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Research Article

Analysis of Mobile-Based Geometry Learning Media Design for Middle School Students

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Abstract.
Nowadays, a lot of students find mathematics a boring and difficult subject to follow. Geometry is one of the fields of study in middle school mathematics which gets a larger portion to be studied by students at school compared to other materials such as algebra, numbers, statistics, and probability. This is due to many concepts contained in geometry and its abstract nature, so in teaching geometry, the teacher needs to plan it well so that it can be understood by students. However, geometry is still considered one of the most difficult materials for students to understand. The use of mobile-based learning media can be an alternative as a solution to make students more active in the learning process. Based on the above background, this research will analyze and design mobile-based geometry learning media for middle school students. The research will be carried out using the design thinking method to get the needs of the target user. Design thinking is a non-linear, iterative process that teams use to understand users, challenge assumptions, redefine problems, and create innovative solutions to prototype and test.

Keywords: mobile-based learning, geometry, media design, middle school students

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1. INTRODUCTION

The regulation of the Minister of Education and Culture of the Republic of Indonesia concerning the 2013 Curriculum for mathematics subjects is included in the curriculum structure. Mathematics is one of the sciences that plays an important role in the development of science and technology. Mathematics is a subject that must be studied so that students have basic skills in life and improve thinking power. Therefore, it can be said that mathematics is very closely related to everyday life and mathematics needs to be studied at every level of education. However, until these days, there are many students who consider that mathematics is a difficult subject, boring, and some even

finds it scary. This is because there are still many students who have difficulties in doing math problems.

Geometry is one of the fields in mathematics that studies points, lines, planes, and spaces as well as their properties, measurements, and relationships with one another [1]. Geometry is one of the fields of study in middle school mathematics which gets a larger portion to be studied by students at school compared to other materials such as algebra, numbers, statistics, and probability. This due to many concepts contained in geometry and its abstract nature, so that in teaching geometry the teacher needs to plan it well so that it can be understood by students. However, in reality, geometry is still considered one of the most difficult materials for students to understand.

In addition, learning mathematics has limited space and time, where middle school mathematics learning in one week only takes 5 hours of lessons, with 1 lesson hour of only 40 minutes in which it is considered still lacking [2]. This condition was exacerbated by the COVID-19 pandemic, which forced teachers and students to carry out distance learning processes.

The learning innovation impacted from Covid-19 actually opens up new paradigm for educational institutions, which no longer describes that learning process has to undergo face-to-face session in the classroom [3]. There is an important role for online remote technology information systems in education that must be prepared to carry out the learning from home method. One alternative is to use mobile-based learning media. Mobile learning can be defined as a facility or service that provides general electronic information for learners and educational content that helps to achieve knowledge without the boundaries of location and time [4]. Mobile learning is a new learning method that maximizes the use of mobile device or smartphone technology.

The use of mobile-based learning media can be an alternative as well as a solution to make students more active in the learning process. Based on the above background, this research will analyze and design mobile-based geometry learning media for middle school students.

2. RESEARCH METHOD

In this research we use design thinking methodology to understand users, challenge assumptions, redefine problems and create innovative solutions to prototype and test. Design thinking is a design methodology that provides a solution-based approach to solving problems. Design Thinking is done to explore the problems/needs faced by

the target user so that they can determine the best solution to be able to solve them. Design thinking is very useful in overcoming complex problems by [5, 6]:

1. Understanding the needs of the people involved
2. Re-framing the problem
3. Human centered
4. Generating lots of ideas in the brainstorming session, and
5. Adopting a hands-on approach in prototyping and testing ideas.

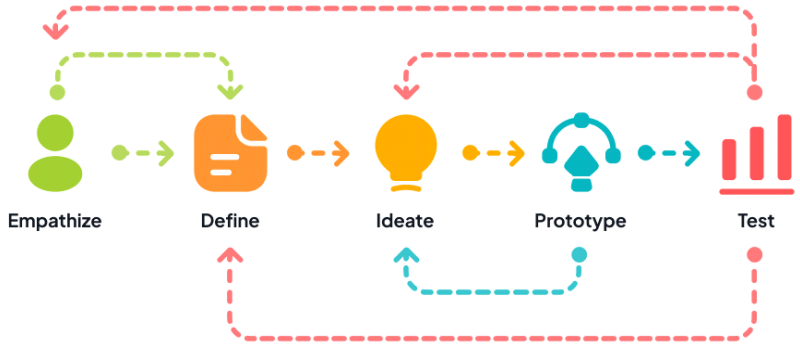

Figure 1: Flow of design thinking.

Design thinking has 5 stages, namely [5]:

1. Empathize

   At this stage, an approach is made to the target user (Students and Teachers of SMP). Empathize is done to be able to understand the needs, goals and abilities of middle school students in utilizing technology for learning media. This stage is carried out using a qualitative method through field observations of the research object of middle school students to obtain details of the problems encountered when carrying out the geometry learning process, as well as to identify the needs as solutions to these problems.

2. Define

   The information that has been collected during the empathize stage is then analyzed to determine the core problems to be solved. This stage is carried out to

define the main problems experienced by users when interacting with a product or process. The final results of this stage are:

(a) What problems will be solved?

(b) Who are we solving this problem for?

(c) What other ways can solve this problem?

(d) Ideation

This stage is the stage for generating ideas. All ideas will be accommodated in order to solve the problems that have been defined at the define stage. It is important to get as many ideas as possible or problem solutions early in the idea phase, and then choose the best way to solve the problem or provide the elements needed to avoid problems that will occur later.

3. Prototyping

At this stage, a number of low-cost, scaled-down versions of the product are produced, or special features found in the product. This prototype can be tested to several to several target users in the next phase.

4. Testing

Tests and evaluations of the product are carried out to users and the results will be made changes and improvements to eliminate problem solutions and gain a deep understanding of the product and its users.

3. RESULTS AND DISCUSSION

The following are the results of user research using the design thinking method that has been carried out by the Research Team:

1. Empathize

The following are the results of the empathize process carried out by the research team in one of the schools in Kabupaten Bandung towards Middle School Students and Teachers:

2. Middle school students

Students are accustomed to learning mathematics by using handbooks that are in accordance with the curriculum and understand mathematics better by looking at the handbooks. In addition, students are accustomed to learning mathematics

by using learning media that have been prepared by the teacher, because with the learning aids/media prepared by the teacher and listening to the explanations given by the teacher, students can better understand learning mathematics. However, students also still need other learning media with an attractive and easy-to-understand appearance to learn mathematics, especially to study geometry material on flat-sided shapes. Especially if the learning media is related to the use of technology that is easily accessible/obtainable so that it can be used anytime and anywhere.

3. Middle school teacher

   Teachers are used to preparing learning tools before teaching in the classroom and using adequate learning media to teach mathematics. Teachers are also able to explain mathematical material to students so that students understand the explanations given. Teachers are accustomed to using handbooks as a medium of learning when teaching since it will be easier to teach mathematics. Besides, teachers often arrange their own learning modules to make it easier in the learning process. Teachers are interested in preparing other learning media besides handbooks and modules for certain topics. For example, the use of mobile-based geometry-based mathematics learning media that can support and help students learn mathematics, especially on flat-sided geometry. The teacher believes that the use of mobile-based geometry mathematics learning media makes the mathematics learning process more interesting and effective to support mathematics learning in the 21st century.

4. Define

   The results of the Empathize stage are then analyzed to determine the core problem to be solved. The following problems are defined:

   (a) Learning media only uses handbooks and modules made by the teacher, while students need other learning media to facilitate the mathematics learning process.

   (b) The needs of learning media that can help the mathematics learning process, especially in the material for building flat sides.

   (c) In the material of flat-sided geometry, students find it difficult to imagine the shapes of flat-sided images, and remember formulas and solve problems of flat-sided wakes.

   (d) Ideation

Here are the solution ideas that the research team succeeded in defining to answer the problems above:

TABLE 1: Ideation.

No	Problem	Solution
1.	Learning Media only uses handbooks and modules made by the teacher, while students need other learning media to facilitate the mathematics learning process.	The existence of other learning media to support the mathematics learning process. For example, learning videos, YouTube, or mobile-based learning media
2.	The needs of learning media that can help in the learning process of mathematics, especially on the material of building a flat side space.	Geometry-based mathematics learning media that can facilitate the study of flat-sided geometry because it will be easy to understand. Especially with the complete content according to the material. With mobile-based learning media, students can easily access learning mathematics anytime, anywhere.
3.	In the material on the flat side, students find it difficult to imagine the shapes of the flat-sided images and to remember the formulas and solve the problems of the flat-sided shapes.	The use of learning media that can contain concepts and elements regarding the shape of the flat side space with a variety of image forms shown from various points of view.

5. Prototyping

The proposed solution is then implemented into a mobile-based geometry learning media design with architectural information as follows:

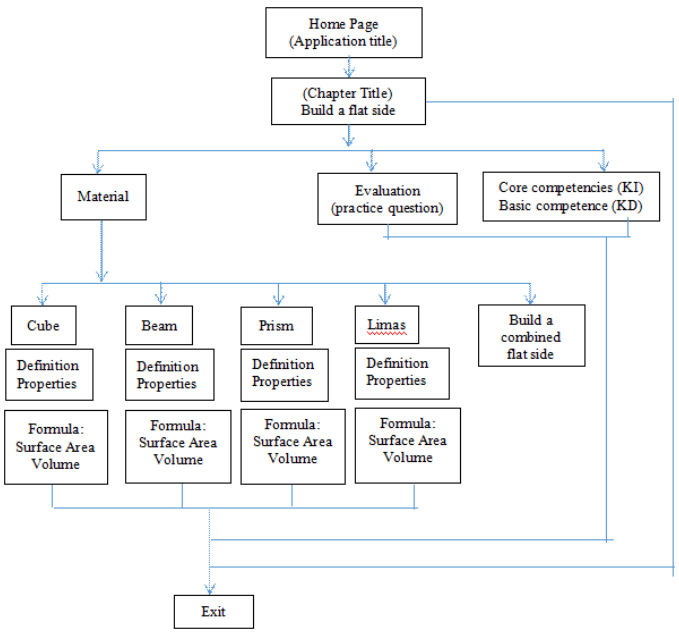

Figure 2: Information architecture.

The following is the design of the mobile-based geometry learning media referring to the information architecture above:

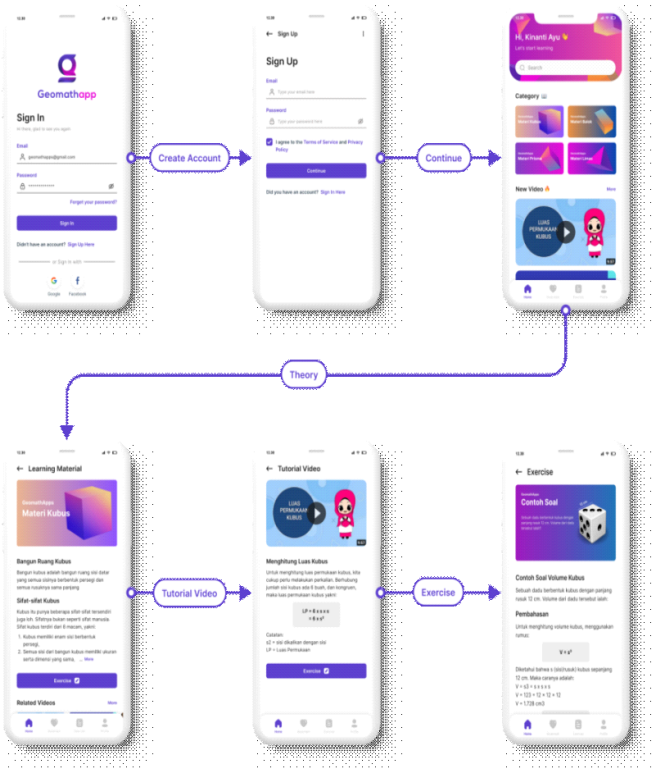

Figure 3: User interface design.

Here are the steps for using the mobile application:

1. Users register first before logging in
2. After logging in, the user will enter the home page which presents categories of geometry material and tutorial video feature.
3. Testing

Testing needs to be done to ensure whether the solution with the developed prototype is sufficient or still needs improvements

4. CONCLUSION

The use of mobile-based learning media can be an alternative as well as a solution to make students more active in the learning process. The Mobile-Based Geometry Learning Media is named Gammachirp. The application is designed based on the analysis of the problems experienced by students and teachers when learning geometry

mathematics with flat-sided geometry. Many students have not been able to solve problems in the material so that mobile-based Geometry learning media is needed which is considered capable of making students interested in learning mathematics on flat-sided geometry and can learn anywhere.

This research is focused on define and design stages. Subsequent research can be carried out at the develop and disseminate stages so that learning media can be used and utilized by students to improve students' understanding and ability in the flat-sided building material. Based on the results of research on mobile-based Geometry Learning Media for middle school students on the flat side space building material, the researchers provide suggestions for the use of learning media as follows:

1. For Students

   Students should be more active in utilizing the media / assistive tools in the learning process so that the objectives and learning outcomes can be achieved optimally.

2. For Teachers

   The needs for the use of technology in the teaching and learning process so that students do not feel bored and can more quickly understand the material presented through interactive learning media.

3. Researcher

   There should be further research in the form of further development of mobile-based geometry learning media. Both improvements to existing ones and the addition of learning material content, especially in middle school mathematics learning.

Here are some suggestions that can be followed up in further research:

1. Usability testing needs to be done to ensure whether the solution with the developed prototype is sufficient or still needs improvements.

2. Involve communities or volunteers who can become contributors to the platform to be developed.

3. Implement prototype so that it can be used and utilized for supporting children with special needs to get an inclusive education.

Acknowledgments

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