

# The Utilization of 3D Technology in Mathematics Learning

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**Abstract:** The development of information and communication technology in Indonesia has developed very rapidly. This can be seen in smartphone users, the number of bloggers in Indonesia, Facebook or other social media users, and internet users. One of the information and communication technologies that is starting to develop in Indonesia is Virtual Reality. This technology in Indonesia is still not much developed. Virtual Reality technology that has entered Indonesia is mostly only in the form of games. There are not many Virtual Reality developers in Indonesia. The Indonesian government itself is currently promoting the digitization of school (learning) materials, one of which is through the Electronic Book Series from the Ministry of Education and Culture for elementary school, junior high school high school and vocational school children. Electronic Series Books are still limited to masters or digitalized books, while the development of Virtual Reality in the education sector in Indonesia is still not large and has not yet developed. In Indonesia, almost no elementary schools utilize Virtual Reality technology in their learning process and mathematics is one of the school materials that is very feared by students, apart from English and regional languages (Javanese). From the above background, researchers developed a mathematics learning application for the elementary school level based on Virtual Reality technology. With this Virtual Reality technology, children are invited to play and learn so that children are able to work on math problems in a fun way.

**Keywords:** 3D; Mathematics; Learning; Virtual reality

## Introduction

The development of Indonesia is in all fields, starting from tourism, security, offices, information and communication technology, and even education (Isma et al., 2022). One of the developments in the education sector in Indonesia is the digitization of school materials. Through the Ministry of Education and Culture, Indonesia is developing electronic-based school materials better known as the Electronic Book Series (BSE) (Agusta, 2019). BSE was created with the aim that students can study anytime and anywhere and reduce the cost of purchasing books.

The Indonesian Government's plan is not wrong, this can be seen from the fact that many Indonesian people now have smartphones. Indonesia is the country with the most active smartphone users in the world (Hudaya, 2018). Apart from being seen from smartphone users, it can also be seen from the number

of bloggers in Indonesia, Facebook users where Facebook users in Indonesia currently reach 63 million, and internet users who access the internet every day on average 34 sites per day. Virtual Reality (VR) technology is a promising technology, where VR users will be presented with a virtual world like the original (Sulistyowati & Rachman, 2017; Kamra, 2019). Promising technology, where with VR users will be presented with a virtual world like the real one.

Currently, in Indonesia, the development of virtual reality is not very rapid, even though in developed countries the development of VR is very promising. In Indonesia, the development of school materials with VR is almost non-existent (Machover & Tice, 2014). VR in Indonesia is still dominated by smartphone users with game applications. In this research, we tried to build a VR-based learning environment where in the development we used Oculus as one of the devices in the VR world. Our

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current research is still focused on developing mathematics materials for Virtual Reality Primary Schools, henceforth in this research abbreviated as VR. VR is a computer-based technology that combines special input and output devices so that users can interact deeply with virtual environments as if they were in the real world (Biocca, 2014). VR allows developers to create virtual environments with the potential to act as simulations. The visualizations that occur in the virtual world when using VR consist of visual, auditory, or other stimuli (Ulva, 2022).

The 3D coordinate system in VR adopts a Cartesian coordinate system, this is because users can see objects in the virtual world in all directions starting from the top, bottom, left, right, back, or front. To view objects from the left or right side use the X axis, to view objects from above or below use the Y axis and to view objects from far or near use the Z axis (Dinayusadewi & Agustika, 2020).

In previous research, it was found that in the VR world, there are five things felt by VR users, namely 70% vision, 20% hearing, 5% smell, 4% touch, and 1% taste (Kurniawati, Santanapurba, & Kusumawati, 2019). These five factors are often researched by developers.

VR offers the potential for training programs to reduce the potential for accidents and deaths, In the field of learning VR offers cognitive learning for participants in determining actions that must be taken in virtual environments (Ultra Gusteti, Rifandi, Gustya Manda, & Putri, 2021). The use of VR can be used in various ways, including VR for the surgical process, surgical image guidance, education and training, pre-operative activity planning, remote and collaborative medicine, an overview of current science, physical and mental health, and rehabilitation (Agushinta & Satria, 2018).

The VR hardware required when developing a VR environment includes a mounted Display (HMD), Force Feedback Data Glove (FFDG), Force Feedback Joystick and Controls (FFJC), Liquid Crystal Display (LCD)/Light Emitting Diode (LED). VR environments are divided into three main types, namely: non-immersive, semi-immersive, and full-immersive (Isma et al., 2022).

## Method

Methodology data is the method used by researchers to solve the problems posed (Ningrat & Yasa, 2022). To solve existing problems, the problem-solving method used is as in Figure 1.

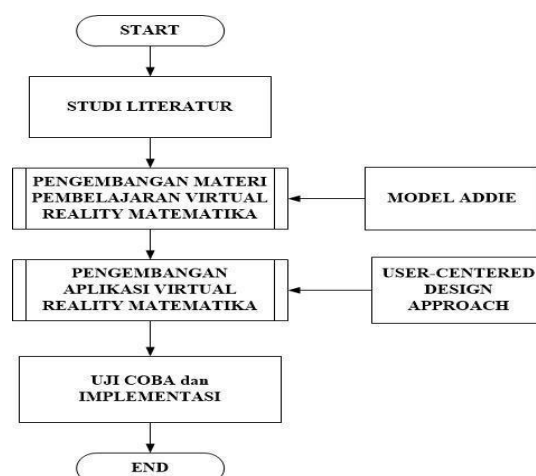


Figure 1. Research methods used by researchers.

## Result and Discussion

Mathematics learning materials are developed using the ADDIE model, in which researchers connect with teachers and students (Sabirin, Mustofa, & Sulistiyarini, 2022). Teachers act as facilitators of mathematics learning in general. From the interview with the teacher regarding the mathematics material that will be focused on research, the teacher suggested focusing on grade 1 of elementary school, on the grounds that in grade 1 of elementary school there are still many students who cannot do calculations or write well. Apart from that, it is recommended that teachers look at the books issued by the government, namely the Electronic Series Books, to further consolidate the existing material (Andi Rustandi & Rismayanti, 2021).

The development of the Virtual Reality Environment is carried out using a User-based approach. The focus of this research is on grade 1 elementary school children. Therefore, we built an application with a style and design that suits the characteristics of elementary school children. In developing this application we built two applications with different 3D technology (Ulva, 2022). The first product uses LEAP MOTION technology and the second product uses VR GLASSES 3D technology.

Application design using Leap Motion will be in a form where the focus of game development is on the effects of using the fingers that are visible on the computer monitor screen (Kounlaxay, Shim, Kang, Kwak, & Kim, 2021). The concept of developing this application is that students are invited to enter objects in the shape of boxes, cylinders, balls, and cones. With this exercise, it is hoped that children can learn the basics of counting.

To develop 3D VR applications using VR GLASSES 3D, researchers used the labyrinth concept (Blazauskas & Gudoniene, 2020). Here players will be

invited to learn basic mathematics, starting to recognize numbers, basic addition, and subtraction by finding a way out of an existing room. Players must find the correct answers to the questions. The correct answer will take the player out of the confusing maze (Sulistyowati & Rachman, 2017). Meanwhile, the hardware requirements that support the VR MATH MAZE game can be seen in Figure 2.



Figure 2. VR MATH MAZE game hardware requirements

This process is an implementation activity of what the researcher has designed. Implementation was carried out for elementary school class children. This application has been tested on three different activities, namely: UN-Habitat Precom 3 in 2016, Indonesia Shari'a Economic Festival (ISEF) in 2016, and GDG PRIME Surabaya in 2016. The total number of respondents who tried the MATH MAZE application was 308 respondents, with total user satisfaction with this application reaching 93.59% and total satisfaction with the MATH MAZE application learning material being 80.84% (Rumeser, 2010).

## Conclusion

Based on the research that has been carried out, conclusions can be drawn including: Researchers have been able to build two mathematics learning applications, the first is based on leap motion and the second is based on 3D VR Glasses. Total user satisfaction with this application reached 93.59% and total satisfaction with the MATH MAZE application learning material was 80.84%. The application has been downloaded 28 times during the day 1 upload process.

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## Author Contributions

Didik Iskandar, Ilmiyati Rahayu, Uyung Amilul Ulum: preparation of the first draft, results, discussion, methodology, conclusion, review, and editing; Lukmanul Hakim and Yayat Ruhayat: analysis and proofreading.

## Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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