



Virtual Reality as a Potential Development in Information Technology Education Media: Evolution with R Studio

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Abstract

The purpose of utilizing Virtual Reality (VR) technology as a potential development in information technology education media is to encourage continuous innovation among students in creating learning support tools to facilitate interactive teaching and learning activities. VR-based learning media serves as an alternative solution to provide a new and engaging learning experience for students. VR presents captivating videos or images with adjustable durations. This article adopts a literature study approach by gathering various sources and information through bibliometric analysis, followed by documentation and reflection-based analysis conducted using R Studio. The use of VR promotes innovation in learning media that differs from traditional methods, enhancing student participation, critical thinking perspectives, and familiarizing students with VR technology. The appropriate technological characteristics, such as Virtual Reality (VR) media, can be effectively implemented in the teaching and learning process within the current Merdeka Curriculum, aiming to attract students' interest and simulate an in-class learning experience similar to offline (face-to-face) education.



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INTRODUCTION

Effective learning media are essential as an intermediary for message delivery, minimizing failures in the communication process. Learning is the process of transmitting messages or materials from the sender to the receiver. The transformation of messages or materials into verbal or non-verbal communication symbols is known as encoding. The interpretation of these communication symbols by students is called decoding. In this process, message transmission may sometimes be successful, but at times, it may fail. Such failures in communication are referred to as noise or barriers. Learning media are crucial for lecturers in assisting with material delivery during the learning process.

The adaptation of digital devices to classroom learning conditions requires the introduction of new methods in teaching so that students regain enthusiasm and develop a passion for learning. This is expected to foster higher consistency in learning compared to previous approaches. Therefore, an urgent need arises for innovative and engaging learning media that enhance the teaching-learning process. One of the solutions is technology-based learning media, particularly Virtual Reality (VR). VR creates immersive simulations that allow users to interact while feeling as if they are within the virtual environment.

Virtual Reality (VR) technology enables the visualization of educational content in three-dimensional (3D) media, creating a more realistic representation of learning materials through computer-generated graphics. With the support of essential components, VR provides an experience where students feel as if they are

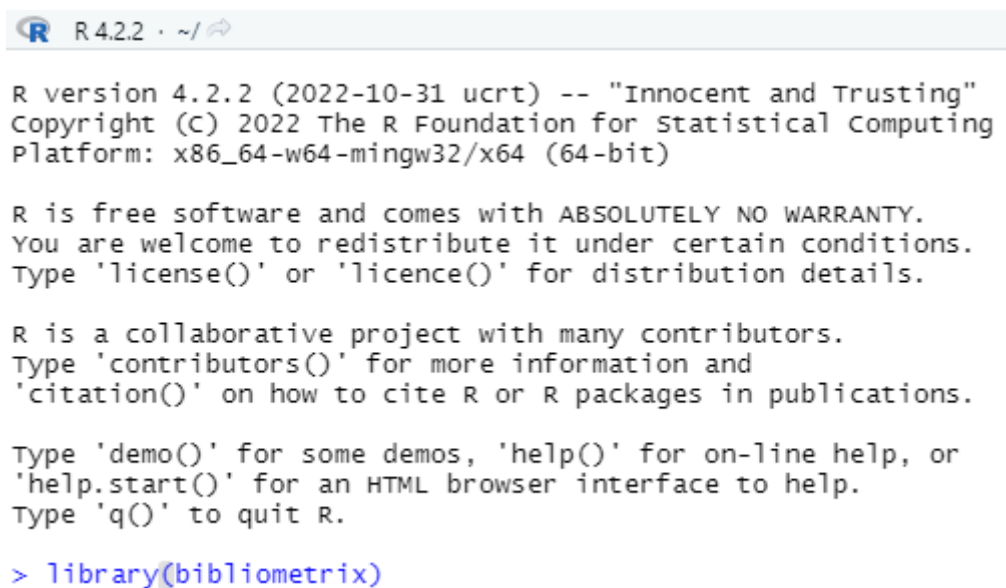
physically present in a pre-determined environment. This technology facilitates easier interaction in the learning process, aligning with advancements in smartphone technology, which plays a crucial role in the implementation of VR-based learning media. Today, VR can be accessed with just a smartphone and a Google Cardboard headset, allowing users to experience a virtual environment effectively.

The primary objective of this study is to analyze the evolution of VR over time using R Studio, encouraging students to innovate in developing learning tools that foster interactive teaching and learning experiences..

METHOD

The research method used in this article is a literature study, gathering various sources and information through bibliometric analysis, followed by documentation and reflection analysis conducted using R Studio. Biblioshiny is employed to track the evolution of VR over time, leading to new scientific discoveries in this study. The literature review process consists of five steps:

1. Citing bibliometric articles from Scopus using a 2013–2023 database,
2. Inputting the data into Biblioshiny,
3. Analyzing VR evolution using R Studio,
4. Conducting analysis according to research objectives, and
5. Interpreting the collected data.



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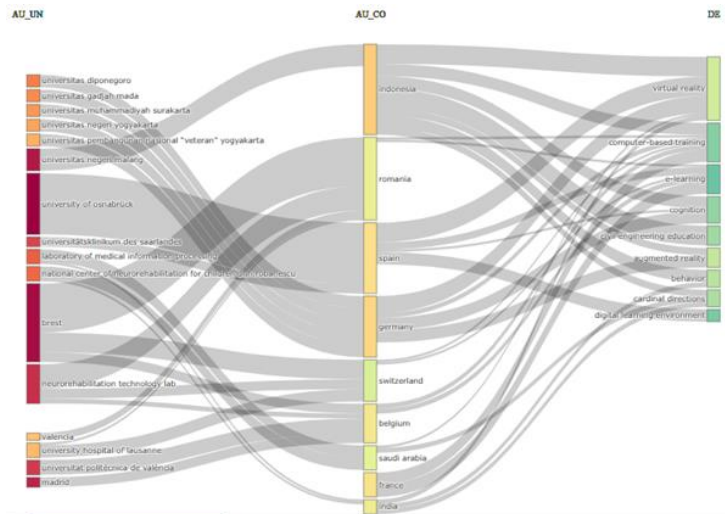
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Figuri 1. Coding R studio for bibliometix

RESULTS AND DISCUSSION

In the Three-Field Plot, the left section represents universities that have conducted research on VR in the last 10 years, while the right section illustrates the order of keywords used as the grand theory of research conducted by countries, with the middle section linking the two. By setting keywords, the number of studies, and the year of publication, 20 top research results were obtained. Currently, Universitas Negeri Malang

stands out as an institution that consistently conducts research on the development of VR-based learning media.



Gambar 2. Three Plot University, Country, dan Keyword

The use and development of learning media based on visual, audio, and multimedia technologies, including Virtual Reality (VR) and Augmented Reality (AR), continue to be explored by experts and researchers. These efforts aim to create an effective and efficient learning process in Indonesia, emphasizing student engagement and better learning outcomes. VR is a significant component of multimedia computing and is emerging as a key trend in the future of teaching and learning. It also serves as a new educational technology strategy for studying appropriate technological systems to be used in the teaching-learning process.

From a global perspective, the top 10 VR-based research publications are led by the University of Osnabrück, while Indonesia ranks among the top 3, with Universitas Negeri Malang contributing three research articles, as shown in Table 1. The integration of mobile applications into VR-based learning reflects the rapid technological evolution in Indonesia, as highlighted by We Are Social Indonesia. VR is gaining prominence as a core computing technology that is expected to transform future teaching methodologies.

Table 1. Number of VR Research Articles Published by Country

Affiliation	Articles
UNIVERSITY OF OSNABRÜCK	5
BREST	4
UNIVERSITAS NEGERI MALANG	3
MADRID	2
NEUROREHABILITATION TECHNOLOGY LAB	2
UNIVERSITAT POLITÈCNICA DE VALÈNCIA	2
UNIVERSITÄTSKLINIKUM DES SAARLANDES	2
CHITKARA UNIVERSITY INSTITUTE OF ENGINEERING AND TECHNOLOGY	1
ISLAMIC UNIVERSITY OF MADINAH	1
LABORATORY OF MEDICAL INFORMATION PROCESSING	1

Countries that actively research VR globally are mapped using R Studio’s bibliometric analysis, showing the evolution of VR research worldwide.

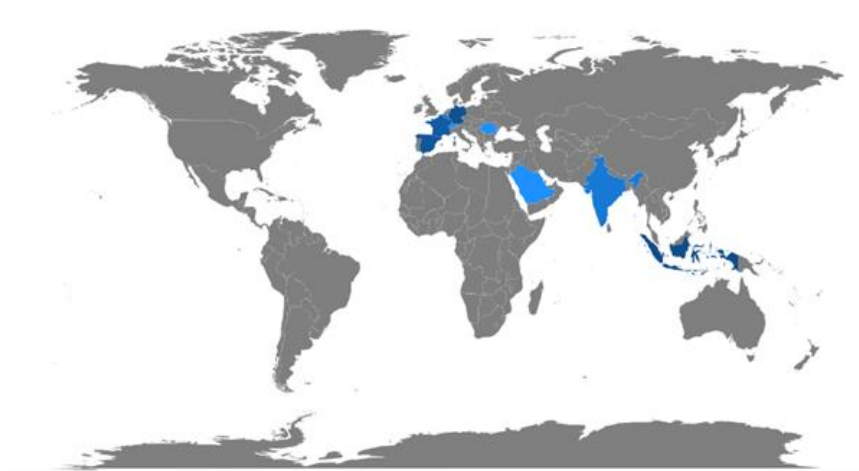


Figure 3. Evolution of VR Research Worldwide

Essentially, Virtual Reality (VR) technology significantly helps humans experience a realistic sense of presence in a virtual environment with full immersion, making it easier to identify and interact with various objects in a clear and lifelike manner. The information presented through VR is not only more extensive but also highly interactive for users, such as students, compared to traditional technologies. The flexibility of virtual world design in VR content makes it an advantageous feature for application in the education sector. Various environments, such as buildings, classrooms, laboratories, and offices, can be realistically visualized in VR, creating an engaging educational experience. This innovation aims to attract students' interest and provide a classroom-like atmosphere even during online learning sessions. Currently, Indonesia ranks among the leading countries in VR research, with a total of 8 publications, indicating a high frequency of studies in this field

region	Freq
INDONESIA	8
GERMANY	7
SPAIN	6
FRANCE	5
BELGIUM	2
INDIA	2
ROMANIA	1
SAUDI ARABIA	1
SWITZERLAND	1

The teaching and learning process in online education often relies on PowerPoint, Word, and PDF as learning media. In the Virtual Reality (VR) environment, these materials can also be integrated, enhancing the visualization effect in online learning systems.

Another notable feature that can be applied to the VR environment is holographic technology. Holographic displays utilize coherent light wave differences to create three-dimensional (3D) projections, making objects appear realistic. This feature is highly eye-catching, as holograms are rarely used in digital education.

Various learning materials that can be implemented using holograms include:

1. Human skeletal models,
2. Chemical reaction processes,
3. Signal convolution analysis,
4. Cellular structure representation, and more.

VR-Based Learning Environment Development

The visualization process in VR learning environments can be customized by developers following these key steps:

1. Classroom Sketching & 3D Modeling: Initial classroom sketches are transformed into 3D models using 3Ds Max, producing an FBX file format.
2. Integration with Unity Engine: The FBX file is then imported into Unity Engine, allowing objects to be added to the VR environment using Google Cardboard SDK.
3. Content Management via JSON Files: Information content is structured using JSON files, enabling dynamic content management through a web-based platform.

Beyond Education: VR Applications in Various Industries

Apart from education, Virtual Reality (VR) is now widely used in various industries, including:

1. Product Design: VR enables realistic product visualization before mass production.
2. Architecture: The construction industry uses VR to assess building designs before physical construction begins.
3. Psychological Counseling: VR is used to support therapy sessions and analyze human interactions with nature and society.

Future factorial analysis in VR research could explore human factors, social media integration, controlled studies, quality of life improvements, and user experience analysis..



Figure 4. Factorial Analysis of VR Research Development

Virtual Reality (VR)-Based Learning Media has consistently received highly positive responses and enthusiasm from students when implemented in real-world learning environments. Compared to traditional learning media, VR-based education offers a more engaging, immersive, and interactive experience, making it a preferred alternative for modern teaching and learning methods.



Figure 5. UMPR Student Satisfaction Test with VR Learning Media

If the learning process can be carried out in a contextual manner, incorporating elements such as related, easy, applying, lesson, interesting, transferring, and actual, then the teaching and learning process becomes a communication-driven activity facilitated through learning media. This occurs when there is effective interaction between the stimulus (educator) and the response (students) through a learning platform. The communication process is complete when feedback is received from students. Therefore, many experts define learning media as a vehicle for delivering essential messages or information to students, particularly in higher education.

CONCLUSION

Based on the research objectives, the findings reveal that the evolution of VR technology over time, analyzed using R Studio, positions Indonesia among the top 10 countries worldwide conducting continuous research on Virtual Reality (VR). One key opportunity identified is for Universitas Muhammadiyah to expand its VR-based learning media research in Central Kalimantan, allowing students to innovate by developing learning support tools that enhance interactive teaching and learning through Human-Computer Interaction (HCI) courses and thesis research on Virtual Reality. This approach is expected to not only increase research citations for the university but also equip students with essential digital skills relevant to the evolving digital world.

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