The development of Geogebra-assisted mathematics learning media on geometry of space flat-side of cubes and blocks

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Abstract. The purpose of this research is to develop the mathematics learning media assisted by Geogebra on Geometry of space flat-side of cubes and blocks. This study uses the ADDIE development model, which are Analysis, Design, Development, Implementation and Evaluation. The subjects of this study were students of class VIII SMP. The results of the study based on the validation of media experts and material experts show that this Geogebra-assisted learning media is appropriate and suitable for use in the mathematics learning process. Meanwhile, based on the evaluation by the teacher, this developed media achieved practical criteria. The overall student response to this learning media is in the very positive category with a percentage of 87.1%. Thus it can be concluded that the Geogebra-assisted mathematics learning media is feasible, valid and practical to be used in mathematics learning on geometry of space flat-side of cubes and blocks.

1. Introduction
The Mathematics is as a branch of science that is important for students to be mastered, because it is able to develop thinking power and can be used to solve problems in everyday life. Learning mathematics is often considered difficult, because the difficulty of students learning mathematics is caused by its abstract nature and requires good conceptual understanding skills [1]. The ability to understand concepts has a huge influence on the learning process. The effectiveness of student success in understanding the concept can be achieved through the use of learning methods or media that are able to actively engage students by optimizing the use and use of media in the learning process.

The facts in the field show that the use and utilization of learning media is still lacking, especially in learning flat-sided shapes, because it is only limited to a presentation on a written board or a PowerPoint which contains an explanation of the unanimated flat-sided figure of cubes and blocks.

The material of the flat-side shapes contains abstract concepts so a medium is needed that is able to connect conceptual understanding between teachers and students. Learning media as an intermediary between teachers and students in understanding learning material so it is more effective, complete and attracts students' interest in further learning. The presence of learning media not only helps teachers in delivering their teaching materials, but provides added value to learning activities [2].

One of the learning media that can be used is computer-based learning media, which is using the Geogebra application. Geogebra is a dynamic geometry software which includes material geometry, algebra and calculus. Geogebra is functions as a medium for learning mathematics with various activities including visualization media that can help students to understand the material and assist students in the process of concept discovery. Through this geogebra-based learning media, it is hoped that it can make
easier for students to understand the concept of flat-sided space because there are moving animations that are able to make students understand the elements of flat-sided shapes [3].

Geogebra is a very useful tool as a medium for learning mathematics in the following ways:

- Geogebra as a medium for demonstration and visualization. In this case, in traditional learning, the teacher uses Geogebra to demonstrate, visualize certain mathematical concepts.
- Geogebra as a construction aid. In this case Geogebra is used to visualize the construction of certain mathematical concepts, for example constructing an inner circle or an outer circle of a triangle.
- Geogebra as a tool for the discovery process. In this case Geogebra is used as a tool for students to find a mathematical concept, for example the place and position of points on cubes and blocks.
- Geogebra as a tool for preparing teaching materials. In this case, Geogebra encourages teachers to prepare teaching materials for the learning process and use them as a means of collaboration, communication and representation [4].

Based on this description, the researcher intends to develop a mathematics learning media on the material of the flat-side space of cubes and blocks using the Geogebra application.

2. Research methods
This research was conducted on class VIII students of SMP Negeri 3 Limboto Barat. The development model in this research is the ADDIE development model which the stands for Analysis, Design, Development, Implementation, and Evaluation. This model was developed by Dick and Carrey to design a learning system. The following stages of learning media development will be carried out using the ADDIE model:

2.1. Analysis
Pre planning: thoughts about the new products (models, methods, media, teaching materials) that will be developed. Identifying the products that is suitable with the goals of students, learning objectives, identifying learning content / material, identifying learning environments and delivery strategies in learning.

2.2. Design
In this stage the researcher designs the new product concepts on paper, designs the new product development tools. Then a design is written for each learning unit. the instructions for implementing the design or manufacture of the product are written in detail.

2.3. Development
Developing the product tools needed in the development based on the product design results, at this stage the products are made that suitable with the model structure. Create an instrument to measure product performance.

2.4. Implementation
Get started with using a new product in a real learning or environment. Looking back at the objectives of product development, interactions between students and asking for feedback early in the evaluation process.

2.5. Evaluation
Look back at the impact of learning in a critical way. Measuring the achievement of product development goals, measuring what the targets that have been able to achieve [5].

Data collection in this study used an interview guide instrument, observation sheets, validation sheets that consist of validation media experts and material experts and questionnaire sheets that consist of media evaluation questionnaire sheets by the teacher and student response questionnaire sheets.
This is the following steps for data analysis techniques for the media and material observation sheets that used in this study:

- Quantitative data from media experts and material experts compiled at intervals of 0 to 4, 0 = Unsuitable, 1 = Inadequate, 2 = Sufficiently Suitable, 3 = Suitable, 4 = Very Suitable and the average score will be calculated for each statement items in the validation sheet obtained by the formula:

\[
\text{average score} = \frac{\sum_{i=1}^{n} X_i}{m}
\]

\[
\text{Total average score} = \frac{\text{average score}}{\text{the number of aspects}}
\]

Note: \(X_i\) = the score of the 1 validator

\(m\) = Number of validators

- Convert the average score obtained into qualitative values according to the following table 1:

| Interval Skor | Criteria          |
|--------------|-------------------|
| The of average validation results > 3,40 | Strongly valid |
| 2,80 < The of average validation results ≤ 3,40 | Valid |
| 2,20 < The of average validation results ≤ 2,80 | Neutral |
| 1,60 < The of average validation results ≤ 2,20 | Weakly Valid |
| The of average validation results ≤ 1,60 | Invalid |

Sorce: Widyoko [6]

Data in the form of suggestions from the validator are used to revise each media component that has been made. This qualitative technique is also carried out to determine the validity of the media with the following assessment criteria:

1 = feasible to production without revision
2 = feasible to production with revision
3 = not feasible to production

The media developed is said to have a good validity value, if the minimum criteria achieved are valid and at least the validator states that the learning media is feasible to be produced with revisions.

This is the following steps for the data analysis technique for the student response questionnaire sheets used in this study:

- Give a score for each statement item in the questionnaire based on the alternative answers given as in the following table:

| Category         | Score |
|------------------|-------|
| Strongly agree   | 4     |
| agree            | 3     |
| Neutral          | 2     |
| Disagree         | 1     |
| Strongly disagree| 0     |

- Calculating the percentage of the response for each aspect. The percentage of response for each aspect is calculated using the following formula:
\[ Ri = \frac{\sum_{j=1}^{n} P_j}{\text{the maximum score of the } j\text{ – aspect}} \]

Note: \( Ri \) = Percentage of response in the I aspect  
\( P_j \) = score of the j respondent  
\( n \) = number of respondents

- Calculating the average percentage of the total. The average percentage of the total is calculated using the following formula:

\[ RT = \frac{\sum_{i=1}^{m} R_i}{m} \]

Note: \( R_i \) = Percentage of response to the I aspect  
\( m \) = number of aspects

- Determine the response category based on the percentage obtained. The response categories used are as follows:

**Table 3. Student response categories.**

| Interval Score | Category         |
|----------------|------------------|
| 85% ≤ RT       | Strongly positive|
| 70% ≤ RT < 85% | Positive         |
| 50% ≤ RT 70%   | Neutral          |
| RT < 50%       | Not positive      |

Note: \( RT \) = Average percentage of responses

From these data, it can be seen that students' responses to the media that have been developed. Student responses are said to be positive if 70% or more of students respond in the minimal category positive for each aspect.

3. Research results and discussion

In this section, the results of the media evaluation questionnaire by the teacher will be described and the student response questionnaire to class VIII students of SMP Negeri 3 Limboto Barat as shown in table 4 and table 5.

**Table 4. Results of media evaluation by teachers.**

| No. | Assessment Aspects          | Average | Criteria |
|-----|-----------------------------|---------|----------|
| 1   | Content Quality and Purpose | 3,40    | practical|
| 2   | Media Quality               | 3       | practical|
| 3   | Learning quality            | 3       | practical|

**Table 5. Student response questionnaire results.**

| number of students | average (%) | Response Category |
|--------------------|-------------|-------------------|
| 18                 | 88%         | Positive          |

Based on table 4, the results of the teacher's evaluation of the media developed achieve practical criteria. Meanwhile, based on table 5, the results of the student response questionnaire show that the average
percentage of the total of all aspects is 87.1%. This shows that most students respond very positively to the use of this Geogebra-assisted mathematics learning media. Thus the Geogebra-assisted mathematics learning media fulfills the criteria of practicality and is accepted and has quality as a medium used in the mathematics learning process. Even these results indicate that the Geogebra learning media developed can attract and direct students' attention to concentrate on learning content. This is in accordance with the view of Levie and Lentz which suggests four functions of learning media, especially visual media, namely (1) attention function, (2) affective function, (3) cognitive function, and (4) compensatory function [7]. These four functions are implemented in Geogebra media. Furthermore, Levie and Lentz stated that learning media through visual symbols or images will facilitate the achievement of goals to understand and remember information or messages contained in images, as well as provide context for understanding text in helping students who are weak in reading, organize information in text and recall it [7].

This media is made as well as possible so that students are able to interact directly with the media. In addition, this media can also be accessed online via cellphones or laptops so that students can access this media anywhere and anytime. Therefore, this media is able to increase students' learning motivation in studying the material of flat side cubes and blocks so that it affects the ability to master the concept.

4. Conclusion
Based on the results of the research and discussion, it can be concluded that the learning media assisted by the Geogebra application which were developed were practical and received positive responses from teachers and students and were effectively used in learning mathematics in the classroom.

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