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Improving student cognitive learning outcomes through the development of interactive multimedia-based biology learning at Muhammadiyah University, Bengkulu

Improving student cognitive learning outcomes through the development of interactive multimedia-based biology learning at Muhammadiyah University, Bengkulu

A Topano*[1], Asiyah[1], Basinun[1], A Walid[1], Alimi[1], D Febrini[1]

[1]State Islamic Institute of Bengkulu, Indonesia

*Corresponding author: adriantopan@iainbengkulu.ac.id

Abstract. This study aimed to improve student cognitive learning outcomes through the development of interactive multimedia-based biology learning at Muhammadiyah Bengkulu University. This research was conducted in April – September 2019. This research is a 4-D (four-D) model development research. The instruments used in this study were a media validation questionnaire, a media practicality questionnaire, a cognitive ability test. Based on the results of data analysis obtained from the results of media validation, it was stated that the media developed was valid by the validator with a mean score of 78.88% and the media practicality questionnaire results were also stated to be very practical with an average score of 86.28% while for student cognitive learning outcomes are normally distributed and homogeneous, where the data obtained during the pre-test for small classes the average score is 70.00% and for the post-test score is 81.78%, while at the time of large class trials the pre-test score was 46.18% and the post-test score was 83.00%. From these data, it shows that there is a significant difference in the average value between the acquisition of pre-test and post-test scores both during small class trials and large class trials. Where the average score of student scores has increased after using interactive multimedia-based learning media (post-test). So that this learning media is very effective to use as learning materials to improve student cognitive learning outcomes.
Keyword: Teaching Material, Biology Learning Media, Interactive Multimedia, 4-D model, Learning Outcomes

Introduction

Education is the main means of forming the nation's next generation. The more advanced the quality of education, the more advanced the country is [1]. The low quality of education in the lecture process, especially seen in student learning outcomes, is currently not well resolved. For this reason, it is necessary to improve the learning process in lectures so that the quality of education also increases, one of which is through learning media that is applied in universities. [2].

The quality learning process must be supported by the learning media presented by the lecturer to the students, because students often have difficulty understanding the learning material presented by the lecturer conventionally, because the information obtained is less real and is limited to memorizing words only so that students are not motivated to learn. This situation occurs because there are still many lecturers who teach have not maximized the use of learning media in the lecture process in the classroom. Therefore, it is necessary to develop good learning media so that they can be used in the learning process.

Good learning media is media that can increase student activity and learning outcomes, is practical and easy to use, stimulates and attracts student attention, and has the ability to provide feedback, feedback including encouraging students to practice learning properly. [3]. Previous research has added that learning media can represent what lecturers cannot express through words and can stimulate students' thoughts, feelings, and willingness so that they can encourage the learning process in themselves [4].

The existing learning media can be a more interesting learning resource when combined with digital computer capabilities to manage information and carry out various activities in the teaching and learning process in lectures. Where lecturers are directly involved in using technology to provide material to be delivered to students. This is in accordance with the opinion of [5] which states that creative use of media will allow students to learn better and students can independently understand certain materials that seem abstract and can improve their performance in accordance with the goals to be achieved

In the Animal Physiology course, the subject of "Digestive System," the material is quite difficult to understand if learning is carried out only through pictures in textbooks or the delivery of words by lecturers through power points, it makes students bored and shows no interest in learn. For this reason, accuracy is needed in choosing the learning media to be used. According to [6,7] he selection of learning media must be appropriate so that it can attract students' attention in learning and can provide clarity of the material being studied. Because the proper use of learning media is important in the learning process, because the media has various advantages, including making abstract and complex concepts into something real, simple, systematic and clear.

In addition, there are also differences in abilities among students in understanding the material being taught. There are students who understand, there are students who don't understand and there are also students who find it difficult to understand the material [8].

Based on the preliminary observations made, the authors get information from the lecturer who teaches the course that the teaching and learning process that occurs in this course has used power point media in the learning process in the classroom but the benefits of using power point media itself are still less effective and efficient in improving student cognitive learning outcomes.

This is of course evidenced by the low student learning outcomes in the animal physiology course in the Biology education study program for the 2017/2018 school year, which is known from the total number of students consisting of 76 students consisting of three classes, namely classes a, b and c. 42.1% of students get a C grade, 36.8% of students get a B grade, and 19.7% of students get an A grade even 1.3% of students get an E.

So, from these data it can be concluded that the use of power point media used in the learning process in the classroom so far has not had a significant impact on student learning outcomes, this is of course proven that almost half of the total number of students still get a C grade, all of that. This is because the power point media used so far are not very interactive, so they are still very difficult to understand the learning material delivered by lecturers who teach the subject, which of course affects student learning outcomes.

Therefore, to overcome students' difficulties in understanding the material and improve student cognitive learning outcomes, lecturers need to create interactive learning media and able to convey messages and display the material in its entirety according to the learning objectives. The learning media that is considered appropriate is interactive multimedia because this media is very interesting and makes it easy for students to understand the material because of its interactive presentation [9].

Based on research conducted by [10] it is stated that interactive multimedia-based learning media is included in the valid category. The effectiveness of the media was achieved, based on the results of student responses, 91.6% gave a positive response to multimedia-based learning media. In addition, student learning outcomes showed 92% or ≥ 80% of 37 students, fulfilling their learning completeness and also this media was categorized as practical because the value of media validation reached 3.7 and was on a scale of $3 \leq RTV \leq 4$ = valid.

The same research was done by [11] which concludes that interactive multimedia is valid and qualified to be used as media with 3.55 RTVTK. In turn, students' responses through interactive multimedia are very positive with an average presentation of 84.15%.

According to previous research interactive multimedia can be used as an attractive learning medium in the classroom because its appearance uses moving images such as video and animation as well as sound that is displayed with images and text so that it is hoped that student activity and learning outcomes will be better [12].

Meanwhile, according to previous research interactive multimedia-based learning is a learning activity that uses computers to create and combine integrated text, images, video, animation and sound, which is equipped with a controller that can be operated by the user, so that user (lecturer) can choose what he wants for the next process [13].

Interactive multimedia has several features that other media do not have, including: (a) interactive by providing easy feedback (b) freedom to determine learning topics and (c) systematic control in the learning process [14].

For this reason, in the teaching and learning process, especially in the animal physiology course, the subject of the digestive system, it is necessary to develop better learning media than the learning media that have been used so far on the basis of the assumption that interactive multimedia in the learning process will be able to increase student learning outcomes, more interesting, motivated, and makes it easy for students to understand the material because the learning presented is more interactive, scientific, so that it can be implemented and displayed in the classroom like a real form in everyday life.

Based on the description, a research was conducted with the title "Improving student cognitive learning outcomes through development of biology learning media based on interactive multimedia at Muhammadiyah University, Bengkulu".

2. Research Method

This research was conducted in April – September 2019 in the biology education study program of the Teaching and Education Faculty of Muhammadiyah Bengkulu University, in semester 6 consisting of 3 classes with the number of students is 95 people Animal Physiology courses for the 2019/2020 academic year.

This type of research is research and development with products in the form of interactive multimedia-based biology learning media, this media designed using the help of Adobe Flash CS 6 software program. This development research adopts a 4 - D (four - D) development model consisting of 4 stages, those are: define, design, develop, and disseminate. The steps in this research and development are shown in the following figure:

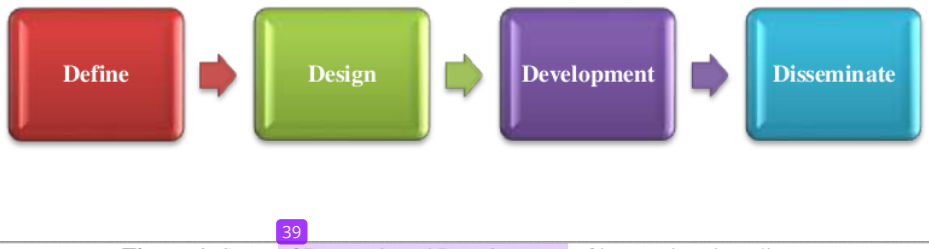

Figure 1. Steps of Research and Development of instructional media.

The instruments used in this study are interactive multimedia learning media validation sheet, media practicality, pre-test and post-test sheet and observer sheet. Data analysis techniques use the prerequisite test of normality and homogeneity while hypothetical testing uses the formula t (test).

3. Result and Discussion

3.1. Description of the Results of the Development of Interactive Multimedia-Based Biology Learning Media

This research is to produce a product in the form of a learning program about the digestive system that is valid and practical and can improve cognitive learning outcomes in semester VI A, VI B, and VI C semester students at Muhammadiyah Bengkulu University.

3.1.1. Define.

This stage is the existence of thinking about determining and defining the needs that exist in the learning process in accordance with the rules or regulations that apply in the curriculum with the following steps:

Problem analysis, Problem analysis aims to raise and determine the basic problems faced by lecturers and students in learning. Through this analysis it allows for more efficient learning alternatives. With the existence of learning alternatives, appropriate learning media are compiled.

Student analysis, Student analysis aims to identify learning targets, namely students which include academic ability, learning motivation, student understanding, creativity, and age of students. Identification makes it easier for writers to design learning media so that they are suitable for use by students.

Task analysis, Task analysis aims to identify and analyze the abilities that must be mastered through determining the content in the learning unit in accordance with the KKNI curriculum. This analysis is in the form of an analysis of Core Competencies (KI), Basic Competencies (KD), and indicators.

Concept analysis, Concept analysis is the identification of the main concepts in the material to be discussed.

Analysis of learning objectives, Analysis of learning objectives is the stage of converting the results of task analysis and concept analysis into learning objectives. This analysis is used to make learning media that will be developed.

3.1.2. Design.

This stage aims to design an effective interactive multimedia-based biology learning media. The instructional media design stage is carried out by choosing a good and correct learning media format. The steps used at this design stage, namely: designing the material items, preparing the material manuscripts, compiling instruments in the form of questionnaires/questionnaires or making questionnaire lattices, making media storyboards and collecting materials in media development.

3.1.3. Learning Media Product Development.

learning media in the form of a program application containing material on the digestive system in animals using the Adobe Flash CS 6 software program. The description of the development of instructional media consists of 3 parts, namely: the pre-introduction section, the introduction, and the content section.

Pre-introduction section, the front page of the program contains the title of the material, image or animation and instructions for using the program

Introduction section, the introductory section includes the author's profile, competency standards, basic competence, learning objectives and learning materials tailored to the subject being studied.

Content section, the content section consists of learning materials that combine explanations with pictures and videos and sounds that are packaged into one unit, learning activities, discussion questions and evaluation questions. The following is a picture of interactive learning media.

Figure 2. Front view of interactive multimedia learning media.

Figure 3. Main Menu Display

Figure 4. Display Learning Materials

Figure 5. Display of Student Discussion Questions

3.2. Analysis of Result

3.2.1. Validation. The validation results from the material expert validators on the interactive multimedia-based biology learning media were 83.75%, while the validation results from the media expert validators were 74%. So that from the results of the validator referring to the conversion table, it can be concluded that the developed biology learning media is suitable for use or can be tested on students in the learning process. here's advice and enter validator:

Table 1. Advice and enter validator

Validator	Suggestions and Comments
Material Expert	1. The learning material is good, it is in accordance with the SK and KD as well as the learning objectives but needs to add more discussion questions in each meeting 2. The learning media presented are good but do not provide activities for students to learn independently in the learning process.
Media Expert	1. We recommend that you create a menu home, next and back 2. Insert a flexible, interactive video

3.2.2. Practicality of Interactive Multimedia-Based Biology Learning Media. The practicality of interactive multimedia-based biology learning media is obtained from student responses to the questionnaire given after the end of learning using the learning media that has been developed.

Limited Test. The limited test was carried out on 9 students in semester VI consisting of 3 people each representing classes a, b, and c. The practicality test results can be seen below:

Table 2. Practical responses of interactive multimedia-based biology learning media

Class	Student Acquisition Score			Average	Practicality category
	1	2	3		
VI A	85,0	76,7	88,3	83,3	SB
VI B	93,3	85,0	88,3	88,9	SB
VI C	96,7	88,3	88,3	91,1	SB
Average percentage				87,8 %	
Criteria				SB/SP	

Based on the data above, it is known that student responses after the implementation of learning can be categorized as very good, with an average percentage of 87.8% so that interactive multimedia is very practical to use in the learning process in class.

Area Test. The broad test is the final stage and is carried out after the product has been developed. The stage is tested on all students who take Animal Physiology courses. The results of the full implementation stage can be seen in the following table:

Table 3. Practical response of interactive multimedia-based biology learning media

Class	Score Results of the questionnaire	Total	Practicality category
VI A	83,53	254,28	SB
VI B	84,51		
VI C	86,24		
Average percentage		84,76 %	
Criteria		SB/SP	

Based on the data above, it is known that the student's response to the implementation of learning on the broad test can also be categorized as very good, namely with a percentage of 84.76%, thus indicating that the biology learning media developed is declared very practical or suitable for use in the learning process in class.

3.2.3. The effectiveness of interactive multimedia as a media for learning biology. The effectiveness of interactive multimedia as a media for learning biology at the Muhammadiyah University of Bengkulu can be seen from the increase in student cognitive learning outcomes.

Student Cognitive Learning Outcomes. Analysis of students' cognitive abilities was carried out by giving pre-test and post-test questions to 6th semester students consisting of 3 classes, namely VI A, VI B and VI. The results of the student's pretest and posttest analysis can be seen in the table below:

Limited Test. This limited test was carried out on 9 students who were representatives of each class of semester VI of the biology education study program.

Table 4. Limited Test of Student Cognitive Learning Outcomes

	N	Min	Max	Mean	Std. Deviation
Pre-test VI A	3	60	75	66,67	7,638
Post-test VI A	3	75	80	76,67	2,887
Pre-test VI B	3	65	80	73,33	7,638
Post-test VI B	3	85	90	86,67	2,887
Pre-test VI C	3	65	80	70,00	8,660
Post-test VI C	3	76	90	82,00	7,211
Valid N	3				

From the table above it can be seen that the pre-test average score of the three classes is 70.00 while the post-test score is 81.78 on the average, it can be concluded that there is an increase in students' cognitive abilities from learning outcomes before and after learning. conducted with multimedia-based biology learning media.

Extensive Test. Data retrieval on student cognitive abilities in the broad test was carried out on all 6th semester students of the biology education study program.

Table 5. Broad Test of Student Cognitive Learning Outcomes

	N	Min	Max	Mean	Std. Deviation
Pre-test VI A	34	20	80	46,18	14,113
Post-test VI A	34	73	94	83,00	5,051
Pre-test VI B	30	24	80	48,53	14,966
Post-test VI B	30	74	90	82,27	4,510
Pre-test VI C	31	20	75	49,52	15,097
Post-test VI C	31	72	90	81,32	5,049
Valid N	30				

From the table above, it can be seen that the pre-test average value of the students 'cognitive ability rning outcomes from the three classes is 48.08, while for the post-test score with an average of 82.20 it can be concluded that there is an increase in students' cognitive abilities. From the learning outcomes before and after learning is carried out using multimedia-based biology learning media.

3.3. Discussion of Research Results.

3.3.1. Validity Data Analysis. The development of interactive multimedia-based learning media in its manufacture uses the Adobe Flash CS6 software program, where this program has been carried out a series of validations by the validator as well as small and large group trials. All of these series aim to obtain data that is used as reference material as input and improvement in order to achieve appropriate and useful learning media to use [15].

From the results of data analysis obtained from the validators including material experts and media experts, it shows that this interactive multimedia-based biology learning media gets an overall score with an average of 78, 88%. So that from the data validation results based on the validity criteria according to Nur'aini, Chamisijatin, & Nurwidodo the developed interactive multimedia-based biology learning media can be categorized as valid for use in learning [16].

This is in accordance with the statement of [17] which states that the development of learning media is considered valid if the overall assessment of learning media reaches the criteria for an achievement level of at least 75%. Riani, Hindun, & Budiyanto added that if the data is valid, it means that the existing program in interactive multimedia is correct and correct so that it is suitable for use [18].

According to Rasyid, Azis, & Saleh, the advantages of using interactive multimedia in learning include the following: (1) a more innovative and interactive learning system. (2) teachers will always be required to be creative and inovative in finding learning breakthroughs. (3) increase student motivation during the teaching and learning process to obtain the desired learning objectives. (4) able to visualize material that has been difficult to explain. (5) train learners to be more independent in gaining knowledge [4].

This is also supported by Surachn, Muntari, & Savalas, (2014) which states that all components presented in interactive multimedia-based learning media are suitable for use in the process [19]. Teaching and learning both in terms of design/structure and in terms of language. Meanwhile, according to Dewi, Jampel, & Gede stated that if it is seen from the three components of the feasibility of the media, namely (1) components of the quality of content a objectives, (2) components of instructional quality, and (3) components of technical quality [20], it can be concluded that the learning media Interactive multimedia-based biology is appropriate for use as an alternative in the learning process in the classroom.

3.3.2. *Practical data analysis*. Student responses are used to determine student assessments of the products being developed. From the results of student responses during the limited trial, it was obtained a mean score of 87.8%, while for student responses to the broad test the score was obtained with a mean of 84.76%.

Based on the student response data above, if consulted according to the criteria of Wardani, Mudzalipah, & Hidayat, (2013) and Syahputra, Hasruddin, & Djulia, (2015) stated about the feasibility of interpreting the media where if ≥ 81% it is classified as very practical to use in learning besides that student's response to interactive multimedia-based learning media is good and positive [5,15]. So based on the above statement it can be concluded that the developed interactive multimedia-based biology learning media is very practical to use in the learning process.

According to Yudasmara & Purnami [22] the practicality of learning media is due to the fact that students easily use learning media according to the situation and condition of students. In addition, learning using interactive multimedia-based media makes delivering information faster and easier, and can make it easier for students to obtain information. which is effective and attracts students to study Biology material presented by the lecturer.

In addition, students find it easier to understand and remember material and are able to find concepts on their own because users can interact intensively with the content or content contained in an interactive multimedia program [23].

3.3.3. *Effectiveness of Interactive Multimedia-Based Learning Media*. The effectiveness of interactive multimedia based biology learning media is known from the improvement of the results of students' cognitive abilities through the tests given.

In this study, data on student cognitive ability learning outcomes were obtained from the test results given before and after learning was carried out using interactive multimedia. The test given aims to determine the effect of media on student cognitive learning outcomes, so that the quality and effectiveness of the media learning developed can be known.

Based on the test conducted, the results obtained during the pre-test for the small class with a mean score of 70.00% and for the post-test score of 81.78%, while during the large class trial the pre-test score was 46.18% and the post-test score is 00%.

From these data, the acquisition of pre-test and post-test scores shows that there is an increase in the average score of students before using the media (pretest) and an increase after using the media (post-test) which means the use of interactive multimedia-based biology learning media which used to affect student cognitive learning outcomes. This is supported by the opinion of Chumaidi, Sulton, & Sulthoni [9] that if the overall post-test average score is more than 70%, then interactive multimedia that is developed is effectively used in learning, this is because interactive multimedia can make it easier for students to master the lesson and ultimately the learning outcomes increase.

According to Mulyati et al. and Yudasmara & Purnama [15,16], the reasons for the use of interactive multimedia-based biology learning media can improve student learning outcomes including: (1) students quickly absorb information and knowledge from the material presented, (2) images, videos, and animation in media are more attractive than text, (3) interactive, and (4) oriented towards problem solving.

Meanwhile, according to [14] interactive multimedia has several features that other media do not have, including: (a) interactive by providing easy feedback (b) freedom to determine learning topics and (c) systematic control in the learning process.

Interactive multimedia is a combination of text, sound, graphics, images, animation, and video that is delivered by computer and can be controlled interactively. So that the learning material will be clearer and easier to understand because this media uses many senses used by students to receive and manage the information conveyed by the lecturer.

This is in accordance with the opinion of Nurlatipah, Juanda, & Maryuningsih, which states that the more senses students use to receive and manage the subject matter delivered by the lecturer, the greater the possibility that the subject matter can be understood by students [3]. [25] added that through this

interactive multimedia, concepts abstract can be presented more realistically in the learning process so that it makes it easier for students to understand it because the more senses students use in learning, the better the student's retention / memory.

[26] stated that with interactive multimedia students would be more motivated follow lessons so that their understanding of the subject matter will increase and learning outcomes will increase.

4. Conclusion

The interactive multimedia based biology learning media developed can be categorized as valid by the validator with a 78.88% rate of the average. Based on the results of student responses, the developed interactive multimedia based biology learning media can be said to be very practical with the average score of 86.28%. Interactive multimedia-based biology learning media in Animal Physiology courses with digestive system material in animals can improve student cognitive learning outcomes.

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