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TEACHING MATERIAL ON METAVERSE FOR MOTION DYNAMICS SUBJECT FOR STUDENTS (MOTION DYNAMIC METAVERSE (MD-VERSE)

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ABSTRACT

The advancement of technology has brought significant impacts to the world of education, opening opportunities for the development of more engaging and innovative learning methods. The utilization of technology, especially in science education such as physics, enables the presentation of material in a visual, interactive, and concrete manner. One of the recent breakthroughs is the concept of Motion Dynamic Metaverse (MD-Verse), which adds a new dimension to physics learning through virtual environments. With its interactive features, MD-Verse provides a dynamic and enjoyable learning experience. This research aims to develop Metaverse Teaching Materials on the topic of dynamics of motion for college students. Validation results indicate that MD-Verse is suitable for use in physics teaching, contributing to enhancing students' understanding and interest in physics concepts.

KEYWORDS *Physics Teaching Materials, Metaverse, Innovative Learning*

INTRODUCTION

The development of technology has had a very significant impact on the world of education, especially in this era of globalization (AlGerafi et al., 2023). The utilization of technology in the context of education has opened up great opportunities to develop traditional learning methods into more interesting, interactive, and innovative ones (Jenita et al., 2023). This allows for the creation of a more dynamic and engaging learning environment for students, which ultimately can enhance their motivation and interest in learning.

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One area where the use of technology has a significant impact is in the complex field of science education (Maulana et al., 2019). Abstract physics concepts are often difficult to understand using conventional learning approaches alone. However, with technology, learning material can be presented in a more visual, interactive, and concrete manner. For example, using computer simulations or virtual reality applications, students can experience complex physics experiments directly, without the need for expensive or bulky physical equipment.

The use of technology can also improve the accessibility of learning materials. With online learning platforms and digital resources, students can access information and learning materials anytime and anywhere (Said, 2023; Tiara et al., 2023). This not only facilitates self-directed learning but also allows for a more personalized learning experience tailored to individual student needs.

Thus, the utilization of technology in education is not just a tool but also a key to enhancing the overall quality of learning (Maghfiroh, 2022). Through innovative, technology-based approaches, it is hoped that science education, especially physics, can become easier to understand and more engaging for students, thereby strengthening their knowledge foundation and improving their ability to comprehend complex concepts.

One recent and interesting development in the use of technology in education is the metaverse technology (Salim et al., 2023). The metaverse is a virtual world consisting of spaces and objects that can be accessed and interacted with by users through their avatars (Roedavan et al., 2023). Metaverse technology adds a new dimension to learning by introducing motion and dynamics into virtual environments (Pustikayasa et al., 2023).

In physics education, metaverse technology is a very useful tool (Laksito & Wibowo, 2022). Students can conduct physics experiments involving the motion of objects in virtual space, such as dynamic motion simulations. They can manipulate variables such as mass, force, and acceleration to see how these changes affect the behavior of objects in the virtual environment. By using metaverse technology, students can observe physics phenomena directly and exploratively, which may not be possible in a physical classroom environment.

Moreover, metaverse technology can also facilitate the learning of complex physics concepts in a more understandable way (Arif & Hayati, 2022). Through dynamic and interactive visualizations, students can explore physics concepts more deeply. They can see and feel how these concepts operate in the virtual environment, which can help clarify their understanding of fundamental physics principles.

Thus, metaverse technology is expected to enhance physics learning by presenting physics concepts in a more visual, interactive, and enjoyable way (Charles et al., 2023). Through the use of this technology, it is hoped that students can gain a deeper understanding of physics principles and develop critical problem-solving skills in the context of a dynamic virtual world. Additionally, learning through metaverse technology can stimulate students' creativity and innovation, paving the way for further exploration in the fields of science and technology (Sulistilawati et al., 2023).

The aim of this research is to develop Metaverse Teaching Materials on the topic of dynamics of motion for college students. Through this development, it can

expand students' understanding of physics principles and enhance their problem-solving skills in the context of a dynamic virtual environment. Thus, this research is expected to make a significant contribution to improving physics education through the utilization of Metaverse technology.

RESEARCH METHOD

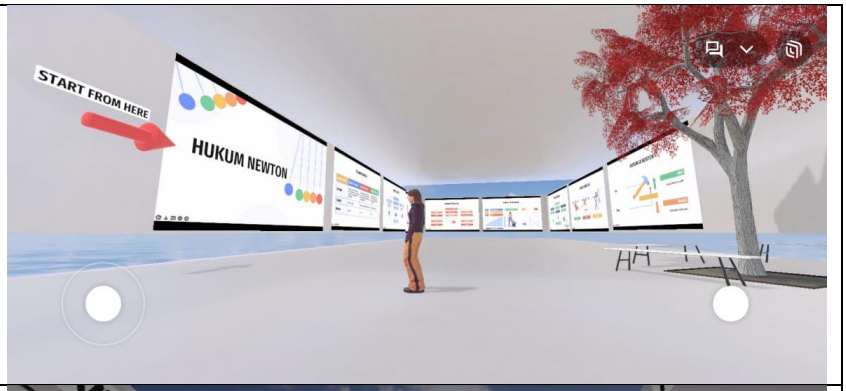
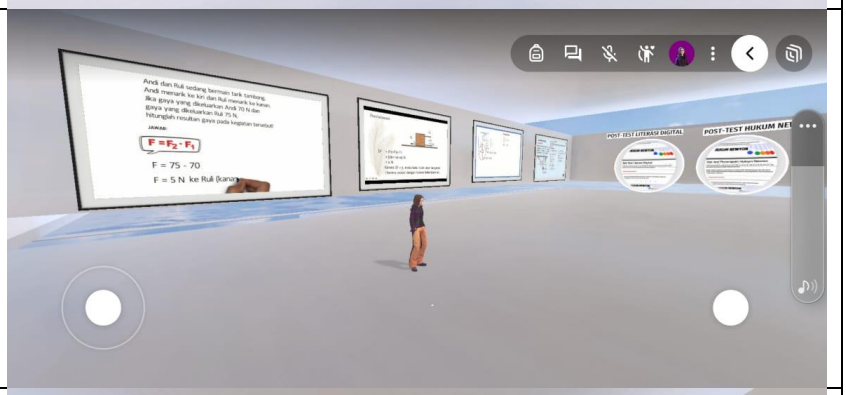
This type of research is research and development (R&D), which is a process to develop a new product (Muqdamien et al., 2021). The development model used is the ADDIE model, which consists of five stages: Analysis, Design, Development, Implementation, and Evaluation. This research on the development of the ADDIE model only reaches the Development stage, as the objective of this research is limited to the development and production of a valid learning media for implementation based on validator assessment.

RESULT AND DISCUSSION

This research successfully produced the Motion Dynamic Metaverse (MD-Verse) learning application as an innovative Metaverse Teaching Material for teaching dynamics of motion to students. MD-Verse is designed to be accessible through various platforms, including PC and smartphones, providing easy and flexible access for users. This application features important elements such as user avatars, pre-tests and post-tests, as well as four learning spaces focusing on Dynamics of Motion material. Each space is designed to present material using different approaches, including simulations, problem-solving applications, and instructional videos. With these interactive features, MD-Verse creates an engaging learning environment that allows students to interact directly with physics concepts in a virtual environment. Table 1 below shows the application's interface.

Table 1. Display and features of teaching materials

Feature	**Display**
Pre-test Dynamics of Motion and Digital Literacy	

Dynamics of Motion material space	
Dynamics of Motion simulation space	
Dynamics of Motion problem-solving application space	
Post-test Dynamics of Motion and Digital Literacy	

Dynamics of Motion instructional video space	

The Motion Dynamic Metaverse (MD-Verse) application offers various features designed to enhance students' physics learning experience. These features include pre-tests and post-tests for Dynamics of Motion and Digital Literacy, allowing students to assess their understanding before and after using the application, as well as develop important digital literacy skills in today's technological era. Additionally, the application provides several learning spaces specifically focused on Dynamics of Motion material. Firstly, the Dynamics of Motion material space presents comprehensive and structured learning content on basic concepts of Dynamics of Motion. Secondly, the Dynamics of Motion simulation space allows students to conduct experiments and directly observe physical phenomena related to Dynamics of Motion in a safe and interactive virtual environment. Thirdly, the Dynamics of Motion problem-solving application space offers exercises designed to test students' understanding and deepen their knowledge of physics concepts.

After exploring the material and completing exercises, students can take the post-test for Dynamics of Motion and Digital Literacy to evaluate their learning progress and further develop their digital literacy skills. Lastly, the Dynamics of Motion instructional video space presents learning material in engaging and informative video format, helping students understand physics concepts in a more visual and interactive way. With these diverse features, MD-Verse provides a rich and engaging learning environment for students to explore and understand physics concepts better. This aligns with Sulistiani's (2023) statement that Metaverse teaching materials provide a deeper learning experience through realistic and interactive simulations. Thus, through this approach, students can actively engage in physics learning, strengthening their understanding of complex concepts (Nugroho, 2022).

The developed teaching material, namely Motion Dynamic Metaverse (MD-Verse), was assessed for its usability by experts in the fields of education, physics, and technology. Evaluation by experts was conducted to ensure that MD-Verse meets relevant learning standards for complex physics content. Experts evaluated aspects such as alignment with the physics curriculum, adequacy of learning material, interactive skills, and clarity of the user interface.

The results of the expert assessment were then used to make improvements and adjustments to MD-Verse. Feedback and suggestions provided by experts were integrated into further development of this teaching material, ensuring that MD-Verse can provide an optimal learning experience for users. The results of the validity assessment by experts are as follows:

Validation Results

The validation results by experts indicate that the Motion Dynamic Metaverse (MD-Verse) Teaching Material for Dynamics of Motion is suitable for use in physics teaching. A comprehensive evaluation of the quality and relevance of MD-Verse as an innovative and interactive physics learning tool has been conducted. Experts acknowledged the alignment of MD-Verse with the physics curriculum, adequacy of the presented learning material, interactive skills offered, and clarity of the user interface. Feedback and suggestions provided by experts have been well integrated into further development of MD-Verse, ensuring that this teaching material can provide an optimal learning experience for users.

This decision provides strong support for MD-Verse's ability to be a valuable learning resource in enhancing students' understanding and interest in dynamics of motion physics concepts. Thus, MD-Verse is expected to make a significant contribution to more effective and engaging physics teaching in educational environments. Furthermore, these validation results also open up opportunities for further development in the field of Metaverse-based education, creating a solid foundation for further educational innovations in the future.

CONCLUSION

The utilization of technology in education has opened up significant opportunities to enhance students' learning experiences, particularly in understanding complex physics concepts. Motion Dynamic Metaverse (MD-Verse) emerges as one of the latest exciting innovations in physics education, presenting concepts visually, interactively, and engagingly. Validation by experts indicates that MD-Verse is suitable for use in physics teaching, providing a dynamic and relevant learning environment. Thus, MD-Verse has the potential to become a valuable learning tool in improving the quality of physics education in educational settings. Furthermore, these validation results pave the way for further development in the field of Metaverse-based education, marking progress towards more innovative and effective education in the future.

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