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# A META-SYNTHESIS OF VIRTUAL REALITY IN LEARNING IN INDONESIA

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**Abstract:** This research was conducted in the form of a literature study. This study investigates the use of Virtual Reality (VR) in teaching, including VR methods and their application to learning. In the literature study, the database used comes from Garuda (Garuda Digital Reference), published by The Ministry of Education, Culture, Research, and Technology. The results of the literature study obtained data that 157 articles discuss the use of VR in learning from 2012 - 2022 and in the majority of VR development using the 3D Modeling method, as much as 43%. Overall, using VR in learning provides positive results that can improve learning outcomes. Three essential things must be considered in the development of VR, namely: (1) the cost of operating VR technology, (2) Accessibility that makes it easy for teachers and respondents to access the technology, (3) Setting up a virtual environment to create a practical learning experience for respondents.

**Keywords:** development; learning; virtual reality.

**Abstrak:** Penelitian ini dilakukan dalam bentuk studi literatur. Dalam penelitian ini, menyelidikan penggunaan VR dalam pembejaran, meliputi metode VR yang digunakan dan penerapannya pada pembelajaran. Dalam studi literature, basis data yang digunakan berasal dari Garuda (Garuda Rujukan Digital) yang dipublikasi oleh The Ministry of Education, Culture, Reseach, and Technology. Dari hasil studi literature diperoleh data bahwa terdapat 157 artikel yang membahas tentang penggunaan VR dalam pembelajaran dari tahun 2012 – 2022. Secara mayoritas pengembangan VR dengan menggunakan metode 3D Modelling, sebanyak 43%. Secara keseluruhan penggunaan VR dalam pembelajaran memberikan hasil yang positif dapat meningkatkan hasil belajar. Terdapat tiga hal penting yang harus diperhatikan dalam pengembangan VR, yaitu: (1) biaya pengoperasian teknologi VR, (2) Aksesibilitas yang memudahkan pengajar dan responden untuk mengakses teknologi tersebut (3) Menyiapkan lingkungan maya (virtual environment) agar menciptakan pengalaman belajar yang efektif bagi responden.

**Kata kunci:** pembelajaran; pengembangan; virtual reality

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## INTRODUCTION

Technology has become an important part of our daily lives. The technology significantly impacts learning and teaching in education [1], [2]. Technology helps students and teachers to access information more easily, facilitates better collaboration and engagement, and enables more interactive and engaging learning experiences [3]-[6]. Interactive learning with technology is a learning method that uses technology to create a more interactive and engaging learning experience [7]. Technology can be used in various forms, such as learning apps, videos, images, animations, and online learning platforms.

The use of technology in learning provides many benefits, including (1) Easier and faster access to information. Technology allows students to access information from different sources more easily and quickly, such as through the internet or educational apps [8]; (2) More interactive learning. Technology enables interactive learning experiences, such as videos, images, and animations [8]; (3) Better collaboration and engagement. Technology facilitates better collaboration and engagement between students and teachers, as well as between students and each other, through online learning platforms and collaborative applications [9]; (4) Time and cost savings. Technology allows students and teachers to save time and cost through video conferencing or online learning materials [10].

Although technology in learning provides many benefits, several challenges must be overcome in implementing it, including (1) Inadequate infrastructure. Infrastructure such as internet networks and hardware needed to implement technology in learning often need to be improved in some places [11]; (2) Inability to manage technology. Students and teachers often need to gain knowledge and skills in managing technology, such as online learning applications or collaborative platforms [12]; (3) Over-dependence on technology. Sometimes the use of technology in learning can lead to excessive dependence on technology, thus ignoring the importance of human interaction in the learning process [13].

The utilization of technology in learning is becoming increasingly important in this digital era. Technology allows students and teachers to access broader, more practical information, resources, and learning tools. Some examples of technology utilization in learning: (1) E-learning or distance learning uses internet technology to deliver learning materials to students anywhere and anytime. Students can access learning materials through online platforms such as LMS (Learning Management System), video conferencing, or social media platforms. In the context of the Covid-19 pandemic, e-learning is one of the alternatives to continue learning without having to meet directly in class [14], [15]; (2) Mobile learning applications such as Duolingo, Quizlet, or Kahoot allow students to learn anywhere and anytime using their mobile devices. These apps generally use gamification and interactive concepts to make learning more fun and effective[16], [17]; (3) Augmented Reality (AR) and Virtual Reality (VR) allow students to experience a more authentic and immersive learning experience. For example, students can use VR headsets to experience being in natural wonders or use AR to see 3D visualizations of subject matter such as human anatomy or molecular structure [18], [19]; (4) Game-based learning uses game concepts to in-

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crease student motivation and engagement in learning. In game-based learning, students play games designed to reinforce the skills or concepts taught in learning [20].

The use of Virtual Reality (VR) in learning can provide an immersive learning experience for students [18], [19]. In a VR environment, students can experience an almost similar experience to the real world, but with a controlled and safe environment. One of the advantages of using VR in learning is its ability to simulate difficult or even dangerous situations [18], [19]. For example, students can see and practice performing first aid actions on someone injured in a safe and controlled environment. In addition, using VR in learning can also help students gain unique and exciting learning experiences. In a VR environment, students can visit places that are difficult or even impossible to access in the real world, such as the planet Mars or the internal structure of the human body. VR in learning can also help increase students' motivation and interest in learning. Students will feel more engaged in learning and feel in control of their learning experience. However, using VR in learning also requires a significant investment in technology and software. In addition, using VR also requires strict management and supervision to ensure the safety and effectiveness of the learning experience. Overall, using VR in learning can provide significant benefits to students in terms of unique and compelling learning experiences. However, remember that using VR technology in learning should be integrated with effective teaching methods and tailored to student's needs and abilities.

The main objective of this meta-synthesis is to describe VR learning in Indonesia. In this analysis, questions were developed on the existing use of VR in learning and the application of VR.
Integrating VR with learning methods can give students a more in-depth and interesting learning experience. Some reasons why integrating VR and learning methods is necessary:

Increase the attractiveness of learning: VR can provide students with a more immersive and interesting learning experience. With VR, students can be more involved in the learning material and feel a more realistic sensation.

Improve comprehension and retention of material: By providing a more interactive and realistic experience, VR can help students understand learning materials better and improve information retention.

Overcoming accessibility limitations: VR can also help overcome accessibility limitations, such as geographical distance or physical limitations. Using VR, students can experience the same learning experience without being in the same physical location.

Facilitate collaborative learning: VR can also facilitate collaborative learning, where students can interact with each other in a virtual space. This can increase students' engagement in learning and improve their ability to work in teams.

To achieve these benefits, VR must be integrated with appropriate learning methods. This can involve proper learning design, adequate teacher training, and evaluation of the effectiveness of using VR in the learning context.

## METHOD

This research was conducted in

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the form of a literature study. A literature study aims to review scientific publications conducted in a particular field or subject [21]. This study investigates the use of VR in teaching, including the VR method and its learning application.

In the literature study, the database used comes from Garuda (Garuda Rujukan Digital), published by The Ministry of Education, Culture, Research, and Technology. The articles obtained were also ranked based on Sinta (Science and Technology Index) [22]. To identify potential research, articles published from 2012 to 2022 were searched.

Literature studies were investigated based on the criteria: (1) location, (2) subject, (3) VR utilization, (4) VR creation method, and (5) results obtained. The researcher used the keyword "virtual reality" in the search engine on Garuda's website.

## RESULTS AND DISCUSSION

All literature study articles were taken from the Garuda database. The articles used specifically talk about VR in learning. Both articles come from primary research and secondary research. The selection of articles is shown in Image 2.

### Types of Publications and Their Distribution

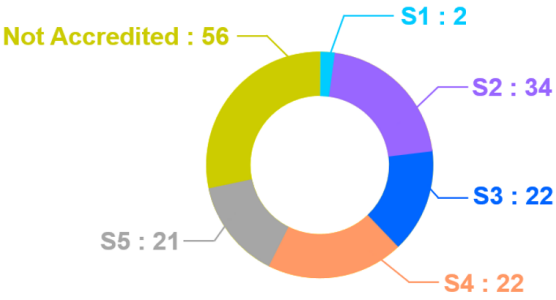


Image 1. Sinta Level

Image 1 shows the distribution of publications based on Sinta rankings. The data is from 2012 to 2022, as shown in Image 3. Of the 157 articles identified, 74.52% have been indexed by Sinta. The existing articles show that 22.93% of the articles have been accredited in Sinta 1 and Sinta 2. From the distribution of research implementation, it is known that

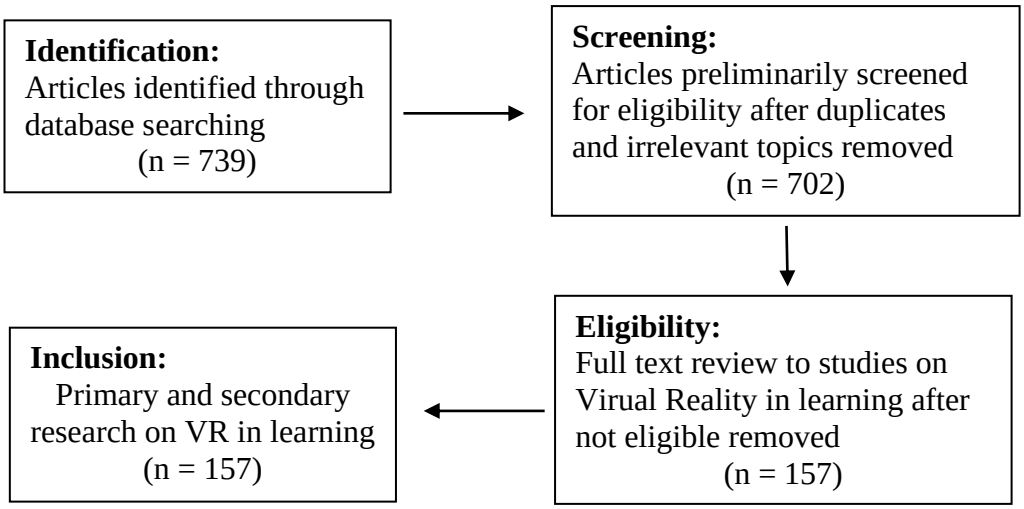


Image 2. Prisma Flow Diagram VR in Learning

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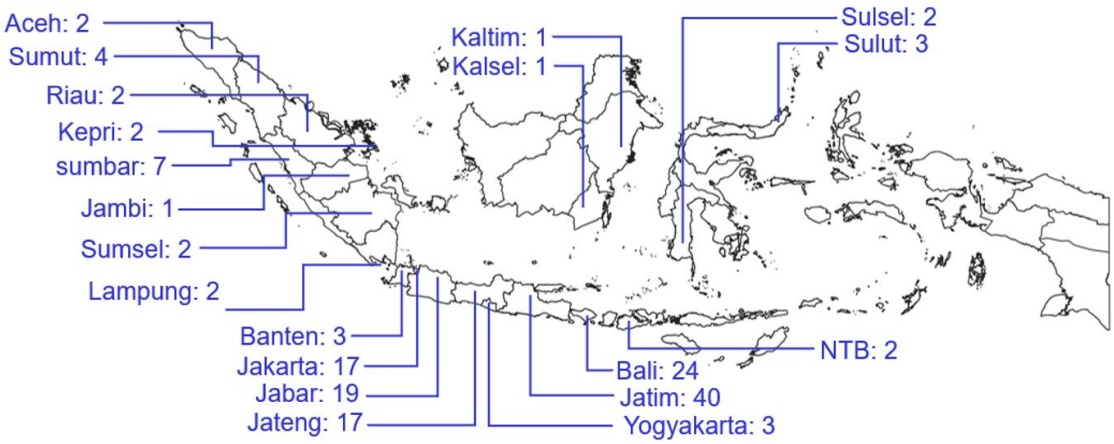


Image 3. Number of Studies by Province

research is predominantly carried out in the province of East Java. The rest of the research implementation is on Sumatra, Java, and the Bali islands. However, there are articles theoretically conducted by authors from outside Indonesia. For more detail, the distribution of research

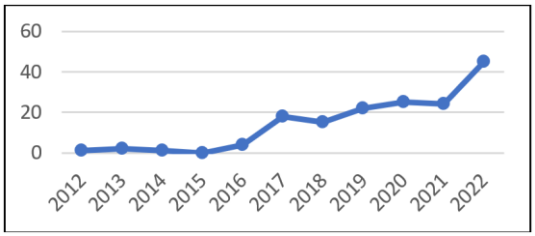


Image 4. Frequency of Studies Regarding Their Time-Period of Publication

implementation is in Image 3 and Image 4.

**Genre VR**

Virtual Reality is a technology that allows users to feel and experience realistic and immersive artificial environments. There are several methods in making VR, namely Photogrammetry, 3D Modeling, 360-Degree Video, Game Engine, and Augmented Reality. In the literature study obtained data that as much as 43% of VR manufacturing uses the 3D Modeling method.

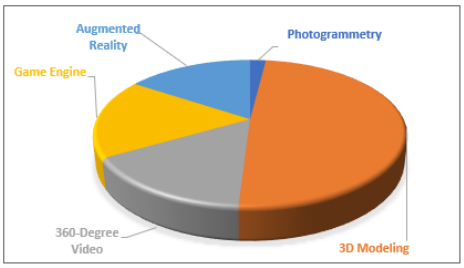


Image 5. Distribution of Reviewed Studies by Genres

**Photogrammetry**

Image 6. Interface in VR Environment [23]

This method involves taking photographs of the environment from several different viewpoints using a specialized camera, then stitching and processing the photo-

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graphs into a 3D model that can be used in a VR environment. Uses Photogrammetry technology to create 3D models of physical objects, such as trees, buildings, and roads. These 3D models are then used as learning media in classroom teaching. The results showed that using Photogrammetry in learning can improve students' understanding of basic mapping concepts. [23]

**3D Modelling**

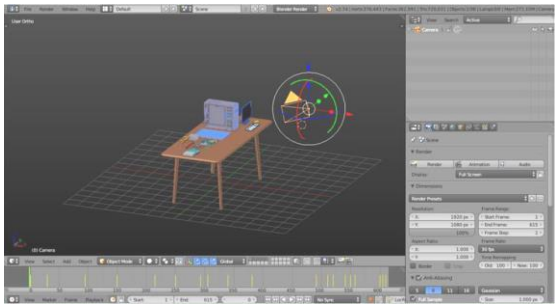

Image 7. Environment Effect Animasi 3D [5]

This method involves manually creating 3D models of the environment using modelling software such as Blender, Maya, or 3DS Max. The modelling process can take a long time and requires expertise in 3D graphic design. The development of Virtual Reality (VR) with 3D methods in Indonesia has increased in recent years. VR is a technology that allows users to experience a simulated environment virtually by using a VR headset. The 3D method is a technology used to create three-dimensional models that can be used in VR environments. In Indonesia, the use of 3D modelling technology in education is still fairly limited and uneven. However, some schools and colleges have introduced the use of 3D modelling in their curriculum to enrich students' learning experiences.

There are three important things that must be considered in the development of 3D modelling, namely: (1) the cost of operating VR technology, (2) Accessibility that makes it easy for teachers and respondents to access the technology, (3) Setting up a virtual environment to create an effective learning experience for respondents [24]. The use of 3D Glassed VR is able to provide satisfaction to users by 93.59% [25].

**360-Degree Video**

Image 8. Gyroscope Sensor

This method involves capturing video from a 360-degree viewpoint using a specialized camera. The video is then processed and customized for use in a VR environment. The sensor that detects a device's rotation or spins based on motion is the gyroscope sensor. *Accelerometer* is a device that works with the gyroscope sensor for features such as tilting or rotating the phone. This tool can provide orientation information with more precision on mobile phones up to 360-degree rotation [26]. The integration of gamification in Virtual Reality (VR) needs to be adjusted regarding equipment, design, and implementation [27]. The recommended method to use is Walkthrough VR. Although with limited visualization, it can explore the entire

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building object. Clients or audiences who see can better understand the design made [28].

**Game Engine**

This method involves creating a VR environment using a game engine such as Unity or Unreal Engine. The game engine has features to create a 3D environment and optimize the performance of the VR environment. The implementation of VR in educational media using Game Engine is considered very suitable, with a value of 92.2% based on the results of field tests [29]. Virtual reality applications can be used as a learning media for elementary school building spaces and increase student interest, motivation and learning outcomes by 24.73% [30].

**Augmented Reality (AR)**

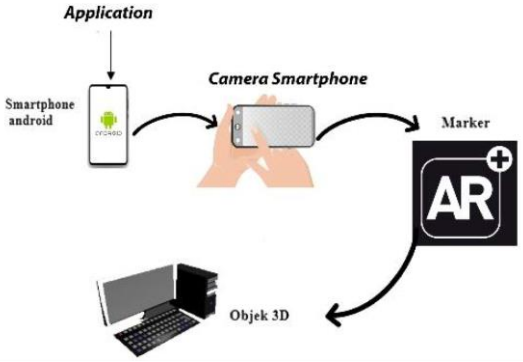


Image 9. Augment Reality Work Diagram [6]

This method involves merging the natural and virtual worlds using technologies such as marker-based AR or markerless AR. This method allows users to experience VR and natural environments. AR is considered very practical to improve the quality of learning by 88.57% [31]. Using RPG Maker MV, converted into an android application, can also increase student motivation [32]. Utilizing molecular geometry learning media based on Mobile Virtual Reality (MVR) is effective because it can improve students' visuospatial skills and help comprehensively represent molecular geometry submaterial [32]. Technological literacy with augmented reality (AR) applications applied in performing arts potentially impacts the future of literacy [33].

## CONCLUSION

The results of the literature study obtained data that 157 articles discuss the use of VR in learning from 2012 - 2022, in the majority of VR development using the 3D Modeling method, as much as 43%. Overall, VR in learning provides positive results that can improve learning outcomes. Three essential things must be considered in the development of VR, namely: (1) The cost of operating VR technology, (2) Accessibility that makes it easy for teachers and respondents to access the technology, (3) Setting up a virtual environment to create a practical learning experience for respondents.

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