Digital module and treffinger model: can improve mathematics ability

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Abstract. The aims of this paper are developed teaching materials of digital modules with Treffinger models on the material to construct curved geometry, to find out increase before and after using digital modules. The research model used is ADDIE development research (Analysis, Design, Development, Implementation, and Evaluation). The instruments use in this research is tests of mathematical comprehension ability, interview sheets, and digital module validation sheets. Learning media developed digital modules assisted by 3D software Pageflip Professional 1.7.1. The results obtained from the study were validation by mathematics lecturers and teachers at 84.7% while the results of ICT teacher validation are 85%, with each validation criterion quite valid, which can be tested according to the validator's suggestion. After being implemented, students' mathematical understanding ability has increased with a high interpretation of 0.72.

1. Introduction
Curriculum 2013 prioritizes scientific-based learning. Based on preliminary analysis known that teachers have difficulties in designing a lesson plan scientifically based [1]. The development of technology can be used to develop educational products, such as e-books using the 3D Pageflip Professional program.

Council of Teacher Mathematic there are five mathematical abilities that must be mastered by students in learning mathematics, including comprehension, problem solving skills, communication skills, connection skills, reasoning abilities, and representation abilities [2]. observations have been made on 30 students of junior high schools in Cirebon showed that students' mathematical understanding ability was still low. The following is the result of an answer from one student with the following question.

Problem: Know a tube has radius r and height t. If the radius becomes 3/2 r and the height is reduced to 1/2, determine the ratio of the volume of the tube before and after experiencing a change.

From the students' answers in Figure 1, it can be seen that students can substitute known numbers, but there are many mistakes in understanding a mathematical problem or working on a problem, the student substitute t with 7 x 7 x 21, that makes students answer with expectations, and respond with abilities that they know. In addition, most students forget to write conclusions at the end of the settlement.
The low ability of students' mathematical understanding is caused by several factors, first the methods and learning media used by the teacher are less attractive so that they cannot be understood by students. Second students still consider mathematics to be an unpleasant, difficult and boring lesson [3-4].

Teaching materials that use the problems of daily life are learning that can give more enthusiasm to students to learn mathematics [5]. One type of teaching material that can be used by students is the module. Modules can also be presented in digital or electronic form. With the existence of modules that are packaged in digital form, it is hoped that it can inspire students to learn mathematics. As stated by Hamalik in the teaching and learning process can increase desire, interest, motivation and stimulus and bring psychological influence to students by using learning media [6].

2. Research methods

This research methods are development research that refers to the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation). Research and development methods (R & D) are a research method used to produce new products, test the effectiveness of an existing product, and develop and create new products [7-8]. This research was conducted on students of class IX B, one of the Cirebon Schools. The research instruments used were interview guideline sheets, test questions for students' mathematical comprehension abilities, digital module validation sheets and student response questionnaire sheets.

Data collection techniques in this research include test techniques and non-test techniques. The technique of collecting data in the form of tests, namely in the form of a test question of students' mathematical understanding skills in the form of a description consisting of 6 questions, which were given before (pretest) and after (posttest) learning using the digital module.

Data collection techniques that are not in the form of tests, such as digital module validation sheets and interviews. The interview sheet is used to conduct interviews with teachers and students, with the aim to find out the difficulties experienced by students regarding the material to construct curved geometry in classroom learning.

In Figure 2 the step of the ADDIE model is presented in the following chart, it can be seen that at this stage of analysis is done by giving questions of mathematical comprehension abilities and interviews with teachers and students. In the design phase this is done by designing a basis for making digital modules that refer to the determination of material and media selection. After the design is complete, the next step is the develop stage, at this stage before the digital module is implemented, it is first validated by several lecturers, mathematics teachers and ICT teachers.

Shulhany said before teaching materials were implemented in a limited manner, it was necessary to do validation first, intended to find out whether the design of the teaching material was valid or not. After obtaining valid results, limited implementation is carried out to see students' responses to the use of digital models in the learning process [9].
Figure 2. Research methods.

Data processing techniques in this study use quantitative and qualitative. Quantitative data obtained from the results of the test questions, the ability of students to understand mathematical understanding of the early abilities and final abilities of students after carrying out learning using digital modules. In addition, quantitative data is also obtained from the results of the validity assessment contained in the validation sheet by several validators. While qualitative data was obtained from responses and suggestions about digital modules through the Treffinger model to improve students' mathematical understanding skills based on expert reviews and input on the use of digital modules in mathematics learning and obtained from student responses. The qualitative data that has been obtained is then analyzed descriptively.

3. Research results and discussion
In the analysis phase the researcher interviewed the teacher and students as well as gave the test questions to students, to find out the learning needs of students and the difficulties experienced by students in learning mathematics.

The results of the analysis were obtained from the results of interviews of researchers with mathematics teachers at SMP N in Cirebon who said in general that students still had many difficulties in learning the material curved geometry where the basic concept is part of a plane such as a circle, a rectangle, and a right triangle, students also do not understand the formula of the surface area of curved geometry students are often confused to determine these formulas, there are also students who still remember the formula but do not understand the calculation of a formula, which can affect a value in determining the formula for surface area, volume and comparison of a curved geometry, and the use of instructional media to help in understanding the material in the curved geometry, where the learning media is limited to PowerPoints and books, but the use of these media has not been able to overcome the learning difficulties experienced by students in understanding the material delivered by the teacher. The students' responses in student learning use digital modules as interesting learning innovations, where students can learn with different situations that can cause curiosity during learning. In addition to interviews, at this stage a test was also conducted to find out the students' initial abilities related to mathematical understanding skills.
From the results of the test of mathematical comprehension ability is still relatively low with an average of 38.03, it can be seen from the indicator of the ability to identify the adequacy of data to solve students' problems.

After doing the learning using a digital module, where in each sample problem in the module is included a complete discussion as in Figure 3.

![Example a problem](image)

**Figure 3. Example a problem.**

Where students are expected to explain in accordance with the original problem, get used to writing what steps should be done, and can check the results of the answers. As for each issue in accordance with the indicators of the mathematical understanding ability students with the lowest to highest difficulty level.

3.1. **Design step**

In the next step is design step. First selection of media and determination of teaching materials, the material is curved geometry, second step is making a media design, the creation or systematic design of media. The designer is made based on purpose so that it can simplify the stages of work or making digital modules. After the media design is completed, the next step is to start making products based on the design. In addition to making conventional modules on Ms. Office Word, there is also a quiz for multiple choice questions on student competency tests using the iSpring Suite 8 application. And applications such as paint and Camtasia and so on for the manufacture of pictures and videos supporting teaching materials will be delivered.

After all the materials to make the digital module are ready, such as conventional modules, learning videos, supporting images to help present the material and practice questions that have been made, all are combined in a professional 3D pageflip application to be the final product in the form of digital modules that can assist students in learning mathematical material.

3.2. **Develop step**

Figure 4 is developed step of developing a digital module is created and designed so that it is interesting then the next stage is the deployment, so that this digital module can be run on a laptop or other computer device. The first step in the deployment process is to publish on a digital module that has been completed and created on a professional 3D pageflip.

![Publish or deployment digital module](image)

**Figure 4. Publish or deployment digital module.**
After that a new dialog box will appear, then select the EXE format so that this digital module can be opened and run on other computer devices.

The initial appearance of the digital module can be seen in Figure 5 where there are several menus or navigation buttons to go to the previous and next pages, the exit button, and also a number of menus that are at the bottom of the module.

![Figure 5. Display of digital modules.](image)

On the next page, it has entered the beginning of the material. On this page, at the beginning of the learning material there is a video about the building in the form of a curved geometry and the history of curved geometry, as an introduction to the real context in the material.

![Figure 6. Display of material.](image)

Before the digital module is implemented, validation is carried out by experts. Validation was carried out by FKIP Study Program lecturers, mathematics teachers and IT Teachers. The validation results by the validators obtained a percentage for each validator 1, 2, 3 and 4 of 87%, 87%, 85% and 80% with validation interpretations which were quite valid, which could be used but needed to be revised small. It is proven from the results of validation on each aspect of the indicator, namely relevance, completeness of the presentation, systematic presentation, conformity with the Treffinger model, module design and module usage. For the use of a real-life context, in the initial learning material in the module a video is displayed as a conduit before entering into problems with the material.

Whereas the results of validation by ICT teachers obtain a percentage of validation of 85% with validation interpretations quite valid, that is, they can be used but there are some parts that need to be revised. In the aspect of module usage, compatibility obtains sufficient validation values because the media created cannot be run through a smartphone, but can only be operated on a laptop. This is because if deployed to a smartphone, the practice questions that use iSpring suite, images, or videos that use the links contained in the digital module cannot function properly. There is a reader application for 3D Pageflip Professional but it does not support the current version of the Android system, but only for the Android operating system version of Jelly Bean and below, and there is no latest version of the 3D
Pageflip Professional, whereas children today are using the system version Latest Android operations, such as Lollipop, Marshmallow, Nougat and Oreo.

Nevertheless, based on the results of the validation of the five validators, it can be concluded that the learning media using 3D professional pageflip on the material curved geometry to improve students' mathematical understanding skills is considered valid and can be tested on students provided there are some minor revisions from the validators.

In the limited implementation phase to class IX B, one of the National Middle Schools in Cirebon Regency uses a combination of simple random sampling and purposive sampling, in this step the pretest and posttest are carried out.

3.3. Increase (gain test)
The normalized gain test results in the pre-test and post-test of 30 students of class IX B showed that there were only 19 students who obtained high criteria, 10 of them obtained moderate criteria, and 1 student obtained a fixed criterion. For the overall average value of 30 students getting normalized gain value of 0.72 and included in the medium interpretation with pretest and posttest scores of 12.17 and 75.17. Can be seen in Figure 7. Digital learning presents better positive effects on learning motivation than traditional teaching does [10].

![Figure 7. Gain score.](image)

4. Conclusion
From the results of the study, it can be concluded that the development of digital modules through treffinger models in curved geometry materials assisted by Professional Pageflip 3D software get overall digital module validation results of 84.8% with fairly valid interpretations and can be tested on students with small minor revisions. from the validators. In addition, this digital module can also improve students' mathematical understanding skills with a high interpretation of 0.72. This digital module needs to be experimented on a wider sample.

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