90% (109)	10% (12)	0% (0)	4.653	

Note : n = 121

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

Agreement = *agree* and *strongly agree*

Disagreement = *disagree* and *strongly disagree*

However, only 20% of the respondents had positive response (agree and strongly agree) that their motivation will be decreased after using the e-AV Biology Courseware for several times, while 15% of the respondents were undecided whether their motivation will be decreased or not after using the e-AV Biology Courseware for several times, whereas 65% of the respondents had negative response (disagree and strongly disagree) that their motivation will be decreased after using the e-AV Biology Courseware for several times (question 34). The table also shows that 98% of respondents had positive response that the e-AV Biology Courseware has positive impact on their learning of Biology, while 2% of the respondents were undecided (question 35). The results also shows that 84% of the respondents had positive response that they have interest to use the e-AV Biology Courseware during the learning of Biology, while 14% were undecided, and 2% had negative response (question 36). The table also shows that 92% of respondents had positive response that the e-AV Biology Courseware was effective in helping them in learning the material, while 8% of the respondents were undecided (question 45).

In addition, 90% of the respondents stated that their knowledge was improved by the e-AV Biology Courseware, while 10% of the respondents were undecided whether their knowledge was improved by the e-AV Biology Courseware or not (q 46).

5. Conclusion

5.1 Improvement of Learning Outcomes

In this research, multimedia technology was used to develop an e-AV Biology Courseware as an instructional teaching strategy. A student-centered model and individual learning was used in this teaching and learning Biology tool. The e-AV Biology Courseware provides students with a lot of Biology learning material such as video lessons and other features. Hence, students can explore the e-AV Biology Courseware individually in the context of the teaching and learning of Biology. Through the e-AV Biology Courseware they were engaged in their learning process, while teacher played the role of a facilitator or guide. The e-Learning method was used to deal with the educational problem in Indonesia. The e-AV Biology Courseware was designed and developed to consist of some video lessons on topics such as renewable energy (biodiesel sources, biodiesel production and biodiesel usage). The advantages of the e-AV Biology Courseware design were expected to increase the quality of both teaching and learning in Senior High Schools in Indonesia, especially in the subject of Biology. This research examined the impact of AV teaching media through an analysis of the implementation of the e-AV Biology Courseware. This research was conducted to find ways to meet the increasing challenge of teaching an important abstract subject such as the topic of renewable energy. Audiovisual media was the key component in the developed e-Learning website, which was based on an instructional design. It was found that the change in students' attitude was more obvious than the change in students' interest. This could be due to a stronger acceptance among students of AV teaching media based on interest and subsequently this may have had an effect on their attitude. In other words, they have more interest in using such media for their Biology learning experience, and changed their attitude after using it. This could be due primarily to the scarce usage of video media through a website, so they felt it was useful and interesting.

5.2 Feedback and Improvement of the e-AV Biology Courseware Design in Terms of the Usefulness, Video Content, and Learning Impact of the e-AV Biology Courseware

The majority of the students gave a positive response regarding the usefulness of the e-AV Biology Courseware for their learning. The respondents gave a positive response about the ease of use of the e-AV Biology Courseware and responded positively that the contents of the e-AV Biology Courseware were easy to understand. Many of them agreed and strongly agreed that the e-AV Biology Courseware was useful for learning and informative, that the contents of the e-AV Biology Courseware were easy to understand and that the information on the e-AV Biology Courseware was presented in an attractive manner. These findings indicated that the e-AV Biology Courseware is easy for students to use in their learning process and is able to improve students' understanding of the contents of the e-AV Biology Courseware, in particular in the topic of renewable energy, which was the main lesson. This is in line with the findings of Campbell, Lum & Singh (2000), who argue that the learning process can actually be improved if certain methods are used in addition to multimedia. By using auditory and visual methods of presenting information, students can process that information more quickly, which often fosters and enhances the learning process (Yusaitis & Storandt, 2008). Many of the students agreed and strongly agreed that the video contents of the e-AV Biology Courseware were useful for learning Biology, that they were suitable for Biology, that the sequence of the video contents was easy to follow, that the video contents could explain abstract concepts clearly, and that this motivated them to learn Biology more.

These findings indicated that the video contents included in the e-AV Biology Courseware are useful, suitable for Biology lessons and able to generate similar perception about abstract concept, particularly renewable energy, which was the main lesson in this research. Lastly, the majority of the students gave a positive response about the learning impact of the e-AV Biology Courseware. The students stated that the e-AV Biology Courseware had a positive impact on their learning of Biology. The respondents showed interest in using the e-AV Biology Courseware during the learning of Biology and reported that they wished that it could be used in the teaching of Biology. The respondents were also motivated to learn Biology after using the e-AV Biology Courseware because the contents attracted their attention. Students did not feel bored studying Biology with the e-AV Biology Courseware and it was able to shorten the time that students spent learning a particular topic. Also, students' knowledge was improved by using the e-AV Biology Courseware. These findings indicated that the e-AV Biology Courseware has a positive impact on motivation, attention, and learning.

This is in line with Smart et al. (2006), who state that students exhibit greater perception and motivation when course content interests them and when they perceive that the content has some personal relevance majority the students have a positive response to the usefulness of the e-AV Biology Courseware, the video contents in the e-AV Biology, and the learning impact of the e-AV Biology Courseware for students' learning.

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