The Development of Guided Discovery Based Learning Materials to Improve Learning Outcomes in High School Biology

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The challenge of education development is to improve the quality and equal distribution of education by reducing the disparity in the quality of education between regions, between sexes, and between the rich and poor. Based on the report of the United Nation Development Program (UNDP), the quality of Indonesia's human resources is low as seen from the Human Development Index (HDI). In 2015, Indonesia was ranked 113 out of 188 countries. One of the subjects of the national high school exam results in Indonesia that are still low are biology subjects. This study aims to develop high school biology learning materials based on guided discovery to improve learning outcomes in biology. The method used in this research is Research and Development (R & D) by Gall, Gall, and Borg. The learning materials developed are Teacher's Guide, Student's Guide and Student Worksheet (LKS). The results showed that Guided Discovery learning materials were developed and evaluated by experts and students. Four experts were involved to evaluate this learning material. According to guided discovery, the learning materials are valid and ready to use. Pre-test and post-test were conducted to see the effectiveness of learning materials and the result was an increase in high school biology learning outcomes. This means that the model is feasible for use in high school biology learning.

Key words: *Guided Discovery, Learning Materials, Learning Outcomes, Biology.*

Introduction

Education is an important factor to improve the quality of human resources. Through education every student can gain knowledge, improve their skills possessed, and develop their potential,

so that they can achieve their future goals, as well as compete, at both a national and international level, in various aspects of life.

In the period of the Republic of Indonesia in 2014-2019 President Jokowi launched the Nawa Cita program, which was to improve the quality of Indonesian human life by improving the quality of education and training with the Smart Indonesia Program. It is also written in the 2015-2019 National Medium-Term Development Plan that to improve the quality of life for humans and Indonesian people, education needs to be developed through the implementation of the Smart Indonesia Program. Internationally the development goals in education are contained in the Sustainable Development Goals (SDGs). The 4th Goal aims to ensure that education is inclusive and equitable, and thereby promotes lifelong learning opportunities for all (BPS, 2017).

Various other programs related to the education sector have been implemented, such as the 2013 curriculum, but until now the quality of education in Indonesia is still relatively low. Based on a report from the United Nation Development Program (UNDP), the quality of Indonesia's human resources is low in view of the Human Development Index (HDI) in 2015, in which Indonesia is ranked 113 out of 188 countries. In addition, based on the results of the national examination data, it is still relatively low.

The low quality of education in Indonesia illustrates that various efforts made by the government of the Republic of Indonesia have not been successful. One of the supporting factors for the quality of education is the standard of educators and education personnel (GTK). In this case the educator plays an important role in improving the quality of our National education. The competence of educators can be improved through training, the provision of certification allowances, and teacher competency testing. The results of the 2017 teacher competency test at the senior high school level in North Konawe District, Southeast Sulawesi Province, showed that the numbers were still below the Minimum Completion Criteria (KKM) of 70, especially for teachers in the MIPA group.

Low teacher competency test scores positively correlated with national exam scores such as in North Konawe District Asera 1 High School in 2016 and 2017 biology subjects including categories C and D. From these factors the authors make direct observations of the learning process in class XI IPA. The author found that students who were less active in the learning process only received information from the teacher, and the packages used in electronic schoolbooks (BSE) lacked appearance and were less attractive. Furthermore, students in biology learned more theory than practice, which made students unable discover new knowledge. In addition, students are less motivated to learn biology because it requires too much memorization, is less abstract in nature (a lot of material cannot be observed directly), relies on inadequate laboratory equipment, and is only taught through picture media. Biology

learning in the classroom tends to be teacher-centred. Teachers explain more material using the lecture method with the help of LCD, without giving students the opportunity to find out the facts that occur in the environment or find something new.

Based on the description above the authors conducted research on the development of guided discovery-based learning materials to improve high school biology learning outcomes. As Yaumi (2013) states, learning materials as a set of materials which are systematically arranged for learning needs sourced from printed materials, visual aids, audio, video, multimedia, and animation, as well as computers and networks.

Biology subjects are one of the clusters of natural science (IPA) subjects. Learning biology involves facts, concepts, and principles about biology as one of the branches of science. The general goal of biology learning is for students to understand biological concepts and their relevance to everyday life, to have skills in the environment, and to be able to develop their knowledge to make the surrounding environment better. In addition, it can help students solve problems that occur in everyday life.

The main problem in biology learning is how to connect facts that have been seen and experienced by students in everyday life with biological concepts, so as to make meaningful knowledge in the minds of students. During this time, students' understanding focused more on the description of biological concepts, without understanding what their meanings are. On the other hand, the environment provides interesting and mysterious natural phenomena. Guided discovery leaning models are thought to spur deeper understanding of content, causing students to direct their own learning so that they are more involved and motivated, trained to solve problems individually, and in possession of greater comprehension.

Eggen and Kauchak (2012) say that with guided discovery learning models teachers give students specific topic examples and guide students to understand the topic. This model is effective for encouraging student involvement and motivation, while helping them gain an in-depth understanding of clear topics, and developing students' thinking. Smaldino., *et. al* (2005) add that the discovery model (discovery) uses an inductive approach, or investigation for learning. This model presents problems to be solved through trial and error.

Research Objective

1. To Develop Guided Learning-based learning materials on biology class XI IPA semester 2
2. To Measure the effectiveness of guided learning-based material on biology class XI IPA semester 2

Literature Review

The discovery learning model is a learning model that is designed so that students better understand concepts, meanings and relationships intuitive processes to finally come to a conclusion. Komara states that Discovery occurs when individuals are involved, especially in the use of mental processes to find several concepts and principles. Discovery is conducted through observation, classification, measurement, prediction, determination, and inference. The process is called the cognitive process, while discovery itself is the mental process of assimilating concepts and principles in the mind (discovery is a mental process through the concept of assimilation and meaning).

The discovery learning model (discovery) uses an inductive approach, or investigation, to learn. This strategy presents problems to be solved through trial and error (trial and error). The purpose of the discovery learning model is to stimulate understanding of content that is more profound by involvement with the content. The discovery learning model has advantages and limitations.

a. The advantages are:

1) Involvement: Discovery learning is very involved for students at all levels of learning.
2) Repeat steps: You can use the procedure or steps that have been taught before.
3) Student control over learning: Discovery makes students feel they can control their own learning process.

b. The limitations are:

1) Time factor: The invention can take a lot of time in terms of design and implementation.
2) Setup is important: Planning for learning discovery requires thinking of all possible problems that students might encounter.
3) Misunderstanding: Learning discovery can lead to the misunderstanding of content.

David, et al. (1978) states that:

"... The discovery method is especially appropriate for learning scientific knowledge in a particular discipline. It also conceptualized the concept of acquisition occurs, and when the prerequisites for acquiring large bodies of knowledge (the accessibility of a large body of higher order - abstraction and transactional terms in cognitve structure) and an abstract mode of assimilating ideas) are not present. Discovery methods can be used for older learners in the early stages of exposure. In part, whether reception learning is truly meaningful".

Dale (2012) argues that discovery involves referring, constructing, and testing hypotheses, rather than simply reading or listening to teacher presentations. Discovery is a type of inductive reasoning, because students move from studying specific examples to formulating general rules, concepts, and principles. Discovery learning is also referred to as problem-based, experiential inquiry, and constructivist learning ".

Eggen and Kauchak (2012) suggested that guided discovery learning models are a learning approach wherein the teacher gives students specific examples and guides students to understand the topic. This model is effective in encouraging student involvement and motivation while helping them gain an in-depth understanding of clear topics. The process of planning lessons using a guided discovery learning model involves four steps, namely:

1. Identifying Topics
2. Determining Learning Objectives
3. Preparing Examples and Non-Examples
4. Technology and Teaching: Using Technology to Make High-Quality Examples

Eggen and Kauchak added that there are four phases to applying the lesson using a guided discovery model:

1. Preliminary phase:
Phase 1 begins the lesson, and is intended to attract students' attention and provide a conceptual framework for what follows. This phase can start in various ways and can consist of simple statements. The purpose of this is for the teacher to try to attract students' attention and set the focus of the lesson.

2. Open phase:
The open-ended phase aims to encourage student involvement and ensure their initial success. In this phase the teacher gives students examples and asks students to observe and compare examples.

3. Convergent phase:
Convergent phases are designed to ensure student success and increase their involvement and motivation. In this phase the teacher asks more specific questions designed to guide students to reach an understanding of the concept or generation.

4. Closing and implementation phases:
This phase occurs when students are able to verbally express the characteristics of the concept or verbally describe the relationships that exist in general. In this stage the teacher guides

students to understand the definition of a concept or generalization and students apply their understanding into a new context.

According to Hosnan (2013) the operational steps of implementation in the learning process are as follows:

a. Preparation Steps for Discovery Learning Strategies
    1) Determine learning goals
    2) Identifying student characteristics (initial abilities, interests, learning styles, etc.).
    3) Choosing learning material to be learned
    4) Determine topics that students must learn inductively (from examples of generalizations).
    5) Develop learning materials in the form of examples, illustrations, assignments, etc. for learners to learn.
    6) Organize simple subject topics to the complex, from concrete to abstract, or from the active stage, iconic to symbolic.
    7) Assess the process and learning outcomes of students.

b. Discovery Learning Strategy Application Procedure
    In the implementation of discovery learning strategies in class, according to Syah, there are several procedures that must be implemented in teaching and learning activities in general.

    1) Problem statement (statement / problem identification)
    After stimulation, the next step is for the teacher to give the opportunity to students to identify as many issues as possible that are relevant to the learning material. One of them is then chosen and formulated in the form of a hypothesis (temporary answer to the problem statement).

    2) Simulation (stimulation / stimulation)
    At this stage students are faced with something that causes confusion, so that the desire arises to investigate themselves. In addition, the teacher can start PBL activities by asking questions, encouraging them to read books, and other learning activities that lead to preparation for problem solving. Stimulation at this stage serves to provide learning interaction conditions that can develop and help students explore material. In this case, Bruner provides stimulation by asking questions that can expose students to internal conditions that encourage exploration.

    3) Data collection (data collection)
    When exploration takes place, the teacher also gives students the opportunity to gather as much information as possible which is relevant to prove whether the hypothesis is correct

or not. At this stage it serves to answer questions or prove the correctness of the hypothesis. Thus students are given the opportunity to collect (collection) various relevant information, read literature, observe objects, interview sources, conduct their own trials, and so on. The consequence of this stage is that students learn actively to find something that is related to the problem at hand, thus unintentionally students connect the problem with the knowledge they already have.

4) Data processing (data processing)
Data processing is an activity to process data and information that has been obtained by students through interviews, observation, and so on. The remainder is interpreted, and everything is processed, randomized, classified, tabulated, and, if necessary, calculated in a certain way and interpreted at a certain level of validity. Processing data is also called coding categorization which functions as concept formation and generalization. From these generalizations, students will get new knowledge about alternative answers / solutions that need logical proof.

5) Verification
At this stage, students conduct a careful examination to prove whether or not the hypothesis set by alternative findings is connected to the results of data processing. Based on the results of processing and interpretation or existing information, the previously formulated statement or hypothesis is then checked, regardless of whether it is answered or not, or whether it is proven or not. Proof, according to Bruner, aims to ensure that the learning process will run well and creatively, if the teacher provides an opportunity for students to find a concept, theory, rule or understanding through examples encountered in his life.

6) Generalization (drawing conclusions / generalizations)
Generalization stage / drawing conclusions is the process of drawing a conclusion that can be used as a general principle and applies to all the same events or problems, taking into account the results of verification. Based on the results of the verification, the principles underlying the generalization are formulated. After drawing conclusions, students must pay attention to the generalization process, which emphasizes the importance of mastering lessons on meaning and rules or broad principles that underlie one's experience, and the importance of the process of regulating and generalizing from those experiences.

The guided finding model places the teacher as a facilitator. The teacher guides students where they are needed. In this model, students are encouraged to think for themselves, analyse themselves so they can "find" the general principle based on the material or data provided by the teacher. Guided discovery or guided model is a discovery learning model which is carried out by students based on teacher's instructions. The instructions given are generally in the form of guiding questions.

Methodology/Materials

This research is an R & D study that uses the steps of R & D research from Gall, Gall, and Borg Eighth Edition in 2007. This model is combined with the R & D research model of Borg and Gall Fourth Edition in 1983. Interviews were conducted with 4 experts, including: instructional design experts, material experts, and media and graphic design experts. 32 students from the Asera 1 North High School District of North Konawe, Southeast Sulawesi Province were involved in this study. Three people were the source of data in one-to-one evaluations, 8 people were the source of data for small group evaluations, and 21 students were the source of data on field trials. The conceptual model is generated based on a synthesis of various theories and concepts in the literature review. The conceptual model was then developed into a physical model in the form of learning material tested by experts and students. The experts provide input for the improvement of biology learning materials in the XI Science Semester class 2. Furthermore, the learning material is tested on several students. Based on the results of the pre-test and post-test, information was obtained that there was an increase in the scores of the pre-test and post-test using learning materials, which meant that guided learning biology-based materials were effective in improving learning outcomes. In addition, information was obtained that students who undertook guided discovery learning were more able to understand the material being studied.

Result and Findings

One-to-one Evaluation with Experts

Content Expert' Reviews

We have interviews with two content experts who have several recommendations for improving the teaching material developed, namely: (1) there must be prerequisites for several objects, for example a student must learn practical guidelines and written tests about what will be learned; (2) understand the material to be learned; (3) form study groups or activities so students will be able to work together and discuss lessons; and (4) give students information about the benefits of learning about the topic being studied.

Instructional Design Expert' Reviews

We conducted interviews with two instructional design experts. These experts have several recommendations for improving the teaching materials developed, namely: (1) The first experts suggest presenting teaching materials into several easy-to-understand, interesting books; (2) In the part of the learning process, there must be a record of reversed activities to distinguish activities carried out inside or outside the class; (3) the second expert suggests that learning

objectives should be explained in more detail. We then explain the concept map of each learning goal

Media and Graphic Design Expert's Reviews

We conducted interviews with media and graphic design experts. Experts have several recommendations for improving the teaching materials developed, namely: (1) using brighter font colours to improve readability; (2) sharper images so that the text cannot be read in the image; (3) the image is better placed in the middle position and that image size must be larger.

Field Trial

A group of 21 students participated in the field trial. The instructional experiment began by pre-test to measure the prior performance of the students.

Discussion

The guided discovery-based learning materials on biology class XI IPA high school subjects are validated by a team of experts in design learning, material, media, and graphical design, to determine their feasibility. Learning materials that have been validated by material experts and design experts will be assessed by biology teachers and students. Assessment by material experts, design experts, biology teachers, and students was based on several indicators. The results of the percentage of the two indicators of the first material expert were 86% in the very good category, so that the biology learning material developed was declared feasible. The validation results from guided discovery-based biology design experts were developed in relation to the first indicator. The form of instructional materials from guided discovery-based biology teaching materials were developed very well with a percentage of 90.50%. Validation results from guided discovery-based biology teaching design experts were developed in relation to the second indicator, namely: the cover and cover layout of guided discovery-based biology learning material, which was developed very well with a percentage of 87%. The results of the assessment of 3 biology teachers at SMA Negeri 1 Asera in the teacher trial, showed that biology-based learning materials based on guided findings on respiratory system material, excretions, and regulations, were very good with an average percentage of 95%. Thus, they were acceptable and feasible enough to be used in the process of learning biology. Likewise, media experts and graphic design experts categorized them as very good.

Conclusion

The development of guided discovery-based learning materials on biology subjects in class XI IPA is very important because it is proven to be effective in improving biology learning

outcomes in class XI IPA. This is because it is arranged in an interesting way and is easily understood by students. In addition, there are learning videos that can be accessed easily through the barcode scans available, and illuminate the digestive system, respiratory system, excretory system and regulatory system, so that abstract properties can be observed as if they are real.

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