DEVELOPMENT OF DISCOVERY LEARNING-BASED E-MODULES TO IMPROVE CONCEPT UNDERSTANDING ABILITY IN FLAT BUILDING MATERIALS

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ABSTRACT

This study uses research and development methods with the ADDIE development model consisting of five stages which include analysis, design, development, implementation, and evaluation. The research aims to produce electronic-based teaching materials (E-Modul) on the ability to understand student’s mathematical concepts on flat-shaped materials. The quality of the teaching materials developed is reviewed from three aspects, namely validity, practicality, and effectiveness. Assessment of the validity of this e-module teaching material is carried out by media experts and material experts, the result shows that the teaching materials developed are valid with a value of 85.9% and meet the criteria for use. The results of the questionnaire analysis of the teacher responses and student responses show that the teaching materials used are practical with the ideal percentages of 90.6% and 89.4% respectively, and scores of 4.53 and 4.47 which indicate practical e-module teaching materials to be taught use. As well as the use of e-module teaching materials in effective learning to improve student’s ability to understand mathematical concepts with the result of the analysis of the mean T-count 12.135 greater than T-table 1.697 and 76.47% of students being able to achieve the KKM score.

Keywords: E-Module Teaching Materials; Understanding Mathematical Concepts

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INTRODUCTION

Mathematics is a subject that is required to be studied and taught at every level of education in Indonesia from elementary school (SD) to high school (SMA). In learning mathematics, understanding the concept is one of the most important aspects. This is because mathematical material is structured and interconnected between one material and another. Students are required to be able to understand the relationship between mathematical concepts. In other words, incomplete understanding of the prerequisite concepts will cause difficulties for students in learning further concepts which will have an impact on student learning outcomes.

As stated in the Regulation of the Minister of National Education of the Republic of Indonesia Number 59 of 2014 explains that one of the goals of learning mathematics in schools is so that students have the ability to understand mathematical concepts, explain the relationship between concepts and apply concepts or algorithms, in a flexible, accurate, efficient, and precise manner. solution to problem.

Based on the stated objectives of learning mathematics, it can be seen that the ability to understand concepts is one of the fundamental goals in learning mathematics. In this case, Nasution stated that if students understand a concept, then he will be able to generalize it in various other situations (Nasution, 2000). According to (Mas’ud Zein & Darto, 2017), understanding is the ability to capture the meaning of subject matter which can be in the form of words, numbers, explaining cause and effect. According to (Muhlisisarini, 2014), the concept is an abstract idea that allows people to classify objects or events and determine whether the object or event is an example or not an example of the abstract idea.

The indicators for understanding mathematical concepts in the 2013 curriculum quoted from (Hendriana, Rohaeti, & Sumarmo, 2017), are: a) Restate the concepts that have been studied, b) Classify objects based on whether or not the requirements that make up the concept are met, c) Identify the properties of operations or concepts, d) Apply concepts logically, e) provide examples or counter-examples of the concepts being studied, f) Present concepts in various forms of mathematical representation (tables, graphs, diagrams, sketches, mathematical models or methods). others), g) Linking various concepts in mathematics and outside mathematics, h) Developing necessary and or not sufficient conditions for a concept.

Based on the results of interviews with seventh grade teachers of SMP Islam Nurul Huda Karadenan, most students cannot give good results in their learning, this can be seen from the enthusiasm during learning in the classroom and from the number of students who have not been able to find out what is the problem. In a question, some students cannot solve a problem if the question is different from the
example given, some students just copy the answers of their friends without understanding the questions that have been given, and some students have not been able to re-explain the concept of the learning material they have learned. The low ability of understanding concepts in class VII students of SMP Islam Nurul Huda Karadenan can also be seen from the data on the results of students' daily test scores. Of the several questions that contain questions about understanding concepts with the number of students in one class, only a handful of students are able to get scores above the KKM.

In an effort to improve the ability to understand concepts, teachers need to prepare and manage strategies for delivering mathematics material to students. The strategy can be in the form of choosing teaching materials that are combined with appropriate learning models where students are actively involved in the learning process so that they can improve students' ability to understand concepts and achieve the expected student learning outcomes. The teacher's role in teaching and learning activities is as a facilitator and motivator to optimize student learning.

Based on the problems that have been described, the teacher must be smart in choosing a learning model that is in accordance with the objectives and learning materials. The application of the guided discovery learning model in the mathematics learning process is an alternative to selecting a model that can increase the ability to understand concepts and can get a good response from students, because according to several previous studies, such as the research conducted by Syaifudin (2008), it was shown that learning based on Discovery learning can reduce students' geometric misconceptions about similarity and congruence as indicated by an increase in conceptual mastery and a decrease in students' error rates in working on problems related to the concepts of congruence and congruence, as well as the results of their research (Karim & Maulida, 2014) which concluded that learning by applying the guided discovery model it has an effect on students' understanding of concepts which is shown that students' activities during the learning process with the guided discovery model are in very good criteria. (Karim & Maulida, 2014) which concluded that learning by applying the guided discovery model it has an effect on students' understanding of concepts which is shown that students' activities during the learning process with the guided discovery model are in very good criteria.

Guided discovery model (discovery learning) is a learning model that puts the teacher as a facilitator, where students find their own knowledge that they do not know by being guided by the teacher's questions, modules, worksheets, and worksheets. New knowledge will stick longer if students are directly involved in the process of understanding and constructing the concepts and knowledge themselves. The guided discovery learning model ends with the process of students finding the concept of the
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material being studied and concluding their own findings based on their own understanding ability.

In addition to the use of learning models, the presence of media can also have an effect on increasing understanding of mathematical concepts. According to Henick et al, (in Suherman, E. et al. 2003:237) in his book, Instructional Media and Technology for Learning, suggest that the whole history, media and technology have influenced education. In this case the media that will be used is kvisoft flipbook maker, kvisoft flipbook maker is a software that has a function to open each page into a book, and can also add several alternative explanations of material such as inserting animated videos, images, and audio. So it can be concluded that with this software when we read an ebook it is no longer monotonous and becomes more interesting, so students will be more fun for reading activities, and make it easier for students to study activities with this discovery learning method.

The material used in this study is a rectangle and a triangle because the discovery learning model is very suitable and makes it easier for students to learn to find their own concepts or solve problems related to the material. The mathematical module based on the discovery learning model assisted by the kvisoft flipbook maker media is expected to maximize students' potential, especially in the ability to understand concepts.

The discovery learning method according to Jerome Bruner cited by (Hosnan, 2014) is "a learning method that encourages students to ask questions and draw conclusions from general principles of practical experience. The discovery learning system developed by Jerome Bruner uses the premise of a teaching and learning approach. The results of learning in this way are easier to memorize and remember, easy to transfer to solve problems. The knowledge and skills of the students concerned can further foster intrinsic motivation, because students feel satisfied or use them themselves.

This study aims to describe the level of validity of the development of discovery learning-based mathematics learning e-modules assisted by the kvisoft flipbook maker application to improve the ability to understand concepts in flat shape material. Benefits of research To be able to develop knowledge and insight about the development of discovery learning-based mathematics modules with the help of a flipbook maker, it can also be used as a provision to later become a professional mathematics teacher who is innovative and creative and can motivate students to increase enthusiasm and understanding of mathematics subjects.
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METHOD

This research belongs to the type of research and development or another name is Research and Development (RnD). The research and development method is a research method which is a research method used to produce a particular product and test the effectiveness of the product (Sugiyono, 2012). In RnD research methods are the steps used or taken to carry out research in achieving the objectives of the research. The product resulting from this research is an e-module of mathematics learning based on discovery learning on flat-shaped material.

RESULT AND DISCUSSION

Research result

1. Analysis

The analysis stage carried out in this research is to conduct field studies and literature studies which aim to develop the module to be developed.

   a. Field study

   Field studies were conducted by analyzing the needs obtained from documentation, interviews, and observations. The results of the documentation show that the learning media used in schools are modules or textbooks.

   The results of interviews conducted with a resource person, one of the teachers at SMP Islam Nurul Huda who is considered capable of providing the data needed in this study. The informant revealed that:

   "During the learning activity, the teacher must write on the whiteboard then the students take notes and continue with the explanation of the material using the lecture method, because many learning media or textbooks that are commonly used are damaged, borrowed are not returned, so the number of books available not in accordance with the number of students, as well as media-based teaching materials are not owned by schools and also teachers do not have the ability to create E-Modules and in the end teaching and learning activities only rely on notes on the whiteboard and continued with lecture or demonstration methods. The results of the evaluation of the class average value below the KKM. The KKM that has been determined is 75, but 60% of students are able to achieve the KKM score. Many students do not understand the concept of the material that has been taught. We really hope that the media is able to facilitate students to learn to be enthusiastic, active, and able to understand the concepts of the material being taught. Complete interview results can be seen in appendix C.

   In the implementation of observations, problems occurred during the learning process, including the teacher using conventional methods in the learning process, the teacher only assigned students to work on the practice questions in the textbook, some
students looking silent and even some students looked sleepy, students confusion in doing the questions, and the lack of interactive students with the teacher. From the results of these observations get an overview of the preparation of learning media, including the media developed must be able to attract students' interest to learn it, and facilitate interactive learning activities. The complete observation results can be seen in the appendix.

The data obtained from documentation, interviews, and observations are then shown in the table below:

<table>
<thead>
<tr>
<th>Problems Found</th>
<th>Common Problem Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Documentati *on</td>
<td>Interview</td>
</tr>
<tr>
<td>Media using package books</td>
<td>Using the package book</td>
</tr>
<tr>
<td>Questions</td>
<td>Exercises</td>
</tr>
<tr>
<td>Media that are often used by teachers is a package book</td>
<td>Media using package books</td>
</tr>
</tbody>
</table>

From the presentation of the problems above, it is necessary to find a solution to solve them. An alternative solution is to arrange learning media based on teaching materials.

a. Literature study

The literature study step is the first step in media preparation. In this step, curriculum analysis is carried out. The curriculum used by the school is the 2013 curriculum (K-13). Curriculum analysis is carried out by examining the KI, KD and the indicators set at the school. The results of the study found KI, KD and indicators in the flat material that requires learning media, in the form of electronic books, along with KI, KD and their indicators.

1. Design

In making the design of teaching and learning materials, the researchers made it as shown in the following table:
## Table 2. Product Design to be produced

<table>
<thead>
<tr>
<th>Name</th>
<th>Picture</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume Pages</td>
<td><img src="image" alt="Volume Picture" /></td>
<td>E-learning modules start with volumes</td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="Concept Maps" /></td>
<td>Basic competence and learning experience</td>
</tr>
<tr>
<td>Concept maps</td>
<td><img src="image" alt="Concept Maps" /></td>
<td></td>
</tr>
</tbody>
</table>
1. Development

At this stage the researchers realized the design of teaching materials that had been designed previously, and then validated by media experts and material experts to be tested for the validity of the teaching materials developed. The validator team is tasked with validating and providing corrections and instructive suggestions for the improvement of product designs and test instruments. Corrections and suggestions from the validator become a reference for product design revisions and test instruments. The scope of the assessment by the validator includes the media and the quality of the test instrument. The following table is the result of the validator's assessment:

**Table 3. Product Design Validation Results**

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Percentage</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>85.9%</td>
<td>Very Worthy</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 4. Pretest Instrument Validation Results**

<table>
<thead>
<tr>
<th>No. Question</th>
<th>Percentage</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>96%</td>
<td>Very Worthy</td>
</tr>
<tr>
<td>2</td>
<td>90%</td>
<td>Very Worthy</td>
</tr>
<tr>
<td>3</td>
<td>90.5%</td>
<td>Very Worthy</td>
</tr>
<tr>
<td>4</td>
<td>96%</td>
<td>Very Worthy</td>
</tr>
</tbody>
</table>
Table 5. Results of Posttest Instrument Validation

<table>
<thead>
<tr>
<th>No. Question</th>
<th>Percentage</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>96%</td>
<td>Very Worthy</td>
</tr>
<tr>
<td>2</td>
<td>90%</td>
<td>Very Worthy</td>
</tr>
<tr>
<td>3</td>
<td>90.5%</td>
<td>Very Worthy</td>
</tr>
<tr>
<td>4</td>
<td>96%</td>
<td>Very Worthy</td>
</tr>
<tr>
<td>5</td>
<td>96%</td>
<td>Very Worthy</td>
</tr>
</tbody>
</table>

(Arikunto, 2014)

Based on the table of product design validation results obtained a percentage value of 85.9% which states that learning teaching materials include criteria suitable for use and validation of the content of Pretest and Posttest instruments with percentages and criteria of 89.2% each very good. The validation sheet can be seen in full in Appendix D, the design of this media and instrument product is then revised in several parts according to the recommendations of the validator. The following is a list of product design revision tables and test instruments:

Table 6. List of Product Revisions

<table>
<thead>
<tr>
<th>No</th>
<th>Revision Suggestion</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(Arikunto, 2014)
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After receiving input and suggestions from the validator, further improvements were made to the developed learning teaching materials. The following is a list of the revised results of the developed teaching materials:

<table>
<thead>
<tr>
<th>No</th>
<th>Revision Suggestion</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. Implementation

The implementation stage is the stage where the teaching materials developed are used in classroom learning. The use of teaching materials is carried out in class VII with 34 students. The use of these teaching materials aims to determine the practicality of teaching materials, shortcomings, errors and weaknesses of these developed teaching materials. In practicality, the assessment product is taken from the data from the responses of teachers and students after the use of learning teaching materials. The results of the calculation of the practicality of teaching materials based on the teacher's response are as follows:

<table>
<thead>
<tr>
<th>Total Score</th>
<th>68</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Score</td>
<td>4,53</td>
</tr>
<tr>
<td>Classification</td>
<td>Layak</td>
</tr>
<tr>
<td>Ideal Percentage</td>
<td>90,6%</td>
</tr>
</tbody>
</table>


Table 9. Results of Calculation of Practicality of Learning Teaching Materials from Student Responses

| Total Score of All Validators | 2280 | 152 |
The results of the calculation of the practicality of learning teaching materials by students are 4.47 and are included in the practical category. As well as meeting the ideal criteria for use with a percentage gain of 89.4%, the complete calculation can be seen in appendix D.

1. Evaluation
The last stage is the evaluation is done by testing the effectiveness of the learning teaching materials developed. The effectiveness of learning teaching materials can be seen from the understanding of students' mathematical concepts. Students were given a pretest before using the developed learning teaching materials and a posttest after using the teaching materials. The results of the pretest and posttest were then analyzed using the t-test which was previously tested for normality and homogeneity first. The following are the stages of the results of the pretest and posttest analysis.

a. Liliefors Uji Test
Normality test is used to determine whether the research sample comes from a population with a normal distribution or not. This normality test uses the Liliefors test, while the results of the calculations are as follows:

<table>
<thead>
<tr>
<th>N Sample</th>
<th>Mean</th>
<th>Deviation Raw</th>
<th>Liliefors Count</th>
<th>Liliefors Table</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pretest</td>
<td>Posttest</td>
<td>Pretest</td>
<td>Posttest</td>
</tr>
<tr>
<td>34</td>
<td>4.6470</td>
<td>12.558</td>
<td>1.2280</td>
<td>1.460</td>
</tr>
</tbody>
</table>

(Budiyono, 2009)

The calculation results show that \( t_{\text{pretest}} \) is greater than 0.1497 with a pretest \( t_{\text{posttest}} \) of 0.181 and a Posttest \( t_{\text{posttest}} \) of 0.162. So it can be concluded that the research sample comes from a sample that is normally distributed. The complete calculation results can be seen in appendix D.
b. Uji Homogenitas

This test is used to determine whether the study population has the same variation or not. The results of the homogeneity test calculation can be seen in the following table:

**Table 11. Analysis of Homogeneity Test Results of Pretest and Posttest**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Pretest</th>
<th>Posttest</th>
</tr>
</thead>
<tbody>
<tr>
<td>F count</td>
<td>1.51</td>
<td>2.13</td>
</tr>
<tr>
<td>F table</td>
<td>1.41</td>
<td>1.84</td>
</tr>
</tbody>
</table>

**Conclusion**

Homogen

Sudjana (2005:205)

The calculation results show that $t_{hitung}$ is greater than 1.84 with $t_{tabel}$ of 1.41 so it can be concluded that the research sample comes from a population that has the same variance. The complete calculation results can be seen in appendix D.

c. Uji T sampel berpasangan dengan satu arah

Paired sample t-test with two different treatments was used to determine if the sample experienced an increase in students' understanding of mathematical concepts. The calculation results are as follows:

**Table 12. T Test Analysis Results**

<table>
<thead>
<tr>
<th>$T_{tabel}$</th>
<th>$T_{hitung}$</th>
<th>Kesimpulan</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.697</td>
<td>12.135</td>
<td>$T_{hitung} &gt; T_{tabel}$</td>
</tr>
</tbody>
</table>

From the results of the calculation of the mean between the pretest and posttest, it can be seen that $t_{hitung}$ with a value of 12.135 is greater than $t_{tabel}$, which is 1.697 and this indicates that the posttest score of students has a greater mean than the pretest value. So learning teaching materials are said to be effective in increasing students' ability to understand mathematical concepts. The complete calculation results can be seen in appendix D.

A. Discussion

a. Development of learning teaching materials

The research method used in this study is research and development (RnD) with the EDDIE development model consisting of five stages which include analysis, design, development, implementation and evaluation. The product is made using the kvisoft flipbook maker.
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Before the product is used, it must be validated by the validator. It aims to see the validity of the developed product. There are four aspects that are seen by media expert validators to provide an assessment, namely navigation, convenience, writing, and appearance. Meanwhile, for material experts there are three aspects that are used, namely, learning, material, and curriculum. The average validation result obtained is 85.9% for the developed media and includes the criteria for use.

b. Product practicality

In addition to looking at the validity of the product developed in this study, an analysis of the practicality of the product was also carried out by giving questionnaires to teachers and students. The questionnaire given to the teacher aims to see the teacher’s response when using teaching materials in learning. The assessment is carried out looking at three aspects, namely learning, material, and curriculum. While the questionnaire given to students aims to see student responses after learning using the developed teaching materials, the assessment is carried out using three aspects, namely convenience, motivation, and usefulness. The results obtained from the teacher’s response were 4.63, the ideal percentage of 90.6% and the results of the student responses the score obtained was 4.47 and the ideal percentage of the student responses was 89.4%.

Thus, based on the results obtained, it is said that the teaching materials developed are in the appropriate and ideal category to be used in helping students learn mathematics. According to students, the developed media is feasible to use because it is easy to use, can motivate learning, is interesting, and is useful in helping students learn.

c. Product effectiveness

In this study the effectiveness of the product can be seen from the results of the pretest and posttest, pretest is given to students before learning using electronic-based teaching materials (E-Modules) in learning, while posttest is given to students after using e-modules. The results of the pretest before using the e-module showed that the average number of pretest results for 34 students was 4.6 and none of the students met the KKM score, while the average posttest result was 12.5 and the percentage was 89.3% or 76.5% students meet the KKM score. And the results of the analysis of the mean of the pretest and posttest results obtained a value of $t_{ung}$ 12.135 greater than 1.697. This result indicates that the e-module is effectively used because it has a positive impact on students' ability to understand mathematical concepts.

B. The final product

The final product in this research is in the form of an electronic module (e-module).
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Its use can be done or opened on a computer, laptop, and smartphone. The e-module contains several things that distinguish it from the media in general, namely:

a. Title
In this section, the title or material to be studied is written on the media.

b. Theory
The material is presented with the discovery learning method, so students are more involved in playing an active role in learning.

c. The practice questions are in the form of descriptions to measure and strengthen the concepts they have found

The complete display of the final product of this e-module can be seen in appendix A

C. Relevant research
The following are relevant research or related to e-module teaching materials as follows:

Research conducted by, (Putra, Wirawan, & Pradnyana, 2017) states that "based on the results of research and discussion on simulation-assisted e-module research oriented to problem solving on data communication subjects, the authors can draw the following conclusions: a) the results the design and implementation of simulation-assisted e-module development oriented to problem solving in data communication subjects for class XI Computer and Network Engineering at SMK Negeri 3 Singaraja using the stages of the problem based learning model has been declared successful. This can be seen from the average percentage of the test results that have been carried out. In general, students look enthusiastic and more active during the learning process, b) the teacher's response to the development of e-modules assisted by simulations is problem solving oriented in data communication subjects for class XI Computer Network Engineering at SMK Negeri 3 Singaraja, the average is 47. If converted into a response classification criteria table, the results are included in the very positive category. Meanwhile, students' responses to the development of the data communication e-module obtained an average of 67.80. If it is converted into a response classification criteria table, the results are included in the very positive category.

CONCLUSION
a. The development of this e-module goes through five stages, namely the stages of analysis, design, development, implementation, and evaluation. At the analysis stage, field studies were carried out by means of the documentation method, the interview method, and the observation method. The documentation method aims to determine the forms of media commonly used and the expected variations of media. The interview method aims to determine the use of existing media, the
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advantages and disadvantages of existing media, and the wishes of the school community to a variety of media to support learning. The method of observation was carried out to determine directly the use of media and the impact of using the media. The next stage is the media design and development stage which aims to get a product design. The product design in this study is an electronic-based module (e-module). At this stage, it includes curriculum analysis and literature review to find solutions to existing problems, and continues with the preparation of e-module product designs. The results of the media product are then validated by experts and after the product design revision is based on constructive suggestions from the new validator, the media is used in learning. Before using the media students were given a pretest first, at the end after using the media students were given a posttest to evaluate learning outcomes using e-modules.

b. The validity of the e-module teaching materials was analyzed from the results of expert validation and obtained the criteria for use with an ideal percentage of 85.9%

c. The practicality of the developed e-module teaching materials was assessed from the responses of teachers and students. The results of the analysis of teacher and student responses showed a mean score of 4.53 and 4.47. Including practical classification. And the ideal percentage of teacher response is 90.6% and student response is 89.4% so that e-module teaching materials are included in the ideal category to use.

d. And the product of this e-module teaching material is effectively able to improve students' understanding of mathematical concepts in building materials with an average posttest score of 12.5 students greater than the pretest score of 4.64 and .76.7% of students fulfilling the score. KKM. And the results of the calculation of the mean analysis with 12,135 greater than 1,697.

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Indonesia.


