Development of Mobile Learning Media Based Android to Support Students Understanding

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Abstract. Technological developments have an impact on the education sector. This study aims to develop and produce android-based learning media on the subject of quadratic equations and knowing the ability to understand material concepts. This type of research is Research and Development. The research model used is the ADDIE model which consists of 5 steps namely (1) analysis (analyze), (2) design (design), (3) development (development), (4) implementation (5), (5) and evaluation (evaluation). This research was conducted at Jiwan State Vocational High School 2. The subjects in this study were the tenth grade students of Machining Technique. The instruments used were learning implementation plans, media validation sheets, student response questionnaire sheets, and post test questions. The results showed that: (1) M-Learning fulfills the element of validity with the average results obtained from the media validation sheet from media experts amounting to 97.33% and from material experts at 88.33%. (2) M-Learning is able to give a positive influence seen from the results of the post test with a percentage of 92.37% and (3) The response of students after using M-Learning in the main field test shows a percentage of 83.68%, so as to attract students in the process learning.

1. Introduction

In mathematics learning, the flow of globalization, issues about the environment, advances in technology and information, the rise of creative industries and cultures, and the development of international education are challenges that are currently being experienced [1]. This is because mathematics is the basis of all fields of science and is the basis for the advancement of science and technology, one of which is a smartphone. Technology is a technical ability based on exact knowledge based on engineering [2]. Technological developments have an impact on the education sector. Therefore, we need a learning media that supports and entertains while keeping up with the existing technological developments [3]. Current technological developments have various benefits. The development of technology can be used for various purposes, one example is the learning media. Android can be used in the learning process because it can do learning anytime and anywhere. So that android can be used as a learning media. In addition to print-based, there are audio-visual based media such as video and film, as well as computer-based media, namely a combination of slides and sounds, [4]. The role of manipulation in enhancing pupil understanding of concept. Concrete manipulative in mathematics teacher education, which can be interpreted by some researchers also states that the help...
of surrounding objects (manipulative media) will make it easier for students to understand mathematical concepts [5].

Based on the results of interviews with the teachers of mathematics studies at Jiwan Vocational High School 2, it was stated that the media used were only Student Worksheets (LKS). The shortcomings of the LKS are the explanation of the material is very limited so that it makes it difficult for students to understand the concept of the material. In addition, the learning method used still uses the lecture method, discussion, question and answer, and assignment. Based on observations made at Vocational High School 2 Jiwan during Apprenticeship II and Internship III, 70% of 36 class X TPM students obtained Daily Deuteronomy scores in Mathematics which were still below the Criteria for Maximum Completion (KKM). This is because students have difficulty in learning mathematics that is less attractive and too monotonous so it is difficult to understand the concept of matter.

One solution related to the problem, teachers should not only use the lecture method, but can apply more than one type of learning media, not only power points, but also silent and motionless visual media. Here educators can take advantage of the technology students have to study at school or at home. The technology in question is an Android-based smartphone commonly called M-Learning. Learning using M-Learning is a learning program using technology that contains learning content including: title, purpose, learning material, learning videos, and learning evaluation, as well as student discussion forums. With the M-Learning learning media, it is hoped that it can create a fun, interesting and effective learning process, and influence student learning outcomes, not least for class X students of Jiwan State Vocational High School 2. This opinion is based on the research conducted [6] that the Android-based M-Learning is more valid and practical used as a learning media for opportunity material. Apart from that, [7] in his research also stated that M-Learning learning was effectively used as a medium of learning in the subject matter of business material and energy. M-Learning here also has content sharing for each user using the same content, and allows instant feedback, [8]. So the role of an educator is very important in utilizing information technology for the learning process.

2. Method
The research method used is a development method (Research and Development) which aims to develop a new product. The research model used in this study is the ADDIE Model (Analyze, Design, Development, Implementation, Evaluation). [9] [10] suggests that data is something that is needed in a study using predetermined parameters. The subjects in this study were the X grade students of Jiwan Vocational High School 2 Engineering. Data collection techniques carried out included unstructured interviews, observations, and questionnaires (questionnaires) [11]. The research model used in this study is described as follows:

**Analysis**
The initial stage of conducting interviews and observations then identifying and analyzing various needs to determine the right problems, solutions, and products, including needs analysis, curriculum analysis, analysis of subject matter, and analysis of student characteristics.

**Design**
The second stage is designing the product concept or design to be developed along with the related instruments. This stage includes the preparation of research instruments, making initial design of learning media (storyboarding), making flowcharts, and making learning videos.

**Development**
The third stage is developing a product in the form of an Android-based M-Learning learning media in accordance with the flowchart and storyboard that has been created and the preparation of data collection instruments. This stage includes the validation of research instruments, research instrument testing, and maintenance software (application testing).

**Implementation**
The fourth stage is implementing products that have been developed in learning at school. Implementation is done by product testing (limited), main field testing, and analysis of learning media.
data. Analysis of learning media data includes validity analysis, effectiveness analysis, and practicality analysis.

**Evaluation**

The final revision of learning media is based on data obtained during implementation.

While the analysis carried out is an analysis of the validity, practicality, and effectiveness of learning media. For the validity of the learning media, each aspect will be validated by the validator, using a score range between 1 and 5. Where the score (1) is not good, the score (2) is not good, the score (3) is good, the score (4) is good, and the score (5) is very good. The formula used to process validation data taken from [12] is stated as follows: \[ V = \frac{V_S + V_2 + V_3}{3} \times 100\% . \]

In the research on the development of Android-based M-Learning as a medium for learning mathematics this involved 6 experts as 3 experts as media experts and 3 experts as material experts. So to find out the overall percentage can be searched by the average formula as follows: \[ V = \frac{V_1 + V_2 + V_3}{3} \]

To find out the validity level of the media, the criteria in Table 1 can be used as follows [12].

| Validity Criteria | Level of Validity               |
|-------------------|--------------------------------|
| 85,01% - 100,00%  | Very Valid, or can be used without revision |
| 70,01% - 85,00%   | Valid enough, or can be used but needs to be revised small |
| 50,01% - 70,00%   | Less Valid, or recommended not to be used because it needs a major revision |
| 01,00% - 50,00%   | Invalid, or may not be used        |

Media for learning mathematics with Android-based M-Learning is declared valid if the results of combined validity show results of more than 70%.

The media of learning mathematics with Android-based M-Learning on the quadratic equation material can be said to be effective seen from student learning completeness from the results of the answers to the post test questions. Students are declared complete if the percentage of individual completeness values has reached KKM which is ≥ 80% [13].

To be able to determine student mastery learning can be calculated using the formula \[ KB = \frac{T}{TT} \times 100\% . \] To find out the effectiveness of the media can be calculated from the percentage of completeness of learning in Table 2 [13].

| Percentage(%)   | Level of effectiveness |
|-----------------|------------------------|
| 90 – 99         | Very effective         |
| 80 – 89         | Effective              |
| 70 – 79         | Effective enough       |
| 60 – 69         | Less effective         |
| < 60            | Ineffective            |

The media of learning mathematics with Android-based M-Learning can be declared effective if the percentage of effectiveness is more than 80%.

Data were analyzed to find out the practicality level of the learning media of mathematics with Android-based M-Learning obtained from student response questionnaires. The Likert Scale used is as follows: Strongly Agree (SS) (5), Agree (S) (4), Neutral (N) (3), Disagree (TS) (2), and Strongly Disagree (STS) (1). The results of the recap of scores from student response questionnaires were calculated using the following formula \[ P = \frac{A}{B} \times 100\% . \] The media of learning mathematics with Android-based M-Learning can be declared practical if it meets the criteria ≥ 70% of students classically give a positive response [11].
3. Results and Discussion

The result of implementation this research activity are describe for each stage of development of learning tools as follows:

3.1 Analysis

Needs Analysis

Based on the results of direct observation and interviews with teachers, it was found that: (1) Teacher innovation is needed in developing learning media so that learning can be more meaningful and attract students to learn; (2) The need to develop learning media by utilizing current technological developments.

Curriculum Analysis
The curriculum used in class X of Jiwan SMKN Machining Technique is the revised 2013 curriculum.

Analysis of Learning Materials
One of the material in the 2013 revised curriculum is the quadratic equation material.

Analysis of Student Characteristics
From unstructured interviews in students, it was found that: (1) The lack of enthusiasm of students during the learning process with the lecture method, thus causing students to become bored following the learning process; (2) Many students have an Android but are not optimal in its use. Most of the androids are only used for games and chatting and have nothing to do with the learning process.

3.2 Design

The design carried out includes:

Preparation of Research Instruments
The research instrument used for this Android-based M-Learning learning media includes media validation sheets, student response questionnaire sheets, and post test questions. Furthermore, validation of the research instrument is carried out by the validator, with the aim of measuring whether the instrument that has been made is appropriate to measure what will be measured.

Making the Initial Design of Learning Media (Storyboard)
Learning media storyboards are made thoroughly then loaded in the application. Design on media includes the KD menu and Learning Objectives, Learning Materials, Learning Videos, Practice Exercises, Learning Evaluations, and application authors.

Making a Flowchart
Flowchart is used as a navigation structure from the next display so that it will clarify the design of the flow of media making.

Making Learning Videos
Learning videos are made to make it easier for students to understand mathematical concepts in Quadratic Equation material and then the learning video is uploaded on YouTube.

3.3 Development

The activity carried out at this stage is expert validation which aims to measure whether the developed media are appropriate to measure what will be measured [15]. Expert validation developed and the researchers conducted limited trials and main fields. From the validation there are improvements and suggestions from some validators to get the appropriate media to measure what is measured. Next is the design of the media display can be seen in Figure 1.
3.4 Implementation

**Limited Trial**
Limited trials were conducted on 6 research subjects. In this activity, the researcher directs students to download applications as learning media in the playstore. After that students install applications on Android and operate them in the learning process. At the end of learning students are given questionnaires for students' responses to see the level of elements of practicality of the media developed. After that, students work on the post test questions that have been provided to measure the effectiveness of the media.

**Main Field Test**
After conducting a limited trial, the researchers then conducted a major field test conducted on 19 research subjects.

**Data Analysis of Learning Media**
The following is the result of validation of Android-based M-Learning learning media from several validators based on validity criteria that can be calculated using formulas. The results of the validation from media experts and material experts obtained data in Table 3 and Table 4 as follows.

| Validator | Media Experts | I | II | III |
|-----------|---------------|---|----|-----|
| Empirical Total Score | 100 | 97 | 95 |
| Total Hope Score | 100 | 100 | 100 |
| Percentage | 100% | 97% | 95% |
| Final Validity Percentage | 97.33% |

| Validator | Material Experts | I | II | III |
|-----------|------------------|---|----|-----|
| Empirical Total Score | 95 | 92 | 78 |
| Total Hope Score | 100 | 100 | 100 |
| Percentage | 95% | 92% | 78% |
| Final Validity Percentage | 88.33% |

The following are the results of the overall post test scores on the main field test.

| Total Score Obtained (T) | Total Score (Tt) | Percentage Learning Completeness (KB) |
|--------------------------|-----------------|--------------------------------------|
| 1755                     | 1900            | 92.37%                               |

The following are the results of filling in student response questionnaires.

| Total Score Obtained (A) | Number of Ideal Score (B) | Percentage of student responses/practicality (P) |
|--------------------------|---------------------------|-----------------------------------------------|
| 508                      | 600                       | 84.67%                                         |

| Total Score Obtained (A) | Number of Ideal Score (B) | Percentage of student responses/practicality (P) |
|--------------------------|---------------------------|-----------------------------------------------|
| 1590                     | 1900                      | 83.68%                                         |
Learning mathematics at Jiwan Vocational High School 2 still uses lecture methods and print-based learning media only. So that results in many students who are less enthusiastic and motivated in following the learning process in class. Therefore, there is a great need for teacher innovation in developing learning media. Learning media helps teachers to deliver material to facilitate students in learning [16]. The innovation that can be done by teachers is by developing learning media by utilizing current technological developments. Effective use of technology for education is a utilization that will facilitate learning activities and access to information for students [17]. The media developed is M-Learning based on android on the material quadratic equation class X. The development of the media is tested for the level of validity with the help of expert validation. Expert validation aims to measure whether the media developed is appropriate for measuring what will be measured, [15]. Validation consists of construct validation, content and criteria. [18] states that the components of material should be based on the state of the art knowledge (content validity) and all components should be consistently linked to each other (construct validity), which can be interpreted as valid components taken based on knowledge (content validity ) and all components are consistently connected to one another (construct validity). Based on data from the validation results in Tables 3 and 4, the percentage of media experts was 97.33% and that of material experts was 88.33%. The data shows the validity level of Android-based M-Learning fulfills very valid criteria and is feasible to use without revision because the percentage obtained is > 85%. [19] also developed an Android-based teaching material focused on magnetic electric material. From the results of the development it was obtained very good validation results from material experts and media experts, so that the Android-based Electric Magnet learning media is feasible to use with very good criteria.

In the main field test, the percentage in Table 5 is 92.37%, so that M-Learning meets the effectiveness in learning because it gets a percentage of > 80%. Whereas in Table 6 and Table 7, it can be concluded that Android-based M-Learning obtained a limited percentage of trials at 84.67% and the main field test was 83.68%. So it can be concluded that the learning media developed meet the element of practicality because the percentage obtained is ≥ 70% and means that students classically give a positive response. This was strengthened [20] where researchers developed an Android-based M-Learning information technology focused on Diponegoro University students. From the results of the development, the results are that Mobile Learning can be used by lecturers and students in exchanging information or data about lectures, to download lecture material, and to view task information and also work on quizzes. This is in line with research [21] which states that M-Learning has a good level of effectiveness when used as a learning medium. [22] also stated that the percentage of graduating students using M-Learning during the post test was better than the pre-test results. The other opinion that states that using learning media shows the effectiveness of student learning outcomes compared to the lecture method [23].

[24] also carried out research related to the development of learning media where the presence of learning media in his research showed that students' interest in filling out the questionnaire responses of students entered into high qualifications. The same study was carried out [25] where in his research using M-Learning suggested that "From the results of field observations with the Media Learning Mathematics shows that the students are very interested", that students are very interested in using mobilemath media ( mobile learning mathematics). Therefore, teacher innovation needs to be improved in developing features in learning media so students are interested in following the learning process. Android-based M-Learning has several advantages including the appearance of interesting and simple media. The media that is developed is easy to operate, understood by the nievesiswa through written explanations and explanations with learning videos, and the buttons on the media also function properly according to the instructions. Material, problem training, and evaluation are in accordance with the Basic Competencies in the syllabus.

Other advantages that exist in Android-based M-Learning are that students can learn independently both whenever and wherever. [26] also conducted research with android-based media where the media can make students learn independently according to the material being studied. This media can also be downloaded through the android playstore of each user. In addition, this media has practice questions
that are equipped with discussion and at the end of the learning evaluation, the results of student work scores are displayed so that they can be used to determine students' achievement after using Android-based M-Learning. The existence of learning media will influence the effectiveness of student learning outcomes compared to the lecture method [27]. As for the weaknesses of the media developed, namely when studying the material through learning videos, it is necessary to use a strong internet network and there are some androids that have errors when operated.

4. Conclusions
From the results of the development of Android-based M-Learning as a learning media for mathematics conducted by researchers, it was found that the results of the development of learning media were feasible to be used with the following details. The level of validity meets the element of validity with the average results obtained from the sheet of media validation from media experts amounting to 97.33% and from material experts at 88.33%. The level of effectiveness meets the element of effectiveness with the average results obtained from the post test value reaching 92.37%. The level of practicality fulfills the element of practicality with the average results obtained from the student response questionnaire in the main field test reaching 83.68%.

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