Learning Transformation in the Digital Era: Development of Virtual Reality-Based Learning Media to Increase Student Efficiency and Creativity

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Article Info	ABSTRACT

During the COVID-19 pandemic, its impact was felt in Indonesia's education world, especially when learning was online or offline. Every lecturer in educational institutions is expected to provide the latest innovations to create an effective learning process. In the post-COVID-19 pandemic era, the digitalization of education in Indonesia is experiencing rapid growth, and advances in information technology are an opportunity to increase creativity in learning media. One proposed method is the development of Virtual Reality-based learning media, which can support the quality of the teaching and learning process. The development of Virtual Reality-based learning media includes intelligent systems for the Informatics Engineering Study Program, and Agro-Industry Plantation Management for the Agro-Industry Management Study Program, especially at Campus 4 PSDKU Sidoarjo – Politeknik Negeri Jember. The results of the development of Virtual Reality-based learning media are in the form of visualization illustrations of students' understanding of the Intelligent Systems and Plantation Agro-Industry Management courses. This technology is expected to facilitate student participation with learning resources more efficiently than conventional learning media which only allows one-way communication. Based on the results of evaluations via questionnaires to students, it is known that learning efficiency reaches 82% when using Virtual Reality-based learning media.

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1. INTRODUCTION

Over time, the educational paradigm has undergone a significant change from a traditional approach to a more inclusive and interactive approach. Education no longer focuses solely on providing information, but places more emphasis on developing skills, understanding concepts, and applying knowledge in real contexts. Rapid developments in technology, especially the internet and digital devices, encourage the integration of technology in education to create more interesting and relevant learning [1]. The need for flexible education, especially in the context of the COVID-19 pandemic, encourages the adoption of interactive learning media as a solution to support distance learning [2]. In addition, this media is designed to increase student involvement by presenting information through images, sound and interactivity, thereby forming students who are ready to face the demands of the ever-changing world of work [3]. Thus, interactive learning media plays a crucial role in preparing the younger generation to face the educational challenges of the 21st century [4].

Learning media is one of the most important components in the teaching and learning process. Without learning media, the teaching and learning process tends to be stiff and boring. The need for creative, interactive

and innovative learning media is very important because the characteristics of students today are very different compared to previous generations. In institutions, every lecturer is required to provide the latest innovations to create an effective learning process. Lecturers in this digital era must utilize available technology to assist teaching both inside and outside the classroom [5]. However, in the process of developing interactive learning, a number of problems are faced. One of them is limited technological infrastructure or infrastructure. One innovation that is increasingly emerging in the world of education is the use of Virtual Reality (VR) and Augmented Reality (AR) technology to create deep and immersive learning experiences.

In this research, we use Virtual Reality (VR) technology as a learning medium because Virtual Reality can create a digital environment that is completely separate from the real world. Interactive learning based on Virtual Reality (VR) presents a new paradigm in education by presenting an immersive and realistic learning experience. VR technology allows students to engage in immersive three-dimensional learning environments, enhancing understanding of concepts in ways that are difficult to achieve through conventional methods. This can help students to increase their skills and knowledge without having to actually do it. Apart from that, this Virtual Reality learning media can also be applied to various courses or lessons so that it can increase student involvement, increase understanding of abstract concepts, and provide a motivating learning experience. With Virtual Reality, complex and boring courses will be more interesting and imaginative and create a more dynamic learning experience, compared to just listening to the teacher lecture. Interactive learning with VR encourages creativity and motivation to learn [6][7].

Several studies that have been carried out in the field of interactive learning based on Virtual Reality (VR) show promising results. These studies emphasize the use of VR technology to increase student engagement and understanding in a variety of subjects. The results show that the use of VR can enrich the learning experience by presenting content in three dimensions, creating a realistic learning environment. The application of this technology also has a positive impact on students' learning motivation and creativity. One of the studies that uses Virtual Reality (VR) based learning media is research conducted by [8]. This research focuses on the implementation of VR in learning English subjects. Interactive learning methods using VR are designed to increase understanding of English subject concepts and student engagement. The research results show a significant increase in the academic achievement and learning motivation of students who use VR learning media compared to using conventional methods. In [9] utilized Virtual Reality technology to improve students' writing skills. The use of this technology has been carried out at various levels of education, such as the introduction of interactive teaching methods for thematic learning in elementary school classes [10], early childhood learning [11], and for middle school, high school and college students [12][13][14]. These studies highlight the potential of VR in increasing learning effectiveness. Overall, these studies support the concept that VR has great potential as an innovative tool to improve the learning process at various levels of education.

Therefore, in the research we are conducting, we will create Virtual Reality-based interactive learning media in the learning system at Campus 4 PSDKU Sidoarjo - Jember State Polytechnic, supported by previous research [15][16]. In this case, the courses being developed are Intelligent Systems for the Informatics Engineering Study Program, and Plantation Agro-Industry Management for the Agro-Industry Management Study Program at Campus 4 PSDKU Sidoarjo. The development of Immersive-based learning will provide an illustration of the visualization of students' understanding of the subject. This technology is used to increase students' enthusiasm for learning in the learning process where students can relate to or experience an event in an area operated by a computer (computer-simulated environment), a this area is actually just an imitation or really a zone that only exists in the imagination [17]. Virtual reality can make it easier for students to analyze courses with the help of VR glasses, thereby increasing students' desire to learn.

2. METHODOLOGY

In this research, the focus is on developing Virtual Reality (VR) based learning media which aims to improve the quality of learning at Campus 4 PSDKU Sidoarjo - Jember State Polytechnic. This project focuses on the Informatics Engineering Study Program and the Agro-Industrial Management Study Program. The steps taken in this research involve a series of stages, starting from analyzing learning needs, designing interactive learning content, to implementation using VR technology. It is hoped that this approach will make a positive contribution in increasing student understanding and engagement, paving the way for further developments in improving the quality of learning in these academic environments.

2.1 Learning Needs Analysis

This stage involves identifying learning needs at Campus 4 PSDKU Sidoarjo for the Informatics Engineering Study Program and the Agro-Industrial Management Study Program. By understanding these needs, you will be able to design appropriate and effective content to improve the quality of learning. This learning needs analysis includes an in-depth understanding of learning objectives, student needs, and challenges faced in the learning process in the Informatics Engineering Study Program and the Agro-Industrial

Management Study Program. Thus, the results of developing VR learning media can provide appropriate and relevant solutions to existing learning challenges, as well as enrich student learning experiences through innovative and effective approaches.

2.2 Design and Implementation of Interactive Learning Content

At this stage, interactive learning content based on Virtual Reality (VR) will be designed in accordance with previously identified needs. This step is an important part of the immersive research process for interactive learning media in the fields of informatics engineering and agribusiness management. Through the system design that has been prepared, we aim to create a comprehensive research flow, ensuring the effectiveness and success of implementing interactive learning media in the academic environment.
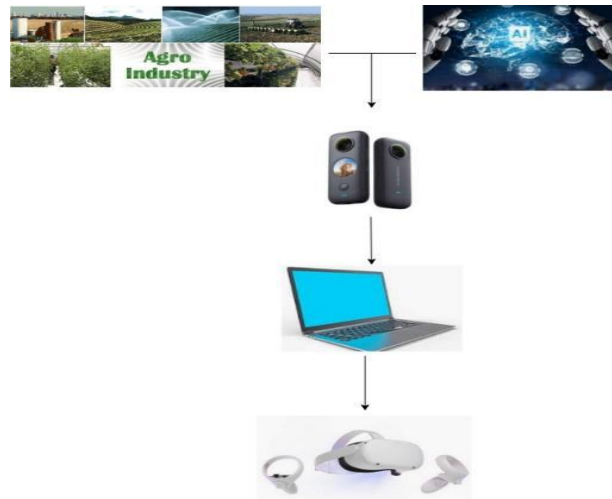

Figure 1. System Design

Figure 1 shows the system design for developing this interactive learning media. The concept is to use a 360 camera to record every detail of the material taught in the Intelligent Systems and Agro-Industry Plantation Management courses. After that, these images will be processed via a computer to become an Android mobile program. The end result of this process will then be integrated into the Oculus Meta device, creating an interactive learning experience that deeply engages users. Thus, this technology provides a new dimension in the development of learning materials, and enables greater interactivity through VR platforms.

Next, the implementation stage involves developing a VR-based application in accordance with the content design that has been previously designed, taking into account the technical specifications that have been set and ensuring conformity between the desired concept and the final result of the VR application being built.

2.3 Workshop Deployment System

At this stage, a Mini Deployment System workshop will be carried out involving stakeholders and students to ensure optimal results in developing learning media. At this stage a user satisfaction survey is carried out. This survey was conducted at PSDKU Sidoarjo with a focus on students who used VR technology in studying the Intelligent Systems and Plantation Agro-Industry Management courses.

2.3.1 Participant
Survey participants consisted of 97 students from the Informatics Engineering Study Program (taking the Intelligent Systems Course) and 17 students from the Agro-Industry Management Study Program (taking the Agro-Industry Plantation Management Course).

2.3.2 Instrument
The instrument used is a questionnaire specifically designed to evaluate user satisfaction with VR-based learning experiences. Questionnaire questions cover aspects such as user interface, resource availability, and level of understanding of the material.

2.3.3 Procedure

The survey was conducted after students attended several VR-based learning sessions. They were asked to fill out a questionnaire anonymously, measuring their satisfaction with this interactive learning media.

2.3.4 Data Analysis

Survey data will be analyzed quantitatively to identify trends and user satisfaction levels. The results of the analysis will be used to evaluate the extent to which the use of VR in learning can meet expectations and improve the quality of student learning experiences.

3. RESULT AND ANALYSIS

3.1 Learning Needs Analysis

The results of the learning needs analysis show the need for innovative and effective learning approaches in the academic environment of Campus 4 Sidoarjo - Jember State Polytechnic. Students need a more in-depth and interactive learning experience to improve their understanding of learning material, especially in courses such as Intelligent Systems and Plantation Agro-Industry Management. It is hoped that the integration of Virtual Reality (VR) technology can provide a solution that meets these needs by creating a more visual, realistic and interesting learning experience for students. Thus, the results of developing VR-based learning media are expected to enrich learning methods, improve the quality of education, and make a positive contribution to student understanding and involvement in the learning process at Campus 4 Sidoarjo - Jember State Polytechnic.

3.2 Design and Implementation of Interactive Learning Content

The development of Virtual Reality (VR) marks a significant innovative step in the field of education, and Campus 4 Sidoarjo - Jember State Polytechnic holds a strong commitment to adopting this technology as an innovative and effective learning medium in their educational environment. In an effort to realize this commitment, various developments in VR technology have been successfully created, opening the door to a more immersive and interactive learning experience on this campus. It is hoped that the integration of VR technology can make a positive contribution in enriching learning methods and improving the quality of education at Jember State Polytechnic Campus 4 Sidoarjo. The following are the results of the development of Virtual Reality that we developed.

Figure 2 shows the VR model world in each frame. The results obtained show significant achievements in interactive learning media based on Virtual Reality (VR), which visually shows the VR model world in each frame. Every detail in the virtual environment is clearly realized, creating an immersive learning experience. Through frame by frame, students can explore and understand concepts in a more visual and realistic way. These results reflect success in creating a rich and detailed representation of the VR model world, supporting the goal of increasing student understanding and engagement through innovative learning approaches.
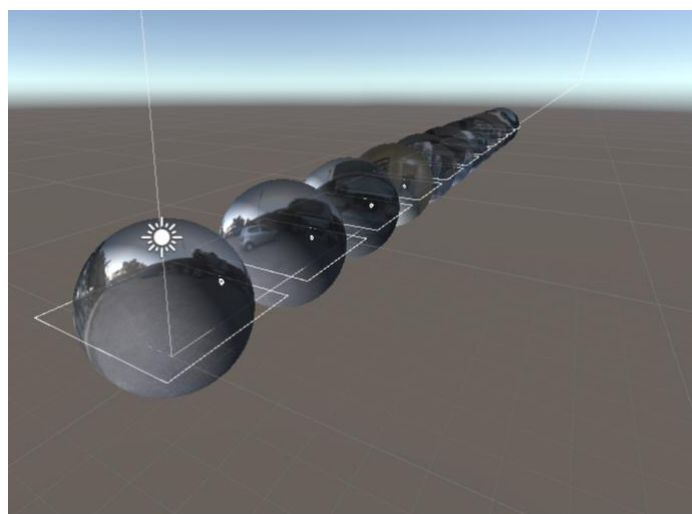

Figure 2. Virtual Reality Model World in Each Frame

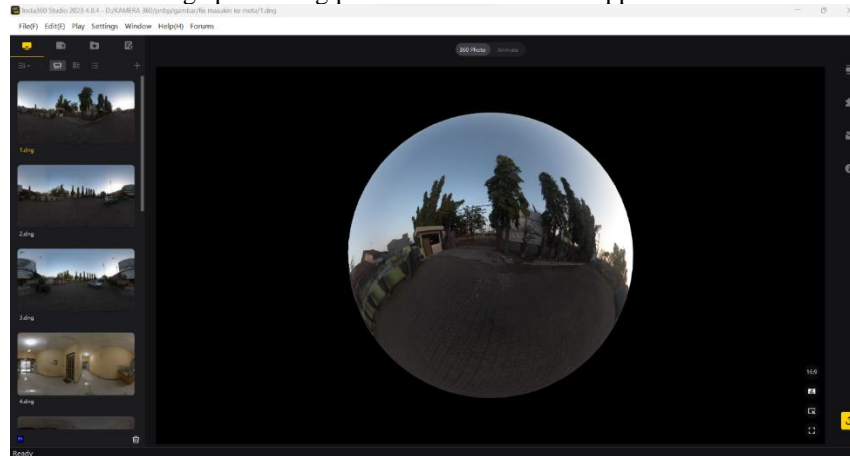In figure 3 below is the image processing process in the Insta 360 application.

Figure 3. Image processing process in the Insta 360 application

Figure 4 shows a view of the classroom used in the learning process at Campus 4 PSDKU Sidoarjo – Politeknik Negeri Jember.

Figure 4. Virtual Reality View in the Classroom

Figure 5 shows the Virtual Reality-based interactive learning process for the Plantation Agro-Industry Management course in the Agro-Industrial Management study program.

Figure 5. Virtual Reality-based Learning for the Agro-Industry Plantation Management Course

Figure 6 shows the Virtual Reality-based interactive learning process for the Intelligent Systems course in the Informatics Engineering study program.
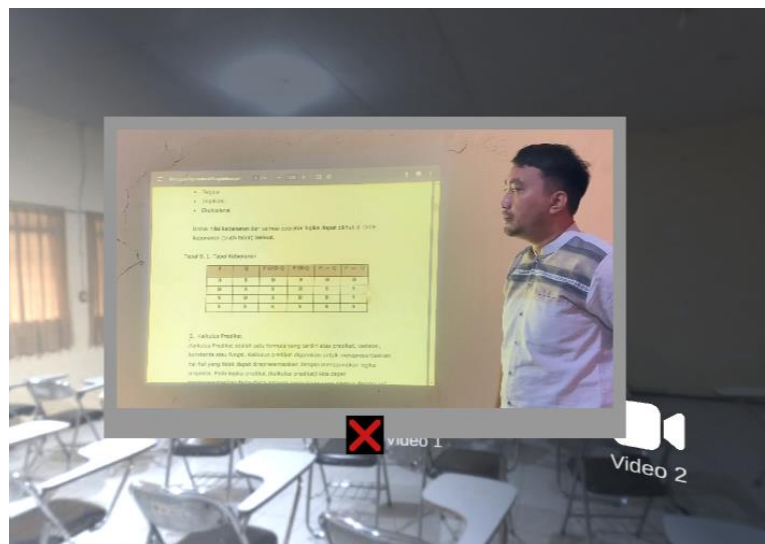

Figure 6. Virtual Reality-based Intelligent Systems Course Learning

The results of the interactive learning process based on Virtual Reality (VR) for the Intelligent Systems and Plantation Agro-Industry Management courses achieved significant achievements. Through the integration of VR technology, students can access virtual worlds that depict course content with a high level of detail. Each element of the learning material, such as intelligent systems and plantation agro-industry management, is presented visually and interactively, creating an in-depth learning experience. Students can explore and interact with the content, increasing their understanding of complex concepts. These results reflect the great potential of VR in providing a new dimension to learning, making a positive contribution to student effectiveness and engagement in the course.

3.3 Workshop Deployment System

The results of the Deployment System Workshop show successful collaboration between stakeholders, lecturers and students in implementing interactive learning media based on Virtual Reality (VR). This workshop provides an opportunity for all parties involved to provide input, discuss challenges, and design effective implementation strategies. This collaboration is an important foundation in ensuring the successful implementation of VR technology in the academic environment. The results of this workshop reflect our commitment to providing innovative and relevant learning approaches for students, as well as making a positive contribution to improving the quality of learning at Jember State Polytechnic Campus 4 Sidoarjo.

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In this research, the results of the development of Virtual Reality (VR)-based learning include visualization illustrations of student understanding in the Intelligent Systems and Plantation Agro-Industry Management courses. The next stage involves a user satisfaction survey, especially students, regarding the use of Virtual Reality-Based Interactive Media for Learning at PSDKU Sidoarjo. Survey results show that this technology is effective in facilitating student participation, outperforming conventional learning media which tends to be one-way. The VR-based learning media developed is able to stimulate students' creativity and significantly increase subject understanding. The evaluation was carried out through questionnaires given to 97 respondents from the Informatics Engineering Study Program with the Intelligent Systems Course, as well as 17 respondents from the Agro-Industry Management Study Program with the Plantation Agro-Industry Management Course. The percentage comparison of the number of respondents from the two study programs is explained in Figure 7. Furthermore, the results of the respondents' level of understanding of courses using VR learning media compared to conventional learning are shown in Figure 8. From the evaluation using a questionnaire, learning efficiency was obtained at 82% when using learning media. Virtual Reality based.
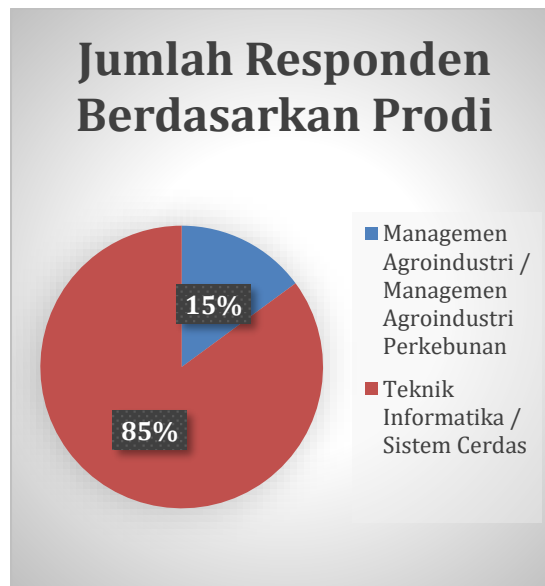

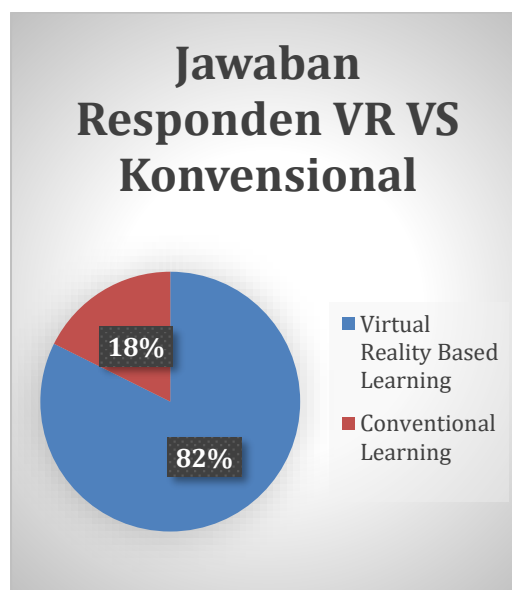
Figure 7. Respondents to Virtual Reality-Based Learning

Figure 8. Results of Virtual Reality-Based Learning Respondents

4. CONCLUSION

In this research, the application of Virtual Reality-Based Interactive Media Applications for Learning at PSDKU Sidoarjo succeeded in proving its effectiveness in increasing student participation compared to conventional learning media. The results of the evaluation involving 97 respondents from the Informatics Engineering Study Program and 17 respondents from the Agro-Industrial Management Study Program showed that Virtual Reality-based learning media was able to increase subject understanding and stimulate student creativity. The evaluation also indicated that learning efficiency reached 82% when using Virtual Reality-based learning media. This confirms that this media not only provides added value in the learning process but also increases students' motivation and enthusiasm for learning.

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