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DEVELOPMENT OF MATHEMATICS INTERACTIVE MULTIMEDIA WITH SCRATCH TO ENHANCE STUDENT'S MATHEMATICS UNDERSTANDING ABILITY

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Abstract

Interactive media is something that is important to be developed in order to improve students' mathematical understanding abilities. One of the learning media used is scratch. Scratch-assisted learning media on rank numbers material is made to make it easier for students to understand concepts and to increase student interest in learning, by studying it is expected to be able to give birth to creative students in making learning media based on scratch animation. The research design used in this research is the research design of 4D model development (Four D Models). This includes 4 stages, namely the definition, design, development and dissemination stages, which the researcher then simplifies by changing from four stages (4D) to three stages (3D), namely: defining, designing and developing.
Keywords: Mathematics Interactive Multimedia, Scratch, Mathematics Understanding Ablility

Abstrak

Media interaktif merupakan hal yang penting untuk dikembangkan dalam rangka meningkatkan kemampuan pemahaman matematis siswa. Salah satu media pembelajaran yang digunakan adalah coretan. Media pembelajaran berbantuan gores pada materi bilangan pangkat dibuat untuk memudahkan siswa dalam memahami konsep dan untuk meningkatkan minat siswa dalam belajar, dengan mempelajari diharapkan mampu melahirkan siswa yang kreatif dalam membuat media pembelajaran berbasis animasi gores . Rancangan penelitian yang digunakan dalam penelitian ini adalah rancangan penelitian pengembangan model 4D (Four D Models). Ini meliputi 4 tahap yaitu tahap pendefinisian, perancangan, pengembangan dan diseminasi yang kemudian peneliti sederhanakan dengan mengubah dari empat tahap (4D) menjadi tiga tahap (3D) yaitu: pendefinisian, perancangan dan pengembangan.

Kata kunci: Multimedia Interaktif Matematika, Scratch, Kemampuan Pemahaman Matematika

INTRODUCTION

Programming is a trending topic in many countries around the world. Over the years, there has been an increase in the use of computational and simulation software in all science, technology, engineering, and mathematics (STEM) professions (Wing, 2008). Programming is a subset of logical reasoning, which represents one of the key skills of what are now called “21st century skills” (Dohn, 2019; Balanskat, Anja & Engelhardt, Katja, 2014). Programming is seen as a fundamental skill of the 21st century, and can even be considered a form of literacy. For decades there have been attempts to introduce children to programming. This can be traced back as far as the late 1960s and programming language logos, where Seymour Papert added the graphic idea of a turtle to support drawing operations (E. C. Förster, et al., 2018)

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and became a symbol of change in basic mathematics education and the very nature of schools themselves (Solomon, Harvey, Kahn, et al., 2020). Papert (1990) believes that the use of the Logo programming language will help students to develop their understanding because he considers these programming languages to be "instruments designed to help change the way you speak and think about mathematics and writing and the relationships between them.

The introduction of programming languages is very important to improve digital competence and the proper use of information and communication technology (hereinafter, ICT) by students (Maloney et al., 2008; Jose Antonio, 2019)). Although today's programming languages are more accessible to elementary school students than the earliest languages, other problems need to be addressed in order to fully exploit their pedagogical abilities. For example, a common mistake consists of designing programming activities that are very disconnected from students' real-life contexts, hence, they are not found to be motivating (Resnick, Silverman, Kafai et al., 2009). In recent years, a new type of programming language has emerged, especially in helping children and students learn programming. One of the best choices right now is Scratch. (Ford, 2009)

Scratch is a programming language that makes it easy for you to create interactive stories, animations, games, music, and art. Scratch was developed by the Lifelong Kindergarten research group at the MIT Media Lab. (Kindergarten, 2013). Scratch was created to help young people learn to think creatively, reason systematically and work collaboratively (Brennan, Balch, & Chung, 2014). Scratch is used more often than other similar software (Price & Barnes, 2015; Wong, Cheung, Ching & Huen's, 2015). Scratch uses a block-based approach, leaving out common problems of text programming languages such as asynchronous brackets (Utting, Cooper, Maloney & Resnick, 2010). The drag-and-drop blocks provided in Scratch help simplify the process of creating and programming animations, games, music, interactive stories, and more. The block-based Scratch grammar hides the syntactical complexity of the JavaScript used to build Scratch. Users program Scratch by dragging blocks from the block palette and pasting them onto other blocks like a jigsaw puzzle. When two blocks are combined, executable code is generated (N. Zamin, Ab Rahim, Savita, et al., 2018). Scratch coding can encourage young students to seek new representations of mathematical ideas and relationships (Hughes, Gadanidis, & Yiu, 2017). In addition, math activities with Scratch allow

teachers to adapt their teaching style to the individual characteristics of students (Benton, Hoyles, Kalas, & Noss, 2017).

Based on research conducted by José Antonio, González, Calero & López (2019) presents the results of a quasi-experimental study with sixth graders who studied the effect of Scratch both on the acquisition of mathematical concepts, and on the development of computational thinking. The results seem to indicate that Scratch can be used to develop students' mathematical ideas and computational thinking. The research conducted by Duncan & Tanimoto (in N. Zamin, Ab Rahim, Savita, et al., 2018) found that which programming language to be taught and at what age to be taught programming depended on many factors including the learning tools used, context, teacher training and confidence as well as how much it allows students to explore concepts for themselves and learn continuously after an introduction to basic programming. Taylor, Harlow & Forret (2010) found that Scratch can encourage students to learn cooperatively and use problem solving processes such as goal setting and generating and testing ideas while learning mathematics. Furthermore, research has found that students develop their mathematical thinking (Calao, Moreno-León, Correa, & Robles, 2015; Dohn, 2019) and problem-solving skills (Su, Yang, Hwang, Huang, & Tern, 2014) while learning to code with Scratch.

It is important for teachers to be able to choose the right method and according to their abilities, because the teacher's ability to design or organize material is one of the things that can actually determine the level of student understanding and success in the learning process (Widjayanti et al., 2018), therefore the teacher must be able to choose the appropriate method depending on the ability of the students in the class, including the suitability for writing teaching materials and supporting materials for learning activities. One of the achievements of the learning methods or teaching materials used is the level of student understanding. Mathematical understanding ability is the ability to absorb and understand mathematical ideas (Lestari & Yudhanegara, 2017) and is related to the ability to understand concepts, operations and relationships or relations in mathematics (Afgani, 2011). Based on the levels in Bloom's Taxonomy, understanding (comprehension) is the second level in aspects of cognition related to mastering or understanding something. At this level, students are expected to be able to understand mathematical ideas or concepts.

Mathematical conceptual errors can be caused by teachers or students. Teacher

factors, such as not mastering the right learning methods and methods. In addition, teachers who do not master the basic material cause conceptual problems in mathematics. If the teacher does not understand the concept, students tend to adopt the wrong concept. Another reason is the teacher's lack of choice in mathematics learning media.

Students are said to already have the ability to understand mathematically if: 1) they can explain mathematical concepts and facts; 2) can easily make logical connections between these different concepts and facts; 3) can use existing relationships into something new based on what is known; and 4) identify the principles that exist in mathematics so as to make the work run well (Alan & Alfriansyah, 2017). The material developed can be arranged into teaching materials for students. Scratch-assisted learning media on rank numbers material is made to make it easier for students to understand concepts and to increase student interest in learning, by studying it is expected to be able to give birth to creative students in making learning media based on scratch animation.

METHODS

The research and development method (Research and Development) is a research method used to produce certain products and test the effectiveness of these products (Sugiyono, 2012) and to develop and validate products (Borg and Gall, 2016). The research design used in this research is the research design of 4D model development (Four D Models). Thiagarajan, Semmel and Semmel (1974) suggest that learning development is carried out in stages according to the 4D step. This includes 4 stages, namely the definition, design, development and dissemination stages, which the researcher then simplifies by changing from four stages (4D) to three stages (3D), namely: defining, designing and developing. In general, the stages of development in this research are carried out as follows:

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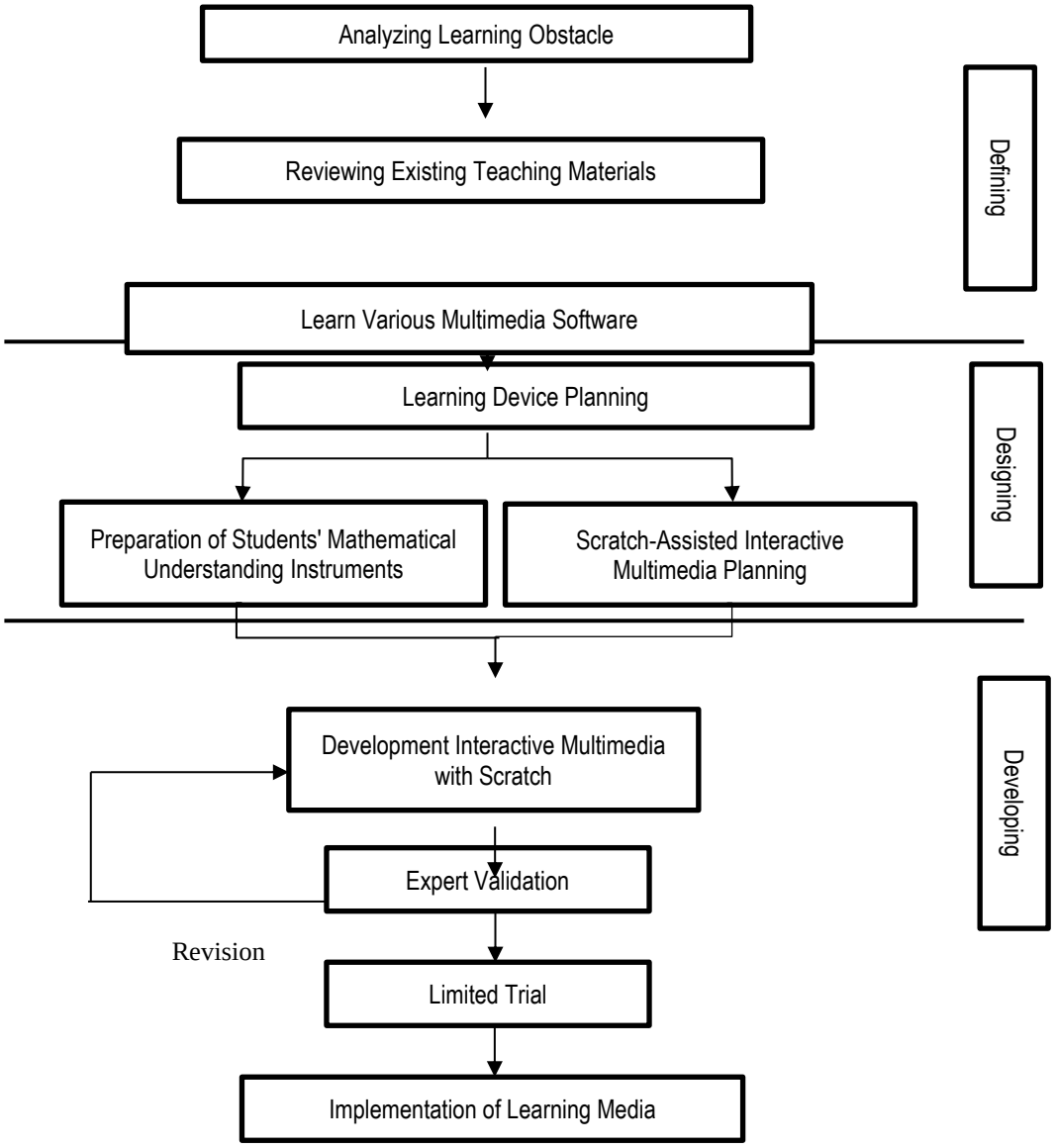

Figure 1. Interactive Multimedia Development Research Design

RESULTS AND DISCUSSION

The stage of presenting trial data in this study was carried out by material experts and media experts. This research and development were carried out using a research design to develop a simplified 4D model into a 3D model that has been adapted to research needs. The data on the results of each stage of the research and development procedure carried out is as follows:

Defining

Defining is to determine and define the requirements needed in learning the power of numbers. This stage includes analyzing student learning barriers, reviewing existing teaching materials, and studying various mathematics software.

Designing

Designing aims to determine effective and efficient ways to develop teaching materials in the form of initial products based on data collected from the definition. The planning stage is the preparation of learning tools, the preparation of students' mathematical understanding instruments, and interactive multimedia planning assisted by scratch.

Developing

Developing teaching materials is the implementation stage of the design with the aim of producing teaching materials that are suitable for use by class VII students regarding rank numbers. As an early-stage development of materials teaching in the form of a textbook must go through the test stage experts to assess the feasibility of this teaching material. The development stage includes validation of media experts and material experts, limited trials, and implementation of learning media. Expert validation is a product validation activity that is carried out before being tested on a limited basis. Validation is done by assessing the teaching materials given to media experts and material experts. The results of the assessment can be seen in table 1 and table 2.

Table 1. Material Expert Validation

No	Evaluation	Validator 1	Validator 2
1	Appearance		
	a. The sequence of concepts presented	4	5
	b. Systematic consistency of presentation of material	5	5
	c. Examples of questions in interactive multimedia with Scratch	4	4
	d. Pictures and videos in interactive multimedia with scratch	4	5

2	Contents		
	a. The accuracy of concepts and definitions in the matter of numbers with powers	4	5
	b. The accuracy of the example with the material to the power of numbers	5	5
	c. The accuracy of pictures and videos in interactive multimedia with scratch on the material of numbers with powers	5	5
	d. Completeness of the material in accordance with the Competence	5	5
	e. The breadth of the material	4	4
	f. Material depth	4	4
	g. Encourage the curiosity of students	5	5
	h. Creating the ability to ask students	4	4
	i. Using examples in everyday life	5	5
3	Language		
	a. The accuracy of sentence structure	4	5
	b. Sentence effectiveness	4	5
	c. The suitability of the statement used is in accordance with the spelling	4	4
	d. The accuracy of the typeface used	4	4
	e. The accuracy of the font size used	4	4
	f. The standard of the term	4	4
	g. The language used in interactive multimedia assisted by scratch is easy to understand	5	5
	h. Ability to motivate students	4	4
	i. The sentences used are in accordance with the ability level of the students	4	4
4	Students' Mathematical Understanding Ability		
	a. Students' mathematical understanding ability	5	5
	b. The suitability of the questions with the criteria for students' mathematical understanding abilities	4	5
	c. Clarity of meaning (understandable and unambiguous)	5	5
	d. Possible problems can be solved	5	5
	Average	4.5	4.6

From the results of the material expert assessment, it was obtained that validator 1 stated that the average value of the teaching materials was 4.5, while the average value obtained from validator 2 was 4.6. The average result of the assessment of the two material

experts has a satisfactory result, which is 91%. These results can be used as a reference for using teaching materials in limited trials.

Table 2. Media Expert Validation

No	Evaluation	Validator 1	Validator 2
1	Simplicity		
	a. Animations displayed in the media are easy to understand	5	5
	b. The animation used is in accordance with the student's character	5	5
	c. Use sentences that are easy to understand	5	5
2	Cohesiveness		
	a. Use of appropriate buttons	4	4
	b. Compatibility of media usage instructions	4	4
	c. The size of the animation, images and text are appropriate	5	4
3	Appearance		
	a. The animation used is interesting	4	4
	b. Easy-to-read font	5	5
	c. The right color combination	5	4
4	Usefulness		
	a. The program can run well	5	5
	b. Users can operate the program independently	5	5
	c. Users do not feel bored to use this program	5	5
	d. Ease of using media	5	5
	e. Possibility of being used for individual study by students or teaching aids for teachers	5	5
	Average	4.8	4.6

From the results of the media expert assessment, it was obtained that validator 1 stated that the average value of the teaching materials was 4.8, while the average value obtained from validator 2 was 4.6. The average result of the assessment of the two material

experts has a satisfactory result, which is 94%. These results can be used as a reference for using teaching materials in limited trials.

CONCLUSION

This research and development were carried out using a research design to develop a simplified 4D model into a 3D model that has been adapted to research needs.The dissemination will publish at a later date because the school does not allow it to do research.

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