

Development of Mobile-Based Learning Media to Improve Creative Thinking Abilities and Learning Interest of Middle School Students

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ABSTRACT

Mathematics, a compulsory subject from elementary school, is essential for developing critical thinking, reasoning, creative thinking, communication and collaboration. However, the ability mentioned above in Indonesian students is still low, as evidenced by the results of PISA and TIMSS. The 4C capabilities, which consist of Critical Thinking, Reasoning, Creative Thinking, Communication, and Collaboration, are very important for 21st century learning. To improve the ability to think creatively, it is necessary to have an innovation that has an impact on student learning outcomes, one of which is through learning media. Geometry, a popular subject in junior high school mathematics, poses challenges for students. This study to improve creative thinking skills and geometry learning media, researchers developed mobile-based geometry learning media using the ADDIE model. The process of developing mobile-based geometry learning media is carried out through the stages of analysis, design, development, implementation and evaluation. Learning using learning media that has been developed is classified as effective. Students can master the material presented in learning using mobile-based geometry learning media.

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Introduction

Mathematics as a compulsory subject taught to students since elementary school aims to equip and prepare students with various thinking abilities, one of which is the ability to think creatively. However, in fact, the mathematical abilities of students in Indonesia can still be said to be very low (Andiyana, *et al.*, 2018; Marasabessy, 2021; Purwitaningrum & Prahmana, 2021). This can be seen from the 2018 PISA report which is carried out every three years to compare the mathematics, reading and science performance of each student. Based on the 2015 TIMSS results, it shows that the mathematics ability of Indonesian students is ranked 44th out of 49 countries with a score of 397 (Hooper, *et al.*, 2013; Dewi, 2022). The basis for measuring TIMSS mathematics and science consists of 2 domains,

namely the content and cognitive domains. The content domain of mathematics consists of algebra, numbers, geometry, data and probability. For the cognitive domain, namely knowledge, application and reasoning.

The fact regarding the low PISA and TIMSS results in the field of mathematics in Indonesia indirectly shows that students in Indonesia still have weaknesses in mathematical cognitive abilities even though in practice these abilities have been trained through the mathematics learning objectives in the curriculum. Apart from that, referring to the demands of 21st century learning, students are also expected to be able to have and develop 4C abilities which are generally known as Critical Thinking and Reasoning, Creative Thinking, Communication and Collaboration. The ability to think creatively is one of the 21st century competencies that today's people need to have. However, students' creative thinking abilities in learning receive little attention and are not even a top priority for some teachers. In fact, students' creative thinking abilities must be considered because they have a very important role in learning mathematics (Anggraeni, *et al.*, 2018; Khalid, *et.al.*, 2020; Yayuk & As' ari, 2020; Bicer, 2021). Moreover, the ability to think creatively is not only needed to face problems in learning mathematics, but is also needed to face problems in real life (Eviliasani, *et al.*, 2018; Glăveanu & Beghetto, 2021; Plucker & Guo, 2021; Rigolot, 2020). However, in reality, students' creative thinking abilities in solving mathematical problems are still relatively low. Interest has a very important role in student learning development.

Several studies state that learning media is very important in the process of learning activities. A decreasing level of use of learning media will have an impact on student interest in learning and student learning outcomes. Geometry is one of the areas of study in junior high school mathematics material that gets a larger share of study by students at school compared to other materials such as algebra, numbers, statistics and probability. However, several research results show that students have difficulty learning geometry. Students' geometry achievements are still low, there are still many students who have difficulty understanding geometric concepts (Amrina & Karim, 2013)

Based on the background above regarding the importance of mathematical creative thinking abilities and learning media, the needs and conditions of existing learning media, it is necessary to make real efforts to create new learning media as a solution for current learning. To realize this learning media, research will be carried out with the title development of mobile-based geometry learning media to improve the creative thinking ability and learning interest of middle school students.

Method

This research is development research oriented towards product development. The product produced is mathematics learning media, in the form of a mobile-based geometry learning application. In this development research, researchers used the ADDIE (Analyze, Design, Development, Implementation, Evaluation) model in developing mobile-based geometry learning media to improve junior high school students' creative thinking abilities and interest in learning, using the ADDIE model. The ADDIE model is used with the consideration that it has advantages in its systematic work stages, each phase is evaluated so as to produce a valid product in accordance with user needs and expectations.

The ADDIE model uses 5 simple stages/steps in its work, namely (Branch, 2009):

1. Analyze

This is the stage for carrying out an analysis of needs to determine problems and appropriate solutions and determine student competence. The activities carried out at

this stage are identifying problems and potential solutions and collecting information to support planning for the development of mobile-based geometry learning media.

2. Design

This is a stage in designing learning media that suits your needs. The activity carried out at this stage is designing mobile-based geometry learning media as a solution to the problems faced by students.

3. Development

The learning media production process is in accordance with the design that was produced in the previous stage. The activities carried out at this stage are developing learning media according to the design that has been created. Based on validation and small-scale product trials.

4. Implementation

Stages of implementing the learning media that have been developed. The mobile-based geometry learning media developed is used in classroom learning. There were three classes of students involved at this stage. After learning, students are given a creative thinking ability test and a learning interest questionnaire. At this stage, researchers and teachers take steps to guide students to achieve the ability that is measured to increase.

5. Evaluation

Special stages for evaluating the learning media that have been developed. The activity in this final stage is processing data after learning. The data analyzed are the results of creative thinking ability tests and questionnaires about students' learning interest in learning media. As well as revising/improving learning media until it meets research objectives. Revisions were carried out by considering test data on creative thinking abilities and students' learning interests. The evaluation results can be used as input for making improvements.

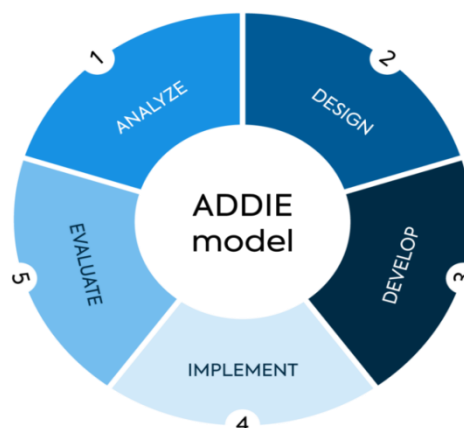


Figure 1. ADDIE Model

Results and Discussion

Research was carried out at one of the State Middle Schools in West Bandung Regency in May 2023 for 1 month. The research carried out uses product development-oriented development. The following is a description of the stages of this research adapted from the ADDIE concept:

Analysis Stage

This stage is carried out with the aim of identifying potential and problems as well as collecting information regarding the materials that will be used to support product planning which is expected to overcome these problems. At this stage the researcher discovered the fact based on the results of interviews with teachers and students, that the teaching materials most often used to support the learning process were Electronic School Books (BSE). One of the mathematical materials presented at BSE which is closely related to learning media and creative thinking skills is the flat-sided geometric material. In general, the use of books is considered adequate, but the use of learning support media still needs improvement. These findings indicate that the use of mobile-based geometry learning media to help students better understand the topic of plane geometric figures is very appropriate to develop.

Design Stage

The design stage is the stage for developing content on learning media and instruments needed in this research. The learning media developed is in the form of mobile-based geometry learning media application products and creative thinking ability test instruments as well as student learning interest questionnaires. The process of designing learning media is carried out by adjusting the results of preliminary studies, analyzing media needs for teachers and students. The first stage in designing mobile-based geometry learning media is a concept map. The concept map contains an outline of the scope of learning material contained in mobile-based geometry learning media (geomath application). The display of the concept map created can be seen in Figure 2.

After being designed simply with a concept map using Ms. Word, next is learning media which is still in the design stage. The final design of Mobile Based Geometry Learning Media has been tested and improved according to expert advice.

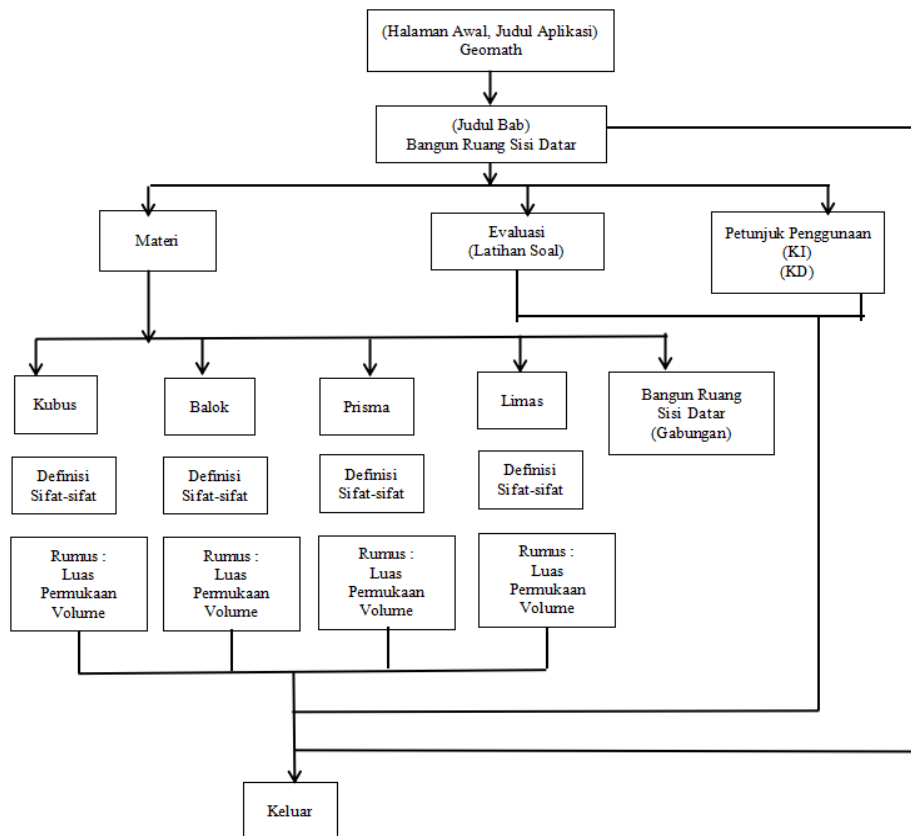


Figure 2. Concept Maps

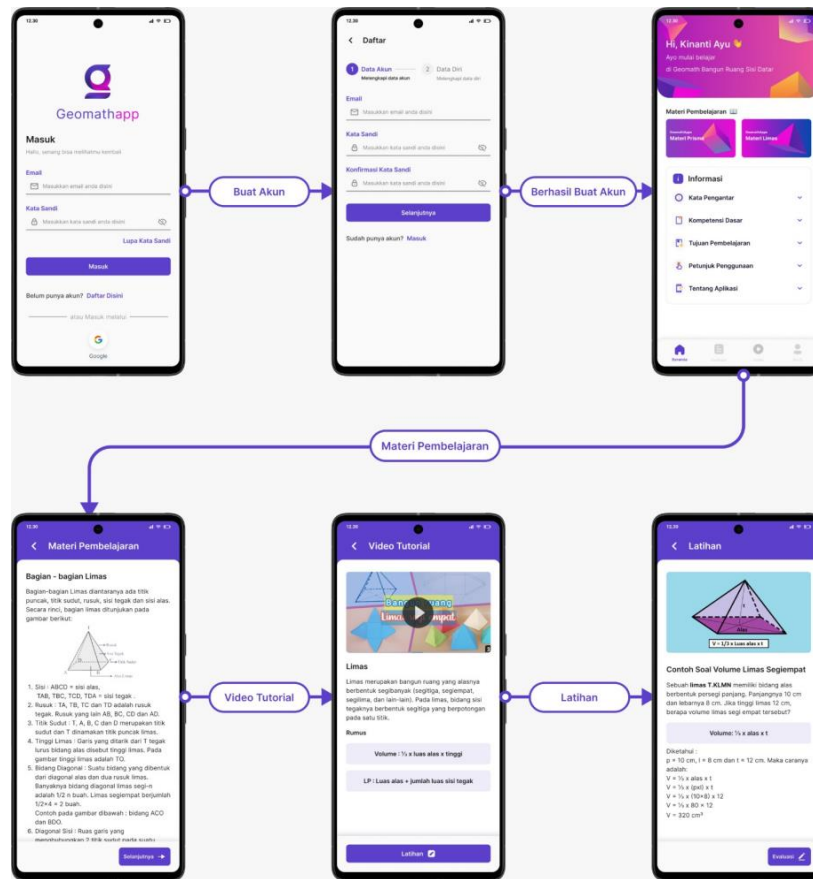


Figure 3. Mobile-based Geometry Learning Media

Development Stage

At this stage, the learning media that has been designed and improved at the design stage is then developed by implementing the software development life cycle. Then, the application that has been developed is submitted to the validator to receive an assessment as well as additional suggestions and comments so that it can be improved again before being given to students at the deployment (implementation) stage. Providing assessments from validators will also be very useful for increasing the level of trust in the learning media that is being developed. The instruments provided by the experts were developed based on guidelines and aimed at linguists, media experts and material experts.

In detail, the results obtained from the instruments provided by the validator are as follows:

Table 1. Validator Assessment of Mobile-Based Geometry Learning Media

Expert Validator	General Assessment	Empirical Score Validation	Validation Criteria
Linguist	Worthy	77.5%	Very valid
Media expert	Very worthy	93.3%	Very Valid
Material expert	Worthy	90.9%	Very Valid

After receiving suggestions from the validator, the learning media was revised again and adjusted its content so that it became a more interactive learning media that was suitable for distribution to students.

Implementation Stage

The implementation stage is the final stage in developing mathematics learning media applications on flat-sided geometric material. This stage is characterized by introducing and distributing applications that have been designed and validated to target users of learning media applications. The process carried out is by distributing learning media application products to three classes in eight grades at one of the junior high schools in West Bandung Regency.

In total there were 5 meetings used for learning and two meetings for carrying out pre-tests and post-tests on students' creative thinking abilities and filling out student interest questionnaires regarding learning using mobile-based geometry learning media applications. The students involved in the implementation stage were 3 classes (90 students) in the experimental class and 2 classes (66 students) in the control class using conventional learning.

Evaluation Stage

The activity in this final stage is processing data after learning. The data analyzed are the results of creative thinking ability tests and questionnaires about students' learning interest in mobile-based geometry learning media. Another activity in this stage is revising or improving mobile-based geometry learning media until it meets the expected goals.

Based on interviews conducted with students after the implementation process, it was found that experimental class students felt very helped by the use of mobile-based geometry learning media (geomath application). This is because the geomath application provides visual reinforcement so that students' interest and attention is maintained during learning. Apart from that, the depiction of flat-sided spatial shapes feels more real than the one on the blackboard or textbook. Mobile based could improved students' creative skills rather than using textbook because it consists of attractive layout which increase their motivations (Cahyono, *et.al.*, 2020; Açıkgül & Şad, 2021; Septian, *et.al.*, 2020).

The following shows a comparison of the percentage increase in students' creative thinking abilities in the experimental class and the control class based on the indicators in diagram 1 as an additional analysis in looking at the quality of the increase in creative thinking abilities.

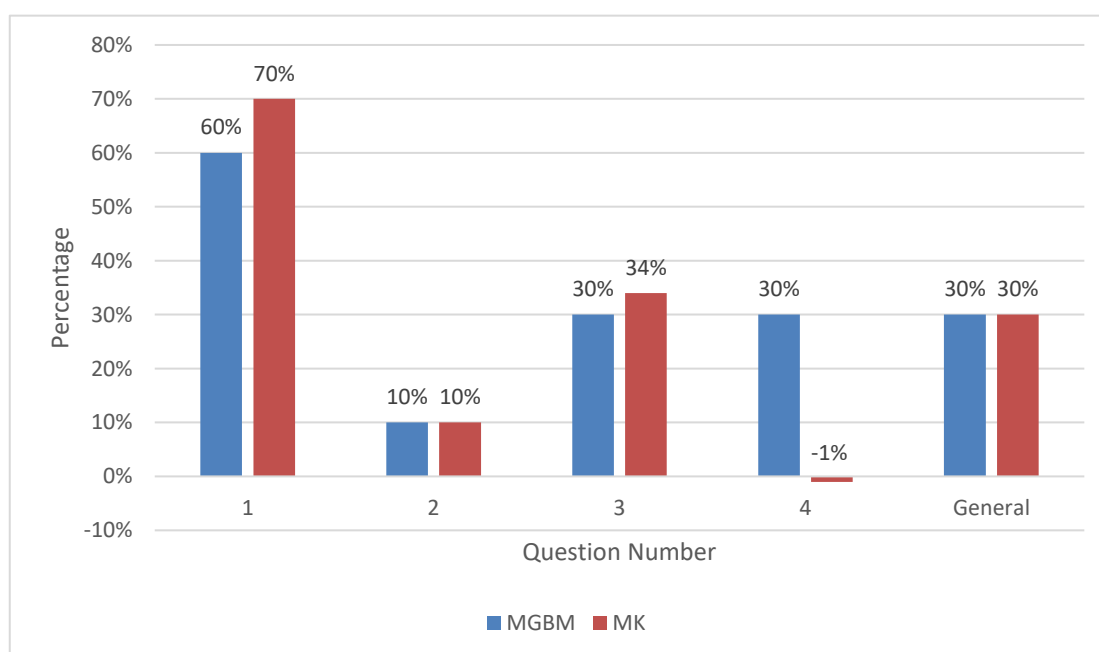


Figure 4 Percentage of Increase in Creative Thinking Ability Based on Indicators

Based on figure 4, the first indicator used is fluency, the second is flexibility, originality and the last is elaboration. The biggest difference between the two classes occurred in the 4th indicator of the elaboration aspect, namely students were able to detail the details of an object to produce an answer. This is because in experimental classes students are used to being trained with questions that require students' creativity in detailing possible answers.

Based on the results of the analysis carried out, it can be seen that the learning interest of students who use mobile-based geometry learning media is better than students who receive conventional learning as a whole. The following student interest scores are presented in the table below:

Table 2. Recapitulation of Experimental Class and Control Class Learning Interest Scores

No.	Indicator	Experimental Class	Control Class	Ideal Score
1.	There is a feeling of joy	3.43	3.04	5
2.	There is an interest in learning	3.49	3.14	5
3.	Pay attention when studying	3.80	3.54	5
4.	There is involvement in learning	3.31	2.92	5

The indicators mentioned above can be used as a benchmark for increasing interest in learning, which will have a positive impact on student learning achievement.

Based on the data obtained at the analysis stage, it is known that the need for learning support media such as mobile-based geometry learning media (geomath applications) is one way to make the learning process better and also interesting. Furthermore, the presence of mathematics learning media also has a great influence on the success of the learning process (Wijaya, *et.al.* 2016; Rachmavita, 2020; Yaniawati, *et.al.*, 2020).

The importance of education that leads and is relevant to the needs of students in the future makes the term 21st century learning one of the very important aspects to get serious attention today. Based on several considerations of these conditions and challenges, finally the development of this learning media is expected to be the right solution to be one of the solutions to the learning challenges faced by students in the 21st century. At this time, students are not only required to have an understanding of mathematics, but are also expected to be able to use their knowledge to solve various problems. Thus, the presence of mobile-based geometry learning media is expected to be a solution to these problems.

Conclusion

The stages of developing learning media successively include the stages of analysis, design, development, implementation and evaluation. The analysis stage is carried out to identify potential and problems as well as appropriate solutions as well as determining student competency and to determine basic needs for learning media and its content. The design stage is marked by the creation of an initial design for mobile-based geometry learning media. The development stage is marked by improvements to the content of the learning media based on suggestions from the validator. The implementation stage is the stage for testing learning media on students at one of the State Middle Schools in West Bandung Regency. The creative thinking ability of students who use mobile-based geometry learning media is not significantly higher than students who obtain conventional learning and the interest in learning students who use mobile-based geometry learning media is higher than students who obtain conventional learning.

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