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Title: Designing A Math Game Based on Virtual Reality with Montessori Approach

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Designing A Math Game Based on Virtual Reality with Montessori Approach

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Abstract— Mathematics lesson is one of the basic sciences that are often found in every level of learning, especially in elementary and secondary schools. According to Mulyono Abdurrahman, mathematics is a way of finding answers to problems encountered by humans; a way of using information, using knowledge of form and size, using knowledge of counting, and most importantly thinking in the person himself in seeing and using relationships. However, mathematics this lesson is one of the most difficult subjects for most learners to understand.

In the current conditions, the development of technology is very rapid, so the use of gadgets both for playing games and social media is the current trend. The difficulty of understanding the learning of mathematics is approached with a Virtual Reality (VR) game app and Montessori's method, so learners can play games and indirectly learn math.

Keywords games; learning math; montessori ; vr

I. INTRODUCTION (*HEADING 1*)

Mathematics lesson is one of basic sciences at every level in elementary and secondary schools. Unfortunately, mathematics lesson is the most feared subject for most learners, and as a result, they get less satisfactory results. Mathematics is actually essential for everyday life. According to Mulyono Abdurrahman, mathematics is a way of finding answers to problems faced by humans, a way of using information, using knowledge of form and size, using knowledge of arithmetic, and most importantly thinking in the person himself in seeing and using the relationships [1]. Meanwhile, according to R.Soedjadi, the purpose of teaching mathematics is:

1. Preparing students to be able to deal with the changing circumstances and mindset in life and the continuously evolving world, and
2. Preparing students to use mathematics and mathematical mindsets in everyday life and in learning various sciences [2]

However, today mathematics is a subject that is difficult to understand for learners. Turmudi argues that many years mathematics has been attempted to be mastered by

learners well by educational experts and mathematics education experts, but the results still show that not many learners in each class like the math [3]. The same opinion is expressed by Abdurrahman that of various fields taught in schools mathematics is considered the most difficult by the learners [1] for the reason that the mathematical concepts which are poorly understood and the limitations of mathematical props used by teachers in delivering learning materials. Sudono explains that props have a function to explain a particular learning material so that learners can build their own experience and knowledge [4]. This is in accordance with the stage of development of children aged 7 - 11 years who are at concrete operational stage, because of the difficulty of this age child in thinking abstractly.

One method of learning that applies many props is Montessori Method. The Montessori Method is a suitable method for use by teachers to help learners understand the mathematical concepts. Montessori props have some characteristics that are interesting, graded, auto education, auto correction as a controller usage and contextual error [5].

Ofcom's 2014 annual report explains that 62% of 5 to 15-year-olds uses mobile devices, up 20% from the previous year. The data indicate that tablets and smartphones are an attraction for children [6]. Supported by a Tempo magazine survey report which explains that children now spend most of their day in a week sitting on chairs while playing outdoors (outdoor activities) for only 2.5 hours per day [7]. The activities of sitting in the chair are spent by playing games or watching television. On the other hand, with the development of children's technology is presented about the complete gadget facilities so they are more interested in playing games or social media.

From the current conditions, there are efforts to take advantage of the development of information and communication technology as an educational tool, especially in the field of mathematics lessons. Technology-Enhanced Learning (TEL) promotes new practices for education, new communication and new ways of communication [8]. On the other hand, many interests emerge in using games as a medium of learning. Playing games means learning

something, at least learning the content and dynamics of the game.

According to Mark Zuckerberg founder of Facebook at the CES (Consumer Electronics Show) event in January 2016 in Vegas America stated that in the next 5-10 years the technology will lead to virtual reality applications [9]. Virtual reality technology or VR is a technology that enables users to view the environment virtually. Currently, developers and manufacturers in the field of Information Technology are trying to develop this VR technology like Google, Facebook, Samsung, LG, Sony and other IT companies. So that can be predicted in the coming years will be flooded with VR application products.

II. LITERATURE REVIEW

A. Learning Media

One important process in learning is learning media because it is a means to display information [10]. According to Edgar Dale's learning cone, the best and most effective results in learning are using simulated media or using a model to gain experience because they will remember 90% of what has been done and the results obtained are the ability to analyze, design, create and evaluate.

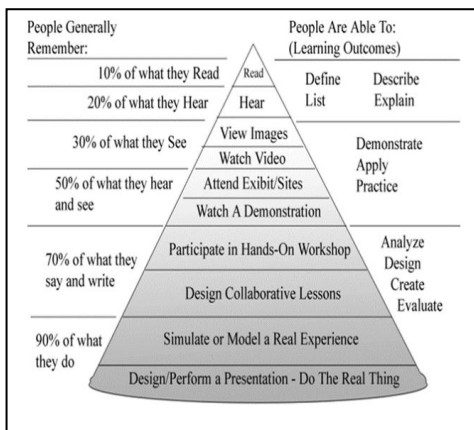


Figure 1. Conical media learning Edgar Dale

By looking at technological developments and child favorites in playing tablets and smartphones, video game can be utilized as a means of learning. Video game is a medium of learning that draws interesting pictures and sounds. Interesting images and sounds which involve hand interaction to play the game will give pleasure but will get good learning outcomes.

B. Realistic Mathematical Learning

Learning mathematics is really not just learning numbers, numbers, and formulas. The concept of learning mathematics can be applied in everyday life not merely

learning something abstract, imaginary and imaginary. To connect between the concepts learned with the application in everyday life, it requires a tool or media that is a representation of the concepts learned in everyday life. It aims to facilitate learners in understanding the concepts in learning mathematics so that it is no longer abstract, imaginary and imaginary. Learning with the realization of mathematical concepts is called realistic mathematics learning [11].

C. Montessori Method

The Montessori Method is a learning method developed by Maria Montessori (1870-1952) with the concept of learning while playing [12]. Montessori creates a learning environment prepared so as to develop personality, knowledge and independence to the maximum extent possible. According to Montessori, a child's success is not taught by the teacher but by the experience itself [13].

The application of the Montessori approach has always been related to props, in which the props are used to teach students in simple, beautiful designs and allow them to explore knowledge, represent concepts and correct their own mistakes [14]. The props designed by Montessori are referred to as didactic props [13]. Montessori's mathematical props are not designed to teach mathematics but to develop the ability to think mathematics, including: understanding command, sorting, abstracting, and the ability to construct knowledge into a new concept [14]. Montessori props have the characteristics: spontaneously attract children's attention, containing a rational gradation of stimulation, auto correction, auto-education and contextual.

D. Review of Existing Game

From Table 1, most games are used on PCs with most of the arches genre with their game paths like existing entertain games but are linked to math problems

Table 1. Review of existing games

Game Name	Mathematics Learning	Game Design	media	Achievement Result	Genre
kopikita	++ : X	Monkeys hanging, looking for figures adjusted with the problems	android	81.3 %	archade
edukasi game	++ : X	Finding questions with correct answers	PC		archade
game berhitung	++ : X	Fight with mathematics problems	PC	62%	casual
pendekar pintar	++ : X	Destroying ships by canon and bullets which match question and answer	android	85%	archade
math	++ : X	Adventure	andr		endle

adventure	X		oid		ss run
petualangan le bombo	+ - : X	Groove with level and addition with quiz model	PC	93%	archade
ular tangga	+ - : X	Mathematical games are related to math problems	PC	85%	board game
game matematika	+ - : X	Adventure by answering math problems	android	90%	endless run

III. METHODOLOGY

A. Object and Research Locations

The selected research objects are elementary school students with age range 6-7 years around Semarang city.

B. Population dan Sample

Data collection on the need for interesting math learning media through games is done by distributing questionnaires to 30 students from several elementary schools.

IV. DISCUSSION

The games are designed on the VR model (Virtual Reality), where players will be brought to interact directly with the virtual world. Another advantage of Virtual gaming is that players interact through body movements through the gyroscope and magnetometer sensors so that the player seems to be carried as in the real world.

In Montessori approach, it is known that props to be used for learning have some characteristics, that is interesting, graded, auto education and have auto correction. The first, props should be interesting. VR apps appeal to primary school students because VR has not been as popular as mobile games. Something new then will make the user interested, especially for elementary school children where a great sense of curiosity. With VR games, players will be brought into the 3D VR world. Secondly, the gradation emphasis in Montessori's learning is based on the child's rationale. Rational skill of child is formed gradually, for that in the game design; the level of game that will be played is made gradually where player will play start at the simplest level first like summation and given big time. Workmanship time will be accelerated along with the level increase that is played. Thirdly, auto education. The design will be created so that the player can learn independently through the given questions. The Player will know the questions answered correctly or incorrectly. If the answer is correct then the value obtained will increase whereas if the answer is wrong it will decrease in value. Challenges are given by setting time limits to solve the given problems. Lastly, auto correction. Game design will give players the opportunity to repeat math problems at that level until they get a certain number of stars. Giving stars adjusted to the size of the score obtained from answering the questions.

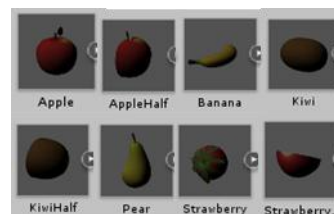


Figure 2. Asset applied in the game

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