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Development of Android-based application on volume material in grade V

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Abstract

In learning mathematics, especially volume material, students still have difficulty understanding the concept. One of the causes is the lack of use of learning media in the classroom to make it easier for students to understand the lesson. This study aims to develop learning media in the form of android-based applications about volume in class V and to determine the feasibility of the applications that have been developed. The research method used in this research is Research and Development (R&D) with the ADDIE development model. The data collection technique used in this study was an expert validation questionnaire and a user response questionnaire. The results showed that the developed application received a material and language expert validation score of 93.91%, and a media expert validation score of 86.67%. In addition, the results of product trials in small groups received a score of 98.33%, and the test results from the large group trial were 96.48%. This android application media on volume material is very feasible to use in learning.

***Keyword**: development, learning media, android-based application, volume geometry, elementary school*

Abstrak

Pada pembelajaran matematika, terkhusus materi volume, siswa masih kesulitan dalam memahami konsepnya. Salah satu penyebabnya yaitu kurangnya penggunaan media pembelajaran di kelas untuk mempermudah siswa dalam memahami pelajaran. Penelitian ini bertujuan untuk mengembangkan media pembelajaran berupa aplikasi berbasis android tentang volume di kelas V dan untuk mengetahui kelayakan dari aplikasi yang telah dikembangkan. Metode penelitian yang digunakan pada penelitian ini yaitu *Research and Development* (R&D) dengan model pengembangan ADDIE. Teknik pengumpulan data yang dilakukan pada penelitian ini yaitu menggunakan angket validasi ahli dan angket respon pengguna. Hasil penelitian menunjukkan bahwa aplikasi yang dikembangkan mendapat nilai validasi ahli materi dan bahasa sebesar 93,91%, serta nilai validasi ahli media sebesar 86,67%. Selain itu, hasil uji coba produk pada kelompok kecil mendapatkan nilai sebesar 98,33%, serta hasil uji dari kelompok besar sebesar 96,48%. Media aplikasi android pada materi volume ini sangat layak untuk digunakan dalam pembelajaran.

Kata kunci: Pengembangan, media pembelajaran, aplikasi berbasis android, volume geometri, sekolah dasar

INTRODUCTION

Students still often have difficulty in understanding learning, especially in volume material when the implementation of mathematics learning takes place, students also do not understand the basic concepts of volume material. As suggested by (Badraeni et al., 2020) that the mathematical understanding ability of students on the volume geometry content is still very weak because students do not really understand the problems and concepts of mathematics. In addition, sometimes teachers use markers and blackboards more often than using ICT media, so it can be said that teachers have not fully used diverse media in delivering material. In fact, with a variety of media in the teaching and learning process can make students motivated in following the material provided by the teacher and will more easily understand the learning material (Abdullah, 2017). This causes students to not understand how to calculate volume correctly. Therefore, there needs to be a change, one of which is through the use of android-based learning media so that students can better understand volume material. This needs to be followed up because if left unchecked, then in the future students will continue to have difficulty in solving problems regarding volume.

There are many studies that discuss volume learning in grade V elementary schools that have been conducted by researchers. Students have difficulty in understanding geometry material, in accordance with the findings of the study (Herdiansyah et al., 2019). It is very important to concretize the formulas and geometric shapes used in this situation. In addition, teachers only use blackboards and textbooks as learning tools. In reality, by only using learning books, students feel bored so that learning does not go well because there is no media that can at least help students to be more enthusiastic about understanding the material. In addition, since students only listen to the teacher's explanation, learning only happens in one direction by using lecture techniques which also tend to make students passive. He created a geometry learning game (cubes and blocks) by utilizing interactive learning materials made with Adobe Flash. In addition, (Arina et al., 2020) states that information collected based on observations that have been made reveals that students' ability to understand and estimate the volume of spatial shapes is generally still low. The volume of spatial contents proved to be difficult for students to master. This is due to the teacher's inaccuracy in choosing media to complement the subject matter taught. He took the decision to produce interactive multimedia learning materials in this way. Then, there are recent studies stating that teachers often use the lecture method. This is an obstacle for students in one school when learning pre-mathematics, especially in learning flat-sided geometry material. Restrictions are

needed, and teachers must provide students with many opportunities to actively develop their skills because the lecture technique makes students passive and does not encourage critical thinking. So in an effort to improve students' critical thinking skills when studying geometry, research was conducted to make TTS learning media (Darmayanti, 2023).

In contrast to previous studies, this research aims to develop an android-based application that can be an interesting learning media, especially regarding volume material. In addition, this study aims to determine the feasibility of the application that has been developed. This research focuses on the following two things: research questions: (1) How is the development of android-based applications on volume material? (2) How is the feasibility of Android-based applications on volume material to be used in the learning process? To answer all these questions, the application development process is carried out and the feasibility test of the application that has been developed.

RESEARCH METHODS

This study uses a development research approach or known as the Research and Development (R&D) research method. Furthermore, William Lee's ADDIE development model was used in this study. The ADDIE development paradigm is divided into five stages: 1) analysis, 2) design, 3) development, 4) implementation, and 5) evaluation. This research aims to create a product, namely learning media in the form of an android application of volume material in class V.

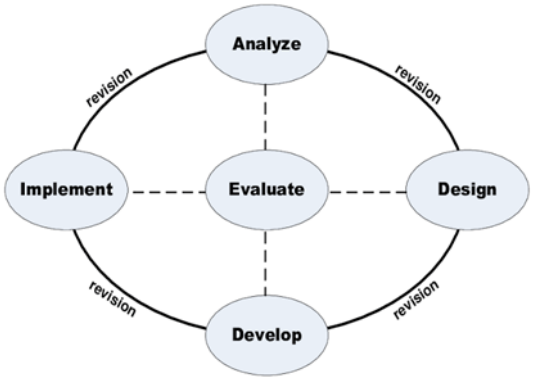

Figure 1. ADDIE development model

The research subjects of this android-based application development are fifth grade students from one of the schools in Sumedang Regency. The practical test was conducted on 24 students which included: Small group trial of 6 students, and large group trials of

18 students. According to Arikunto (2013) the subject of small group trial was conducted to 4-14 respondents and for large group between 15-50 respondents.

The research was conducted in one of the elementary schools in Sumedang Regency, West Java in class V. Research activities were carried out in the odd semester of the 2023/2024 school year. In this development research, the research procedure is based on the ADDIE model development research model which includes 5 stages, namely:

Analysis

In this analysis stage, it is carried out by conducting a needs analysis, then identifying existing problems at school and finding solutions to existing problems. Identification of needs is carried out by conducting interviews regarding mathematics learning with the fifth grade teacher regarding what are the obstacles during learning. At this stage, it produces findings that students still have difficulty understanding volume material, one of the causes is the lack of use of learning media that can make it easier for students to understand learning material. Therefore, the solution that researchers propose is the development of android applications, especially on volume material.

Design

After obtaining information about the needs and solutions that are relevant to the problem, then a product design is made to realize the android-based application learning media on volume material. In this design stage, researchers made application mockups using Microsoft Word 2019 which can provide an overview of the work to be produced. Besides making application mock-ups, researchers also compiled and research instruments.

Development

At this stage of development, researchers realize the development of android applications using a website that is very supportive of making android applications, namely using the Mit App Inventor website, making background designs and application logos using the Canva application, while making videos using the CapCut application. After the application has been made, then the application is exported into an android application. After exporting, the application only needs to be installed on the cellphone. After that, proceed with the expert validation test. This validation test was carried out by experts, namely material and language experts and media experts.

Implementation

After the development is complete, the android application on volume material is tested for practicality. Implementation of the practicality test was carried out at the intended school by providing a user response questionnaire.

Evaluation

This evaluation stage is carried out in every android application development process, starting from the analysis, design, development and implementation stages. The evaluation stage makes application development run well android applications can be feasible to use in learning.

The data collection technique used in this study was an expert validation questionnaire and an android application media user response questionnaire. The use of expert validation questionnaires and user responses is to obtain product feasibility data. Data analysis in this study uses a likert scale measurement design as an assessment criterion from expert validators and user responses. The score obtained from the feasibility assessment by the expert test will be calculated using the following formula:

$$NP = \frac{R}{SM} \times 100\%$$

(Purwanto, 2013)

Description:
NP = Average value in percent (%) given
R = Score obtained from each aspect
SM = Maximum score of all aspects

The media eligibility criteria used are as follows (Riduwan, 2015; Widarti, H. R., Rokhim, D. A., & Kadafi, 2023).

Table 1. Media feasibility category

Percentage of Achievement	Feasibility Category
81 - 100%	Highly Feasible
61 - 80%	Feasible
41 - 60%	Fairly Feasible
21 - 40%	Less Feasible
0 – 20%	Not Feasible

RESULTS AND DISCUSSION

This research is focused on developing products in the form of learning media android applications that are suitable for use in learning. The research results form five themes as follows: (1) analysis, (2) design, (3) development, (4) implementation, and (5) evaluation.

Analysis

At the problem analysis stage, an interview was conducted with one of the fifth grade teachers at an elementary school regarding the learning difficulties experienced by students. After identifying the needs, it was found that there were difficulties in learning mathematics in volume material. There are students who do not understand the concept of volume, and do not understand the units of volume. Based on the independent curriculum outcomes such as elements at the end of phase C, learners should be able to construct and decompose spatial shapes (cubes and blocks). And recognize spatial visualizations (front, top and sides). They can compare characteristics between buildings and between spaces. However, in reality students do not understand some of these materials. Thus, the efforts made by researchers after conducting a needs analysis were decided to develop learning media in the form of android applications on grade V volume material.

In the research conducted by (Karim et al., 2020), this analysis stage was carried out by conducting interviews. It was stated that there were still many students who had difficulty understanding mathematics material caused by low interest in learning mathematics because during the teaching and learning process the teacher only used books to convey material. At the analysis stage, the researcher did the same thing, namely carrying out the interview process with the teacher. In addition, Gambini & Lénárt (2021) in his research stated that students still have a negative view by viewing mathematics and geometry as a very objective science where only flawless answers are acceptable, and it is up to the instructor to decide whether the answer is flawless.

Design

The next stage is product design. The first thing to do is to make an application design or commonly called an application mockup. Mockup is a concept of a work that is made digitally so that it looks real. The advantages of mockups are clearly easier, simpler, cost-effective, and can make revisions easily (Ramos et al., 2022). Application mockups are made through Microsoft Word 2019 which can provide an overview of the work to be produced. Besides making application mock-ups, researchers also compiled research instruments. The application mockup can be seen in **Figure 2**.

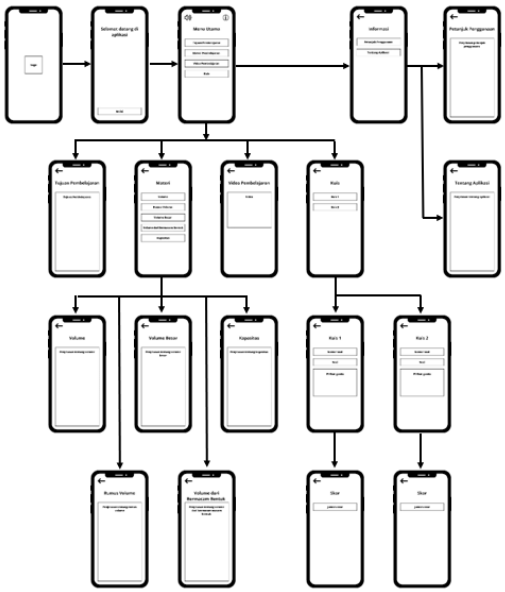

Figure 2. Application Mockup

In the research conducted by (Sari et al., 2023), this design stage is carried out by making simple media concepts such as selecting colors and designing products according to field needs. Not much different from the research, in this study, design is also carried out according to needs, but the difference is that in this study the research makes application mockups. The existence of making this mockup is certainly better, because the application design is more illustrated and well structured. Meanwhile, (Kamalodeen et al., 2021) in her research states that the design process focuses on designing gamification interventions to change the learning environment in basic geometry involving elementary school teachers and students.

Development

This stage is an activity that contains the making of previously designed products in the form of android applications on volume material. After making an application mockup that has been adapted to the material, the next step is to make the background of the application, the background of the learning video, and the icon that will be used for the application using the Canva application. Canva is a complete design tool that is simple to use and ideal for both professionals and amateurs. One of the most useful features is the large number of simple templates for data visualization, marketing, and branding. The program's drag-and-drop functionality makes it user-friendly, and the web platform allows users to access their work from numerous devices (Gehred, 2020). To create it, researchers opened the Canva website. Then, researchers selected the desired

template and added elements, text, and images. After the editing process is complete, the results are saved by clicking share and then download.

After that, making learning videos that will be loaded in the application is made using the CapCut application. This application is frequently used for pleasure, but it can also be utilized for educational purposes. The CapCut program is a video editing software that is widely downloaded currently, so it is highly popular and should be utilized as a video editing tool that can make original films, particularly in learning videos (Silvia et al., 2023). To create it, first download the CapCut application in Playstore. After that, the researcher opened the CapCut application and then clicked on the new project. After that, selected the photos or videos that would be included in the video. Then, the researcher entered the music, text, and other things needed and customized it. Finally, chose the video resolution and saved the video.

The Mit App Inventor website is used to create the entire application. MIT App Inventor is a web-based and free development tool that provides users with a graphical interface for creating and designing fully working Android applications. It makes use of Google Blockly's block-based programming language. MIT App Inventor is divided into two parts. These are the block editor and the designer. The designer is in charge of creating the application's displays and content. The block editor is a graphical environment in which the designer can alter the logic of their application using color-coded blocks that interlock like jigsaw pieces to describe the software (Top & Gökbulut, 2022). To create an application, first enter the Mit App Inventor website. After that, the researcher logs in using the account that will be used. After that, created a new project and entered the editing process. Next, the researcher creates the screen needed and then adds the required pallete such as layout, text, buttons, etc. and adjusts the size, color, and placement. After the design was complete, the researcher entered the code into the application in the blocks menu. Finally, researchers save the application in apk form by clicking the build button, waiting until the saving process is complete.

All of these apps are easily accessible online and can be used for free. The development process is also easy. The application developed in the form of an apk file is stored on Google Drive with the address http://bit.ly/AplikasiTNDbyOlisn. The results of the application display can be seen in **Figure 3**.

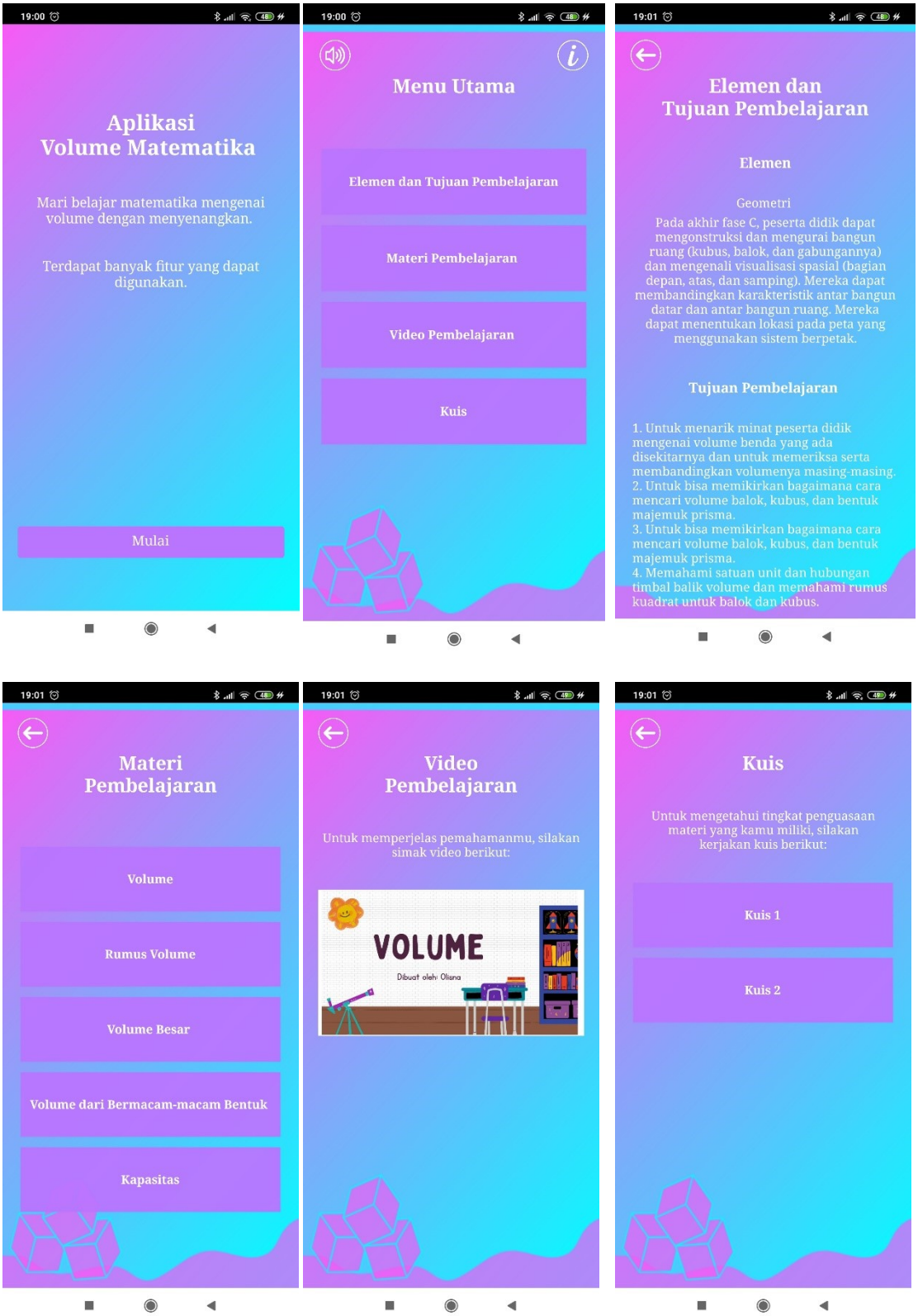

Figure 3. Application view

After the development process is complete, then the android application on volume material is carried out a validation test process by experts from media experts, material experts and linguists. The validation test was developed by the researcher by reading references and then adjusted to the needs of this research. The assessment in this validation test includes the feasibility in terms of the material contained in the application, the suitability of the use of language in the application, and the function and appearance of the application that has been developed. The results of the assessment from material and language experts can be seen in **Table 2**. While the results of the assessment of media experts can be seen in **Table 3**.

Table 2. Material and language expert validation results

No.	Indicator	Score
1.	Media in accordance with the material on the elements in phase c	5
2.	Media in accordance with learning objectives	5
3.	The material contained in the media is in accordance with the ability level of grade V students	4
4.	The correctness of the material concept in terms of scientific aspects	5
5.	Clarity of learning topics	4
6.	The accuracy of the sequence of presentation of learning materials in the media	5
7.	The completeness of the material	5
8.	The conciseness of the presentation of the material	5
9.	Attractiveness of material presentation	4
10.	Appropriateness of presentation of examples	5
11.	Correctness, clarity, depth, breadth of material	4
12.	Alignment of images, text and colors	5
13.	The location of the image does not interfere with the material	5
14.	The language used is easy for students to understand	5
15.	Accuracy/calmness of the language used	5
16.	Using good and correct language rules	5
17.	Accuracy of spelling used	5
18.	Accuracy of language selection in describing the material	4
19.	Uses terminology that is in accordance with the concepts on the subject matter	5
20.	Clarity in providing information in the presentation of material	4
21.	Communicative use of language	5
22.	The language used is appropriate for fifth grade students.	5
23.	Appropriateness of language to students' level of thinking	4
	Total score	**108**
	Percentage (%)	**93,91%**

The results of media validation by material and language experts received an total score of 108 with a percentage of 93.91%. Based on the results of material and language validation, it can be concluded that this android-based media application on volume material gets very feasible criteria.

Table 3. Media expert validation results

No.	Indicator	Score
1.	Media illustrates learning material	5
2.	Media can lead to learning objectives	5
3.	Media is easy for students to use	5
4.	Media can attract students' interest in learning	5
5.	The media is running well	5
6.	Accuracy of font selection for easy reading	4
7.	Appropriateness of font size for easy reading	4
8.	Image display quality	4
9.	Video display quality	4
10.	Audio quality	4
11.	Accuracy of video with material	4
12.	Background accuracy with the material	4
13.	The accuracy of the layout proportion	4
14.	Accuracy of text color combination with background	4
15.	The accuracy of the size and function of each button	4
	Total score	**65**
	Percentage (%)	**86,67%**

The results of media validation by media experts received a total score of 65 with a percentage of 86,67%. Based on the results of media validation and it can be concluded that the android-based application media on this volume material gets very feasible criteria. In addition, overall according to the comments from the validators, the learning media in the form of this android application is good, the material is quite complete, the language is good, and the media display is quite attractive, so the application that has been developed does not require revision.

In the research conducted by Nurfadhillah et al. (2021), at this stage of development, product development is carried out on the Quizizz application. Unlike this research, the resulting product is an application designed from scratch. However, it is adjusted to the needs. The android application that the researcher designed is better if you want to make an application that is tailored to your needs. However, if you want to make

a media that is simpler and faster to make, it is better to use Quizizz, because it does not require special application development skills. Meanwhile, (Yuan et al., 2023) in his research stated that the development of this type of software, such as GeoGebra, continues to support teaching and learning activities in mathematics at the elementary school level.

Implementation

After the development stage and validation test are completed, then at the implementation stage a practicality test is carried out in class 5. The trial instrument was developed by the researcher by reading references and then adjusted to the needs of this research. The practicality test is carried out by giving a user response questionnaire to small group trial students as many as 6 students, and a large group trial of 18 students.

Small Group Trial

This small group trial was conducted on 6 students. The results of the small group trial can be seen in **Table 4**.

Table 4. Small group trial results

No.	Indicator	Score
1.	Learning media for diatonic scales android application is easy to use	29
2.	Learning media can be used anywhere and anytime	30
3.	The language used is easy to understand	29
4.	The appearance of the android application is interesting	30
5.	Images and videos in the application are very clear	30
6.	Selection of type and size of letters used is easy to read	29
7.	The suitability of the material contained in the android application with learning objectives	29
8.	The suitability of media content with learning material	29
9.	The material is easy to understand	30
10.	Android application media makes me more excited about learning	30
11.	Android application media makes me more interested in learning	30
12.	Ability to increase knowledge after using the android application	29
	Total score	**354**
	Percentage (%)	**98,33%**

The trial results got an total score of 354 with a percentage of 98,33%. Based on the results of the small group trial, it can be concluded that the android-based application media on this volume material gets very feasible criteria.

Large Group Trial

This large group trial was conducted on 18 students. The results of the large group trial can be seen in **Table 5**.

Table 5. Large group trial results

No.	Indicator	Score
1.	Learning media for diatonic scales android application is easy to use	88
2.	Learning media can be used anywhere and anytime	88
3.	The language used is easy to understand	86
4.	The appearance of the android application is interesting	88
5.	Images and videos in the application are very clear	87
6.	Selection of type and size of letters used is easy to read	88
7.	The suitability of the material contained in the android application with learning objectives	85
8.	The suitability of media content with learning material	87
9.	The material is easy to understand	86
10.	Android application media makes me more excited about learning	87
11.	Android application media makes me more interested in learning	87
12.	Ability to increase knowledge after using the android application	85
	Total score	**1042**
	Percentage (%)	**96,48%**

The trial results got an total score of 1042 with a percentage of 96,48%. Based on the results of the large group trial, it can be concluded that this android-based application media on volume material gets very feasible criteria. But in addition, during the trial process, there were still obstacles such as some students who did not have a cellphone, so they had to try on their friend's cellphone. Then, there were cellphones that could not install the application. Other than that, everything went well without a hitch and students seemed happy to try the android application that the researchers had developed.

In the research conducted by (Ula et al., 2021), at the implementation stage, the media application process was carried out, then students were asked to work on the final results to determine the level of understanding of concepts after using Kelubatar media. In contrast to this study, at the implementation stage, no measurement of the level of understanding of concepts was carried out, but an assessment of the media was held based on the application trials that had been carried out. Meanwhile, in another study conducted by (Hwang et al., 2021), the implementation was carried out by

experimentation, namely dividing participants into experimental groups and control groups.

Evaluation

The evaluation stage is always present at every stage of this android-based application development process, starting from the analysis, design, development, and implementation stages. Evaluation is carried out during the analysis stage while developing an overall analysis of the things needed by students. At the design stage, the evaluation is carried out by determining whether the application mockup design made is adequate and practical to be included in an application. At the development stage, the evaluation is carried out by independently evaluating whether the application made by adjusting the material, language, and learning media is feasible and allows it to proceed to the next stage. At the implementation stage, material, language, and media experts evaluate the validity and practicality of the application to be tested, after which the application is changed based on the experts' ideas and comments. Finally, as users of the application, students and teachers evaluate whether the application is feasible in terms of use, appearance, material, and learning benefits. The application that has been developed by researchers is a simple application that only discusses one discussion of material, namely volume material, it would be better for future researchers to develop applications that are much wider range of material and a more attractive appearance.

In the research conducted by Amanda & Putri (2019), at the evaluation stage, data presentation and analysis of product trials as well as pretest and posttest results were carried out. In contrast to these studies, in this study, researchers evaluated the application development process as a whole and there was no pretest and posttest process. Meanwhile, the evaluation conducted by Kuzle (2023) is by evaluating the items of questions regarding geometry learning.

CONCLUSION

In conclusion, two research questions have been answered. Answering the question "How is the development of android-based applications on volume material?" The development of this android application uses the ADDIE development model which has 5 stages. The first stage is analysis, at this stage the researcher analyzes the problem. The second stage is design, at this stage researchers design the needs of making applications. The third stage is development, at this stage researchers develop the application as a whole and conduct expert validation tests. The fourth stage is implementation, at this stage the practicality test is carried out in small group and large group. The fifth stage is evaluation, at this stage the evaluation is carried out in the previous four stages.

Furthermore, answering the question "How is the feasibility of Android-based applications on volume material to be used in the learning process?" Judging from the results of the material and language expert validation test, the score was 93.91% and the media expert was 86.67% with an average score of 90.29%. That way, the results of the expert validation test on this android application media are included in the very feasible criteria. Furthermore, the practicality test in the small group received a score of 98.33% and in the large group received a score of 96.48% with an average score of 97.40%. The results of the practicality test show that this android application media is included in the very feasible category. The shortcomings of this study are in terms of material development that is still lacking and few. Suggestions for other researchers are to be able to develop learning media in the form of applications or other media with more complete material coverage and a more attractive appearance.

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