



Development of interactive multimedia in improving the ability to think logically in cell concepts



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ABSTRACT

This research is motivated by educators who do not optimize learning media in teaching biology in high school, so this will have an impact on students' thinking skills at a concrete level. This study aims to develop learning and the application of multimedia to improve students' thinking power. This study uses the Borg and Gall development model through the stages of research and information gathering, planning, initial product development, initial field trials, main product revisions, main field trials, product revision operations, operational field trials, final product revisions, outreach, and implementation. Follow-up research combined with quasi-experimental research. This multimedia validation involves media experts, content experts, and linguists as well as students. The research instrument used was in the form of multiple-choice questions. The development results have been assessed by expert judgment. The developed multimedia learning can be used well at the high school level in Class XI IPA and is classified as very good. The results obtained for improving students' thinking skills in biology learning can be used in the learning process by obtaining the results of increasing students' thinking skills.

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INTRODUCTION

The process of learning biology in the classroom, especially abstract concepts, often causes problems due to the low logical thinking skills of high school students. The concept of a cell is difficult to observe easily observed without the help of media directly, because of its very small size,



then inside there are cell organelles that are smaller than the cell itself. Logical thinking skills are skills that need to be developed from the elementary school level to the tertiary level. Not only in learning science, but also in other fields that need to be developed (Yaman, 2005). This is necessary to achieve the goals of learning, so that technological assistance is needed to convey a concept to students (Mahnun, 2012).

Abstract learning concepts will be easier to understand using multimedia compared to conventional learning, the use of multimedia optimizes audio and visual assisted learning from the multimedia. Theoretically, technology can help students master concepts in the learning process. Hajar & Aini (2010) argued that computer-based learning guides students in improving skills or strengthening mastery of concepts and communication. Learning media is one of the factors that support success during the teaching and learning process (Yanti, 2017). other opinions also reveal that Learning Media is one of the important things in achieving learning goals (Manjale, 2017).

The concept of a cell is not easy to observe directly because of its relatively very small size, in which there are cell organelles that are smaller in size compared to the cell itself. This situation makes cell concepts abstract in nature which are difficult to explain and understand so that it has an impact on students' mastery of concepts. In fact The results of preliminary observations using the instrument test of logical thinking (ToLT) (Tobin and Capie, 1980, in Valanides, 1996) show that the intellectual development of most students is still at the concrete operational level of 54.48% in one of the city's public high schools. Bandung, which means that there are still many students who have logical thinking skills at a concrete level. Indirectly someone who has logical thinking skills will be able to interpret an image, both two-dimensional (2D) into three-dimensional (3D) and even 4-dimensional (4D), so that it will be easy to master and improve mastery of abstract concepts (Hardin, 2008). referring to the research that has been done, the development of multimedia with the concept of cells supported by students' logical thinking abilities has never been done, so the development of this research is a new thing in explaining the concept of cells. Mastery of abstract concepts requires the ability to think logically. Based on this, one of the efforts to improve students' logical thinking skills is by developing multimedia. Therefore, it is necessary to develop interactive multimedia in improving the ability to think logically on cell concepts.

RESEARCH METHODS

Research Design

The research design conducted in this study uses Research and Development (R&D). Research and Development, is the concept chosen to be used to produce a product and to be able to test the effectiveness of the product (Sugiyono, 2008). Research and development is a research model that can be used to develop products used in education during the learning process (Wibisono, 2017). There are several models in multimedia development, including: Hannafin and Peack models, Decide, Design, Develop, evaluate (DDD-E) Model where according to Azizah & Sumarno (2012) the use of the DDD-E model in the development stage has 4 steps. Bergman and Moore's model, where according to Tegeh et al., (2014) there are six steps, namely (1) analysis, (2) design, (3) develop, (4) produce, (5) combine, and (6) validation. Each step has three parts namely input, output and evaluation. Dick and Carey Model, this model is used mostly by learning and training designers. There are ten steps that must be carried out starting from development to becoming the desired product in the development process. (Aji, (2016), ADDIE model, according to Safitri et al., (2015) there are five steps to the development process, namely (1) analysis, (2) design, (3) development, (4) implementation, and (5) evaluation (evaluation).

Development used Borg and Gall model. the use of this model is based on the suitability of developed media, where this model has very detailed steps by having 10 development steps,



including : Research and information collecting, Planning Develop preliminary form of product, Preliminary field testing, Main product revision, Main field testing, Operational product revision, Operational field testing, 8). Final product revision, Dissemination and Implementation.

Population and Samples

The population used was all high school students in the Science class of 224 students and Social Sciences of 212 students in one of the public high schools in Bandung. The sample used was all science class students as many as 224 students at one of the Bandung State Senior High Schools by using purposive sampling technique. The choice of this technique is because the sample used has criteria that have been specifically determined by the researcher, then the sample used has the same characteristics in the population.

Instruments

The measure students' logical thinking skills, instruments are used by adopting existing instruments using the Test of Logical Thinking. According to Valanides (1996), items on the test of logical thinking ability (TOLT) were used to obtain quantitative data in the form of the level of reasoning of the research subjects before and after treatment.

The research instrument uses the Test of Logical Thinking (TOLT), which was originally developed by Tobin and Capie (1981), used in the ability of students' formal reasoning levels. The psychometric characteristics of ToLT have actually been well documented by the developers. This instrument consists of 10 items designed to measure the level of reasoning of students (items 1 and 2) to show the level of proportional reasoning, (items 3 and 4), indicate the level of reasoning controlling variables, (items 5 and 6) indicate the level of reasoning probability, (items 7 and 8), indicates the level of correlational reasoning and the level of combinational reasoning is indicated by (items 9 and 10). Examples of instruments used are as follows:

A series of eight problem is presented. Each problem will lead to a question. Record the answer you have chosen and reason for selecting that answer.

I. Orange Juice#1

Four large oranges are squeezed to make six glasses of juice. How much juice can be made from six orange?

- a. 7 glasses
- b. 8 glasses
- c. 9 glasses
- d. 10 glasses
- e. Other

Reason

1. The number of glasses compared to the number of oranges will always be in the ratio 3 to 2
2. With more oranges the difference will be less
3. The difference in the number will always be two
4. With four orange the difference was 2. With six orange the difference would be two more
5. There is no way of predicting.

Procedures

Common steps in the R & D (Research and Development) cycle or research and development with the Borg and Gall model (Borg & Gall, 2003). Research and information collecting. This stage is carried out at the beginning to find out the needs needed in the learning

process. Planning. This step is making learning media scenarios that will be developed, as well as making modules and story boards. Develop preliminary form of product. This stage is the stage in developing an evaluation tool or research instrument. Preliminary field testing, This stage is the stage for testing media developed on preliminary field testing, main product revision, This stage is the stage for revising the results preliminary field testing, main field testing, This stage is the main testing stage of the results of product revisions that have been developed, operational product revision, This stage is a revision of the results of the main test conducted by involving several experts. Operational field testing, This step is carried out to retrieve data from the results of the media that have been developed, final product revision, This stage is the final revision of the input results at the stage operational field testing, dissemination and implementation. This stage is the implementation stage in the learning process in class and the dissemination of the media that has been developed.

Data Analysis

The data analysis technique uses descriptive qualitative statistical analysis. Where the data obtained is developed in the form of a narrative, then supported by pre-existing theories. From the results of the data that has been obtained then distributed in a table which describes the transitional form of logical thinking skills to the cell concept which illustrates the relationship between the developed media and students' logical thinking skills.

RESULTS

There are 2 research results in developing a multimedia to improve students' logical thinking skills.

I. Development Research

The result of this development is learning multimedia in which it discusses the cell concept. This software development was built with Adobe Flash. This multimedia can only be used with a laptop or computer.



Figure I. Main Menu

The main menu display of the developed media is visible on the main screen when the multimedia application is opened (Figure I). The display has a cell sentence which indicates the material being opened is material about cells.



Figure 2. Main Course

The appearance of the course is to explain the contents of the sections that will be explained in the media that have been developed which these features can be used by students in carrying out the learning process such as learning objectives, then material related to the cell itself. The menu course can be seen in Figure 2.



Figure 3. Introductory view

This display is an introductory display that leads students to the learning process, in this view students will be reminded again of materials related to the cell concept, so that students know in general that the cell concept will relate to previous concepts that have been discussed. The introductory view can be seen in Figure 3.

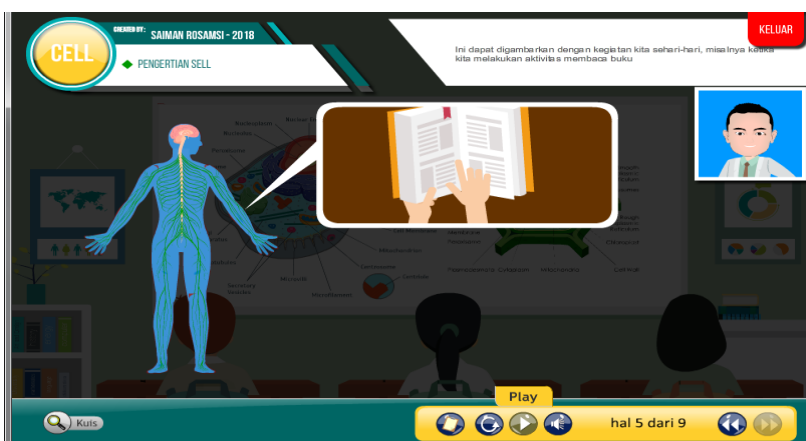


Figure 4. Cell meaning

This display explains the theoretical meaning of cells which is explained using analogies such as moving pictures and videos, so that students' understanding becomes logical. The cell meaning view can be seen in Figure 4.



Figure 5. History of cell development

This display explains the history of cell development from year to year by displaying pictures and explanations of each history of the development of theories about these cells. The history of cell development view can be seen in Figure 5.



Figure 6. Structure and Function of Cell Organelles

This display explains the structure and function of each cell organelle found in animal cells and plant cells (Figure 6). The appearance of cell organelles is analogous to pictures that resemble the pictures of the cells themselves so that students can easily understand them.

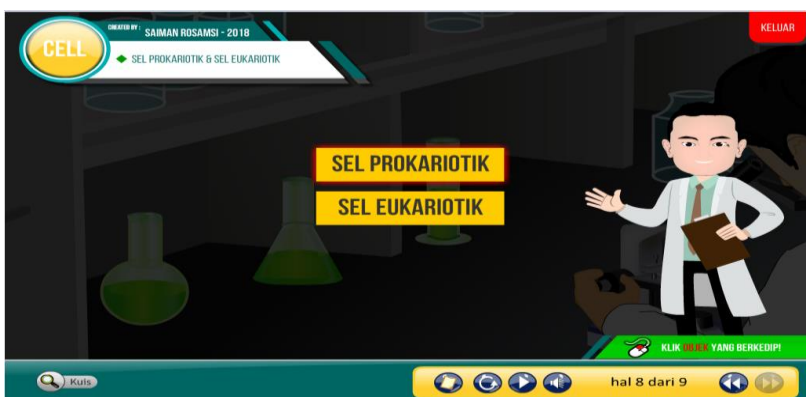


Figure 7. Prokaryotic and Eukaryotic

This view explains the difference between prokaryotic cells and eukaryotic cells (Figure 7). In this view, two displays are given so that you can choose one of the two options, which one will be studied first.



Figure 8. Substance Transportation

This display explains the various types of substance transportation (Figure 8), and how to transport them, at this stage a video is added to make it easier to understand how the process of transporting these substances. Multimedia has been tested using several experts including Media expert test, linguist test, and content expert test. then the results obtained from the expert test are presented in the following table. The final results obtained after making revisions are presented in the following Table I.

Table I. Results of Expert Judgment

Judgment Expert	Percentase	Qualification	Information
Media	78%	Good	Not revised/Valid
Content	93 %	Very good	Not revised/Valid
Linguist	86 %	Very good	Not revised/Valid
average	85%	Very good	Not revised/Valid

The product has been assessed by expert judgment and declared feasible to be applied in class XI SMA IPA on the cell concept.

2. Logical thinking skills test results

Data from research on the development of multimedia in improving students' logical thinking skills, the following data results are obtained presented in the following Table 2.

Table 2. Comparison of the Number of Pre-Test and Post-Test Students in the Ability to Think Logically in the Experimental Class and the Control Class

ToLT indicator/ Levels	Number of Students			
	Experiment Class		Control Class	
	Pretest	Postest	Pretest	Postest
Concrete	47	11	49	38
Transitional	46	49	38	37
Formal	19	52	25	37
Jumlah	112	112	112	112

From these data, it can be seen that there is a change indicating an increase from before the test was carried out and after the test was carried out which was seen in the experimental class where the number of students who had concrete logical thinking skills at the time before the test was more than after the test, this indicates an increase. the number of students who have logical thinking skills after learning using multimedia that has been developed.

DISCUSSION

From the results of the multimedia development that has been implemented, it is found that the multimedia can be used in order to improve the ability to think logically. This is because in the development of multimedia it can involve several senses so that the information obtained by students can be optimal, as we know that multimedia learning is a means of transmitting or conveying messages and in a teaching and learning perspective sending subject matter content to students, to achieve learning objectives (Omeng, 2016). So that the message that will be conveyed in the multimedia can reach students because it uses several of the five senses involved.

In addition to the many five senses involved, the use of writing in multimedia contributes to the success of multimedia development, so that the information obtained is more clearly received. In line with this, Netriwati (2015) said that "Your writing and the use of your spoken language helps students to learn" thus the multimedia that is developed is made in such a way as to attract the attention of students. Another opinion was conveyed by Ridwan (2017) who said that, increasing students' mastery of concepts using multimedia in the learning process is related to the characteristics and characteristics of the multimedia, the multimedia can contain audio and visual components so that the process involves a lot of interactivity. This can manipulate the theory conveyed in an image.

Media developed using flash makes students more curious because the multimedia design developed makes very abstract material about cells more real. This is in line with the opinion put forward that good multimedia is multimedia that can increase students' curiosity as a motivational supporting factor (Priyambodo, 2012). This multimedia is equipped with supporting buttons to make it easier for students to decide for themselves which part to learn. So that these activities can encourage students to learn independently (Munir, 2015). Likewise, the use of developed multimedia can support the process of changing knowledge in learning abstract concepts (Moraes & Pereira).

Similar to what was stated by Naz (2008). Says that learning using multimedia keeps information longer in the minds of students, and makes the learning process more meaningful. (Ridwan, 2018). One of the causes of increasing students' logical thinking skills using multimedia is the presentation of exercises to answer questions about the cell concept, the presentation of the questions is displayed in the form of questions that can trigger students to think logically.

Changes in a person's level of logical thinking are inseparable from how the brain works. Saputro (2017), said that any information in the learning process will enter the brain through stimulation of the sensory system and be passed on through the nervous system and will be processed in the brain. The use of multimedia is one of the efforts to optimize brain work in improving students' logical thinking skills, because its use involves the five senses.

CONCLUSION

Based on the results of the development that has been carried out, it can be concluded that the multimedia developed through the 10 stages of Borg and Gall can be said that the multimedia is feasible to be applied in the biology learning process in the cell concept of class XI IPA in improving students' logical thinking skills. The implication of this research is that students' understanding can be increased by using the developed learning multimedia, this is supported by

the increased level of students' logical thinking skills which will have an impact on understanding the concept of cells.

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