DEVELOPMENT OF ANDROID-BASED MATHEMATICS LEARNING MEDIA ON THREE DIMENSIONAL SUBJECT MATERIALS

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ABSTRACT
This study aims to develop learning media products in the form of an android application called Geometry Learning to help students understand the concept of three dimensions. This research is included in the Research and Development (R&D) type using the ADDIE research development model (Analysis, Design, Development, Implementation, and Evaluation). The development of this research is based on several assessments of the developed Android-based learning media. The assessment results given by material experts have an average percentage of 87% (very feasible), and the assessment given by media experts has an average percentage of 91% (very feasible). In addition, the students were also assessed with an average percentage of 96.6% (very decent), and the average percentage of the teacher's assessment was 81% (very decent). Thus, the application of learning media in the form of an android application is feasible to be used in the learning process.
Keywords: Android, Three Dimensions, Learning Media

PRELIMINARY

Learning mathematics is still a frightening specter for students at school (Tyas, 2016). This makes students feel that concepts in mathematics are complicated to understand. This difficulty is caused by students' lack of focus on learning, understanding basic mathematical concepts, and using learning methods and resources (Padli et al., 2021). In addition, the use of learning media to present material is also one factor that makes it difficult for students to understand mathematics. Using suitable media can build students' understanding of mathematical concepts and support a more enjoyable learning system (Naufal et al., 2021). This explanation agrees with the study results, which show that the learning facilities available in schools also affect student learning success (Pertiwi et al., 2019).

Based on the results of field monitoring conducted at a school in East Sumba, especially the city of Waingapu, when researchers carried out Field Experience Practices (PPL) for all students in class XII IS 2, it was found that the results of daily assessments and midterm assessments obtained by students on the three-dimensional topic learning is still in the deficient category. This is shown in a diagram in Figure 1. Based on the diagram, 63% of students do not have sufficient KKM, and 37% achieve KKM. One of the causes of the high percentage of students who have yet to reach the KKM is the lack of use of media that can enable students to re-simulate what they have seen before. Thus, it is necessary to develop a learning tool that triggers students to re-simulate what they have seen before. This is because learning Mathematics is practical if it is supported by learning media (Tralisno, 2019).
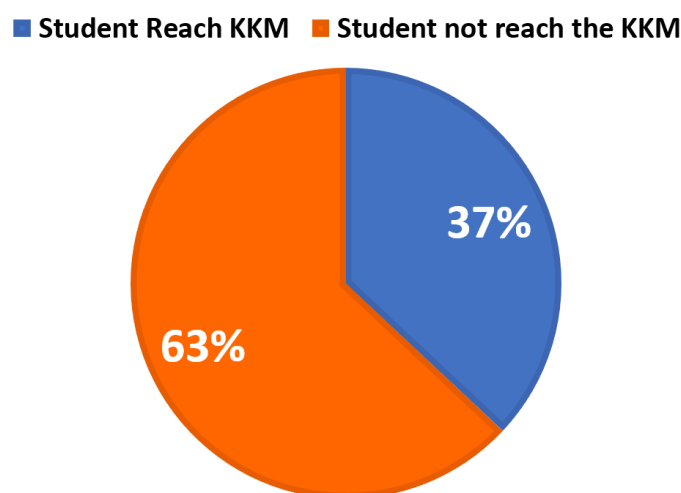

Figure 1. Diagram of the Results of the Daily Assessment of Three-Dimensional Material for Class XII IS 2

Learning applications are one example of media development in mathematics learning. Mathematics learning applications can be made using computer technology and accessed via desktop or mobile devices. An operating system is needed to organize these applications (Hanifah & Sari, 2021). The most commonly used operating system is Windows operating system. This is in accordance with the research that shows that learning using application-based media that runs on Windows is effective to apply based on evaluations from material and media experts and educational practitioners (Ambarwati, 2019). However, the Windows operating system can only be accessed using PC/Laptop devices, whereas currently, many students do not have computers/laptops. Thus, students who do not have laptops cannot use the media to study independently.

In addition to Windows-based operating systems, there are other operating systems, such as Android. Based on the results of field monitoring conducted at SMA Negeri 1 Waingapu, information was obtained that one of the most popular operating systems among students was Android. Therefore, this study's development of learning devices is focused on android-based learning devices. A study shows that using learning media in the form of Android learning applications can improve students' mathematics learning outcomes, specifically in geometric material (Purnomo & Suparman, 2020). In addition, implementing Android-based learning media makes students enthusiastic about learning mathematics. The use of Android-based learning devices significantly affects student learning freedom (Ashim et al., 2019).

Making learning media in the form of an Android application requires software. One software that can be used is Smart Apps Creator 3.0 (SAC). Researchers chose SAC as the software used to elaborate Android-based learning media because it is straightforward to operate without requiring a complicated programming language (Khasanah & Rusman, 2021). The output obtained from the development of learning media in SAC is in the form of an Android application in the APK format. The Android application that has been developed is then run on student smartphones that use the Android operating system. Thus, students can use the application to study mathematics, specifically three-dimensional substances.

This research aims to develop learning media in the form of an android application that can help students understand the concept of three dimensions. This research is expected to make the learning atmosphere more colorful. Thus, there can be an increase in student learning outcomes in three-dimensional material..

METHODS

The type of research used is Research and Development (R&D), which adopts the ADDIE development model (Analysis, Design, Development, Implementation, and Evaluations). Researchers chose this research and development method because this study aimed to develop learning media. This research method is selected alongside the definition of research and development methods, namely research procedures to describe certain matters (Afandi, 2020). The research was carried out from 18 November 2021 to 23 October 2022. The procedure for this study is shown in Figure 2.
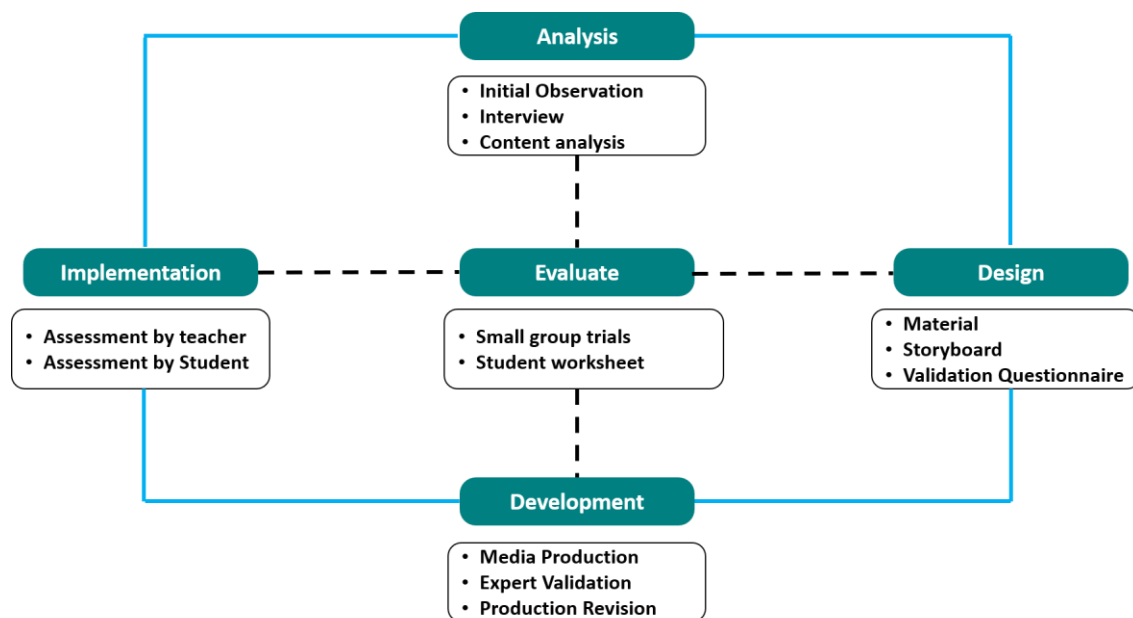
Figure 2. Development Stages with the ADDIE Model

In the Analysis phase, a problem identification process is carried out to see potential problems in the field. Furthermore, at the Design stage, content, display, and animation are determined by applying mathematics learning media. Then at the Development stage, the manufacturing process or process to produce a product is carried out concerning the previous stage, namely the design stage. Furthermore, at the Implementation stage, the learning media product in the form of an android application that has been completed is tested at SMA Negeri 1 Waingapu class XII IPS. Then, at the Evaluation stage, the researcher checks the product's appropriateness.

To measure the feasibility of the learning media products that are made, the researcher presents a questionnaire given to experts in terms of material related to three dimensions, media experts, students, and teachers to study the development of media products in terms of ocular quality and system quality. Material experts validate material and questions on learning media products. The material expert who assessed the material in this android application is a lecturer at the Mathematics Education Study Program, Wira Wacana Christian University, Sumba. Meanwhile, media experts validate the media, from the appearance aspect to the operational aspect (Tegeh & Kirna, 2013). The media expert in this study is one of the lecturers from the Informatics Engineering Study Program at Wira Wacana Christian University, Sumba. The assessment results are then processed to see the results of the feasibility percentage using a Likert scale. The android application that has been developed is feasible if the average of each evaluation value has at least good

criteria. The percentage of application eligibility is calculated by the following formula (Sugiyono, 2014).

$$Eligibility\ Percentage\ (\%) = \frac{Score\ obtained}{Maximum\ score} \times 100\%$$

RESULT AND DISCUSSION

The final result of this research is a mathematics learning media product in the form of an android application developed using the ADDIE model. This android application was developed using five stages of development. The five stages of development are described as follows:

1. **Analysis**

   This research started from observations made by researchers at SMA Negeri 1 Waingapu, especially in class XII IPS 2. Based on these observations, most students had difficulty understanding the concept of three dimensions. This condition can be seen from daily evaluations and midterm assessments, which are still relatively low. 63% of students still need to reach the KKM, and 37% achieve the KKM. The low score obtained by students is due to the use of learning media that strengthens students to re-simulate what has been observed before is still very minimal. One of the learning media that is used to help students re-represent the results of their observations is learning media in the form of an Android application. The ease of operating the Android system helps teachers deliver material and encourages students to study independently anywhere and anytime (Mulyani, 2018). In addition, Android-based smartphones are mostly used by teenage users (Mahuda et al., 2021).

2. **Design**

   This stage is the design stage; the media design process is developed by referring to the results of the analysis phase so that the media design process is adapted to the needs of the field. The design carried out at this stage is material, validation sheet, and storyboard. The following is a draft of the storyboard that the researcher has made.
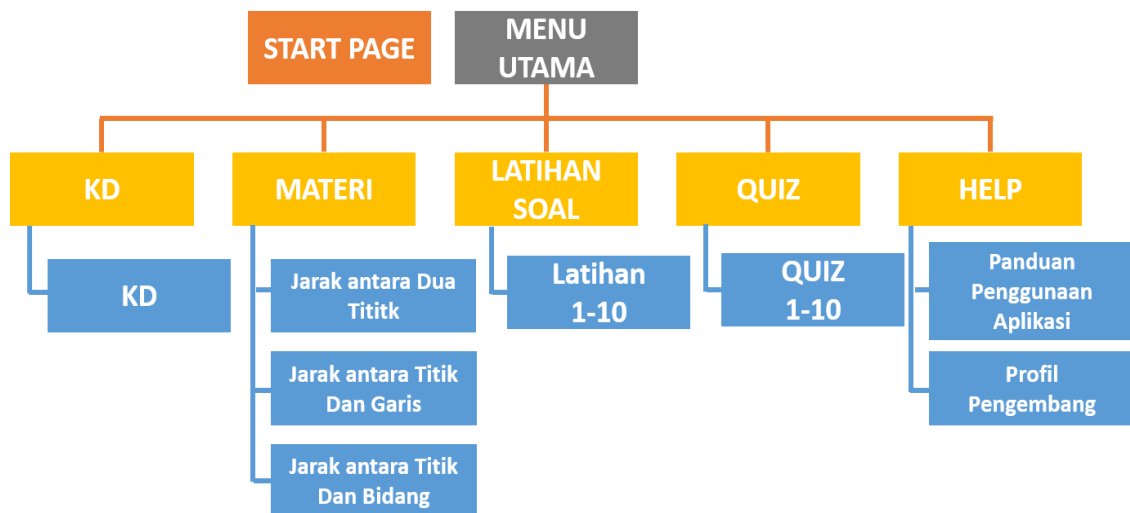
Figure 3. Storyboard Display of Geometry Learning Media

Figure 3 shows the results of making a storyboard. The storyboard is a rough sketch that describes the learning media application as an Android application. The android application that has been developed is named "Geometry Learning". The application has several main menus, such as essential competencies, material menus, practice questions menus, quiz menus, and help menus. The KD menu has a sub-menu of actual competency content. The material menu has three sub-menus: the distance between two points, the distance between points and lines, and the distance between points and planes. There are ten practice questions on the practice questions menu, and on the quiz menu, there are five quiz questions. Meanwhile, the help menu has a sub-menu of application usage guides and developer profiles.

3. **Development**

Learning media development in the form of android applications can be done using software such as android studio, ispring suite, and Smart Apps Creator. In this study, the name of the media created was "Learning Geometry" designed using Smart Apps Creator.3 software or SAC. SAC can be operated on the Windows 10 operating system using the details of a 320 GB hard disk and 4 GB of RAM. Researchers chose SAC as the application used to create android applications because the SAC application is straightforward to operate and does not require complicated programming code to develop an application (Khoirudin et al., 2021). In addition, the SAC display is straightforward and comfortable to use, and the results of making applications with SAC can be saved in apk, ios and exe formats. However, the SAC software cannot be obtained free of charge, so in this study, a Trial version was used, which can be used within 30 days (Apriyani & Ramdhan, 2022). Making this learning media refers to the

storyboard prepared at the design stage. Here is the initial page form of geometry learning.
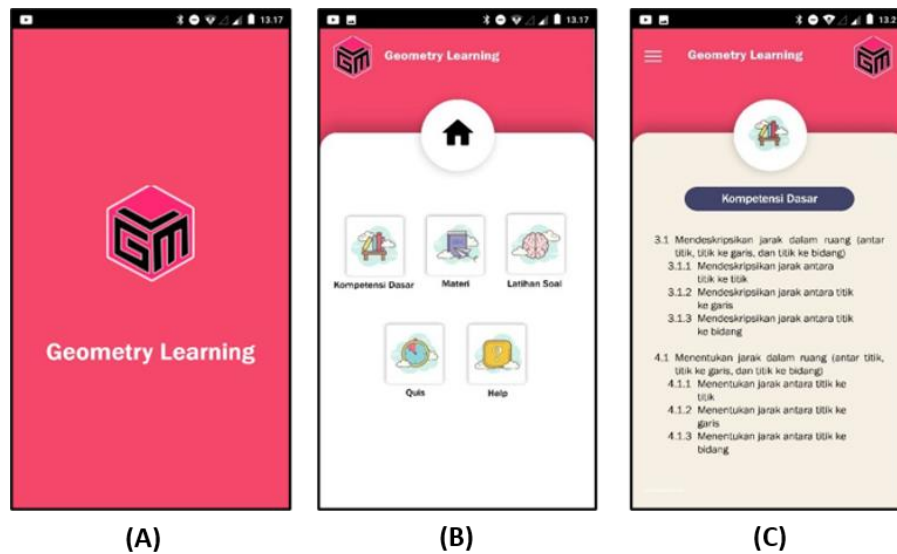

Figure 4. Display of the start page of the learning media in the form of an android application called Geometry Learning

Figure 4a shows the initial appearance of the Geometry Learning application. When the Geometry Learning application is opened, a page will appear, namely the start page. This start page is 5 seconds long. If the display duration is complete, it will automatically change to the next page, namely the main menu, as shown in Figure 4b. The main menu page has five buttons: the *Kompetensi Dasar* button, the *Materi button*, the *Latihan Soal* button, the Quiz button, and the Help button. If the *Kompetensi Dasar* button is pressed, a page describing essential competencies related to three-dimensional material will appear.
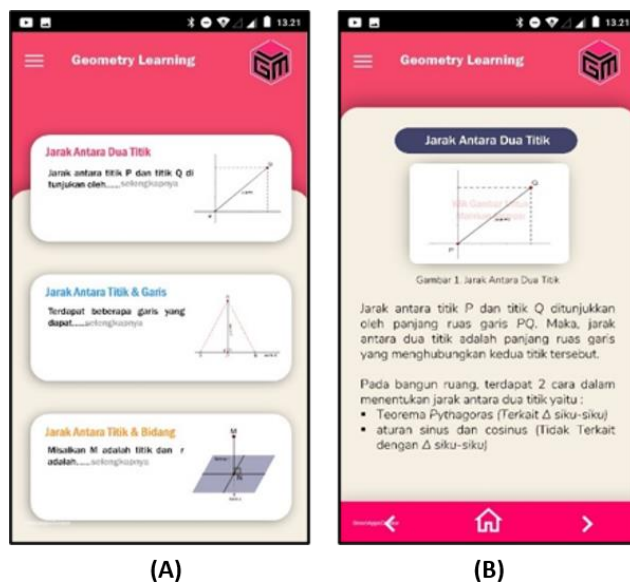
(A)   (B)

Figure 5. Display of the Material Menu Page

When the Material button on the main page is pressed, a page contains three buttons: the *Jarak Antara Dua Titik* button, the *Jarak Antara Titik & Garis* button, and the *Jarak Antara Titik & Bidang* button will appear, as shown in Figure 5a. If each button is pressed, it will show the page view of the material discussed in the Geometry Learning application. The material discussed is the distance between two points, between points and lines, and between points and planes, as shown in Figure 5b. In order to see the overall contents of the material discussed, users can use the two navigation buttons provided at the bottom of the material page. Meanwhile, the main page will appear if the user presses the Home button, as shown in Figure 5b. The material page also provides three-dimensional animated videos related to the topics discussed so students can see them visually. Research shows that visualization of geometry material using learning software significantly influences student learning outcomes and motivation (Akhirni & Mahmudi, 2015).
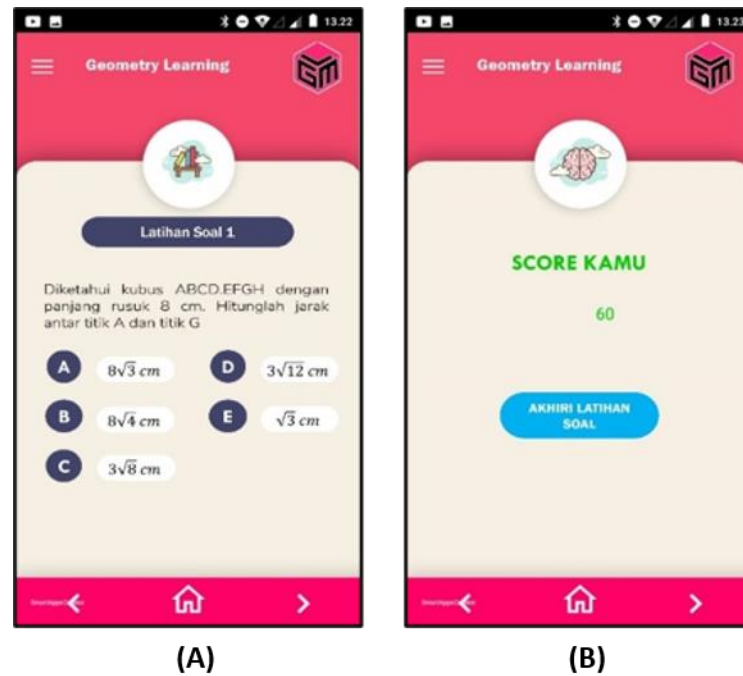
Figure 6. Display of the practice questions page

When the *Latihan Soal* button on the main page is pressed, a page containing practice questions will appear. The practice question page contains ten multiple-choice questions on three-dimensional material that material experts have validated. On each page containing the practice questions, there are five answer option buttons: A, B, C, D, and E, as shown in Figure 6a. To answer these questions, application users can directly click on one of the five option buttons that have been provided. Furthermore, if all the questions have been done, the score obtained will be displayed automatically at the end of working on the practice questions, as shown in Figure 6b.
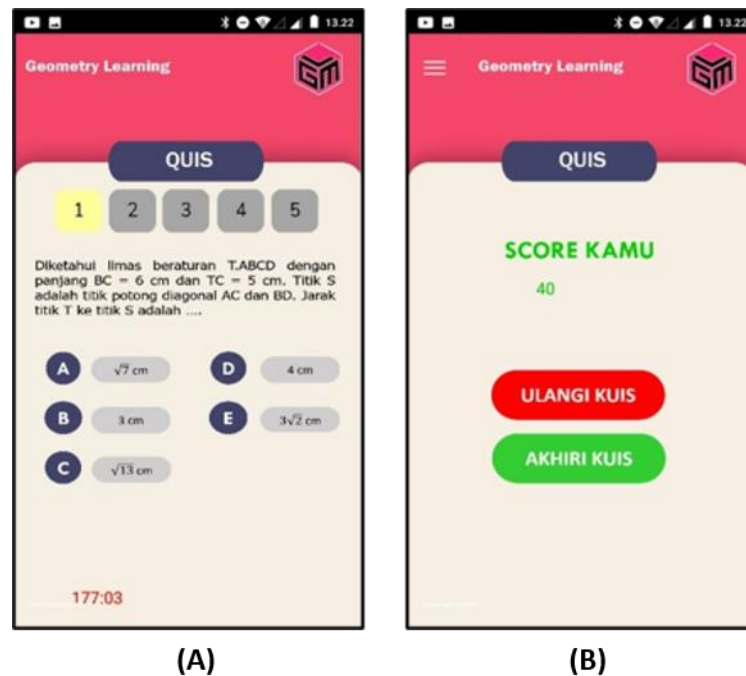
(A) (B)

Figure 7. Quiz page view

The quiz practice page contains five multiple-choice questions on three-dimensional material that material experts have validated. In addition, the Geometry Learning application also provides quizzes so that students become more fluent in three dimensions. This Quiz page will appear when the user presses the Quiz button on the main page, as shown in Figure 7a. On each page of this quiz, there are five answer option buttons: A, B, C, D, and E. In addition, there is a timer in the lower left corner to work on the questions. The user must complete the entire quiz within 15 minutes. As on the practice questions page, users can immediately click on one of the five option buttons provided to answer these questions. Moreover, if the user has done all the questions, the score obtained will appear automatically at the end of the quiz. If the score obtained has yet to reach the KKM, which is 70, then the user can rework the quiz questions by selecting the Repeat Quiz button. Meanwhile, if the user presses the End Quiz button, the user will return to the main page.

This app also comes with a help page. This page will appear if the user presses the help button located on the main page. The help page has two buttons, the *Profil Pengguna* button and the *Panduan Penggunaan* button, as shown in Figure 8a. If the user presses the Panduan Penggunaan button, a page will appear describing how to use this application, as shown in Figure 8b. Thus it can help users who have difficulty using the Geometry Learning application.
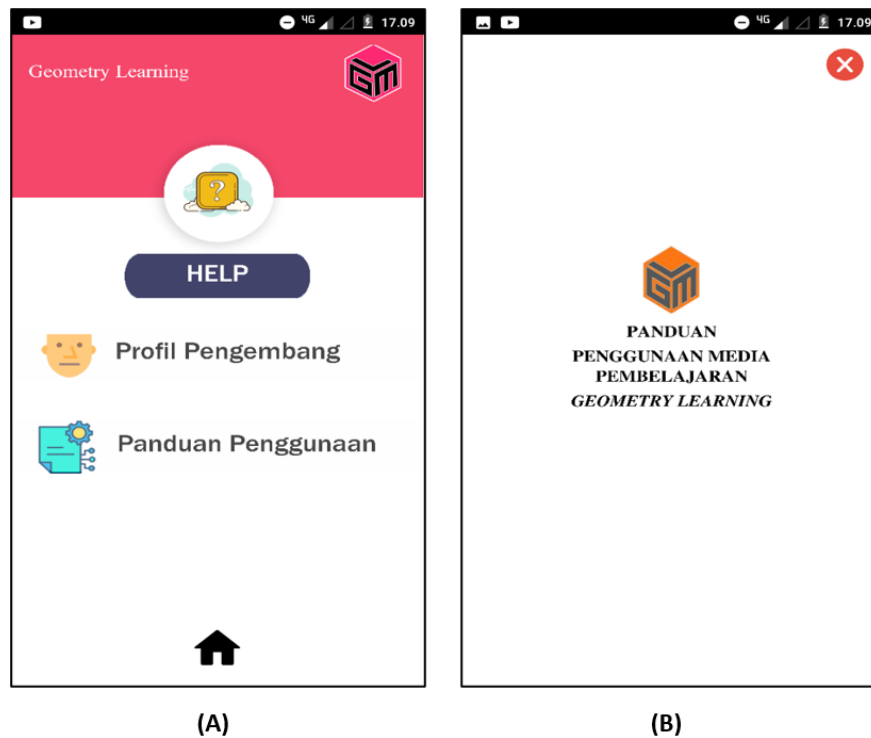
Figure 8. Help page view

After the android application called Geometry Learning has gone through the development process, the next stage that must be passed is the validation test. This test was carried out to determine the feasibility of the developed media so that students could implement the media.

Table 1. Media Expert Validation Results

Number of Indicators	Number of Statement Items	Total Score
1	6	24
2	6	27
3	6	30
4	5	24
Total Overall Score		105
Average		4,6
Percentage		91%
Criteria		Very valid

Table 1 shows the results of the assessment conducted by media experts. The total score achieved from the assessment of media experts is 105, with an average value of 4.6 and a percentage of 91%. Based on the feasibility grouping table, learning media in the form of an android application called Geometry Learning is stated to be very feasible to use. There are inputs and revisions from media experts. Revisions made to Geometry Learning can be seen in Figure 9.
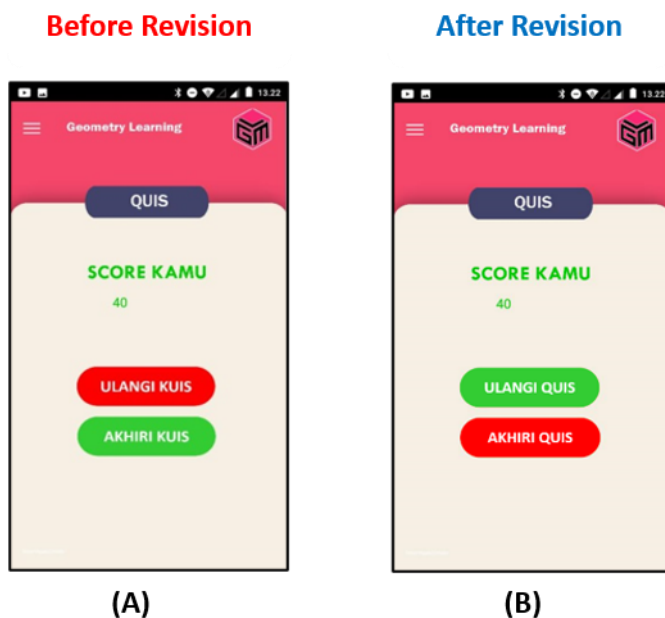
Before Revision   **After Revision**

(A)   (B)

Figure 9. Results of the Quiz Score Page Revision

Learning media called Geometry Learning has gone through revision. Figure 8 shows the appearance of the quiz score page before revision and after revision. On this quiz results page, it was suggested by media experts that the color on the end quiz button be changed to red while the color on the repeat quiz button is changed to green. In addition to media assessments, there are assessments on materials such as the following.

Table 2. Material expert validation results

Number of Indicators	Number of Statement Items	Total Score
1	5	22
2	6	26
Total Overall Score		48
Average		4,3
Percentage		87%
Criteria		Very valid

Table 2 summarizes the evaluation by material experts. From the data above, the overall total score is 48, with an average of 4.3 and a percentage of 87%. Based on the feasibility grouping table, learning media called Geometry Learning is categorized as very feasible to use without revision.

4. Implementation

After the learning media in the form of an android application named Geometry Learning was revised according to suggestions from media experts to produce a finished product, the next stage of Geometry Learning was implemented in a limited

way in small groups. This implementation process involved eight students as respondents.

Table 3. The results of the assessment carried out by students

Number of Respondents	Number of Indicators	Number of Statement Items	Total Score
8	4	9	349
Total Overall Score			349
Average			33,8
Percentage			96,6%
Criteria			Very feasible

Table 3 shows the results of the assessment through a student questionnaire. From the results of this assessment, a total score of 305 was obtained for the Very Good category and a total score of 44 for the Good category. The average score for student assessment is 33.8, with a percentage of 96.9%, so it meets the very decent criteria.

Table 4. The results of the assessment carried out by the mathematics teacher

Number of Indicators	Number of Statement Items	Total Score
10	27	170
Total Overall Score		170
Average		4
Percentage		81%
Criteria		Very feasible

The android application called Geometry Learning is implemented for students, and teachers also participate in conducting assessments. Table 4 shows the results of the assessment through a questionnaire conducted by the mathematics teacher. From the table, the total score assessed for all aspects is 170, with an average of 4 and a percentage of 81%. Based on the feasibility grouping table, an android application called Geometry Learning is classified as very feasible to use.

5. Evaluation

Based on the feasibility percentage at the implementation stage, the learning media in the form of an android application called geometry learning is very feasible. The percentage of the feasibility of learning media based on the expert judgment can be seen in Table 5.

Table 5. Percentage of eligibility media

Evaluation	Percentage	Category
Material Expert	87 %	Very feasible
Media Expert	91%	Very feasible
Practitioner (Teacher)	81 %	Very feasible
Student	96,6 %	Very feasible

The table above shows the learning media in the form of an android application called Geometry Learning which has been developed and declared very feasible. This is based on the scoring criteria indicating that the media is feasible to use if the percentage is within the 81% -100% value range. This is in line with a research result that proves the development of android-based mathematics learning media on trigonometry with a percentage of 81.4% which is very practical (Dewi & Manuaba, 2021). In line with this research, other research results were conducted in 2017 related to the development of android-based learning media in three-dimensional material, which obtained an average percentage of 82%, which was classified as very feasible (Takdir, 2018).

CONCLUSION

The development of learning media in the form of an android application called Geometry Learning adopts the ADDIE development model through five stages: Analysis, Design, Development, Implementation, and Evaluations. After going through the five stages of ADDIE development, Geometry Learning obtained an assessment result with a percentage score from material experts 87%, a percentage score from material experts 91%, a percentage score from students 96.9%, and a percentage score from teachers 81%. Thus, Geometry Learning is declared very feasible.

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