

THE DEVELOPMENT TEACHING MATERIALS ON THE AREA OF TRIANGLES AND QUADRILATERALS BY USING GEOGEBRA-ASSISTED DISCOVERY LEARNING METHOD TO IMPROVE MATHEMATICS UNDERSTANDING ABILITY

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ABSTRACT

The understanding mathematics ability is a basic ability that is very important and must be possessed by students in learning mathematics. In fact, the ability to understand mathematics is still relatively low, especially in triangles and quadrilaterals. The purpose of this study is to produce teaching materials on triangles and quadrilaterals based on the GeoGebra-assisted discovery learning method that is valid, practical, and effective to improve students' mathematical understanding abilities. The method in this study is the ADDIE type of research & development method. The teaching materials developed in this study were student worksheets and learning videos. The subjects in this study were seventh grade junior high school students. Data processing techniques consist of analysis of the results of the validation of material experts and ICT experts, practicality analysis obtained from the results of filling out questionnaires for student responses to teaching materials, and effectiveness analysis obtained from the results of students' mathematical understanding ability tests. The results of this study are student worksheets and learning videos developed that meet the criteria of being very valid, very practical, and very effective for improving mathematical understanding skills. The developed teaching materials can be used by teachers so that students are able to easily understand the concepts in the area of triangles and quadrilaterals.

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INTRODUCTION

Students' mathematical comprehension skills are an important goal in learning because students who have an understanding of mathematics will have a solid foundation or foundation in learning mathematics. Nirmala (2019) said that a person's mathematical knowledge will develop if the person can build understanding on every mathematical learning

activity. The material received by students is not only to be memorized but to enable the development of further mathematical knowledge. Students who have a mathematical understanding have a solid foundation in their understanding. If the student forgets the formula in the math problem, the student who understands still has the opportunity to solve the correctness of the result he got by solving the problem without using the formula. This is under Santrock's statement (2007) that understanding concepts is a key aspect of learning. Similarly, understanding mathematics is an important foundation for thinking in solving mathematical problems and real-life problems.

According to the regulation of the Depdiknas (2004) students are considered to understand if students can:

1. Restating a concept;
2. Develop the necessary terms or sufficient conditions of a concept;
3. Present concepts in various forms of mathematical representations;
4. Classifying certain objects according to their properties; and
5. Use and utilize and choose a specific procedure or operation.

Hiebert & Carpenter (1992) stated that the lack of understanding in mathematics often makes students lose interest and affects their learning development. Students who lose interest in mathematics will feel bored, eventually, students will have difficulty learning mathematics, which in turn will affect the student's achievement. Based on research by Putri, Nursyahban, Kadarisma, & Rohaeti (2018), students' mathematical understanding abilities, especially on triangles and quadrilaterals material, are still relatively low. And based on research by Nusaibah, Pramudya, & Subanti (2021) student's mathematical understanding abilities on triangles and quadrilaterals materials still low.

To realize this, it is necessary to package a learning product in the form of teaching materials that can influence the achievement of students' mathematical understanding abilities and self-concepts. Prastowo (2011) said that all forms of materials are used to assist teachers or instructors in carrying out the learning process in class. Given the need for a learning method with teaching materials that can trigger students' creativity and activity to find concepts independently, teaching materials are developed using learning methods that can encourage active students, and learning is carried out by students. One of the learning methods that can make students active is the discovery learning method. This agrees with Depdikbud (2014) which states that applying discovery learning repeatedly can increase the individual's self-discovery ability.

In addition to the methods used, of course, ICT-based interactive teaching materials are also needed that support these methods to help learning activities reach their goals. Oktaviyanthi & Supriani (2015) said that the use of interactive teaching materials, especially in integrating mathematics software, can make it easier for students to understand concepts. One technology in learning mathematics that can be utilized is GeoGebra.

The use of discovery learning assisted by GeoGebra can change passive learning conditions to be active and creative. Not only makes students active in learning activities, but discovery learning methods also encourage students to be able to develop critical, logical, systematic, and creative thinking skills. In addition, by using GeoGebra students are expected to be able to learn independently even without formal teaching. Students can explore their abilities in using this software (Lestari, 2018). Based on research conducted by Septian & Prabawanto (2020) that learning with GeoGebra was able to improve mathematical representation and

understanding abilities. And based on research by Batubara (2019) Geogebra-assisted discovery learning was able to improve critical thinking and understanding abilities. There's why Geogebra-assisted discovery learning worth to use to improve understanding ability.

Learning with the discovery learning method assisted by GeoGebra requires students to find new things for themselves in the form of concepts, procedures, and so on that are learned by students. The discovery made by the students doesn't mean that the discovery is new because it has been found before and has been known by the teacher. In the process of finding, students make guesses, guess, and try according to their experiences to arrive at the information that must be found. The results of learning with discovery are the result of students' creativity so that this learning outcome will be durable.

With the development of teaching materials using the GeoGebra-assisted discovery learning method, it is hoped that students will further develop their mathematical understanding skills. The ability to understand mathematics is related to the discovery learning method because this method requires students to find a concept, when students have found the concept, students have understood the material. This is in line with Purwatiningsi (2013) which states that through the discovery process, students are required to use the ideas and understanding they already have to find something new. Thus, learning with the discovery method allows students to understand what is learned well. The research by Beti (2016) showed that students' mathematical understanding abilities can be increased by using the discovery learning method, and by using Geogebra, they can change the abstract view of triangles and quadrilaterals into real ones.

METHOD

The method used in this study is research & development with the ADDIE development design (Analysis, Design, Development, Implementation, and Evaluation). The development steps in this study are illustrated by the following diagram:

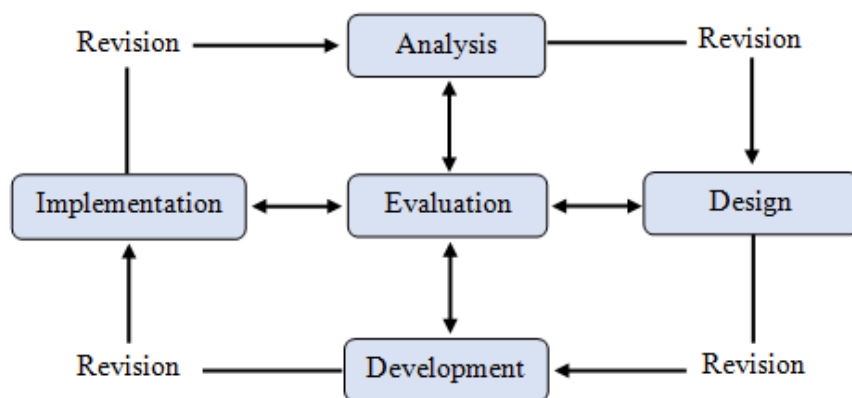


Figure 1. ADDIE Model Development Research Steps of This Study

The subjects in this study were students of SMP PGRI 1 Cimahi, with the subject in the limited test 29 students in grades 7-F, in the broad test 59 students in grades 7-G and 7-H, and the product test of 60 students in grades 7-I and 7-J. Limited, broad, and product trials were conducted in eight meetings.

The instruments used in this study were a list of interviews, validation questionnaires, student response questionnaires to teaching materials, and mathematical understanding ability test questions. Interviews were conducted with teachers who teach mathematics as a preliminary study to identify potential problems. Then validation questionnaires were given to material

experts and ICT experts as material for reviewing the validity of the development of teaching materials, questionnaire responses to teaching materials were given to students as a review of the practicality of teaching materials, and tests of mathematical understanding abilities are given to students after students get learning using teaching materials developed by researchers as material for reviewing the effectiveness of teaching materials on students' mathematical understanding abilities.

The Likert scale is used to measure the validity (Ruseffendi, 2010). This validation uses an assessment with five levels as follows:

Table 1. Score of Statement Likert Scale Validity

Statement	Score
Very Good	5
Good	4
Enough	3
Bad	2
Very Bad	1

Then, to measure the practicality of the results of student responses, the Likert scale is used (Ruseffendi, 2010). To avoid students' neutral answers (N), the researcher deletes the neutral statements (N) as follows:

Table 2. Score if Statement Likert Scale Practicality

Statement	Positive Statement	Negative Statement
Very Agree	4	1
Agree	3	2
Disagree	2	3
Very Disagree	1	4

Data analysis uses percentages for validity, practicality, and effectiveness using the following formula (Yudhanegara & Lestari, 2017):

$$P = \frac{f}{n} \times 100\%$$

Explanation

$\overline{P}$: Percentage of answers

$\overline{f}$: Answer frequency

$\overline{n}$: Respondents

The results of validity, practicality, and effectiveness obtained are then interpreted according to the following categories:

Table 3. Category Percentage of Answers

Pernyataan	Kategori
$0\% < x \leq 20\%$	Very Low
$20\% < x \leq 40\%$	Low
$40\% < x \leq 60\%$	Enough
$60\% < x \leq 80\%$	Good
$80\% < x \leq 100\%$	Very Good

RESULTS AND DISCUSSION

Results

This research begins with the analysis stage, this stage is carried out as an initial preliminary study to identify potential problems, the need for the development of teaching materials, and the collection of information about the importance of students' mathematical understanding abilities. Beginning with the formation of a research team, the researchers then drafted interviews with teachers as a source of problem identification. From the results of the interviews, several things were concluded, that:

1. Teachers still have difficulties in overcoming students whose mathematical understanding abilities are relatively low, especially on triangles and quadrilaterals which have a wider scope;
2. Simplifying the discussion of the material and providing a more realistic visual picture so that it can be understood by students is one that may be applied in the preparation of teaching materials;
3. Learning does not run actively, students do not contribute to learning, so learning methods are needed that make students active; and
4. During the Covid-19 period, learning is carried out remotely, not all students can use google meetings or zoom meetings because of the limited quota students have, so teaching materials are needed that can be used independently by students and can be used repeatedly.

After the analysis stage has been completed, the design stage is carried out to design teaching materials to obtain an initial draft. The teaching materials that would be developed are worksheets and learning videos with the GeoGebra-assisted discovery learning method which aims to be attractive teaching materials and provide convenience for students in learning. In addition to used google meetings, researchers designed learning videos as a media, this is intended so that students who cannot attend google meetings could still participate in learning, and students who have attended google meetings can also repeat learning. For students to stay active in learning activities, researchers designed student worksheets based on the discovery learning method, which aims to enable students to find their formulas for the area of triangles and quadrilaterals by looking at the transformations/changes of triangles and quadrilaterals without reducing the size of the area on the GeoGebra display. The following are the results of the design and development of teaching materials carried out by researchers:

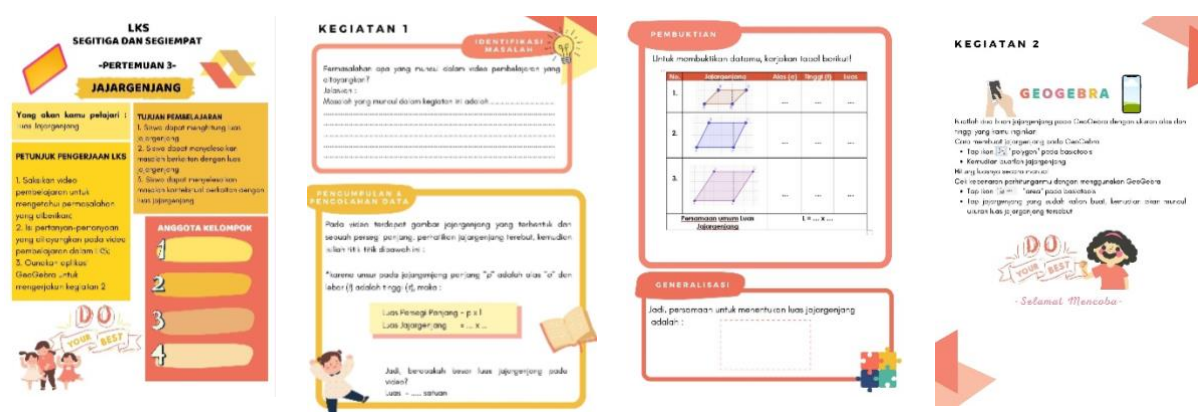


Figure 2. Student Worksheet Product Design



Figure 3. Learning Video Product Design

The teaching materials that have been designed are then validated by material experts and ICT experts (development step). Validation by material experts was carried out by one of the IKIP Siliwangi lecturers and two mathematics teachers at SMP PGRI 1 Cimahi, the following are the results of the initial validation by material experts:

Table 4. Teaching Material Validity Test Results by Material Experts

Aspects Observed	Percentage	Category
Material requirements conformity	93,33%	Very Good
Didactic requirements conformity	83,33%	Good
Construction requirements conformity	88,33%	Very Good
Technical requirements conformity	88%	Very Good
Mean	88,25%	Very Good

Based on Table 4, the validation of teaching materials based on the material reached 88.25% with a very good category, meaning that the teaching materials in the form of the content of the material on the worksheets and learning videos that were designed could be said to be very suitable to be used for learning on the area of triangles and quadrilaterals.

Then, to review the validity of ICT-based teaching materials, validation scores were given by an ICT expert conducted by one of the lecturers of IKIP Siliwangi, and one of the presenters of P4TK 2021 in the field of GeoGebra, here are the results of the validation by ICT experts:

Table 5. Teaching Material Validity Test Results by ICT Experts

Aspects Observed	Percentage	Category
Software: GeoGebra		
Visual display	80%	Good
Educative	88,33%	Very Good
Teaching Materials: Learning Videos		
Visual display	90%	Very Good

Accessibility and educative	90%	Very Good
Audio element	90%	Good
Mean	87,67%	Very Good

Based on Table 5, the validation of teaching materials based on ICT reached 87.67% with a very good category, meaning that the teaching materials in the form of videos that were designed could be said to be very suitable to be used for learning in the area of triangles and rectangles.

After getting the validation results at the development stage, then the implementation stage is carried out, given teaching treatment with teaching materials that have been developed to students, then students are asked to fill out a response questionnaire to see how practical these teaching materials are used by students at each meeting. Here are the practical results:

Table 6. Practical Test Results by Students

Meeting Class	Percentage	Category
1	79,89%	Good
2	81,27%	Very Good
3	80,78%	Very Good
4	81,08%	Very Good
5	79,91%	Good
6	80,57%	Very Good
7	81,59%	Very Good
8	79,32%	Good
Rata-Rata	87,67%	Very Good

Based on Table 6, it can be seen that the average practicality value by students reached 87.67% with a very good category. That is, teaching materials based on the GeoGebra-assisted discovery learning method developed by researchers are very practical for students to use at every meeting.

Then after we got the practical results, the teaching materials were then tested for effectiveness. The effectiveness test was obtained from the results of the student's understanding ability test. Students are given five questions about the ability to understand mathematics in the form of essays, each of which is arranged based on indicators of mathematical understanding. The effectiveness test is said to be effective if more than 60% of students in one class can achieve the KKM score (KKM = 71). The following are the results of the test of the effectiveness of teaching materials:

Table 7. Effectiveness Test Results

Number of Students Reached KKM	Percentage	Category
25	83,33%	Very Good

Based on Table 7, it can be seen that the percentage value reached 83.33% with a very good category. Of the 30 students, 25 students passed the KKM score and the percentage value of effectiveness reached more than 60%, this means that the teaching materials developed by the researchers are effectively used in learning activities to improve students' mathematical understanding skills in the area of triangles and quadrilaterals.

Teaching materials that have been validated and tested then evaluated, to serve as a review chart of what things should be improved on the developed teaching materials. At the evaluation stage, it was found things that needed to be improved and added to the teaching materials were as follows:

1. Adding the writing of learning objectives and steps for working on worksheets in the learning video;
2. Fix the student answer column on the worksheets;
3. Add steps to use GeoGebra with the device on the worksheets;
4. Fixed the illustration of the area of a rectangle in the learning videos; and
5. Adding the teacher's explanation voice on the learning videos.

These things are then corrected and get maximum results by reviewing the results of validity (Tables 4 and 5), practicality (Table 6), and effectiveness (Table 7).

Discussion

Based on data processing of the teaching materials developed in the form of worksheets and learning videos, it was concluded that the teaching materials on the area of triangles and quadrilaterals based on the GeoGebra-assisted discovery learning method that had been developed by researchers in terms of the results of validity by material experts and ICT experts reached the "very good" category. valid". Based on the results of the assessment of students for their responses after using these teaching materials, overall it can be stated that the teaching materials developed fall into the "very practical" category. Then, on the results of the effectiveness test, which the researchers did to students, by giving a test of students' mathematical understanding abilities, they reached the "very effective" category because 25 out of 30 students were able to do the mathematical understanding ability test seen from the value that exceeded the KKM score of 71.

Based on these results, the development of teaching materials based on the GeoGebra-assisted discovery learning method is very well used to improve students' mathematical understanding skills in the area of triangles and quadrilaterals. This is following research conducted by Haryanti & Saputro (2016) which develops teaching materials for the learning process-oriented to the ability to understand mathematical concepts which result in that the teaching materials developed are in a very good category so that the test results of students' mathematical understanding abilities reach high numbers thanks to the developed teaching materials. Similarly, the research conducted by Pratikno (2020), with the title "Improving the Learning Achievement of Junior High School Students Using Guided Discovery Learning Methods in Mathematics Learning" concluded that in the cognitive aspect, the percentage of students who met KKM 70 reached more than 75% of students. This means that learning with the guided discovery learning method makes the percentage of KKM achievement fulfilled. And based on research conducted by Ramdhani (2017), with the title "Development of Triangle and Quadrilateral Broad Concept Learning Media Based on GoeGebra Software" concludes that the results of developing broad learning media are valid based on content, language, and the appropriateness of the context used and practical based on ease of use. student.

CONCLUSION

Based on the results of the processing, it can be concluded that teaching materials in the form of worksheets and learning videos on the area of triangles and quadrilaterals using the discovery learning method assisted by GeoGebra are in the very valid category, teaching

materials in the form of worksheets and learning videos on the area of triangles and quadrilaterals using the discovery learning method assisted by GeoGebra are in the very practical category, and teaching materials in the form of worksheets and learning videos on the area of triangles and quadrilaterals using the GeoGebra-assisted discovery learning method is in the very effective category for improving students' mathematical understanding abilities.

Teaching materials with GeoGebra-assisted discovery learning method can be developed on a wider range of materials, and need to be redeveloped on other materials, in order to motivate and increase students' interest in learning in an active learning process.

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