Validity Of An Android-Based Mathematic Equation Editor Product

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Abstract: The long-term goal of this research is to develop Android-based learning as an alternative in mathematics learning. Meanwhile, the specific objective to be achieved in this study was to examine the effect of Mathematics Equation-based editors on Android on mathematical representation of students in high school and to examine the effect of Mathematics Equation learning media in the form of Android-based Mathematic Equation editors on increasing mathematical representation of students in high school. The ability of mathematical representation is an inseparable part of other mathematical abilities. This research is a Research and Development (R & D) study. There are 8 stages in this study, namely (1) Potential and problems, (2) Data collection, (3) Product design, (4) Design validation, (5) Design revisions, (6) Product testing, (7) Design revisions , and (8) Trial usage. The stages that have been completed are until product validation. And the results are valid with pearson-correlation 0.322 and appropriate to use with revisions as recommended.

Index Terms: Validity, Research and Development, Editor of Mathematic Equation.

1. INTRODUCTION

INDONESIA nowadays is preparing for the ASEAN Economic Community (AEC). The purpose of the establishment of the AEC is to enhance economic stability in the ASEAN region, and it is expected to overcome the problems in the economics between ASEAN countries. For all of that, Indonesia must have superior quality of human resources [1]. One of causes the low quality of education in Indonesia is students' achievement of learners still low [2]. One of trend in education research nowadays is STEM (Science, Technologi, Engineering, Mathematic). Students in a school committed to teaching for deep understanding were more likely to find context enabling, although the overall performance in both schools was poor [3]. Similarly, many researchers suggest that engineering practices in education will be effective to direct students toward STEM areas that include science and mathematics disciplines[4]. They can form their own structures of mathematical knowledge through the help of teachers by discussing the possible alternative answers [5]. Mathematics learning have cognitive aspects that include behaviors that emphasize intellectual aspects such as mathematical abilities, namely in the form of basic knowledge and skills needed to be able to do mathematical manipulation and thinking skills in mathematics. One of the mathematical abilities is the ability of mathematical representation. Representation is an important aspect of learners in building a relational understanding of mathematical concepts. But the ability of a mathematical representation of students in building relational understanding is still very limited [6]. The ability of students to connect mathematically is one of the essential things that must be achieved by students in the learning process because if students know the relationship between the concepts, they will quickly understand the mathematics itself and open opportunities for students to develop their mathematical skills [7] The ability of mathematical representation is the ability to restate notations, symbols, tables, images, graphics, diagrams, equations or other mathematical expressions into other forms. Visual representation, images, written text, equations or mathematical expressions are components of mathematical representation. In the National Council of Teacher of Mathematics (NCTM) it is stated that representation is a method used by someone to communicate the answers or mathematical ideas in question. This representation acts as a model or as a substitute form of a problem situation used to find a solution. However, the same amount of development may not be gained by each student, because students' interaction level with this environment varies [8]. Basically representation can be divided into two forms, namely internal representation and external representation. Thinking about mathematical ideas which are then communicated requires an external representation whose forms include: verbal, pictures, and concrete objects. Thinking about mathematical ideas that allow someone to work on the basis of these ideas is internal representation.

Creating visual representations which emphasize spatial relationships in the process of solving mathematical problems may contribute to problem solving success [9]. The ability of mathematical representation is an inseparable part of other mathematical abilities. With the ability of mathematical representation students can solve problems both in life and society. In addition, the usefulness of mathematics in everyday life makes it important for mathematics to be learned in schools so that with representation, students can see and observe objects around them so that they can motivate learning and provide experiences to themselves and develop their mathematical thinking skills. One effort that can be done to provide influence so as to develop the ability of students' mathematical representation is to choose a learning model that is appropriate and can encourage students' enthusiasm so that they are able to develop students' mathematical representation abilities to the maximum and learn more meaningfully through IT assisted learning (Information Technology)/ICT (Information Communication Technology). The development of science and technology support and encourage efforts toward renewal in utilizing the results of the learning technologies implementation. As an educator, in his duties are expected to use learning media as a tool in the

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learning process; both of simple to sophisticated; such as the use of smartphone as a learning media [10]. The implementation of Information and Communication Technology (ICT) in educational world, in turn, will improve the quality of the education itself [11]. The learning should also be supported by the use of ICT [12]. Such learning can be achieved using the Android. Android is a software stack for mobile devices that includes an operating system, middleware and key applications [13]. Android is designed primarily for touchscreen mobile devices such as smartphones and tablet computers [14]. The long-term goal of this research is to develop Android-based learning as an alternative in mathematics learning. Meanwhile, the specific objective to be achieved in this study was to examine the effect of Mathematics Equation-based editors on Android on mathematical representation of students in high school and to examine the effect of Mathematics Equation learning media in the form of Android-based Mathematic Equation editors on improving Mathematics student learning outcomes in High school

2 RESEARCH METHODS

This research is a Research and Development (R & D) study. This research is a development innovation with the theme: Design of Android-based mathematical equation learning media in an effort to improve students' mathematical representation by making it easier for students to type mathematical expressions using mathematical equation editors which will be developed into Android-based mathematical equation learning media that can be used using Android-based smartphones that can be used wherever and whenever. The stages in this study are 8 stages, namely (1) Potential and problems, (2) Data collection, (3) Product design, (4) Design validation, (5) Design revision, (6) Product testing, (7) Design revisions, and (8) Usage trials. Data analysis in this study was carried out by testing the difference in average population in the control class and experimental class, based on the results of the pretest and posttest assessment. In developing this learning media in collaboration also with the Partner Research Team. In collecting data and information that is used as material for the development of learning media that is expected to overcome existing problems. In this study, the data obtained came from the results of observations, interviews and questionnaires. The expected product design in the development of learning media is media that has the attraction to increase students' enthusiasm in learning in which there is content that can help students in mathematical equation learning well wherever and whenever. The next step is design validation which is an activity process to assess whether the design of media development for android-based mathematical equation learning is worthy of being said as a good learning media rather than old learning media and getting suggestions as material for consideration of the revised learning media developed. After validating the design of android-based mathematical equation learning media, the weaknesses of the learning media will be known. From these weaknesses, the learning media must be corrected according to the validator's suggestions so that the learning media becomes feasible and ready to be tested on the research subject. The media of android-based mathematical equation learning has gone through the stages of validation and revision so that the media is ready to be tested. After the media was validated, revised and tested, the results of data analysis were made and for the results of the study documented in the form of softcopy and hardcopy. Product testing of a limited sample can show that the performance of a new work system turns out to be better when compared to the old system. A very significant difference, so that the new work system can be applied or enforced. The final stage is a trial used to determine the effect of this media on participants' understanding of the mathematical equation. Tests are given before and after the interactive game begins. The results will be compared with the appropriate statistical test.

3 DEVELOPMENT OF PRODUCT

The development procedure is the stages carried out by the researcher in accordance with the development model used. This research develops a product in the form of an Android-based mathematic equation editor. Based on Thiagarajan [15] the development procedure is designed with the 4D development model (Define, Design, Develop, Dessimination) that has been adjusted according to the needs and limitations. The stages of development are as follows.

3.1. Defining Phase (Define)

The defining stage is carried out before developing teaching materials by determining goals and problems as a benchmark in the preparation of an android-based mathematic equation editor. The definition phase consists of five steps, namely initial analysis, student analysis, concept analysis, task analysis, and specification of learning objectivesFront-end analysis is the study of problems faced by teachers in mathematics learning. The analysis was carried out during pre-research through learning observation activities, teacher interviews, and giving questionnaires to students. Pre-research was conducted in year X of SMAN 3 Kuningan. In the initial analysis we encountered several problems in mathematics learning in the classroom. Based on the results of observations, teachers still rarely use interactive learning media by utilizing Android technology. In addition, student learning interest is also still low. Therefore, an Android-based learning media is needed to increase the interest in learning mathematics and the ability of mathematical representation. Analysis of the characteristics of learners (learner analysis) is carried out as an initial stage in the development of learning media. The results of the analysis of the students of year X at SMAN 3Kuningan were obtained to find out how students 'learning interests and students' mathematical representation abilities. Based on the results of the analysis, it is known that students' interest in learning is still low. Students generally have difficulty writing mathematical expressions using Android. Concept analysis aims to identify, detail, and systematically compile the tools of the relevant editors to be developed into mathematic equations which are then integrated in the learning of mathematics year X at high school in exponential function material presented in Figure 1.

Task

Fig.1 Mathematic Equations Tools

analysis is carried out by identifying the main skills needed in accordance with the curriculum. This activity is aimed at identifying the academic skills that will be developed in learning, namely KD 3.1 applies the concept of rank numbers, root shapes and logarithms in solving problems, and KD 4.1 Presents solutions to problems of rank numbers, root shapes, and logarithms. Analysis of the tasks that have been carried out on the material of the Exponential Function as in table 1.

TABLE. 1
TASK ANALYSIS FOR RESEARCH

Material	Task Analysis
Exponential Function	Find the concept of exponential numbers Explain the meaning and characteristics of a positive round rank Change the form of negative rank to positive rank and vice versa Finds the negative power formula, the power of zero, and the power of the fraction of the rank Complete algebraic operations in the form of ranks using positive rank properties Skilled in applying concepts / principles and problem solving strategies related to exponents or rank numbers Identify root shape numbers Change the shape of the fraction to the root shape and vice versa Understanding the nature of rank in algebra Operate root form numbers

Specifying instructional objectives aims to convert the results of task analysis and concept analysis into learning objectives that are expressed by behavior. Based on the results of the material analysis and task analysis, the specification of learning objectives was arranged in the material of exponential functions. The learning objectives are used as the basis for the preparation of learning outcomes tests and the design of instructional media in the form of mathematic equation editor.

3.2 Designing Phase

Applications editor mathematic equation will be run on an Android-based mobile operating system and has a function to display mathematical editors with limited scale. This application must be able to display several mathematical symbols according to the needs in the field. Users will interact with the application through the user interface provided by the application. The user will be presented with a button consisting of mathematical symbols needed such as root functions, logarithms, rhythms and fractions.

In this stage is analysis of software specifications and Requirements, the software to be built has features and arooves as:

1. equation superscripts
2. equation fraction –
3. equation radical √‾
4. left subscripts superscripts

The explanation of the flowchart is as follows:

1. the user starts the program by clicking on the program symbol
2. the user clicks on the text field first
3. the user clicks on a symbol or number according to needs
4. the user can choose the mathematical symbol needed
5. the user clicks back on the letters and symbols needed
6. Application creation method

This method describes the activities of making a program where it describes a systematic and sequential approach to software development as in figure 2.

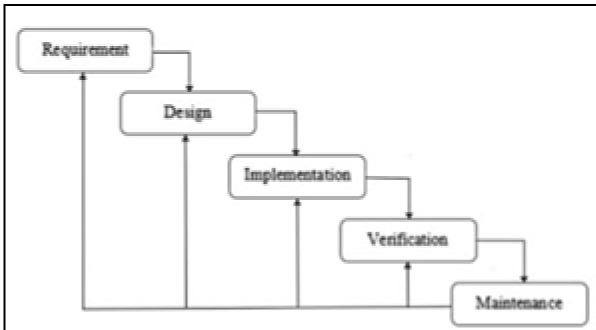

Fig. 2 Application creation method.

1. Requirement Analysis
   At this stage, an analysis of the needs of the needs needed in both the interface needs and the equation requirements needed is present.
2. System Design
   This stage designs the initial display according to your wants and needs, while this design only consists of buttons/buttons from the template equation and the text field to display the results.
3. Implementation
   In the implementation phase the program is built using the Java programming language with the help of Android Studio as the main application maker.
4. Integration & Testing
   This testing phase examines the extent to which the program can be run, to find out about this program well then testing is limited to competent users and media experts.
5. Operation & Maintenance
   For this final repair phase, based on the input received when testing the limited product.

3.3 Stage of Developing

The purpose of the development phase is to produce a revised version of an android mathematic equation editor based on expert input and data obtained from the trial. Activities at this stage are expert assessments, limited trials, and field trials.

1. Expert appraisal

A number of experts were asked to evaluate an Android-based mathematic equation editor in an effort to improve the ability of mathematical representation. The results of the expert validation are used as a basis for revising and perfecting an Android-based mathematic equation editor. The validation data obtained were then analyzed and revised. The revised editor of Android-based mathematic equation is called draft 2.

2. Limited Trial

Draft 2 is then tested on several students who have different abilities, namely ordinary, moderate, and high. Limited group testing is done to test the quality of product development on a small scale. Limited tests conducted include readability and implementation of learning. Readability test for Android-based mathematic equation editors is given to teachers and students to get input and advice on Android-based mathematic equation editors. The second revision was called draft 3, which was based on input from limited trials.

3. Field Trial (developmental testing)

The field trial aims to determine the practicality and effectiveness of the product. Field trials are conducted to test the quality of product development on a larger scale. The practicality of the product can be seen from the implementation observation observation sheet, student response questionnaire, and user practicality assessment questionnaire. Product effectiveness can be seen from the representation ability test and student questionnaire.

Based on the results of the field trials, input is obtained for product revisions. The revised result is called draft 4 which is the final product of the process of developing an android-based mathematic equation editor that has been done. The final product obtained is an Android-based mathematic equation editor that is valid, practical, and effective.

3.4 Stage of Desimination (Disseminate)

This stage is the stage of using an Android-based mathematic equation editor that has been developed on a wider scale, for example in other classes, other schools, by other teachers and the wider community.

4. RESULT & DISCUSSION

Adevice is called valid if is concerned, the material (the intended curriculum) must be well considered [16]. The components of the material should be based on state-of-the-art knowledge (content validity) and all components should be based on consistently linked to each other (construct validity)" Based on this opinion the validity of a learning media can be seen from its relevance, the goal of developing the product itself must be truly considered. The components underlying the manufacture of the product must be appropriate (content validity) and the extent to which all components are interrelated (construct validity). The combination of ideal and formal curriculum or intended describes the validity criteria of learning media. It means that learning media is said to be valid if it fulfills two things, namely fulfilling the criteria of content validity, the results of expert/practitioner assessment state that the learning device developed is based on a strong theoretical foundation; and there is internal consistency between media components. Data in the form of assessment scores from expert validators, students, and teachers consist of 5 categories, which are very good (5), good (4), sufficient (3), less (2), very less (1) converted in qualitative data. The steps in analyzing this qualitative data are as make a conversion table. Data in the form of a rating with a scale of 5 is converted into scale 5 qualitative data. The conversion criteria can be carried out based on the following criteria as table 2.

TABLE 2

CATEGORIES OF VALIDITY PRODUCT

Formulas	Category
$X > \bar{X}_i + 1{,}8 \times sb_i$	Very Good
$\bar{X}_i + 0{,}6 \times sb_i < X \le \bar{X}_i + 1{,}8 \times sb_i$	Good
$\bar{X}_i - 0{,}6 \times sb_i < X \le \bar{X}_i + 0{,}6 \times sb_i$	Fair
$\bar{X}_i - 1{,}8 \times sb_i < X \le \bar{X}_i - 0{,}6 \times sb_i$	Poor
$X \le \bar{X}_i - 1{,}8 \times sb_i$	Very Poor

4.1 Content validity

The instruments of validity and construct validity are proved. Retnawati [17] said proving the validity of the content by using expert judgment. The validity of a test as mentioned by Reynolds, Livingston, & Willson [18] refers to the feasibility or accuracy of interpretation of the test score itself. In other words, a valid test is a test that can measure what you really want to measure. The validity of the test developed is obtained from the assessment of experts and practitioners in the relevant field. The validation by experts and practitioners aims to obtain evidence of content validity. After being validated by the validator, the instrument was revised based on input and suggestions from experts and practitioners. The evaluation of the product development is in the form of quantitative data and qualitative data in the form of suggestions and comments from the validator. Quantitative data is converted to predetermined criteria. This is used as a basis in determining the validity level of the corresponding component. The suggestions and comments provided are the basis for making product repairs before small-scale testing. In general the results of the assessment of the three validators state that the instrument is feasible and ready to be used with revisions. The validation process involved 4 validators consisting of 2 lecturers of Mathematics Education at Ahmad Dahlan University in Yogyakarta and 2 IT experts who validated learning media in the form of the editor of the mathematic equation. Suggestions and comments from the validators were analyzed and used as material for revision I of the products produced to become products that are ready for use in limited trials. Based on the results of expert validation and practitioners know the feasibility of the product being developed. The feasibility of this product is based on data in the form of an average score from the four validators presented in the table 3.

TABLE 3

CATEGORIES OF VALIDITY PRODUCT

No.	Aspect	Average	Category
1	Design media	4.44	Good
2	Navigation	4.56	Good
3	Conformity	5.00	Very Good

4.2 Construct validity

Get proof validity of the construct using analysis factor. The results are both validating that prove that the instruments are valid because it has a value of more than 0.5. The analysis factor for 11 items of questionnaire validity of media got the KMO value is 0.501> 0.5 with significance 0.335 and there is a component that has Eigen's value > 1 and the total variance is 60.277%. The results of analysis the validity with a product moment using SPSS as shows in the figure 3.

Correlations

		no	total
no	Pearson Correlation	1	.322
	Sig. (2-tailed)		.335
	N	11	11
total	Pearson Correlation	.322	1
	Sig. (2-tailed)	.335	
	N	11	11

Fig. 3 The result of analisis the validity product

5. CONCLUSSION

The stages of this research that have been completed are until product validation. And the results are valid with pearson-correlation 0.322 and appropriate to use with revisions as recommended. Because the results of product validation have a minimum value of good, this shows that the product is based on strong theoretical aspects and there is a consistent relationship between products. Based on these results and Nieveen's opinion, it was concluded that the product was categorized as valid.

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