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Development of Science teaching materials with visual media based on discovery learning to improve student learning outcomes at Wori Christian middle school

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Abstract
This study aims to develop science teaching materials with discovery learning-based visual media and discuss improving student learning outcomes using science teaching materials with discovery learning-based visual media on human circulatory system material. This research refers to the procedure of conducting research "Research and Development" follow the stages of floating research according to the Directorate General of Higher Education by combining the stages of Dick and Carrey. The test subjects consist of theoretical trials and empirical trials. The theoretical trials consist of learning material experts and instructional media experts in the field of Natural Sciences. The empirical trial consists of 10 students in small groups and 16 students in large groups. The instruments used were interviews, questionnaires, and learning achievement tests. The results of the validation of expert learning materials and media products were included in the excellent category with a value of 90.76% The data obtained were analyzed by using an Paired Sample t Test was found to be Sig (2-talied) <0.05, meaning that the development of teaching materials with visual media based on discovery learning was already good and feasible to be used in the implementation of learning and development of teaching materials with teaching media based on visual media Discovery learning is very good to use because it can significantly improve student learning outcomes in the material of the circulatory system in humans in class VIII.A in Wori Christian Middle School.

Keywords: Science teaching materials with visual media, based on discovery learning, learning outcomes

Introduction

One of the main factors that determines the quality of education is the teacher, in the hands of teachers it will produce quality students, academically, skills (skills), emotional maturity, moral and spiritual which will ultimately produce future generations who are ready to live with challenges in his era (Purwanti, 2014).

The selection of one of the teaching methods will influence the appropriate type of learning media, so it can be said that the main function of the learning media is as a teaching aid that also influences the climate, conditions, and learning environment that are arranged and created by the teacher, so that it will affect the success of learning (Nisa and Widodo, 2013).

Science subjects have many scientific concepts that must be mastered, so it is not easy to convey the material. Science (IPA) is not just a collection of knowledge about objects or living things, but it involves the way it works, how to think and how to solve problems. The ability of teachers to develop learning media, it is also expected that the ability of teachers to design teaching materials becomes a very important role in determining the success of learning and learning processes through a teaching material (Wahyudi *et al*, 2014). One of the elements of the lesson plan is a learning resource, teachers are expected to develop teaching materials as a learning resource. Teaching materials as learning materials because a lot of teaching materials used in learning activities, generally tend to contain only field of study information and are not well organized (I. Lestari, 2013 in Pratiwi, 2014). In the learning process, the presentation of teaching materials becomes the main competence of a teacher in designing activities and thinking abilities such as what students must master (Susilawati, 2014). According to Amri and Ahmadi (2010) in Purwanto (2015), teaching materials are all forms of materials used to assist teachers / instructors in carrying out teaching and learning activities in class.

According to West, *et al* (1991) in Sukmawati (2015), organizing teaching materials must be in accordance with the reasoning power of students. Teaching materials will be better organized if integrated with discovery learning learning models.

Discovery learning is a learning process where the teacher has to create problematic learning situations, stimulate students to find their own answers, and conduct experiments (Mubarok and Sulistyo, 2014). Discovery learning material learning model is delivered so that students are encouraged to identify what they want to know, followed by finding their own information then organizing what they know and understand in a final form. Students can organize according to the reasoning power of students.

Discovery learning model combined with visual teaching material, according to Bruner (1966) in Arsyad (2016), there are three main levels of learning mode, namely direct experience (enactive), pictorial / picture (iconic) experience, and Abstract (symbolic) experience. These three levels of experience interact with each other in an effort to gain new experiences (knowledge, skills, or attitudes). This is in line with the discovery learning model aimed at creating students who participate in learning in order to gain experience with experiments.

Visual teaching materials are very effective because in the

expert's view the comparison of the acquisition of learning outcomes through the senses of sight and sense of hearing is very prominent difference, according to Baugh (1989) in Arsyad (2016) approximately 90% of a person's learning outcomes are obtained through the senses of view, only about 5% obtained through the senses of hearing, and 5% more from the other senses. Furthermore Dale (1969) in Arsyad (2016) estimates the acquisition of learning outcomes through the senses of sight around 75%, through the sense of hearing around 13% and through the other senses around 12%.

Based on observations and interviews with science subjects in Christian junior high school, Mrs. Mouren Kantale, S. Pd, most of the science subject tests have not yet reached the KKM target of 75 (appendix 1 a) because the learning process tends to be conventional, meaning teachers still dominate the learning process, the teacher has not used the discovery learning model in learning and the teaching materials used are not yet innovative because only in the form of student support books are purchased, so the learning process becomes ineffective and unattractive.

Circulatory system in humans has abstract concepts so that students are not easy to understand, so it takes the role of teaching materials, one of which is that students are easier to learn the material. Concepts that are considered abstract in science education can be visualized into concrete concepts (Nurdin, 2009). The development of science teaching materials with visual media based on the discovery learning model developed in this development research is a product that is used to assist in carrying out science learning activities that can facilitate the needs of learners to more easily learn the material being taught so as to increase student learning outcomes.

Research Method

The Research conducted is a research development or known as the type of research "Research and Development" by following the stages of development research according to the Directorate General of Higher Education (2008) by combining the stages of the learning model according to Dick and Carrey (1990).

1. Planning

The results of the analysis are used as a reference in the compilation of science teaching materials with visual media based on discovery learning models. The contents of teaching materials describe the entire initial material to the last about the organs of the circulatory system in humans, the mechanism of the circulatory system in humans, and abnormalities / diseases of the circulatory system in humans and real problems will be loaded in teaching materials by IPA based visual media discovery learning. The stages of learning planning are:

a. Analyze the material to be displayed
b. Determine the visual teaching material used
c. Determine the practice questions
d. Place and time of research: This research will be conducted at Wori Christian Middle School, in March 2019/2020 school year.

Analyze the software that will be done to find out what software can support the development of teaching materials. The software in this research are:

a. Microsoft Power Point is a software that can load material interestingly.

Hardware analysis (Hardware), hardware analysis conducted to find out what hardware can accommodate the development of teaching materials in learning.

The hardware in this research are:

a. The laptop
b. LCD Projector
c. Flash disk

2. Exploration Study

Analysis activities are generally carried out through field studies and literature studies. Literature study by conducting a theoretical study through books and other sources of information relating to teaching materials to be developed. Field studies are conducted to obtain information about the material that will be used in the development of teaching materials such as the elaboration of the curriculum and the circumstances of how to deliver the material in the field.

3. Development of Initial Product Forms

The activity in this step is an activity of making product design that will produce the desired initial shape, which means collecting materials needed in the development of science teaching materials with visual media based on discovery learning models. At this stage also continued with validation, the next stage is the improvements made based on the results of the review by experts, as will be explained in the following figure:

4. Data Collection and Analysis Instruments

a. Data collection techniques: Observation, interview, questionnaire and test
b. Instruments: Observation format, questionnaire and written test instrument / learning outcomes.
c. Research instrument

1) Questionnaire sheet

Questionnaire sheet is a list of questions answered by respondents themselves by choosing alternative answers. The questionnaire sheets needed in this study are questionnaire responses from learning material experts, questionnaire responses of students to learning activities after using science teaching materials based on visual media. discovery learning in small and large groups.

2) Learning achievement test instruments (pretest and posstest questions) Used to measure student learning outcomes before and after product implementation.

a. Data collection technique

1) Student learning outcomes data obtained at this stage, namely the stage of field trials according to the procedure design by subject.

b. Research data analysis techniques

1) Descriptive Analysis

The data obtained in this research are quantitative data and qualitative data from the questionnaire on developing products. Qualitative data in the form of comments and product improvement suggestions from learning material experts and media experts in the field of Suti which will be described descriptively in a qualitative way to revise the products in Developed by researchers. While quantitative data in the form of assessment scores obtained from the results of a questionnaire of material experts and instructional media and analysis students' responses are used

as a reference that is adapted using a Likert scale that will be described qualitatively.
The scale used in this research development is 5 scales, namely:
a. Strongly agree (SS) score 5
b. Agree (S) score 4
c. Doubt (RG) score 3
d. Disagree (TS) score 2
e. Strongly disagree (STS) score 1

To analyze the questionnaire data, steps are taken as explained by Arikunto (2010) in a qualitative descriptive analysis as follows:
a. The first step, researchers add up the check mark in each column and then look for the percentage for each category.
b. The second step, adding up the number of check marks in each column contained a tool matrix. The number is compared with the total description of all material then look for the presentation.
c. Step three, write down the percentage in the column. Furthermore, to calculate the percentage of each subject can be written as follows (Sugiono, 2010).

$$\text{Percentage} = \frac{\text{answer} \times \text{weight of each choice}}{\text{n} \times \text{height weight}} \times 100\%$$

Information: $\sum$ = number
n = number of all questionnaire items
Information to provide meaning and decision making is used as an indicator of the success of expert learning and media validation. In the test of learning material experts and media experts, the percentage of each item is said to be successful or valid if the results vary within the range of 81% -100%, 61% -80%, or in the range 41-60% i.e. the criteria are very good, good, sufficient . The following table shows the range of percentage and criteria for the program according to (Arikunto, 2010).

Table 1: Range of Presentations and Qualitative Criteria of Programs

No	Interval (%)	Criteria
1	81-100	Very Good
2	61 -80	Good
3	41-60	Good enough
4	21-40	Less
5	0-20	Less Good

2) The results of the pretest and posttest in the prerequisite test analysis
To test normality the data will be tested using SPSS version 22.
3) The results of the pretest and post-test were analyzed by hypothesis testing
Numerical data of student learning outcomes were analyzed using t test with the help of SPSS software version 22.
For hypothesis testing, the pretest and posttest data of the experimental class will be analyzed using paired sample t-test (different test of two paired samples), which tests the average difference between two paired samples taken from the same population and normally distributed.
The criteria for testing this hypothesis are:
a) If the value of P or Prob.or Sig (significance) <value α = 0.05 then reject Ho (accept H1).
b) If the value of P or Prob. or Sig (significance) <value α = 0.05, then accept Ho (reject H1).
The statistical hypothesis in this study is:
H_0: The average learning outcomes before learning using science teaching materials with visual media based on the discovery learning model are smaller or equal to the average learning outcomes before learning.
H_1: The average learning outcomes after learning using science teaching materials with visual media based on discovery learning models is greater than the average learning outcomes before learning.

5. Validation
In the validation step there are two stages that must be considered:
a. Instructional aspects are lessons about suitable material, when incorporated into natural teaching materials with visual media based on discovery learning models.
1) Clarity of basic competencies that must be achieved in learning activities.
2) Clarity in study instructions
3) Ease to understand the material
4) Determination of the order of presentation
5) Evaluation provisions
6) Clarity of feedback and so on

b. Product aspects, used in learning activities are science teaching materials with visual media based on discovery learning models. Clarity of instructions for implementing learning activities.
1) Posts
2) The quality of the material presented
3) Image, chart, map and graphic quality.
4) Color composition
5) Quality of narratives and so on

Product validation is done through:
a. Expert Validation
This validation is carried out by experts in the product field to review the initial product.
b. Field Test

Field test is a product test on the subject of research in Wori VIII.a Christian Middle School. The design used for field testing is quasi-experimental.
Validation through field testing is done by quasi-experimental design conducted on a limited scale by using the initial product in the real situation in learning to use a trial product. Empirical data on initial product trials is information to reflect and revise products, then produce trial products that are ready to be used in actual learning. The trial product research data is information to revise the product, which then produces the final product.
This stage is an empirical test to test the validity of hypothetical products. Empirical tests or experiments carried out by experimental methods and design by subject (treatment design by subject) (Colton, 1985).
Matters that are necessary and related to the empirical test design by subject with the experimental method are explained as follows:
a. The population in this study were all students of class VIII who were enrolled in the 2019/2020 school year at Wori Christian Middle School. The sample in this study is class VIII.a, amounting to 16 people.

b. Research variable

1) The independent variable is teaching material through science teaching materials with visual media based on discovery learning models.
2) As the dependent variable is the learning outcomes of students in class VIII.a.

6. Revisions Based on Validation Results

This stage is the final stage of the product produced. The product produced at this stage is a stage that is ready to be shown to the target group. The revision was based on input from the results of the operational field trials described in the previous step.

7. Product Dissemination

This stage is a step to report the products produced at scientific meetings or scientific journals.

Results and discussion

The front cover of the product can be seen in the image below:

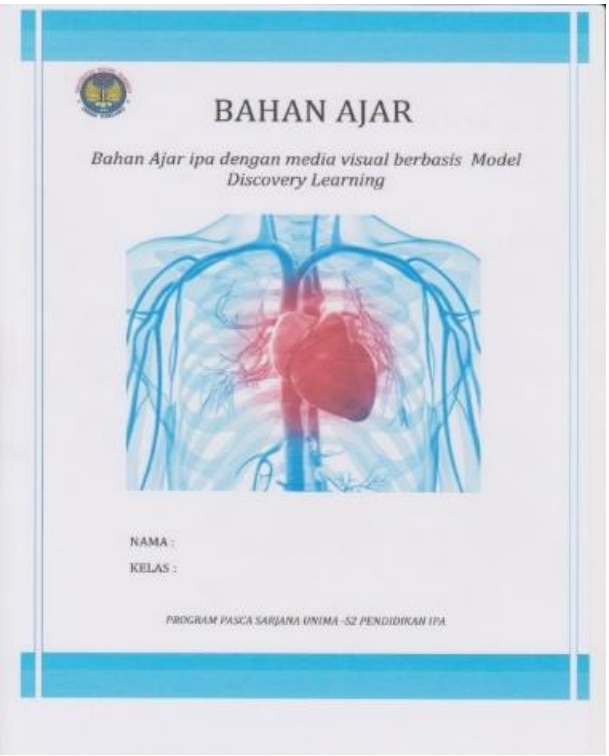

Fig 1: Product Front Cover

1. Data Collection Instruments

The instruments used in this research are as follows:
a. Questionnaire
The questionnaire used was a learning expert questionnaire (Material) and a learning media expert questionnaire that was used for product validation needs at the beginning and end before estimating and questionnaire responses for students to be tested individually in small groups or large groups. This questionnaire was used as a wrong one instrument in this research.
b. Learning Outcomes Test
The learning achievement test is an instrument used to measure students' learning success in the unit of learning material. The instrument used in class VII.a by applying product development.

2. Data Analysis

Analysis of the data in this study used SPSS version 22 software to do the Normality test, hypothesis testing, paerid t sample test and percentage descriptive analysis.
Expert Validation of learning materials and media
After the initial product being developed is finished being made, this product is then validated by an expert. This validation expert uses it to find out its advantages and disadvantages. This process researchers present some field or experienced experts to assess the products that have been made. Test the learning material experts and media experts the qualitative data collected from input, suggestions and comments from learning material experts and instructional media experts, related to the material teaching science with visual media based on discovery learning models. From the calculations obtained a percentage of 93.33%. These percentages are included in the category of very good and worthy of trial in the field.

Discussion of Research Results

Products that are produced through the revision stage starting from the material and learning media. Therefore, it is necessary to know that the purpose of developing this product is to produce a product that can be utilized as a source of learning so that students more easily understand a material, especially the material of the circulatory system in human science teaching materials with discovery learning based visual media not only includes material but also with rare discovery learning. So in the discovery learning model the material is not delivered in the final form but the students are encouraged to identify what they want to know, continue to search for their own information then organize what they know and understand in the final form. This is proven to be effective because the evaluation results show an increase in learning outcomes, meaning that the products made influence can increase student learning outcomes. The development is carried out with the development procedures that have been described in the research methodology and are based on material experts and learning media, as well as respondent from students both small groups and large groups. In making this product the material and media experts are revising so that this product must follow the rare- rare discovery learning. The aim of the revision of the material experts and learning media is to be able to perfect this product. The next product is validated by the material experts and learning media and obtained an excellent press release.

Conclusion

The results of the study can be summarized as follows:

1. Development of science teaching materials with visual media based on discovery learning that is good and feasible to use in implementing learning.
2. The development of science teaching materials with discovery learning based visual media is good to use because it can significantly improve student learning outcomes of the circulatory system in humans in class VIII.A in Wori Christian Middle School.

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