

Development of Smartphone Application-Based Learning Devices to Improve Learning Outcomes and Independent Learning of Students at Nurul Amaliyah High School Tanjung Morawa

Khairun Nisa Pulungan, Pargaulan Siagian, Mariani
Postgraduate Mathematics Education Study Program, State University of Medan
Medan, North Sumatra, Indonesia
nispul503@gmail.com

Abstract

This study aims to describe: 1) Validity, Practicality, and Effectiveness of Learning Devices based smartphone application in Mathematics Learning on Matrix Subject; 2) Improving student learning outcomes on the Matrix Subject after using the developed learning devices 3) Increasing the student learning independence in Matrix subjects after using learning devices developed. This study is development research with 4D Model in XI class Senior High School Of Nurul Amaliyah Tanjung Morawa. From the first trial and second trial obtained: 1) Learning Devices of Smartphone Application to improve Learning Outcomes and Independent Learning is Valid, Practice, and Effective. 2) In the first and second trials, there was an increase in learning outcomes from an average score of 60 increasing to an average score of 78.7. 3) In the first and second trials there was an increase in learning independence from 3,36 in the first trial and increasing to 3,9 in the second trial. Thus, the development of smartphone application-based learning devices can improve student learning outcomes and independent learning in XI Class IPA SMA S Nurul Amaliyah Tanjung Morawa.

Keywords: Development of Learning Devices, Development of *Smartphone* Application, 4D Model, Learning Outcomes, Learning Independence.

DOI: 10.7176/JEP/13-7-07

Publication date: March 31st 2022

INTRODUCTION

Today, computer science and information technology are growing. The development of science encourages new efforts in the use of technology for learning. Teachers must be able to use the available tools and materials to create interesting learning following the times. Technology in the form of computers, cellphones (smartphones) are no longer objects that are difficult to find in society, especially students. As research by Razak (2014), it is explained that children and adolescents aged 10 to 19 years have accessed the internet to find information for their studies, to entertain themselves, and meet friends on social media.

Mathematics is a subject that is given from elementary school to college. This is because, in mathematics, students are taught to act creatively, logically, systematically, analytically, and critically. This has been stated in the Regulation of the Minister of National Education of the Republic of Indonesia (Permendiknas) in 2006 number 22, namely "Mathematics subjects need to be given to all students starting from elementary school to equip students with logical, analytical, systematic, critical, and creative thinking skills and have the ability to think logically, analytically, systematically, critically, and creatively. ability to work together." This is per Ibrahim and Suparni (2008) who argued that "Mathematics as a universal science underlies the development of modern technology which has an important role in advancing the power of human thought. Along with the rapid development of science and technology, the world of education also needs to innovate or renew in various fields, including learning implementation strategies. Therefore, education is an interesting thing to continue to study and continue to develop".

In general, the mathematics learning process at the senior secondary level is delivered using the lecture, question and answer, and discussion methods. The lecture method is to convey the material persuasively to students. This is the most popular method in learning practice. This method is considered very passive for students because there is only one-way communication from the teacher so that students do not get an opinion. While the question and answer method and discussion try to provide space for students, from the standpoint of independence it is less effective. Due to the lack of boundaries and discussion that widens from the focus of the material.

Independent learning of students is an important thing that should be owned by every student. This is in line with the explanation of one of the mathematics teachers at SMA S Nurul Amaliyah, Mr. Suyitno, who explained that students' independence needed to be improved. Through the implementation of interesting, innovative learning and also using current technology.

Besides that, student learning outcomes are also important considering that the majority of students at the school still do not meet the criteria for learning completeness in several materials, especially matrix material.

This is because students are less interested and feel that mathematics is a difficult subject. Lack of motivation is also a factor in the low learning outcomes of students at the school.

LITERATURE REVIEW

Learning tools are a collection of learning resources that allow students and teachers to carry out learning activities. according to Trianto (2011:201), learning tools include lesson plans, LKD, and evaluation instruments which in this study are in the form of tests of learning outcomes and student learning independence. The Ministry of National Education (2008) also states that learning tools serve as (1) guidelines for teachers who will direct all their activities in the learning process. as well as a substance of competence that should be taught to students. (2) guidelines for students who will direct all their activities in the learning process, as well as a substance of competence that should be mastered. (3) evaluation tool of learning outcomes achievement.

Learning Plan is a plan that contains procedures or steps for teacher and student activities that are arranged systematically as a guide for teachers in carrying out the learning process in the classroom. The better the planning made, the easier the implementation of learning activities so that the higher the possibility of learning outcomes achieved. RPP was developed from the syllabus to direct students' learning activities to achieve Basic Competence (KD). Every educator in the education unit is obliged to compile a complete and systematic lesson plan so that learning takes place interactively, inspiring, fun, challenging, efficient, motivating students to participate actively, and providing sufficient space for the initiative, creativity, and independence according to their talents, interests, and abilities. physical and psychological development of students.

Given the different ability levels of students, the device needs to be equipped with student activity sheets. The existence of this LKPD is intended to make it easier for teachers to accommodate different levels of student abilities, providing it can also make it easier for teachers to manage learning based on Matrix application-based learning.

The teacher's manual is a book that is used by the teacher as a guide in carrying out the contents contained in the teaching materials. According to Prastowo (2012:17), teaching materials are information materials and tools that have been systematically arranged consisting of competencies, planning, and implementation objectives that will be mastered by students in carrying out a learning process. So teaching materials are needed in carrying out the learning process. Without teaching materials, teachers will experience difficulties in carrying out the learning process.

According to Nahel (2012: 1), the student book is a book that contains subject matter in the form of concepts and understandings that will be constructed by students through the problems in it which are arranged based on an approach. Student books can be used by students as a means of supporting the smooth running of their learning activities in class and at home.

The smartphone is a mobile phone that has an operating system for the wider community. Which has functions that are not limited to SMS and telephone only, but users can freely add applications, add functions or change photos according to the wishes of the user. In this case, the Matrix application will be installed with an Android/iOS operating system to meet the needs of respondents in the field.

Android is a Linux-based operating system designed for touch screen mobile devices such as smartphones and tablet computers. Android was originally developed by Android Inc., with financial support from Google, which later bought it in 2005. According to Syarief (2014: 19), the first Android system released was Android beta in November 2007. While the first commercial version, Android 1.0, was released in September 2008.

iOS is a hardware operation from Apple. Initially made only for the iPhone, iOS has since grown to support other Apple devices such as the iPod touch, iPad, and Apple TV.

Thunkable is a web application that can be used to create smartphone applications with the Android and iOS operating systems. The design of Android or iOS applications on Thunkable uses visual programming concepts that are drag and drop. The visual programming language used is Scratch. Scratch was developed by the Massachusetts Institute of Technology (MIT). Currently, Scratch has been adopted by several software development applications. Both software for certain operating systems and software for embedded systems such as Arduino. The drag and drop concept promoted by Thunkable makes this web application easier to use for beginners who want to learn to make Android and iOS applications.

According to Abdul Majid (2014: 28), learning outcomes are things that can be viewed from two sides, namely from the student's side and from the teacher's side. From the student's perspective, learning outcomes are a better level of mental development when compared to before learning. The level of mental development is manifested in the types of cognitive, affective, and psychomotor domains.

According to Drost (1993: 43), independence is an individual who can face the problems he faces and can act maturely. Meanwhile, according to Panen et al (2001: 21), the main characteristic of independent learning is the development of student's abilities to carry out the learning process that does not depend on teachers, friends, and others. The level of student learning independence can be determined based on how much initiative and responsibility students take to play an active role in learning planning, learning processes, and learning

evaluations. The greater the active role of students in various activities, it indicates that these students have a high level of learning independence.

Based on this, the authors are interested in developing learning devices based on smartphone applications to improve learning outcomes and student learning independence at SMA S Nurul Amaliyah Tanjung Morawa. Nieveen (2007) states that to determine the quality of the results of the development of teaching materials, several criteria are needed, namely: (1) validity, (2) practicality, and (3) effectiveness. This is also in line with Akker's (1999) opinion that a learning model is said to be good if the model is (1) Valid, (2) Practical, (3) Effective.

RESEARCH METHOD

This research is included in development research (Development Research). This study uses a 4D development model. This research is centered on developing a smartphone application-based mathematics learning device.

This research will be conducted at SMA S Nurul Amaliyah, Jl. Sei Merah Kerawang Trading Village, Tanjung Morawa. Deli Serdang Regency, North Sumatra 20362 in grade XI Semester II Academic Year 2021/2022.

The subjects in this study were students of class XI with a total of 30 people, while the objects in this study were a smartphone application-based mathematics learning device with matrix topics. The devices developed in this research are smartphone application-based learning media, lesson plans, LKPD, Teacher's Books, Student Books, Learning Outcomes Tests, and Learning Independence Questionnaires.

The development model used is the 4-D model developed by Thiagarajan and Semmel (Trianto, 2014) which consists of four steps: define stage, design stage, develop stage and disseminate stage. The data collection used is in the form of interviews, distributing questionnaires, and tests. The data analysis used was quantitative and qualitative including analysis of validity, practicality, and effectiveness as well as comparison of learning outcomes and learning independence from the first trial to the second trial.

RESULT AND DISCUSSION

The development of learning tools is carried out using the 4D development model, namely: define, design, develop, and disseminate. The result of the development that has been done is learning tools of a smartphone application on the material of matrix in the form of lesson plans, teacher books, student books, matrix application, student worksheets, post-test and independent learning questionnaires which all of the tools had validity score, practicality score and effective score in improving outcomes learning and increasing independent learning of class XI students of SMA S Nurul Amaliyah.

Validity Analysis Results

The validity of learning tools that have been developed can be seen from the result of the validation sheets that have been filled in by five expert validators (Lecturers and Teachers). The validity of the learning devices is briefly summarized in Table 1.

Table 1. Summary of Learning Tool Validation Results

No.	Rated Devices	Average Total Score	Category
1	Matriks Application	3,81	Valid
2	Learning Implementation Plan (RPP)	3,81	Valid
3	Student Activity Sheet (LKPD)	3,9	Very Valid
4	Teacher's book	3,85	Valid
5	Student's book	3,81	Valid
6	Outcomes Learning test	3,85	Valid
7	Independent learning questionnaires	3,9	Very Valid

Table 1 above, shows that the total average validation value for Matriks Application is 3,81 or declared valid. The RPP set is 3,81 declared valid. The LKPD set is 3,9 declared very valid. The teacher's book set is 3,85 declared valid. The student's book set is 3.81 declared valid. Outcomes learning test is 3,85 declared valid and independent learning questionnaires is 3,9 declared very valid. Thus, based on the results of the assessment of practitioners and expert validators (teachers and lecturers), it is concluded that all learning tools developed are declared valid and suitable for use in the learning process in the classroom.

Results of Practicality Analysis

a. Practicality Data from Teacher Response

The Smartphone Application-based Mathematics Learning Media developed in this study is said to be practical if the score obtained from the practicality test questionnaire filled out by the teacher has a practicality score of at least 70% in the practical category. The results of the practicality of learning media questionnaire scores are

presented in table 2

Table 2. Summary of the Practicality of Learning Devices Based on Teacher's Response

Aspects Observed	First Trial		Second Trial	
	Score (%)	Criteria	Score (%)	Criteria
Effective aspect	85,6	Practice	89,4	Very Practice
Interactive aspect	83	Practice	89,77	Very Practice
Interesting Aspect	87,5	Very Practice	93,75	Very Practice
Efficient aspect	79	Practice	87,5	Very Practice
Creative aspect	87,5	Very Practice	92,5	Very Practice

Based on the table above, it can be seen that the average score of the practicality questionnaire on the smartphone application-based mathematics learning media developed with Thinkable is in the practical category with a score for the effective aspect of 85.6%, the interactive aspect of 83%, and the interesting aspect of 87.5%. , the efficient aspect is 79% and the creative aspect is 87.5%. Based on the criteria for the practicality of the media, it can be concluded that the mathematics learning media developed is quite practical.

b. Practicality Data from Student Response

The smartphone application-based mathematics learning media developed with thinkable in this study is said to be practical if the scores obtained from the practicality test questionnaire filled out by students have a practicality score of at least 76% in the practical category. The results of the practicality of learning media questionnaire scores are presented in table 3

Table 3. Summary of the Practicality of Learning Devices Based on Student's Response

Aspects Observed	First Trial		Second Trial	
	Score (%)	Criteria	Score (%)	Criteria
Effective aspect	80,13	Practice	82,58	Practice
Interactive aspect	80,23	Practice	83,29	Practice
Interesting Aspect	79,17	Practice	80,15	Practice
Efficient aspect	80,81	Practice	84,56	Practice
Creative aspect	78,79	Practice	79,94	Practice

From the table above, it can be seen that the assessment by students of the learning media developed is in practical criteria. It can also be seen that there is an increase in the average score of each aspect.

Effectiveness Analysis Results

Learning media is said to be effective in terms of (1) classical student learning completeness, namely at least 85% of students who take the test have had at least moderate learning outcomes (getting a score of 2.51 or at least B) and (2) at least 80% of many subjects studied (for each trial) gave a positive response to the learning media and learning activities, and (3) the achievement of the time used was less or the same as the usual learning time. The following will present a discussion for each indicator in measuring the effectiveness of learning media.

Table 4. Summary of the Effectiveness of Learning Devices based on the classical value

Category	Student's Learning Outcomes					
	First Trial			Second Trial		
	Students	Percentage	Average	Students	Percentage	Average
Complete	11	36,7%	60 (C+)	26	86,67%	78,7 (B)
Incomplete	19	63,3%		4	13,33%	
Total	30	100%		30	100%	

Based on the table above, the results of the analysis of the improvement in students' mathematics learning outcomes in trials I and II show that in the first trial the effectiveness criteria have not been met, but in the second trial, the effectiveness criteria have been met. Besides that, it can also be seen that the average learning outcomes obtained from the trial I were 60 or C+ with the number of students who completed was 11 students while the average student learning outcomes obtained from trial II was 78.7 or B. with the number of students who completed as many as 26 students.

The results of the questionnaire data analysis of student responses to the developed Smartphone application-based mathematics learning media are presented in the following table:

Table 5. Result of Student Response Analysis Test I

Question Item	Student's Response	
	Yes	No
This Matrix application is interesting	27	3
I enjoy learning by using this application	29	1
This app motivates me even more to learn	29	1
The appearance of this application attracts attention	30	0
The material presented is easy to understand	29	1
The Worksheet presented made me understand more about the Matrix material	28	2
The images presented make it easier for me to understand the Matrix material	27	3
The size of the text is appropriate so that it makes it easier for me to read the material	28	2
The language used is communicative and interactive	27	3
Having a video application made me understand more about the matrix material	30	0
Total	284	16
Average	28,4	1,6
Average Total Percentage	94,6%	5,3%

Based on the results of the student response questionnaire analysis in the table above, it can be seen that the percentage results of all positive answer statements are 94.6%, while there are 5.3% of students stated negative answers. If these results are referred to the criteria that have been set in the previous chapter, it can be concluded that the student's response to the learning media is positive, because more than 80% of the students gave a positive response to the Smartphone application-based learning media developed.

Table 6. Result of Student Response Analysis Test II

Question Item	Student's Response	
	Yes	No
This Matrix application is interesting	30	0
I enjoy learning by using this application	30	0
This app motivates me even more to learn	29	1
The appearance of this application attracts attention	30	0
The material presented is easy to understand	30	0
The Worksheet presented made me understand more about the Matrix material	29	1
The images presented make it easier for me to understand the Matrix material	30	0
The size of the text is appropriate so that it makes it easier for me to read the material	30	0
The language used is communicative and interactive	29	1
Having a video application made me understand more about the matrix material	30	0
Total	297	3
Average	29,7	0,3
Average Total Percentage	99%	1%

Based on the results of the student response questionnaire analysis in the table above, it can be seen that the percentage results of all positive answer statements are 99%, while there are 1% of students stated negative answers. If these results are referred to the criteria that have been set in the previous chapter, it can be concluded that the student's response to the learning media is positive, because more than 80% of the students gave a positive response to the Smartphone application-based learning media that was developed.

Improved Mathematics Learning Outcomes

Based on the analysis of learning outcomes in trials I and II, it shows that there is an increase in students' mathematics learning outcomes. This increase in learning outcomes can be seen from the average learning outcomes obtained by students. As for the increase in student learning outcomes seen from the average obtained in the first trial of 60, it increased to 78.7 in the second trial. This shows that the use of smartphone application-based mathematics learning media has an impact on improving student learning outcomes. Thus, based on the results of the research that has been done, it can be concluded that the developed mathematics learning media can improve student learning outcomes.

Improved Mathematics Independent Learning

Based on the results of the questionnaire data analysis of students' mathematics learning independence in trials I and II, it showed that students' learning independence increased (better). This increase in learning independence is seen from the average results of the learning independence questionnaire that is filled out by students, the average value of total student learning independence in the first trial is 3.36, an increase in the second trial, which achieves an average total learning independence of 3.9. Thus, it can be concluded that smartphone

application-based learning media can increase students' independence in learning mathematics. From the results of the study, it can be seen that students' learning independence is very high in learning mathematics using learning media, so this shows that the use of mathematics learning media based on the Smartphone application developed has an impact on increasing students' mathematics learning independence, which then has an impact on students' mathematics learning outcomes. Based on the things described above, it can be concluded that the smartphone application-based mathematics learning media that was developed can increase students' independence in learning mathematics.

CONCLUSION

Based on the research and development findings that have been carried out, the following conclusions are obtained :

1. The smartphone application-based learning device developed has met the validity criteria. The amount of validity by the matrix application is 3.81, RPP is 3.81, LKPD is 3.9, teacher's book is 3.85, student's book is 3.81, learning outcomes test is 3.85 and learning independence questionnaire is 3.9. Based on this, it is obtained that the average validity of the entire device is 3.85. So it can be concluded that the learning tools developed are in the valid category.
2. The smartphone application-based learning device developed has met the practical criteria. This can be seen from the following practicality criteria, namely the average value of the practicality of the media in the first trial from the teachers of 84.52% (practical) and students 79.83% (practical). In the second trial, the teachers were 90.58% (very practical) and students were 82.10% (practical). The use of time is also ideal because it does not exceed the usual schedule for learning mathematics.
3. The Smartphone application-based learning media that has been developed has met the effective criteria. This can be seen from the following effectiveness criteria, namely the classical learning completeness in the first trial of 36,7% (not effective). From the students' responses in the first trial of 94.6% and the second trial of 99%. From the learning independence questionnaire, the average score was 3.36 or 84% for the first trial and 3.7 or 92% for the second trial.
4. There is an increase in students mathematics learning outcomes using learning media developed on the subject of the matrix with the average value increased from the first trial of 60 to 78.7 in the second trial.
5. There was an increase in students' learning independence in mathematics using smartphone application-based learning media on the subject of the matrix from trial I to trial II on each item of learning independence statement, namely in statement 1 of trial I of 3.93 increased to 4 in trial II, statement 2 trials I was 3.76 increased to 3.93 in trial II, statement 3 trials I was 3.13 increased to 3.83 in trial II, statement 4 trials I was 2.36 increased to 3.67 in trial II, statement 5 trials I amounted to 3.8 increased to 3.9 in trial II, statement 6 trials I was 2.03 increased to 3.63 in trial II, statement 7 trials I of 3.53 increased to 3.93 in the second trial, the statement of 8 trials I of 2.8 increased to 3.87 in the second trial, the statement of 9 trials I of 3.6 increased to 3.8 in the second trial. trial II, the statement of 10 trials I of 2.76 increased to 3.97 at u trial II, statement 11 trials I was 2.96 increased to 3.9 in trial II, statement 12 trials I was 3.06 increased to 4 in trial II, statement 13 trials I was 3.56 increased became 3.97 in the second trial, the statement of 14 trials I was 3.9 increased to 4 in the second trial, the statement of 15 trials I was 3.1 increased to 3.93 in the second trial, the statement of 16 trials I of 3.86 increased to 3.97 in the second trial, the statement of 17 trials I was 3.66 increased to 3.87 in the second trial, the statement of 18 trials I was 3.76 increased to 3.93 in the trial II, statement 19 trials I amounted to 3.63 increased to 3.93 in trial II, statement 20 trials I amounted to 3.93 increased to 4 in trial II. Based on the data, it can be seen that the average total learning independence of students in the first trial was 3.36, an increase in the second trial, which reached an average of 3.9 total learning independence. Thus, it can be concluded that smartphone application-based learning media can improve students' mathematics learning independence.

BIBLIOGRAPHY

- Depdiknas. 2008. *Education Unit Level Curriculum*. Jakarta: Document
- Drost, J. 1993. *Becoming an Adult and Independent Person*. Yogyakarta: Kanisius
- Ibrahim, and Suparni. 2008. *Mathematics Learning Strategy*. Yogyakarta : Bidang Akademik
- Majid, Abdul. 2014. *Authentic Assessment Process and Learning Outcomes*. Bandung: Remaja Rosdakarya
- Nieveen, N.2007. Formative Evaluation in Educational Design Research. In. T. Plomp, J Van den Akker, B. Bannan, A.E. Kely, N. Nieveen. *An Introduction to Educational Design Research* (pp.89-101). Shanghai: The East China Normal University
- Pannen, Paulina, dkk. 2001. *Constructivism in Learning*. Jakarta: Depdiknas
- Minister of National Education Regulation Number 22 of 2006 concerning Mathematics Subjects
- Prastowo. 2012. *Creative Guide to Making Innovative Teaching Materials*. Yogyakarta : Diva Press
- Syarief Salbino. 2014. *Android Gadgets Transfer Book for Beginners*. Jakarta : Kunci Komunikasi

- Trianto. 2011. *Integrated Learning Model Concepts, Strategies and Their Implementation in the Education Unit Level Curriculum (KTSP)*. Jakarta: Bumi Aksara
- Trianto. 2014. *Thematic Learning Development Design*. Jakarta: Earth Literacy
- Nahel, Bintu. 2012. *Student's book definition* (Online), [http://www.id.shvoong.com/socialsciences/education/2251813 -pengertian-buku-siswa/](http://www.id.shvoong.com/socialsciences/education/2251813-pengertian-buku-siswa/) , diakses 25 February 2022).
- Razak, N. 2014. *Last Study: Most Indonesian children are online, but there are still many who don't realize the potential risks*. Downloaded from: https://www.unicef.org/indonesia/id/media_22169.html