



Development of Android Application-Based Learning Media for Mathematics at Elementary School

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This study aims to produce a feasible and practical Android-based learning application for students. Development research is a type of research whose ultimate goal is to create something through a development process whose feasibility is examined through research. This research is a type of research R & D (Research and Development). The model used in this development research is the ASSURE model which consists of six steps, namely: 1) analyze the learner. 2) state standards and objectives. 3) select strategies, technology, media, and materials. 4) utilize technology, media and materials. 5) require learner participation. 6) evaluate and revise. Data analysis technique is an important step in research, because the data analysis is used to answer existing problems. The data generated from this study are in the form of quantitative and qualitative data. In the feasibility assessment, the total value of each aspect that is assessed as a whole will be interpreted into the product feasibility category. The results of the validation of instructional media are: (1) Material experts rate it well with a percentage of (100%). (2) Media experts rated it well with a percentage of (100%). (3) The learning design experts rated it well with a percentage of (100%). Based on these results, the learning media that has been developed is suitable for use in the mathematics learning process in elementary schools.

Keywords: Research & Development, ASSURE, Mathematics, Android



Introduction

The most important part of education is the learning process. The learning process must be able to combine various things, be more adaptive, interactive, and so on to produce meaningful learning [1]. The notion of learning is a process of interaction between students and educators in a learning environment using materials, delivery methods, learning strategies, and learning resources [2].

Therefore, learning becomes an important process rather than attitudes or learning resources related to the process of interaction between students and educators, and the learning environment instructional objectives. Mathematics is one of the lessons that have an important role in life ([4]; [3]) and becomes the basis for the development of other sciences [5]. However, mathematics has so far been considered a difficult subject for most students ([6]; [7], [3]; [8]).

The use of instructional media is very limited [9] and methods of delivery that are not precise and minimal variation [11] make mathematics increasingly difficult. Instructional media can change abstract mathematical perceptions [12] and make the learning process interesting, and increase student interest in learning ([10]; [13]).

Learning media can be developed on mobile devices that are easy to carry anywhere, such as smartphones [14]. Students can also easily interpret data, increase understanding, compress information, present data, generate motivation and interest in students in learning so that students do not only listen to explanations from the teacher, but through learning media, students can also make more observations and demonstrations.

The development of learning media can meet students' needs if it is studied in the field of learning technology. Learning technology has a role in facilitating learning and improving performance by creating, using, or utilizing and managing appropriate technological processes and resources [15]. Educational technology is human learning, so recently, the term educational technology tends to be replaced by learning technology [16].

The development of learning media cannot be separated from the role of learning technology, namely theory and practice, in the design, development, utilization, management, and evaluation of learning processes and resources. In learning technology, the relationship between regions is synergetic. The result of teaching media for android applications focuses not only on the development area or coverage of the region but also on theory and practice from the other regions.

The purpose of this writing is to develop an android-based comic learning media in Mathematics subject with the subject of arithmetical operating systems for grade 3 SD.



Method

This research is a type of research R & D (Research and Development). This study aims to produce a feasible and practical Android-based learning application for students. Development research is a type of research whose ultimate goal is to create something through a development process whose feasibility is examined through research.

This research was developed to make media suitable for Mathematics subjects. With this Android-based media, it is hoped that it will be able to assist teachers in conveying discussions and helping students to understand lessons about arithmetic operating systems.

The model used in this development research is the ASSURE model which consists of six steps, namely: 1) analyze the learner. 2) state standards and objectives. 3) select strategies, technology, media, and materials. 4) utilize technology, media and materials. 5) require learner participation. 6) evaluate and revise. Data analysis technique is an important step in research, because the data analysis is used to answer existing problems. The data generated from this study are in the form of quantitative and qualitative data. In the feasibility assessment, the total value of each aspect that is assessed as a whole will be interpreted into the product feasibility category.

Result

1. Results of Model Development

The development of this research media uses the ASSURE development model which consists of 6 steps as follows: The first step is **Analyze learner**, namely conducting interviews with mathematics teachers, there are several stories obtained by researchers including (1) the average student in one class is 40 students (2) the low level of mathematics in class 3 is due to the transition process from offline learning to online (3) students cannot use Google Classroom to retrieve and store or upload assignments from the teacher (4) teaching methods during a pandemic are less effective because teachers can only send assignments via Word and PPT sent via WhatsApp, Google Class Room and so on.

Furthermore, the second step is the **State Objectives**, namely ensuring the learning objectives that will be raised in the material comic media or the sub-chapter on the nature of arithmetic operations.

The third step is **Select Methods**, Media, Materials, namely developing media, making storyboards. After the media is designed, the next stage is product development. The design stage includes making the application background design, buttons, and so on. The appearance of the product after being developed is as follows.



Figure 1 Display News and questions



Figure 2 Display of distributive, associative and commutative material

The fourth step is **Utilize Media**, Materials, which is examining whether all of the media can be used, is the conversation in the comic application clear, does the media have to use a strong signal, can the application attract students' interest in learning what the student's learning experience is after learning using the application the.

The fifth step is **Require learner participation**, namely testing the product that we will provide to students whether the product is appropriate for giving to students or still needs improvement. The sixth step is **Evaluate & revise**, namely distributing questionnaires to media experts, learning design experts, teachers or material experts. The results of the sixth step are as follows:

a. Learning Design Expert

Table 1. Results of Learning Design Expert Assessment

No.	Indicator	Value	Criteria
	Aspects of Specific Learning Objectives		
1	Are the indicators clear?	1	Good
2	Are the indicators easy to understand?	1	Good
3	Are the indicators in accordance with the curriculum?	1	Good
	Assess aspects of specific learning objectives	3	
	Average aspect of specific learning objectives	1	
	Percentage of aspects of learning objectives	100%	
	Aspects of Material / Content		
4	Does the material match the indicators?	1	Good
5	Is the content up-to-date or useful?	1	Good
6	Is the material suitable?	1	Good
	Value aspect of Material/Content	3	
	Average Aspects of Material/Content	1	
	Percentage of Material/Content Aspects	100%	
	Linguistic Aspect		
7	Are the instructions given clear?	1	Good
8	Does it match the language used?	1	Good
9	Is the language used in accordance with the emotional students	1	Good
10	Can it stimulate student curiosity?	1	Good
11	Is the language used polite?	1	Good
12	Is the text correct with the material?	1	Good
	The value of linguistic aspects	6	
	The average aspect of language	1	
	Percentage of linguistic aspects	100%	
	Presentation Aspects		
13	Is it coherent or is the material presented sequentially?	1	Good
14	Does it support the way the media is presented on student involvement in learning?	1	Good
15	Is the media easy to use?	1	Good
	Value aspect of presentation	3	
	Average presentation aspect	1	
	Percentage of presentation aspect	100%	
	Media Aspects of Learning Strategies		
16	Does this media support student learning independence?	1	Good
17	Is this media able to increase student motivation?	1	Good
18	Does this media add to students' knowledge?	1	Good



No.	Indicator	Value	Criteria
	The value of media aspects of learning strategies	3	Good
	The average aspect of the media on learning strategies	1	Good
	Percentage	100%	Good
	The total value of all aspects	18	
	Average total of all aspects	1	
	Percentage of all aspects	100%	

The results of the assessment table above show that the assessment of the android application media from learning design experts obtains an overall score of 1 for all aspects with a percentage of 100% which is included in the good category to be tested in the next stage

b. Media Expert

Table 2. Results of Media Expert Assessment

No	Indicator	Value	Criteria
	LANGUAGE ASPECT		
1	Are the instructions given clear?	1	Good
2	Does it match the language used?	1	Good
3	Is the language used in accordance with the emotional students	1	Good
4	Can it stimulate student curiosity?	1	Good
5	Is the language used polite?	1	Good
6	Is the text correct with the material?	1	Good
	Language Aspect Value	6	
	Average	1	
	Percentage of Linguistic Aspects	100%	
	PRESENTATION ASPECT		
7	Is it coherent or is the material presented sequentially?	1	Good
8	Does it support the way the media is presented on student involvement in learning?	1	Good
9	Is the image presentation good?	1	Good
	Presentation Aspect Value	3	
	Average Aspects of Presentation	1	
	Presentation Aspect Percentage	100%	
	MEDIA ASPECTS OF LEARNING STRATEGIES		
10	Is the media easy to use?	1	Good
11	Does this media support student learning independence?	1	Good



No	Indicator	Value	Criteria
12	Is this media able to increase student motivation?	1	Good
13	Does this media add to students' knowledge?	1	Good
14	Is this media able to broaden students' horizons?	1	Good
	The Value of Media Aspects of Learning Strategies	5	
	Average Aspects of Media Against Learning Strategies	1	
	Percentage of Media Aspects of Learning Strategies	100%	
	OVERALL VIEW FEASIBILITY		
15	Is this media display interesting?	1	Good
16	Is the look or design of this media regular?	1	Good
17	Are the types and fonts of this media interesting?	1	Good
18	Do the drawings and materials match?	1	Good
19	Is it easy to read the writing?	1	Good
20	Is the selected color suitable?	1	Good
21	Is the image appropriate for the material?	1	Good
22	Is the operational view good?	1	Good
	Full View Eligibility Aspect Value	8	
	Average Aspect Eligibility Full View	1	
	Percentage of Comprehensive Feasibility Aspects	100%	
	Total Value of All Aspects	22	
	Average Total Aspects	1	
	Percentage of Overall Aspects	100%	

The results of the assessment table above show that the assessment of the android application media from media experts obtains an overall score of 1 for all aspects with a percentage of 100% which is included in the good category to be tested in the next stage

c. Material Expert

Table 3. Results of Material Expert Assessment

No	Indicator	Value	Criteria
	ASPECT OF SPECIAL LEARNING OBJECTIVES		
1	Are the indicators clear?	1	Good
2	Are the indicators easy to understand?	1	Good
3	Are the indicators in accordance with the curriculum?	1	Good
	Value aspects of learning objectives	3	
	Average Aspects of Learning Objectives	1	
	Percentage of Aspects of Learning Objectives	100%	
	ASPECT OF MATERIAL / CONTENT	1	
4	Does the material match the indicators?	1	Good
5	Is the content up-to-date or useful?	1	Good
6	Is the material suitable?	1	Good
	Material/Content Aspect Value	4	
	Average Aspects of Material/Content	1	
	Percentage of Material/Content Aspects	100%	
	LANGUAGE ASPECT		
7	Are the instructions given clear?	1	Good
8	Does it match the language used?	1	Good
9	Is the language used in accordance with the emotional students	1	Good
10	Can it stimulate student curiosity?	1	Good
11	Is the language used polite?	1	Good
12	Is the text correct with the material?	1	Good
	Language Aspect Value	6	
	Average Language Aspect	1	
	Percentage of Linguistic Aspects	100%	
	PRESENTATION ASPECT		
13	Is it coherent or is the material presented sequentially?	1	Good
14	Does it support the way the media is presented on student involvement in learning?	1	Good
15	Is the image presentation good?	1	Good
	Language Aspect Value	3	
	Average Language Aspect	1	
	Percentage of Linguistic Aspects	100%	

No	Indicator	Value	Criteria
	MEDIA ASPECTS OF LEARNING STRATEGIES		
16	Is the media easy to use?	1	Good
17	Does this media support student learning independence?	1	Good
18	Is this media able to increase student motivation?	1	Good
19	Does this media add to students' knowledge?	1	Good
20	Is this media able to broaden students' horizons?	1	Good
	The value of media aspects of learning strategies	5	
	Average Aspects of Media Against Learning Strategies	1	
	Percentage of Media Aspects of Learning Strategies	100%	
	OVER ALL VIEW FEASIBILITY		
21	Is this media display interesting?	1	Good
22	Do the drawings and materials match?	1	Good
23	Is it easy to read the writing?	1	Good
24	Is the image appropriate for the material?	1	Good
25	Is the operational view good?	1	Good
	Full View Eligibility Value	5	
	Full View Eligibility Average	1	
	Full View Eligibility Percentage	100%	
	Total Value of All Aspects	25	
	Average Total Aspects	1	
	Percentage of Overall Aspects	100%	

The results of the assessment table above show that the assessment of the android application media from learning design experts obtains an overall score of 1 for all aspects with a percentage of 100% which is included in the good category to be tested in the next stage

2. Model Effectiveness

2.a. Adequacy Test of Learning Design Experts

Table 4. Feasibility Results of Learning Design Experts

No	Aspect	Feasibility (%)
1.	Aspects of learning objectives	100
2.	Material/content aspect	100
3.	Linguistic aspect	100
4.	Presentation aspect	100
Average		100

2.b. Media Expert Due Diligence

Table 5. Media Expert Due Diligence Results

No	Aspect	Feasibility (%)
1.	Linguistic Aspect	100
2.	Presentation Aspects	100
3.	Media Aspects of Learning Strategies	100
4.	Presentation aspect	100
Average		100

2.c. Material Expert Due Diligence

Table 6. Material Expert Due Diligence Results

No	Aspect	Feasibility (%)
1.	Aspects of learning objectives	100
2.	Material/content aspect	100
3.	Linguistic aspect	100
4.	Presentation aspect	100
Average		100



Discussion

The product developed in this study is a digital comic application media aimed at Mathematics in elementary schools which can be accessed through the available applications. The material discussed in this product includes associative, distributive, and cumulative.

The product that the researcher has developed from this linguistic aspect is good with a percentage of 100% to be given to grade 3 students in elementary schools, this product is also easily accessible from anywhere and anytime.

The product that the researcher developed is easy to use by students in grade 3 elementary school and the media aspect of the learning strategy is good with a percentage of 100% that can be given to students. This product is also easy to read by anyone, especially grade 3 students, media experts obtained a score of 100% for all aspects. This product is also good for the elementary level, especially for students in grade 3 elementary school. From the material experts, it obtained a score of 100% for all aspects. This product has also passed product trials by 3 experts and the results are in the good category for use by students, as well as for language experts, a score of 100% is obtained from all aspects.

This research has succeeded in developing an Android-based learning application product that has proven its quality, especially in terms of experts. Smartphone-based application development has been shown to show many benefits for students and teachers [18], because it is easier to use and easy to repeat as needed [17]. The use of Android-based applications that can be accessed easily by students will certainly make students interested and want to use it further [19]. This shows that the use of technology is necessary as a tool in learning in the classroom.

Interesting learning media will also make mathematics learning more directed, more effective [20], motivating and attracting learning interest, increasing student enthusiasm in learning [21], and ultimately will improve student learning outcomes in school. In fact, the use of applications in learning can be applied in everyday life and makes it easy for students to understand the subject matter, especially mathematics [22].

Summary

The results of the feasibility study of learning design experts on digital comic media are 100%, which means good, then the results of the feasibility study of media experts trials are 100%, which means good and the results of the material expert trials are 100%, which means good. The product that the researcher has developed is useful for the teaching and learning



process. This product is categorized as proper or good for the learning process in grade 3, according to students in direct interviews the comic media made is interesting to read

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