Developing Educational Game of Mathematics Calculating Concept for Elementary School

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ABSTRACT

This learning media aims to assist students in increasing understanding of mathematical concepts, being able to explain the relationship between concepts and the application of concepts or algorithms in a flexible, accurate, efficient and precise way in problem solving. The advantage of this educational game is that there are several materials that are equipped with animations, sound images and quizzes so that they can generate enthusiasm and interest in students in learning mathematics. The results of observations that have been made at SDN 1 Trangsan are that mathematics learning carried out in schools is not fun or still uses the lecture method in learning so that mathematical concepts are not conveyed. In this study, the method used was R&D (Research and Development) and the ADDIE development method (analysis, development, design, implementation, evaluation). This media has been tested on 3 media experts and obtained the result that the average coefficient V is 0.90 and can be declared valid. While the results of the reliability test from media experts is 0.710 and can be stated as strong reliability. While the material was tested on 2 accompanying teachers in elementary schools who obtained an average value of coefficient V of 0.92 which was declared valid. The results of the material expert reliability test obtained a value of 0.768 and declared strong reliability. The results of the interpretation test of the percentage of tests carried out by 10 respondents or students obtained a percentage value of 67.4% which was included in the "Agree" category. The results of the pretest and posttest can be concluded that the value of sig> 0.05, which means the data is normally distributed.

Keywords: learning media, educational games, mathematics

INTRODUCTION

Mathematics is one of the most important subjects that has to be mastered well by students. This is because learning mathematics has benefits for everyday life. Therefore, mathematics is studied at every level of education from elementary school to college. In line with the opinion of Mirati (2015) and Amir (2014) that mathematics is a very important branch of science. Almost every study uses mathematics from elementary school to university level. One of the characteristics of mathematics is that it has an abstract object of study. This trait causes many students to experience difficulties in appreciating and understanding mathematical concepts. One of the mathematics goals is that students are able to understand mathematical concepts, this is in line with (Permendiknas no 22 of 2006) which states that the main purpose of learning is to understand mathematical concepts, explain the relationship between concepts and the application of concepts or algorithms in a flexible, accurate, efficient manner and precise in problem solving.

However, practically, the elementary school students still found difficulty in understanding mathematical concepts. This was because in general in elementary schools' mathematics learning is given classically through lectures without seeing the possibility of applying other models that are in accordance with the material to be taught. In line with Widodo & Kartikasari (2017) state that learning mathematics in schools is not fun or still uses the lecture method in learning so that mathematical concepts are not conveyed. According to Amir (2014) states that mathematics subjects at the elementary school level are both getting the knowledge of mathematics itself, and developing students' thinking power logically, analytically, systematically, critically, and creatively, and develop patterns of work habits, solving problems collaboration, and shaping the child's personality as well as guided by the development of science and technology.

The interview results of grade elementary school teachers showed that the learning method used by the teacher is still traditional. Teacher used teacher-centred method and still used surrounding objects as the learning media. Therefore, to support existing learning, the latest learning media is needed and utilizes technology that is developing at this time. In answering the various problems above, the researchers will design educational games to improve understanding of mathematical calculation concepts for fourth grade elementary school children that can help teach mathematics lessons by developing students' thinking power logically, analytically, systematically, critically, and creative.

METHOD

The research used R&D (Research and Development) research methods and using ADDIE development which means Analyze, Design, Develop, Implement and Evaluate. This method is usually used to assist the development of a product that can be applied to create performance-based learning. The philosophical underpinnings of the ADDIE approach lead in to meaningful learning that results in innovative, original and engaging students. Therefore, this method is designed to help you learn in a more active, flexible, context-sensitive and engaging way.

Method which is used in this research is developing model used ADDIE approach based on Branch Theory. There are 5 steps in this method namely, (1) analysis, (2) design, (3) development, (4) implementation, and (5) evaluation. According to Branch (2009:2), there are 5 steps in R&D research method which usually called as ADDIE approach. ADDIE itself stands for *Analysis*, *Design, Development, Implementation,* dan *Evaluation.* The following figure describe the stage of ADDIE and the steps of R&D research method using ADDIE.
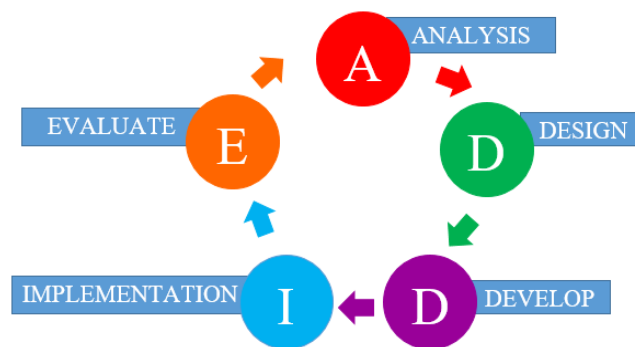

Figure 1 Steps of R&D Research using ADDIE based on Branch Theory (2009)

Based on the ADDIE concept described in Figure 1, analysis is defined as the activity of identification of the possible causes of the gap. The results of the analysis process concludes that design is verification of the desired performance and appropriate testing methods so that the design of the product to be developed is created. The next step is called developing stage. In this stage, learning source is made and validated based on the developing design in the beginning of the process. After the Development stage, in this phase, learning resources are created and validated according to the design developed after the initial process. After the product is made, proceed to the next implementation process, namely the application of the product. The manufactured products are usually applicable for various research purposes. The

last is Evaluation, assessing the educational quality of the product and the pre- and post-implementation process, ensuring that the product meets its original purpose or does not meet its goal of creating a product.

The first stage is called Analysis. Through needs analysis, it helps to find appropriate problems and solutions that can measure students' understanding. The purpose of this stage is to collect information which is needed to develop educational game applied in the class. Because in the learning process especially mathematic calculation, the students are easily bored and found difficulties in practicing the formula that is taught by the teacher. This happened because the students are less capable in remembering the formula which is written in the board. Then, the next step is the researcher will develop mathematic game calculation which is used for elementary school students especially fourth grade.

The second step is design. In this stage, the researcher designed the product step by step based on student's need. The concept of the product is made using use case diagram for helping the researcher in knowing how the product worked. The following chart is use case diagram which will be used in education game "*Kotak Otak Atik Matematika*".
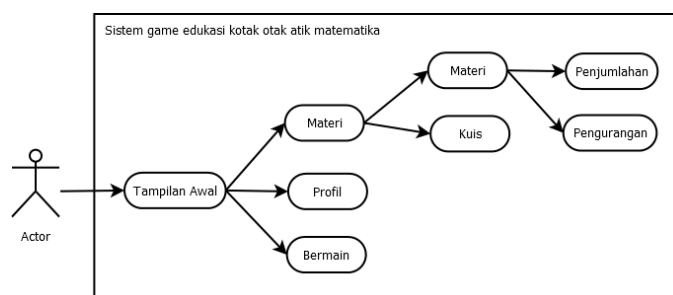

Figure 2 Use Case Diagram

The next step is development stage. In the product making stage, the next stage is the third stage of development (Development), In the product manufacturing stage, it is in accordance with the interface design that has been designed. The next step is implementation. Implementation stage in this educational game is using blackbox method. Blackbox method is a program testing that prioritizes testing the functional requirements of a program whether it runs well.

RESULT AND DISCUSSION

1. Result

Based on the development and testing procedures carried out in this study, the Android-based educational game "Mathematic Brain Box" as a medium for learning mathematics for elementary school children in grade IV was developed using software construct 2. The development of this educational game is based on the interface design that has been made by researchers. The following is a picture of the results of the development of the educational game "Mathematics Brain Box" that has been made by researchers:

Figure 3. Home

Figure 4. Material dan Exercise Display

Figure 5. Playing Display

Figure 3 is the initial view of the game " *Kotak Otak Atik Matematika* ". The educational game " *Kotak Otak Atik Matematika* " discusses how to count in mathematics using interesting formulas. The display design is equipped with pictures so that it can attract the attention of students. It causes students more enthusiastic in learning mathematics with a more pleasant nuance. In this game, students can select material, profile, and play buttons. While on the top right there is a button how to play (a pop-up will appear how to play), back sound (used to turn on/off the sound), exit button, and also the profile of the game maker.

Figure 4 is a display of materials and exercises in the educational game " *Kotak Otak Atik Matematika*" Material button allow students to access the material selection display. When the

material button is clicked it will go to the addition and subtraction material view. In addition, when the quiz button is clicked it will go to the quiz display where students have to work on all the questions given by selecting the available answers. At the top right there is also an explanation button about the existing UI, a back sound button on/off, and at the top left there is a Back button which will go to the initial screen.

Figure 5 is a display for the game menu. When students click the play button on the initial screen, they will go to the game menu. In the game section, students are required to arrange the answers provided so that they can get the results of the numbers in the middle of the screen. In addition, in this display also has a long working time which will be a reference for teachers to assess students' understanding. At the top right there is also an explanation button about the existing ui, the back sound button is on/off, and at the top left there is a Back button which will go to the initial screen

2. Discussion

Table 1. is a case processing summary, regarding information on the number of samples or respondents (N) that have been analyzed in the SPSS program. N as many as three lecturers, because there are no empty respondent data (respondent answers are filled in all) then the valid number is 100%. Table 2. is a statistical reliability, there are N of Items (number of items or questions) there are 20 items with Cronbach's alpha value of 0.710. Because Cronbach's alpha value of 0.710 is a range of $0.7 \leq a \leq 0.9$, then as the basis for decision making in the reliability test above, it can be concluded that the 20 or all items in the questionnaire are strong reliability.

Table 3. is a case processing summary, regarding information on the number of samples or respondents (N) analyzed in the SPSS program. N is a respondent that include as many as two teachers of SDN 1 Trangsan. There is no empty data (respondent answers are filled in all) then the number of valid is 100%. Table 4. is a reliability statistic, it is known that there are N of items (number of items or questionnaire questions) there are 23 pieces with a Cronbach's alpha value of 0.768 which is a range of $0.7 \leq a \leq 0.9$ so as the basis for decision making in the reliability test above, it can be concluded that the 23 or all items in the questionnaire have strong reliability.

During the testing of this educational game, its eligibility will be checked or verified by media and materials experts to determine the eligibility of this educational game. Experts will advise if the game or material is not feasible. Based on the results of the feasibility assessment from media experts and material experts, it is described as follows:

a) Media Expert Validation

The average result of the media expert's V coefficient is 0.90 which is declared valid. The results of the media expert's reliability test are 0.710 which is stated as strong reliability.

b) Material Expert Validation

The average result of the material expert's V coefficient is 0.92 which is declared valid. The results of the material expert's reliability test are 0.768 which is declared strong reliability.

Table 1. Case Processing Summary
Media Professional

Case Processing Summary

		N	%
Cases	Valid	3	100.0
	Excluded[a]	0	.0
	Total	3	100.0

a. Listwise deletion based on all variables in the procedure.

Table 2. Reliability Statistic
Media Professional

Reliability Statistics

Cronbach's Alpha	N of Items
.710	20

Table 3. Case Processing Summary Material Expert

Case Processing Summary

		N	%
Cases	Valid	2	100.0
	Excluded[a]	0	.0
	Total	2	100.0

a. Listwise deletion based on all variables in the procedure.

Table 4. Reliability Statistic Material Expert

Reliability Statistics

Cronbach's Alpha	N of Items
.768	23

CONCLUSION

Game-based Mathematics learning media can help improve understanding of basic mathematical concepts (addition, subtraction and multiplication), besides that game-based learning media can help students learn fun with the attraction of students to games that are easily accessible with android devices owned by students. By using this learning media, it helps teachers in the use of learning media, which so far teachers are still having difficulties in creating and developing learning media.

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