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DEVELOPMENT OF MATHEMATICS MOBILE LEARNING APPLICATION ON ANDROID-BASED SMARTPHONE USING SOCIAL ARITMETICS

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Abstract

Great interest in the use of mobile phones, especially types of smartphones can be utilized in the field of education and given that most internet users are students, the development of applications to help implement learning or known as mobile learning will be a good prospect. The aim of this research is to describe the development process and produce the Mathematics Mobile Learning application on Android-based Smartphones with Social Arithmetic material in good quality. This study refers to the development model according to Plomp (2013) which consists of three stages, namely (1) preliminary research, (2) prototyping phase, (3) assessment phase. The application developed is tested in a limited way to six seventh grade students with different schools. The application developed is in the good category, because it fulfills the criteria of valid, practical, and effective. The results of the application validation developed were declared valid because it obtained a total average score of 2.96. The application developed fulfill theoretically practical criteria because the application is declared valid from the validators and empirically practical because the response questionnaire filled in by the research subject is 81.5% where based on the practicality criteria of the media, it can be stated that the application as learning media can be used without revision. In addition, the application developed also fulfills the effective criteria because all students who are subjects receive score minimum 78 so that it can be stated that the application developed is very effective.
Keywords: *Learning Media, Social Arithmetic, Mathematics Mobile Learning.*

INTRODUCTION

Science and technology, changes in society, understanding of children's learning, advances in communication and information media give their meaning to educational activities (Rosyada, 2013). This is one of the basics of the importance of a technological approach in the management of education and learning. The survey conducted by the Indonesian Internet Network Providers Association (APJII) revealed that in 2017 the average internet user in Indonesia uses a handheld or smartphone device and the penetration composition of internet users based on age is 13-18, which is 75.50 percent. This means that smartphone usage is quite high among students. The use of smartphones that is quite high among students is not a strange thing. Students who are included in the development stage of adolescents will be more or less affected by technological developments. Great interest in the use of smartphones can be utilized in the field of education and given the penetration composition of internet users are children who are still in school, the development of applications to help implement learning or known as mobile learning will be a good prospect. In line with the opinion of Darmawan (2012), an alternative learning service that is carried out wherever and whenever is mobile learning (m-learning). In the learning concept, m-learning brings the benefits of the availability of teaching materials that can be accessed at any time and the visualization of interesting material.Until now there have been several mathematical mobile learning applications that have been developed. Zameni & Kardan (2011) conducted a study entitled "the effect of information and communication technology on learning Mathematics", and concluded that the use of information and communication technology was effective in changing problem attitudes and stability, reasoning, and creativity and finally active in Mathematics learning. With the development of technology, mobile learning can be developed that uses problems in everyday life in the form of games for mathematics. One material in mathematics that is closely related to everyday life is social arithmetic material. The use of contextual problems is a learning concept that assumes that children will learn better if the environment is created naturally, meaning learning will be more meaningful because agreeing. So with the existence of mobile learning that presents contextual problems in the form of games will make students feel invited to actively think and try to find an understanding of the material independently and meaningfully. It is expected that students do not rely on memorization only in understanding a material so that when students encounter problems related to social arithmetic in everyday life, they

are able to provide problem-solving that is in accordance withthe concepts have learned and experienced.

Therefore, the application of mathematics mobile learning is developed on Android-based smartphones with social arithmetic material for seventh-grade students in junior high school where the application contains material and examples of questions presented in the form of stories involving users then practice questions packed into educational games. The development process will be described to produce good quality applications. In accordance with the opinion of Nieveen (1999) (in Plomp & Nieveen, 2013: 28) states "a number of generic criteria for high-quality interventions, namely validity, practicality, and effectiveness". Based on Nieveen's statement, the criteria that must be fulfilled so that the application developed is said as of good quality, valid, practical, and effective. With the development of the mathematics mobile learning application on Android-based smartphones with social arithmetic material for seventh-grade students, it is hoped that it can become a learning medium for seventh-grade students who can be accessed anytime and anywhere and can be used as an alternative learning medium for junior high school teachers.

METHOD

This research is a type of development research that uses the Plomp model development method (2013). The subjects of this study were six subjects from various schools seen from the value of the user's initial ability tests given by the researcher, which consisted of two subjects with high mathematical abilities, two subjects with moderate mathematical abilities, and two subjects with low mathematical abilities with details of each subject ability category. One subject was female and one subject was male. The instruments of data collection consisted of a validation sheet which included application validation sheet, initial ability test validation sheet, and a validation test for learning outcomes, initial ability test, a learning outcome test and a response questionnaire. Analysis of students' abilities is done to classify the test subjects, validity analysis is obtained from the assessment of validation sheets filled in by the validator. Practical analysis was obtained from the validator's assessment which assessed the application in general and the assessment of the response questionnaire filled in by the subjected of the trial. Effectiveness analysis is obtained from the results of the learning outcomes test.

RESULTS AND DISCUSSION

The purpose of this study consists of two things, namely to describe the development process and produce the Mathematics Mobile Learning application on Android-Based Smartphones with the subject of matter of social arithmetic for grade VII students which in good quality. The process and results of development using the Plomp development model (2013) which consists of three stages, preliminary research, prototyping phase, and the assessment phase that can be described as follows.

The first phase is preliminary research. For the development carried out by researchers, in this stage needs analysis (curriculum analysis, material analysis and smartphone user analysis) and literature review, in addition to the design of Mathematics Mobile Learning applications on Android-based smartphones in the form of storyboards and instrument design research.

Curriculum analysis obtained results that the current educational curriculum applies. Curriculum 2013 is an educational curriculum that is being applied in Indonesia. KI and KD for social arithmetic material were taken from Permendikbud No.24 of 2016. From basic competencies, indicators of learning that will be achieved after learning using the Mathematics Mobile Learning application on Android-Based Smartphones will be elaborated. The material discussed in the application based on material analysis includes sales, purchases, profits, losses, discounts (deductions), taxes, gross, net, and tara, single interest.

From the analysis of smartphone users it was found that the average internet access in Indonesia in 2017 using a smartphone and aged 13-18 obtained the largest percentage. This means that smartphone usage is quite high among students, so there is a need for learning media in the form of applications that can be accessed on smartphones. Then assessment of the theories regarding the application of Mathematics Mobile Learning on an Android-based Smartphone is conducted, its use as a learning media, concepts about interactive media and educational games, Dienes learning theory and applications to create media through literature collection in the form of books, journals, and articles so that reference can be made to develop the Mathematics Mobile Learning application on Android-based Smartphones for social arithmetic material.

After that, doing designed Mathematics Mobile Learning application on Android-based Smartphones for social arithmetic material presented in the form of storyboards based on needs analysis and literature review and designing research instruments consisting of validation sheets, initial ability test sheets, and learning outcome sheets, and response questionnaires in the form of a grid.

Then the second phase is prototyping phase. This stage is the process of making prototypes of applications and research instruments that are the realization of the design that has been made before. Following is the description of the stage of making a prototype.

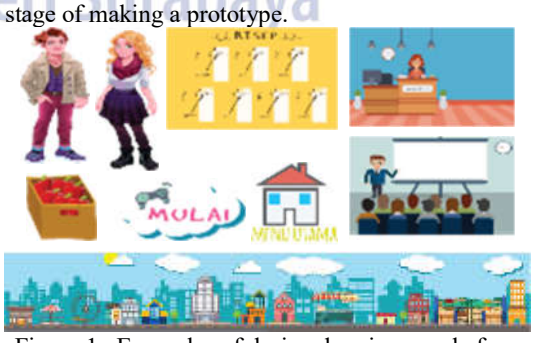

Figure 1. Examples of design drawings made for application developed

Before realizing the design of the application, image design will be added to the application such as characters,

buttons, supporting images, and background. Making is done using the help of the Adobe Illustrator application and stored in the .png format. Figure 1 are the results of several design drawings that have been made.

After completing the drawing design to be added to the application developed. So then realize the design of the application design. The steps taken to realize the design of the application design are as follows.

(1) Install Unity
(2) Create a new project
(3) Importing all image designs that have been made to a new project at Unity
(4) Make one by one the desired scene
(5) Create a script for the buttons that are needed
(6) Create a script to connect between scenes
(7) Publish the application into the .apk format by using the help of the Android SDK tool.

The following are the menus in the Mathematics Mobile Learning application on Android-based Smartphones.

Figure 2. Display the application's main menu

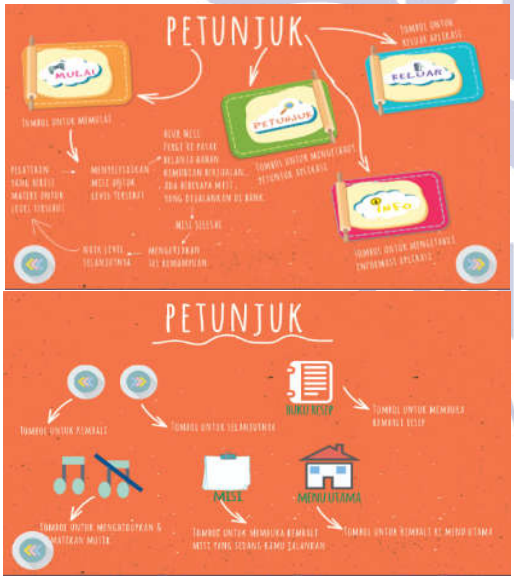

Figure 3. Display of page instruction

Figure 4. Display of one material in application

Figure 5. Display of mission

Figure 6. Display of page for shopping

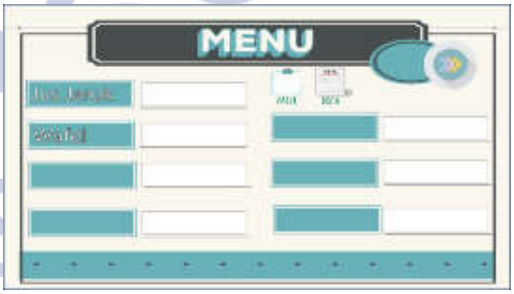

Figure 7. Display page to determine the selling price

Figure 8. Display an example of selling animation

Figure 9. Display of understanding test page

In the previous stage, an instrument design in the form of a grid has been prepared. The grid of validation sheets that have been designed are then developed into validation sheets for applications, initial ability test validation sheets, and learning outcomes test validation sheets. The initial ability test grid and learning outcome tests are then developed into questions. And the response questionnaire grid was developed into a student response questionnaire. After doing realization of the research desigin then doing validation. The validation results obtained for the application developed were 2.96. Based on validation criteria it can be stated that the application is valid. In addition to giving an assessment, the validator also provides suggestions for the application being developed. Then revisions are made based on suggestions from the validator.

The validation results obtained for the initial ability test are 3.03. Based on validation criteria it can be stated that the initial ability test is valid. In addition to giving an assessment, the validator also provides suggestions for the initial ability test to be used.

The results of the validation obtained for the learning outcome test are 2.90. Based on validation criteria it can be stated that the learning outcome test is valid. In addition to giving an assessment, the validator also provides suggestions for tests of learning outcomes that will be used. Then revisions are made based on suggestions from the validator.

Then the final phase is done after completing the revision of the prototype that has been considered valid by the validator, the revised results are called prototypes 2. At this stage a limited trial is conducted on the subject of the study and analyze the results obtained. The obtained data are.

a) Practicality data

Practicality in terms of two aspects namely theoretically practical and empirically practical. Theoretically practical based on the general assessment results conducted by the validator in a minimum validation of application validation, while empirically practical depending on the data obtained from the questionnaire the response of users in using categorized applications in criteria can be used with little revision or can be used without revision.

The results of application validation obtained an average total value of 2.96, the application developed obtained valid criteria. So that it can be said that applications are developed theoretically practical.

b) Effectivness data

The application developed is said to be effective if there is a minimum of 75% of learners or users get a minimum score of 78 on the test of learning outcomes given after learning to use the application. The following results are obtained by students.

Table 1. Learning Outcome Test Data

Subject Code	Mathematics Ablity Category	Learning Outcome Test
L1	High	84
P1	High	83.5
L2	Medium	82
P2	Medium	83
L3	Base	78
P3	Base	78

Table description:

L: Grade VII male junior high school students

P: Grade VII female junior high school students

Based on the results above it can be concluded that the percentage of students who get a score above 78 is 100%, then the application developed has very effective criteria.

In addition to getting two data as described above, when conducting limited trials the researcher gets the final score from the comprehension test in the application. The following is the final score obtained by the subject of the trial.

Table 2. Final Score Results On The Application

Subject Code	Mathematics Ability Category	Final Score
L1	High	100
P1	High	90
L2	Medium	95
P2	Medium	80
L3	Base	85
P3	Base	80

Based on the results above, it can be concluded that the application developed by researchers can be used for students of low mathematical abilities, moderate mathematical abilities, and high mathematical abilities. Because all test subjects get scores above 78 when working on understanding tests for all levels in the application.

The results of the development in this study is the Mathematics Mobile Learning application on Android-based Smartphones for class VII social arithmetic material that is categorized as good because it meets 3 criteria, namely valid, practical, and effective. The application developed is an offline application or does not need to be connected to the internet to use it. This application can be used on all Android-based smartphones for all versions of the Android operating system from the Cupcake version (1.5) to the Android Pie version (9.0+), so that this application can be used anywhere and anytime.

The application developed contains practice questions which are packaged into educational games. It is said that the educational game because it meets the criteria according to Hurd & Jenuings (2009) which includes: 1)

overall value or value contained in the game, the value of a game is centered on design. The application developed was made with attractive designs as evidenced by the results of the application aspect display validation got an average score of 2.96 and the response questionnaire about app attractiveness stated 3 subjects strongly agreed and the remaining 3 agreed that the application developed was interesting; 2) usability or easy to use and access. The application developed is easily accessible anytime and anywhere because the application is offline or does not have to be connected to the internet; 3) accuracy of the content in the game, the application developed can be said to be accurate because the design of the game can be realized in the form of an application and can be used in limited trials; 4) appropriateness or accuracy of game design adaptation based on user needs, applications developed can be used as learning media, this is evidenced by the questionnaire questionnaire on the usefulness of the application stating 3 subjects strongly agree while the rest agree with the benefits of the application as a learning medium; 5) feedback so that players know their performance in the game, in the application developed there is feedback in each field filled in by the user and at the end of the game there is a score; 6) giving motivation to players, in the application developed there is material and at the end of the material there is information relating to entrepreneurs which is used as motivation to study the material.

The application that was developed was based on the theory of learning of Dienes in which it contained the game using rules or games based on daily contextual problems about trade and banking. The rule is that the user seems to be an entrepreneur who must master the concept of social arithmetic material to run his business. So that the application involves users and will make users feel invited to actively think and try to find an understanding of the material independently and meaningfully. This makes the test subjects interested in using the application as a learning media as evidenced by the percentage of the total value of the results of the questionnaire responses about the interest and ease of use of the application of all trial subjects on the overall statement of 81.5% or otherwise practical empirically and this application is considered effective for the success of learning the trial subject because all the test subjects completed the test on learning outcomes.

The results of the response questionnaire found two statements in the unfavorable category that received less response results. The statement "requires the help of others to understand the material in the MML application" obtained the results of 2 out of 6 users agreeing with the statement, this could be because not all test subjects have learning styles that tend to be easier to understand when using media. There are three learning styles according to Bobbi DePorter and Mike Hernacki (2007) in Quantum Learning books, namely: visual, auditory, and kinesthetic. Students who have auditory learning styles where they learn by listening so students with this type prefer to be explained directly by the teacher. This causes students difficulties if they have to study independently so that they still need help from others in understanding the material when using the developed media. The second statement that received an unfavorable response was "needing the help of others to use the MML application" which obtained the results of 2 out of 6 users agreeing with the statement, this could be because not all test subjects are accustomed to using learning media on smartphones, so they are not used to opening the instructions page first.

There are several things that were discussed in the study. At the time of application development validation was carried out. The researcher conducted application validation, validation of the initial ability test, and validation of the learning outcomes test. But validation has not been done for the questions in the application specifically, it should be validated using aspects of construction and language so that the questions can be said to be valid. Then the second, there is a validator suggestion that researchers cannot do in the application revision, which is on the understanding test page. The suggestion from the validator is to create a question bank so that when the user enters for the second time it will get a different question in the comprehension test. But this cannot be done by researchers, because researchers did not find the script for the question bank. And finally, at the time of data collection, the researcher did all data collection in one day. So there is a possibility that the results of the learning outcomes test are also influenced by the state of students who are tired of thinking.

CLOSING

Conclusion

Based on the research objectives there are two things that need to be described, namely the process and results of the development of the Mathematics Mobile Learning application on Android-Based Smartphones with the subject matter of social arithmetic for seventh grade students of SMP. The process and results of the development using the Plomp development model (2013) which consists of three stages, namely, preliminary research, prototyping phase, and the assessment phase which can be summarized as follows.

a. Preliminary research

At this stage needs analysis (curriculum analysis, material analysis, and smartphone user analysis) and literature review, in addition to the design of Mathematics Mobile Learning applications on Android-based smartphones in the form of storyboards and research instrument design.

b. Prototyping Phase

The process of making a prototype of the Mathematics Mobile Learning application on Android-based Smartphones and research instruments which is the realization of the design that has been made before. The results of the application design realization are called prototypes 1. Then prototype 1 is submitted to the validator to be validated. The results of the application validation developed were declared valid because they obtained a total average score of 2.96. After revision according to the suggestion of the application validator the revised result is called prototype 2.

c. Assesment Phase

At this stage the prototype 2 is tested on a limited basis on the subject of the study. The research subjects needed were 6th grade junior high school students who had different mathematical abilities, namely low, medium and high and different sexes, namely male and female. From the limited trials conducted, data were obtained to measure practicality and effectiveness.

1) Results of practicality of application, practical application theoretically because the application is declared valid from the validator and empirically practical because the response questionnaire filled in by six students obtained a positive response that is equal to 81.5%. Based on the practicality criteria of the media, it can be stated that the application can be used without revision. dinyatakan aplikasi dapat digunakan tanpa revisi.
2) The results of application effectiveness are stated to be very effective because 6 out of 6 students get scores above 78.

The application developed contains practice questions which are packaged into educational games based on the theory of learning Dienes. The application developed can be accessed anytime and anywhere because it is used on Android-based smartphones. Based on the results of validation, effectiveness, and practicality, the application developed can be stated as a good application. In addition, the application can be used by students with low mathematical abilities until students with high mathematical abilities.

Suggestion

1. Create an application with 3D animation to make it look more real and creative.
2. Use other materials to be more able for the development.
3. In the ability test page of each level, it is better to make a question bank so that each user can work on different questions even at the same level.

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