Stepping Into the Future of Vocational Education: Exploring the Role of Virtual Reality Technology

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Abstract. Virtual reality (VR) technology and applications are developing very quickly. This can be seen in various technology products and VR technology support products on the market. Similarly, applications that use and absorb VR technology are increasingly used in various fields. However, the utilization of VR technology in the field and environment of vocational education is still lacking, even though VR technology should assist students in increasing their understanding and skills of the material being studied. This happens because of the limitations of the technology owned, the understanding of VR technology, and the benefits of VR technology itself. This paper will focus on reviewing and providing an overview of VR applications in the field of vocational education and providing an overview of factors that need to be considered and carried out in the use environment, such as technology that must be prepared, system interaction, and effectiveness, ease and constraints of use in order to obtain ideal conditions contained in the three elements of the subject of VR technology use activities which include the organizer side, VR material sources, and students. The paper references national and international articles published between 2017 and 2022. The final result of this research is to get a perfect picture of and positive impact of using VR technology in vocational education.

Keywords: Virtual Reality · Vocational Education · Learning Environment · Learner Knowledge

1 Introduction

Virtual technology utilizes multimedia and human-computer interaction to create an interactive, simulated environment that can feel realistic to users. Users can use the necessary devices to communicate with objects and people in this virtual world. By

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breaking the boundaries of physical space, virtual reality technology enables users to connect with distant objects and individuals via computer simulation [1]. Compared to older simulation technologies, virtual reality has three key features: fusion, imagination, and interactivity. In education and training, these features are essential. Fusion refers to the extent to which users feel immersed in the virtual environment, while imagination refers to the ability to acquire new knowledge through multi-dimensional perception. Together, these features can transform users' understanding of the world around them [2].

Interactivity refers to communication between a user and a computer, specifically in a virtual environment. Virtual reality technology can create three distinct types of virtual environments, each providing a unique experience for users. These include immersive, simple, and shared environments. An immersive environment is designed to fully engage users, creating a self-learning environment where they can become immersed entirely [3]. A simple environment, on the other hand, may not provide the same level of realism but still offers valuable learning experiences. A shared environment is one where many users can connect and communicate virtually, making it useful for various virtual communication purposes.

It is worth noting that the development of virtual technology has revolutionized various industries, from gaming and entertainment to healthcare and education [4]. Virtual reality technology has allowed medical professionals to simulate surgeries and other medical procedures, providing a safe and controlled environment for training and research. Virtual education has opened up new possibilities for immersive learning experiences, allowing students to explore different environments and scenarios that would be difficult or impossible to replicate in real life. As virtual technology continues to evolve, it has the potential to transform the way we live, work, and learn [5].

Vocational education is education that is oriented towards specific skills and expertise and can be ready to work. Vocational education is a flexible education model that must align with real challenges in the world of work, such as the emergence of the Industrial Revolution 4.0. The Industrial Revolution 4.0 is a transformation effort to increase efficiency in each value chain by integrating digital capabilities and industrial production lines that refer to increased automation, machine-to-machine communication, human-to-machine, artificial intelligence, and sustainable technology development.

This challenge is inevitable and must be faced by preparing ourselves as much as possible. In line with this, vocational education builds eight competencies for its graduates [6], namely: (1) Communication Skills; (2) Critical and Creative Thinking; (3) Information/Digital Literacy; (4) Inquiry/Reasoning Skills, (5) Interpersonal Skills, (6) Multicultural/Multilingual Literacy; (7) Problem-Solving; (8) Technological Skills. The Industrial Revolution 4.0 is characterized by digitalization in various fields, so initially, humans, the center of the economy, have now begun to be replaced by digital technology [7, 8]. Similarly, vocational education is transforming and adjusting to the digital era. This transformation can be seen from the learning process that has utilized digital technology, which impacts the efficiency and increased absorption of the learning presented.

In the era of the Industrial Revolution 4.0, virtual reality technology is implemented in educating the learning process; this is a solution for teachers and students as a learning

medium. The use of VR technology in learning can encourage students to understand the material, think positively, and generate positive emotions from students. VR technology duplicates the natural world and is combined with a computer system that involves reactions from the five human senses [9, 10]. Some things that focus on using VR Technology are (1) to increase curiosity and enthusiasm for learning; (2). to encourage students to think critically and creatively; (3). the teacher will be easier to deliver learning materials [3]. In vocational education, several subject matters need to be simulated, one of which is computer assembly; in this situation, virtual reality (VR) can be used to improve student focus, attract student attention, and reduce simulation costs.

However, in planning the use of Virtual Reality applications, it is necessary to consider various things related to the problem: (1) On the organizer side, does the organizer have the readiness of technology, teachers, and socialization according to standards; (2) On the application side, whether the VR application used has the visual material needed, interactive and easy to use. (3) On the learner side, does the learning process become more attractive, imaginative, and quality.

2 Methods

The research technique used in writing this paper is a literature study. A literature study is a research method that examines and analyses documents and other relevant written sources that support the research question or topic [11, 12]. In this case, the literature study builds an ideal concept about what must be prepared to apply virtual reality technology to vocational education, especially in Indonesia. The literature sources used in this study include journals, research reports, relevant books, scientific articles, and other written materials that provide insights into the use of virtual reality technology in vocational education. The author collected and reviewed various literature sources to gain a comprehensive understanding of the current state of virtual reality technology and its applications in vocational education.

After collecting and reviewing the literature sources, the author summarized and analyzed the crucial points related to the application of virtual reality technology in vocational education. The author synthesized the critical findings from the literature to develop an ideal concept of what must be prepared to apply virtual reality technology in vocational education, particularly in Indonesia. The literature study is an effective research method for building an ideal concept because it provides a strong foundation for the research process. It allows the researcher to understand the research topic comprehensively and helps identify the gaps in the existing literature that need to be addressed [13, 14]. By analyzing and synthesizing the literature, the researcher can develop a well-supported concept that can guide further research and practical applications.

3 Result and Discussion

VR is one of the impacts of the Industrial Revolution 4.0 that can be used as a learning media in vocational education. VR has several remarkable capabilities, including constructivism-based learning components, which can help students with impairments, and the instructor's function as an educational facilitator. In many studies, VR will always

be associated with feasibility as a learning medium and students' impact on learning. The author divides three ideal conditions that must exist in VR-based learning.

3.1 On The Education Organizer Side

Implementing VR technology-based vocational education is one of the solutions to creating skilled and relevant graduates. This can be understood because, with VR technology, students can manipulate the interaction process of a skill without having to come into direct contact with the actual skill. Although it is expensive to procure and maintain, VR technology will still be considered. The following are the ideal conditions in an institution that organizes vocational education. VR technology-based vocational education can create skilled and relevant graduates [15]. VR technology enables students to manipulate and practice the interaction process of a skill without having to come into direct contact with the actual skill, making it a valuable tool for vocational education.

3.1.1 Infrastructure

Infrastructure will be the main thing and must exist in VR-based vocational education learning, among others:

3.1.1.1. Hardware and Software

The hardware required to use VR will depend on what model of VR is used: (1) non-Immersive: the devices used can be navigated through cell phones and regular PCs. (2) Semi-Immersive: devices used mouse, keyboard, glasses, joystick, headset, and 3D screen. (3) Immersive VR: Headsets, motion detection hand controls, and other devices worn during the learning process will provide real sensations and experiences, such as haptic gloves, full-body haptic suits, trackers, and omnidirectional treadmills. As for the software, it will be adjusted to the VR application needed.

3.1.1.2. Interaction Room

Interaction rooms that support VR activities are also needed to maximize the experience of the VR technology-based learning process. In VR-based learning, interaction rooms can be used for various purposes, such as simulations, games, and virtual field trips. For example, students can use VR headsets to explore historical sites, practice complex tasks in a safe environment, or participate in collaborative learning activities with peers from different locations. Interaction rooms can also help address some challenges associated with VR-based learning, such as motion sickness, disorientation, and limited physical space [16]. By providing learners with a dedicated space to interact with virtual environments, they can have a more comfortable and enjoyable experience, enhancing their motivation and engagement.

3.1.1.3. Instructor

Teachers with standardized knowledge of VR and related skills are essential in the learning assistance process. Teachers with a consistent and uniform understanding of VR technology and related skills are crucial in helping students learn using VR technology. These teachers possess standardized knowledge and skills that enable them to integrate VR technology effectively into the learning process and support students in using it [17]. Having standardized knowledge means that teachers have a shared understanding of the concepts and principles related to VR technology and how it can be used in education.

They are familiar with the best practices, tools, and strategies for creating practical VR-based learning experiences and can apply this knowledge to design and deliver quality instruction.

3.2 VR Application Side

The idea and theme of VR applications will determine how interesting VR applications are built; developers must be able to develop VR learning systems with system concepts that can create authentic experiences for students. The problem is that many developers have difficulty transferring traditional instructional learning systems to VR learning spaces. Several things can be considered to produce engaging, fun VR learning systems and, most importantly, increase students' understanding.

3.2.1 Concept-Oriented VR Learning

The basic idea is to provide conceptual orientation to learners about what it is like to have certain conditions so that learners can better understand the implications of these conditions, for example, a VR learning system for virus researchers, where learners can explore the parts of the virus, mutations that may occur and the impact that occurs if the virus attacks humans so that the concept of viruses and humans can be connected in learners' minds to understand it properly and correctly.

3.2.2 VR Learning for Critical Situations

If practiced in the real world, the basic idea is that learners are confronted with unexpected or dangerous events, such as VR applications for fire safety. This design attracts attention because it will present learners with a relevant and realistic environment so that learners have to think and react quickly as in an actual situation.

3.2.3 VR Learning for Operational Activities

The basic idea is interaction and manipulation of objects to gain proficiency in function and performance, for example, VR applications for irrigation settings where learners can be in the irrigation setting room and can also be in other locations related to the source or purpose of the irrigation itself. So that learners can see the consequences of the settings, whether the irrigation settings are correct or even make a location short or excess water.

3.3 Learners Side

To thoroughly understand VR-based learning, students must have an environment supporting their learning process. This environment should focus on several key aspects, such as socialization of VR technology, learning comfort, avoiding health problems due to the learning process (such as motion sickness), ease of understanding learning content, and the ability to extract detailed information on the material studied. Students must be introduced to the technology and its features before using it for learning purposes. This

socialization process can take the form of workshops, orientation sessions, or tutorials, where students can learn how to navigate the VR environment, interact with objects and avatars, and use the available tools effectively.

The learning environment must be comfortable and conducive to learning. This can include appropriate lighting, sound quality, temperature, and ergonomic design [18]. VR headsets can also cause discomfort, so it is essential to ensure that students take regular breaks and are provided with comfortable seating arrangements. The risk of motion sickness is a significant concern when using VR technology, especially for extended periods. To avoid this, the learning environment should be designed to minimize rapid movements, ensure a stable frame rate, and avoid intense visual stimuli. The learning content must be presented in a way that is easy to understand and engaging. This can include using interactive elements, gamification, and immersive simulations to enhance the learning experience [19].

4 Conclusion

Vocational education is oriented towards expertise and expertise that is unique and can be ready to work. Advances in VR technology will be very relevant in vocational education to increase students' absorption and understanding of the material. However, the use of VR technology in vocational education must be accompanied by preparations involving three elements of the learning process activities: organizers, VR applications, and students. The results of previous research show that the feasibility of material testing and media testing as well as evaluating interest and increasing knowledge of the use of VR technology in the learning process, will depend on each element's synergy and reasonable standards to produce an ideal learning process.

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