Android-based teaching material for straight-sides solid

A Prabowo\textsuperscript{1, *}, R P Anggoro\textsuperscript{1}, U Rahmawati\textsuperscript{1} and N Rokhima\textsuperscript{2,3}

\textsuperscript{1}Universitas Ahmad Dahlan, Jl. Ring Road Selatan, Tamanan, Banguntapan, Bantul, Yogyakarta, Indonesia
\textsuperscript{2}SEAMEO QITEP in Mathematics, Jl.Kaliurang, Condongcatur, Depok, Sleman, Yogyakarta, Indonesia
\textsuperscript{3}SMPN 3 Depok, Sopalan, Krodan, Maguwoharjo, Depok, Sleman, Yogyakarta, Indonesia

*Corresponding author: anggit.prabowo@pmat.uad.ac.id

Abstract. Straight-sides solid subject matter was one of difficult subject matter to be understood by junior high school students in Indonesia. Developing teaching material was one of alternatives to solve that problem. This research aims to develop the application of Android-based teaching material for straight-sides solid for supporting students of junior high school in comprehend of straight-sides solid subject matter. Define, design, develop, and disseminate were the steps in developing the application. The first step of developing was identify the problem and define the product which will be developed. The next step after product defined was design the storyboard as the guidance to develop the application. Teaching experts and media experts had validated the application. They judged that the application developed was valid. The application had been disseminated to mathematics teachers and students in junior high school. Teachers stated that this application was very useful to delivered concept of straight-sides solid in junior high school while the students stated that it helped them in understanding the concepts of straight-sides solid.

1. Introduction

In 21\textsuperscript{st} century, students should have skills in information, media, and technology. They should have good literacy skills in information, communication, and technology. This is due to, nowadays, the instructional process cannot be separated with digital technology. Computer, notebook, LCD, and internet are devices that almost used by all of teachers in instructional process. Teaching materials used by teachers are not only provided by printed but also in it prefer provided in electronic. Learning resources are not only from teachers. There are a lot of around the students. School is not the only one place for student to study. Students can explore the knowledge from internet, computer, mobile application, mobile game, etc. From the case can be stated that the use of technology and information-based devices will have an important role in student learning activities.

In Indonesia, student are very familiar with smartphone. Sixty-five percent of Indonesians use smartphones in 2017 [1]. In other word, it is about 25% of Indonesians who operate smartphones in their daily life. From that amount, 16.68% of them are students in school age [2]. They use smartphones for three main activities: social media, chatting and playing games [3]. This is unfortunate that most of students do not use smartphone to support learning activities.
In fact that the intensity of students in using smartphone is very high, it is necessary to develop ways to utilize smartphones to make activities related their study. One way is by utilize smartphone as a teaching material or learning resource for students. One type of smartphone utilization is by conducted it as mobile learning. Mobile learning is the next generation of e-learning that is based on mobile devices [4]. Mobile Learning or M-Learning is a type of e-learning that delivers educational contents and learning support materials through wireless communication devices [5]. Likewise, mobile learning as a personalized, connected, and interactive use of handheld computers in classrooms, in collaborative learning during fieldwork, and in counseling and guidance [6]. Mobile learning that can be developed for learning is to load applications in the form of teaching materials with Android-based. Android is a mobile operating system based on Google [7]. In Indonesia, 94% of smartphone users use smartphones with Android operating system.

In Indonesia, mathematics is a subject studied by students at various levels of education. The results of the national examination in 2016 show that at the junior school level, there are 4 competencies tested. There were numbers, algebra, geometry, and statistics and probability [8]. Geometry was the second of most difficult for junior high students in Indonesia. The average score of junior high school students in Indonesia on geometry material was only 47.19. Further, presented in Table 1.

| Number | Competency               | Score  |
|--------|--------------------------|--------|
| 1      | Numbers                  | 52.74  |
| 2      | Algebra                  | 52.97  |
| 3      | Geometry                 | 47.19  |
| 4      | Statistic and probability| 46.73  |

The kind of geometry subject matter that learned by students is straight-sides solid. The low percentage in mastering of straight-sides solid could be affected by some factors. Teaching material is one of the factor affected how good students comprehend material. It has main rule to make instructional efficient and improve students’ performance [9]. The most frequent errors made by student in solving problems in trigonometry include comprehension error, transformation error and process skill error [10]. It assists the teacher and allows students’ interaction and make students to achieve better and higher in lesson [11]. Instructional material used by the teacher was one of learning facilities kind which affect the students learning activity.

Visual teaching material is the most popular instructional material used by teachers in Indonesia. They usually use handout, book, module, and student’s worksheet in their lesson. The characteristic of these instructional materials are only present the seeing media like pictures, texts, or graphics. Straight-sides solid student’s comprehension could be improved if students have an innovative and flexible learning resource so students can learn whenever and whereever. Therefore, it need to develop the Android-based application for straight-sides solid subject matter in junior high school.

2. Method
It was a research and development (R&D) using four D procedure (Define, Design, Develop, and Disseminate) [12] showed at figure 1.

![Figure 1. Research and development procedure](image)

First stage was define. The product developed was an Android-based application as teaching material for straight-sides solid. Stage 2 was design the product. Designing product was done by constructing the
storyboard and preparing the tools and material. The application was developed by using MIT App Inventor. Step 3 was develop the product based on the design. The product developed has been reviewed by four experts (2 multimedia experts and 2 teaching experts) and tried to 25 junior high school students. The last stage was disseminate the product to mathematics teachers and junior high school.

3. Result and Discussion

The first step in developing the Android-based application for straight-sides solid was defining the product. The product that would be developed was the application as teaching material of straight-sides solid. This application can be operated in smartphone with android system operation. It could be applied in smartphone which using android system operation. The advantages of this product is the interactivity between user and the features. Users can access the application to operate it and get a response base on their instruction. It was developed using MIT App Inventor platform.

This designing of the product was conducted by mapping out the storyboard. Storyboard is idea visualization to build the application that give an overview of the application to be generated [13]. Storyboard shows the stages of a story or an order of events [14]. Storyboards also defined as “…a visual reference depicting particular scene or action, usually taken from a screenplay or some other form of written storyline.” [15]. It presents a script of visual as outline of project which will be the guide the developer to develop the product. It is showed at figure 2.

![Figure 2](image-url)

**Figure 2.** The above view is the main menu of application. It contains 1 title and 5 menus (Material 1, Material 2, Material 3, Material 4, and Test).

The menus above are button. It means by pressing them, the screen will show content related. Material 1 contains the cube. When it is pressed, the stage will display the content knowledge related cube like definition, property, formula of volume and surface area, and exercise. Material 2 contains the block. When it is pressed, the stage will display the content knowledge related block like definition, property, formula of volume and surface area, and exercise. Material 3 contains the prism. When it is pressed, the stage will display the content knowledge related prism-like definition, property, formula of volume and surface area, and exercise. Material 4 contains the pyramid. When it is pressed, the stage will display the content knowledge related pyramid-like definition, property, formula of volume and surface area, and
exercise. When the storyboard had been prepared, it needs to specify the tools and materials used to develop the product. They are showed at table 2 and 3.

**Table 2. Tools required**

| Tools          | Function                                      |
|----------------|-----------------------------------------------|
| Personal Computer | Used to develop the application               |
| Smartphone     | Used to be device of mobile learning and to operate the application |
| Printer        | Used to print storyboard                      |
| Scanner        | Used to scan images to be used in teaching materials |
| Flash drive    | Used to save data                             |
| Speaker        | Used to check the functionality of audio      |

**Table 3. Materials required**

| Material                  | Function                                      |
|---------------------------|-----------------------------------------------|
| MIP App Inventor          | Used to design the application                |
| Audio                     | Used as the back sound of application         |
| Straight-sides solid shape| Used as the content of developed teaching materials |

After the tools and materials needed were prepared, the designing product was ready for product development. Product was developed based on the design. Based on the storyboard that has been compiled, the product is successfully developed showed at figure 3.

![Figure 3. Products developed](image)

In developing stage, this application was validated by instructional multimedia and mathematics content knowledge experts. The result is showed at table 4 and 5.
Table 4. Validation from media experts

| No | Validation                                          |
|----|-----------------------------------------------------|
| 1  | The image must be displayed proportional with the screen wide |
| 2  | The icon in menu button will represent the contain   |
| 3  | The type font of the text is clear                   |
| 4  | The size of texts are proportional                   |
| 5  | The menu icon must represent the contain             |

Table 5. Validation of mathematics content knowledge experts

| No | Validation                                                                 |
|----|---------------------------------------------------------------------------|
| 1  | The item test must be suitable with material                              |
| 2  | Distractor should outwit student low performance                         |
| 3  | Try to access test result without collect the sheet                       |
| 4  | The item test must be related with students daily activity                |

After the product revised based on the expert assessment, they gave assessment about the quality of the product, presented at table 6.

Table 6. Product quality based on expert’s judgment

| Validator | Expert     | Category    |
|-----------|------------|-------------|
| Expert 1  | Media      | Very good   |
| Expert 2  | Media      | Very good   |
| Expert 1  | Teaching material | Very good |
| Expert 2  | Teaching material | Very good |

Table 6 shows that application is very good valid category. It means based on the validators, the application is proper to be used as teaching material of straight-sides solid. The last step, the application disseminated to 18 mathematics teachers of mathematics in junior high school and tried to 25 junior high school students.

These days, school is not the only one place for students to study. Instructional conducted nowadays is not a traditional learning. It is learning at the classroom where students receive learning material from the teachers [16]. Curriculum in Indonesia had change this method to be constructivist method. Students are given the opportunity to build their knowledge by constructing the knowledge from a lot of resources (internet, peers, parents, society, and nature). Information, technology, and communication are used in instructional. Along with these developments, there exists a prodigious increase in the amount of educational software provided for use in a class [17, 18]. Many applications are provided to develop teaching material. Every new technological development opens new opportunities for lesson planning for teachers and learning tools for student [19].

This research had produced an application of mobile learning as instructional material for trigonometry using android system operation. It is one type of Computer Aided Learning (CAL). CAL means the application of computers integrated with learning system for instructional [20]. It was developed to help student in mastering trigonometry material. In the developing process of computer-based learning program, the concern is not on “what technological tools are to be used during the development process of e-learning program”, but it is on “how to design and plan an e-learning program that ensures the achievement of the learning objectives” [21].

The application can be used the mathematics teacher of junior high school to teach straight-sides solid. Various model of teaching can use it. This is corresponding with the study in 2016 that by integrating the teaching material and teaching method can be implemented optimally [22].
Implementation of the application developed in class shows that it help students to comprehend the straight-sides solid material. The score of student achievement in trigonometry was passed the minimum completeness criteria (75.00). It is because students more flexible in their learning activity. Students can operate it to explore material not only at the classroom but also in everywhere and every time they want using interactive multimedia teaching material [23]. By interactive mobile learning, the information more meaningfully and repeatedly can be obtained by students [24]. The implementation of Information and Communication Technology (ICT) in educational world, in turn, will improve the quality of the education itself [25]. Finally, this application can enrich the teaching material for teachers and students in order to enrich the students’ capability in comprehend the material.

4. Conclusion
This research has produced a valid Android-based application as a teaching material for straight-sides solid using android system operation. It had been disseminated to mathematics teachers and implemented in class of trigonometry instructional. This product help students to comprehend the concept of straight-sides solid and give the teacher an alternative teaching material of straight-sides solid.

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