The Effect of Interactive Multimedia on Students’ Cognitive Learning Outcomes on System Materials

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Abstract

This study aimed to determine the influence of interactive multimedia on students’ cognitive learning outcomes in class XI. This study employed a quasi-experimental method using Posttest-Only Control Design. The population is students of class XI MIPA. Samples were taken by random sampling; an experimental class that uses interactive multimedia with as many as 30 students and a control class that does not use interactive multimedia with as many as 30 students. The data collection technique is carried out by providing a post-test to obtain data on student cognitive learning outcomes, and the data analysis technique used is an independent sample t-test with a significant level (\(\alpha\)) = 5%. Based on data analysis and hypothesis testing, it shows that there is an influence of interactive learning multimedia on cognitive learning outcomes because of the significant value of 0.000 < 0.05. There are differences in student results, which can be seen through hypothesis tests that H\textsubscript{0} is rejected and H\textsubscript{1} is accepted. Students accept the use of interactive multimedia in the classroom in carrying out the teaching and learning process. Based on the study results, it was concluded that interactive learning multimedia influences the cognitive learning outcomes of class XI students.

Keyword: Interactive multimedia, cognitive learning outcomes, digestive system material

INTRODUCTION

Today's prevailing slant in interactive media applications for industry and society is the ever-growing scale of media collections. As the common open has been given apparatuses for phenomenal media generation, capacity, and sharing, media era and utilization have expanded definitely in later a long time. Besides, up and coming mixed media applications in incalculable domains—from shrewd urban spaces and trade insights to wellbeing and wellness, lifelogging, and entertainment—progressively require joint displaying of numerous modalities (Khan et al., 2020). According to Muhsetyo (2008), media is a learning aid that is deliberately and planned, prepared by teachers to the student, or explains lesson materials and is used by students to be able to engage directly with learning. One learning media for students that offers a direct virtual experience is interactive multimedia, a learning media designed for independent learning, creating a fun learning environment and motivating students in the classroom. Learning media has a function to convey learning messages and clarify the presentation of messages, overcome the limitations of space and time and allow for more varied and passionate teaching and learning interactions. The use of learning media is expected to positively influence student learning outcomes to achieve the desired learning goals (Arsyad, 2010).
According Kurnia et al. (2019) stated that learning with interactive multimedia is a combination of various media or file formats in the form of text, images, or vectors, graphics, sounds, animations, and interaction videos that have been packaged into a digital or computerized file whose function is to convey messages to the public and can be controlled by as much as possible. Interactive multimedia is a medium that has enormous potential to help the success of the learning process both online and offline. The basic purpose of the need for multimedia learning is to increase the effectiveness and efficiency of the learning process. Interactive multimedia is not linear (sequential or sequential). Still, students have choices that match the menu offered. In studying a topic of discussion, students can choose which one to learn first. Thus the characteristic of interactive multimedia is the existence of a kind of controller commonly called the Graphical User Interface (GUI) in the form of icons, buttons, scrolls, or others. Each of these GUIs can be operated by learners (use) to search for the desired information for a student in the class.

The utilize of multimedia seem make strides authority of concepts has been carried out by a few specialists, particularly in science. Husein et al. (2015) state that interactive media can upgrade information of concepts, and it can be expressed that intuitively interactive media is exceptionally supportive in passing on data within the learning handle. The learning prepare can be done confront to confront or without having to bargain with accessing it yourself. Usually what underlies the execution of this inquire about to optimize innovation within the world of instruction within the 21st century (Rosamsi et al., 2019). Online learning gives a space for understudies to get to consistent learning and builds connections between understudies and understudies, understudies and instructors, and instructors and understudies. These connections increment communication and interaction in learning. Subsequently, understudy learning results make strides viably. The ICT-based CLMB learning demonstrate was created based on a constructivist hypothesis with a mixed approach to learning. This model is supported by information and communication technology, either face-to-face classroom learning or online learning (Adnan, 2014).

For interactive multimedia, teachers curiously allude to the utilize of multimedia and ICT equipment’s to offer an successful discourse between the teachers and the understudies in comparison with conventional strategies of instructing, which may need such interactivity. Be that as it may, supporters of routine instructing strategies contend that face-to-face communication can be more intelligently; mixed media has been broadly utilized in instructive innovations. It is additionally anticipated that long term will see more of the utilization of such devices in instruction. A few contend that interactive media and e-learning
tools can be utilized as a supplement to conventional classes (and not as a substitution). Utilizing intelligently interactive media within the educating prepare may be a developing wonder. It plays a imperative part in helping understudies in their learning forms. In this manner, it can be concluded that interactive media upgrades and empowers understudies to memorize more viably (Nusir et al, 2012).

According to Graham (2019), the benefits of interactive multimedia in education / especially learning, include the learning process being more interesting and interactive. The amount of teaching time can be reduced, and the quality of learning can be improved using interactive multimedia. The teaching and learning process can be carried out anywhere and anytime, and the learning attitudes of students can be improved.

Asyhar (2021) states that the most concrete learning is direct experience, meaning that using real object learning media is most effective in achieving learning objectives. One of the learning media that offers a virtual designed hands-on experience is Interactive Learning Multimedia. According Adnan (2015), the use of ICT helps the development of learning and provides opportunities for learners in the form of problem-solving searches and improves the idea-creation process, improves learners' understanding of the subject matter, increases the motivation of teachers and learners to learn and teach, and increases the use of ICT appropriately can positively affect aspects of school life, such as the implementation of learning, the quality of learning, and teacher development opportunities. This shows that technology in education is very important in improving student learning outcomes.

The National Education Systemformulates educational objectives, both curriculum objectives, and instructional objectives, using a classification of learning outcomes from Benjamin Bloom which broadly divides them into three domains, namely: (a) Cognitive, (b) Affective, (c) Psychomotor. The cognitive realm includes developing intellectual skills (knowledge) with the following levels: (a). Knowing, (b) Understanding, (c) Applying, (d) Analyzing, (e) Evaluating, and (f) Creating. The following explains some cognitive aspects a. Knowing (C1) includes memories of things that have been learned and stored in memory. Recalling or recognizing knowledge stored in memory will be unearthed when needed. b. Understanding (C2) includes the ability to construct the meaning and meaning of something learned. c. Applying (C3) consists of using a procedure to solve a problem or work on a task. d. Analyzing (C4) includes deciphering a problem or object to its elements and determining how the elements are related. e. Evaluating (C5) consists of the ability to form an opinion on a matter, accompanied by the accountability of that opinion, based on certain criteria. f. Create (C6) includes the ability to combine several elements into a unitary form.
Cognitive learning outcomes can be assessed using instruments in the form of tests. The test that researchers use is an objective test in the form of a multiple-choice test. The multiple-choice test consists of a statement or notification about an incomplete understanding. And to complete it, you have to choose one or several possible answers that have been provided or consist of a description section (stem) and a possible answer or alternative part (options). The possibility of an answer (options) consists of one correct answer, namely the answer key, and several detractors (Arikunto, 2013).

Based on the interview results conducted with teachers of biology class XI that the value of daily test results in the previous Digestive System material was not satisfactory because the learning process used conventional methods. So different learning is needed and contains a real effort to facilitate learning in the classroom.

Biology talks about abstract things that need to be structured, which makes it difficult for learners to understand. This causes understanding that students can not only listen to explanations from the teacher, but also requires a medium that can explain in more detail. The level of understanding of students who listen is undoubtedly different from students who listen and also see the material learned in the classroom to be taught (Adnan et al., 2014).

This study used multimedia Articulate Storyline 3, one of the multimedia authoring tools used to create interactive multimedia applications with content in the form of text, images, graphics, sound, video, and even animation and simulation. The results of the publication of Articulate Storyline 3 are in the form of web-based media (html5) or application files (.exe) that can be run on various devices such as laptops, tablets, and smartphones.

Pros of Articulate Storyline: (a) This AS feature is very similar to the feature in Ms. PowerPoint. (b) Easy to learn for beginners who already have the basics of creating media using Ms. PowerPoint. (c) Support Game-based learning because it is Interactive. (d) Content can be a combination of text, images, graphics, sound, animation, and video. (e) The publication results can be run via Desktop, in the form of a Web browser application (exe) file, in the form of an HTML5 file. An Android smartphone, by converting it into an LMS (Learning Management System) APK like Moodle, is a SCORM file. (e) It has a relatively small file size of publications and APK conversions, so it is lightly installed on a smartphone. Has a lot of documentation from the Articulate Storyline 3 user community, making it easier for us to solve problems faced when creating media/applications. The cons of Articulate Storyline, maybe I can mention a few: Media display when run on a smartphone cannot be correct 2 full screen. So, there is still a margin of ± 1-3 pixels from the border of the
smartphone screen. But in terms of content, everything can be run well. If friend2 uses a back sound on the media, then the back sound will be run only on the slide/layer where the media was added. However, if friends2 wants the back sound to run throughout the media, friends can add a specific script to prepare for it.

Adnan et al (2017) posits that reflection plays an important role in the learning experience. The process of reflection helps to strengthen the expertise in the learner's memory, increasing the potential for further learning. Student interaction in the LMS provides an opportunity to build effective communication with other students and lecturers so that students' potential to construct knowledge based on their experiences is increasingly open. Thus, LMS can directly or indirectly strengthen learning motivation and student cognition ability in the form of learning outcomes and metacognitive awareness.

**METHOD**

The research was conducted in February 2022 at Senior high school with 60 students from two classes, namely the control and experimental classes. Quasi-Experimental Design in which samples used for experimentation or as a control group are taken randomly from the specified population. The research variable in this study consists of the independent variable, interactive multimedia, and the dependent variables are students' cognitive learning outcomes.

The research design that will be used is the Posttest-Only Control Design. In this design, there are two groups: the control group and the treatment group. The research instrument used in this study is a test for learning outcomes that expert validators have validated. A written test in the form of a 25-number multiple choice test form with five options for each question item. The aspects measured are the cognitive realm at the level of remembering (C1), understanding (C2), using (C3), analyzing (C4), and Evaluating (C5). The test carried out is a written test conducted by testing research instruments using SPSS 26, which aims to determine the validity of the research instruments used.

Data collection is carried out by the test method. In this study, 25 validated multiple-choice numbers were used. The test is carried out by providing exam questions in multiple choices. The test is given after the learning is completed (posttest). Each question item that is answered correctly is given a score of 4, and the wrong one is given a score of 0 from the score obtained, then calculated to determine the value of the learning outcomes obtained using the following formula:

$$Mark = \frac{\text{Number of correct answers}}{\text{Number of questions}} \times 100$$
Based on the formula above, adjustments are made to the value distribution table to determine the interval of values obtained by students in Table 1.

<table>
<thead>
<tr>
<th>No</th>
<th>Category</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Excellent</td>
<td>85-100</td>
</tr>
<tr>
<td>2</td>
<td>Good</td>
<td>65–84</td>
</tr>
<tr>
<td>3</td>
<td>Keep</td>
<td>55-64</td>
</tr>
<tr>
<td>4</td>
<td>Low</td>
<td>35-54</td>
</tr>
<tr>
<td>5</td>
<td>Very low</td>
<td>0-34</td>
</tr>
</tbody>
</table>

After the research data were obtained, the assumption test or prerequisites (normality and homogeneity test) was then continued with the hypothesis test. We used an independent t-test to determine the influence of interactive multimedia used on students' cognitive learning outcomes in the form of student post-test results. The data test was carried out through the IBM SPSS Statistic 26 application.

RESULTS AND DISCUSSION

This study aims to determine the influence of interactive multimedia on students' cognitive learning outcomes on the Digestive system's material. This study's descriptive statistical analysis describes research data, including the amount of data, maximum value, minimum value, average value, and so on. The research presented is descriptive data of learners' final ability (Posttest) on biology learning. The media used in the form of Articulate storyline three software is one of the multimedia authoring tools used to create interactive multimedia applications with content in the form of text, images, graphics, sound, video, and even animation and simulation. The results of articulate storyline publications are web-based media (html5) or application files (.exe), which can be run on various devices such as laptops, tablets, and smartphones. Figure 1 displays the prefix Articulate Storyline 3 on the digestive system material.

![Figure 1. Articulate Storyline 3 main page view](image)

Things that must be considered in Articulate Storyline 3 are 1). Visual elements include text, font size, color, letter model, and spacing. 2). Message patterns, including layout, color,
sound, animation, image, and video settings. 3) The content of learning and evaluation of material that is automatically known to the results by learners. Figure 4.1 is the initial display of Articulate Storyline 3 which contains (a) KD, (b) Digestive system main material, (c) Learner Evaluation Materials, (d) Learning videos, (e) Games, and (f) Researcher information.

One of the activities of students in interactive multimedia in the experimental group is when students can explain the process of food digestion and the flow of food contained in the digestive system material, which can be seen in Figure 2.

![Figure 2](image1.jpg)

**Figure 2.** Interactive multimedia activities supporting cognitive dimensions C1

Figure 2 shows that learners explain the food digestion process through the observation of the video directed, furthermore, as a support for the achievement of cognitive dimensions at the C1 level. For the activity of students in supporting the achievement of the cognitive level of C2, we included observations of disorders in the digestive system, which can be seen in Figure 3.

![Figure 3](image2.jpg)

**Figure 3.** Supporters of C2 cognitive level achievement activities.

In addition to supporting C2 activities in interactive multimedia, there are various achievement activities at the C3 cognitive level. Students are able to apply how to take care of
the digestive tract, as shown in Figure 4.

![Figure 4. Supporting activity of the cognitive level C3](image_url)

In addition, in supporting the achievement of the C4 cognitive level dimension, researchers include the caloric value produced in food so that students can compare it with the caloric value they eat every day, as shown in Figure 5.

![Figure 5. Supporting activity of the cognitive level C4.](image_url)

In addition to calculating calories in food, one of the activities of students in interactive multimedia that supports the achievement of cognitive dimensions at the C5 level researchers includes how to calculate BMI and BMR so that students can prove by calculating their respective body masses, as shown in Figure 6.
Descriptive Analysis of Research Data

Descriptive statistical analysis helps expose and describe research data, including the amount of data, maximum value, minimum value, average value, and so on. The descriptive research data presented in Table 2 is descriptive data of students with the final ability (Posttest) in biology learning experimental class and control class.

<table>
<thead>
<tr>
<th>Number of learners</th>
<th>Min.</th>
<th>Max.</th>
<th>Average</th>
<th>Std. deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Class Value</td>
<td>30</td>
<td>40</td>
<td>76</td>
<td>56.40</td>
</tr>
<tr>
<td>Experimental class grades</td>
<td>30</td>
<td>76</td>
<td>88</td>
<td>81.80</td>
</tr>
<tr>
<td>Sum</td>
<td>30</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Based on the results of observations from all students who use interactive multimedia and classes that do not use interactive multimedia, each of which is 30 people given a biology learning test in the form of 25 posttest questions. Therefore, the average score that students are able to achieve in classes that use interactive multimedia is 81.80 ± 77.22, while the average score that students can achieve in classes that do not use interactive multimedia is 56.40 ± 44.01, based on the results of data analysis above, it can be explained as follows.

a. Description of the value of cognitive learning outcomes of learners of experimental classes and control classes. Based on the observations of all students in the experimental class and control class, it can be seen in Table 3.

<table>
<thead>
<tr>
<th>Category</th>
<th>Value Range</th>
<th>Number of Learners</th>
<th>Experimental Class</th>
<th>Control Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>85 – 100</td>
<td>8</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Good</td>
<td>65 – 84</td>
<td>22</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Keep</td>
<td>55 – 64</td>
<td>-</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>35 – 54</td>
<td>-</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>Very Low</td>
<td>0 – 34</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Sum</td>
<td>30</td>
<td>30</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Based on the data in Table 3, it can be explained that there is a difference in the scores obtained by students between classes that use interactive multimedia and classes that do not. The number of students in classes that use interactive multimedia gets excellent scores of 8, while none get excellent value in classes that do not use interactive multimedia. In addition, in the category of good grades in classes that use interactive multimedia, 22 students get good scores, while in classes that do not use interactive multimedia, as many as seven people. For the medium score category in classes that use interactive multimedia, there are no students in the medium category because, in the medium category, there are only nine students who do not use interactive multimedia, and the low category is 14 students. Therefore, we analyze the value of the correct answer results that students can answer according to the level of cognitive levels C1 to C6, which will be described in Table 4.

Table 4. Number of respondents who answered correctly according to cognitive levels

<table>
<thead>
<tr>
<th>Cognitive Dimensions</th>
<th>Number of Respondents Who Answered Correctly</th>
<th>Number of Questions</th>
<th>Experimental Class</th>
<th>Control Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1 (Remembering)</td>
<td>8</td>
<td>30</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>C2 (Understanding)</td>
<td>6</td>
<td>15</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>C3 (Apply)</td>
<td>5</td>
<td>15</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>C4 (Analyze)</td>
<td>4</td>
<td>10</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>C5 (Evaluate)</td>
<td>2</td>
<td>5</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>C6 (Creating)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

Based on Table 4, the test given to students is 25 numbers that can be answered. For C1 questions (Remembering), all students can remember and understand the questions. As for C2 (Understanding), the number of students who can answer in classes that use interactive multimedia and classes that do not use interactive multimedia is 15 people.

While the C3 question (Applying), the number of students who can answer questions in the experimental class is 15 people, while in classes that do not use interactive multimedia, as many as ten people, but for C4 questions (analyzing), the number of students who can answer questions is ten people from classes that use interactive multimedia while classes that do not use interactive multimedia are five people and for C5 questions (Evaluating) as many as five people from the number of participants students who are in classes that use interactive multimedia and classes that do not use interactive multimedia are two students, and C6 (Creating) questions no students can create. This proves that with the achievement of the number of learners who answer correctly according to the cognitive level of C1 to C6, it is stated that classes taught using interactive multimedia have a higher level of ability than classes taught with conventional models.
2. Inferential Statistical Analysis

Inferential statistical analysis with t-tests was carried out to reveal the effectiveness of multimedia interaction in learning biology, especially Digestive System material. The results of inferential statistical analysis are intended to answer the research hypothesis formulated previously. Inferential statistical analysis using the help of the IBM SPSS Statistical 26. Before conducting Inferential Statistical Analysis, normality and homogeneity test is first carried out as a condition for conducting a t-test.

a. Normality Test

Normality test results are obtained from post-test scores. In learning the biology of the Digestive System material in the experimental class. The data was then processed using the IBM SPSS Statistic 26 program with the Kolmogorov-Smirnov formula. The requirement for normally distributed data is if the P value obtained from the calculation is greater than the significant result of 5% (0.05), and the data is not normally distributed if the P value obtained is smaller than 5% (0.05).

b. Homogeneity Test

The homogeneity test results were obtained from the posttest scores of the experimental class and the posttest of the biology learning control class. The data is then processed using the IBM SPSS Statistics 26 program.

Based on the calculations and number processing results carried out with the IBM SPSS Statistical 26 program, values based on an average of 0.17 > 0.05 can be concluded that the two data groups have homogeneous variants.

c. Hypothesis Test

For hypothesis, interference statistics are used with the help of IBM SPSS Statistic 26, t-test statistics. In this case, an independent test of the t-test sample with testing criteria if the hypothesis H 0 is accepted, and H1 is rejected if the value of t counts < t table. This means that there is no difference between the two treatments given. In contrast, the hypothetical H 0 is rejected, and H1 is accepted if the t value is calculated > ttable, This means that the biology learning outcomes of students taught with multimedia are better than the biology learning outcomes using multimedia because students understand more about learning using multimedia and are more focused on the material conveyed by the teacher.

In general, multimedia research is effective in learning biology, as evidenced by the results of the numbers obtained, namely H0 rejected and H1 accepted. This means there are differences in the ability of biology learning outcomes using interactive multimedia and
without multimedia. So, interactive multimedia has proven effective in learning biology in class XI students at senior high school.

Based on the hypothesis test results, interactive multimedia's influence on cognitive learning outcomes in the experimental group and the digestive system material control group at senior high school, where a significance value of 0.000 < 0.05 was obtained. It means that H₀ was rejected and H₁ was accepted, so it can be concluded that there is an interactive multimedia influence on the cognitive learning outcomes of class XI MIPA students of the digestive system material at senior high school.

Based on the results of the independent t-test sample that has been processed, a significant value of 0.000 is smaller than 0.05, which means that H₀ is rejected and H₁ is received, so it can be said that there is an interactive multimedia influence on the cognitive learning outcomes of students of the digestive system material at senior high school. One of the reasons lies in the value of knowledge carried out in research in classes that use interactive multimedia, which has several opportunities for researchers to see the pace of learning speed of students.

The results of this study align with research that Rasnawati et al. (2019) that students' biology learning abilities after the learning process can increase, both students who are taught using multimedia and students who are taught without multimedia. This is in line with what was said by Triyanti (2015), who stated that there was an increase in student learning outcomes after using interactive multimedia. Therefore, this research is also in line with that of Wilsa (2019), which states that using Interactive Multimedia can improve student learning outcomes so that students are more enthusiastic about learning. Meanwhile, Ratini (2011) states that learning biology using interactive multimedia can increase student activity and learning outcomes.

One of the activities of students who use interactive multimedia encourages those in the classroom, in terms of publication in Articulate Storyline 3, which is in the form of web-based media (html5) or application files (.exe) that can be run on various devices such as laptops, tablets, and smartphones. Articulate Storyline 3 to provide motivation and convenience in the teaching and learning process in the material of the human digestive system. Therefore, the average score that students can achieve in classes that use interactive multimedia is 81.80 ± 77.22, and the average score that students can achieve in the control class is 56.40 ± 44.01.

This thought process has a lot to do with the use of information management abilities in cognitive knowledge and the application of strategy knowledge and knowledge to oneself in revealing information to others. This proves that with the achievement of the number of
students who answer correctly according to the level of cognitive levels C1 to C6, which is stated that classes taught using interactive multimedia have a higher level of ability compared to classes taught with conventional models. So, students can understand the learning that has been given.

The low learning outcomes of students in classes that do not use interactive multimedia are due to the learning process that uses conventional methods that do not spur students to be actively involved in learning; teacher-centered learning is less effective in making students understand more. During the learning process, the learner is more silent; there is no effort to seek knowledge on his own through the teaching materials he has, such as package books. Learners are more fixated on what the teacher explains; there is no other knowledge they have gained besides what is explained by the teacher during the learning process. This is often the trigger for problems where the dominance of the conventional learning process causes learning that makes the classroom atmosphere tend to be teacher-centered so that students become passive. In this case, students need to be taught learning strategies to understand how to learn, think, and be active in the classroom.

CONCLUSION

Based on the results of the independent sample t-test, a significant value of 0.000 is smaller than 0.05, which means that H0 is rejected and H1 is received. There is an interactive multimedia influence on the cognitive learning outcomes of students of digestive system material at senior high school.

REFERENCES


