Acceptance of Metaverse Technology in Teaching and Learning: A Case Study of Virtual Reality Course

Ikmal Faiq Albakri Mustafa Albakri[1], Mohd Hafiz Zakaria[2*], Mohd Khalid Mokhtar[1], Asniyani Nur Haidar Abdullah[1], Mohamad Lutfi Dolhalit[1], Amni Syazana Nor Hisham[2], Muhammad Aliff Muhd Farid Arfian[1], Low Wei Shang[3]

[1]Pervasive Computing & Educational Technology, Department of Interactive Media, Fakulti Teknologi Maklumat dan Komunikasi, Universiti Teknikal Malaysia Melaka, Melaka, Malaysia

[2]Advanced Interaction Technology, Department of Interactive Media, Fakulti Teknologi Maklumat dan Komunikasi, Universiti Teknikal Malaysia Melaka, Melaka, Malaysia

[3]Virtualtech Frontier (VTF) Sdn Bhd, Selangor, Malaysia

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ABSTRACT

The acceptance of metaverse technology in the field of teaching and learning (T&L) among educators and students is a relatively new and emerging area of study. While Metaverse has the potential to enhance educational experiences, its adoption and implementation in educational environments remain limited. This study aims to investigate the acceptance of metaverse in T&L and identify the factors that influence educators' willingness to use it. This study employs a quantitative research approach and utilizes a survey questionnaire that consists of Likert-scale questions, open-ended questions, and items based on the Technology Acceptance Model (TAM). The survey will be administered to students who have used the Mitoworld platform to create metaverse worlds in virtual reality classes. The study found that educators and students have a positive attitude towards the use of metaverse in T&L. Perceived usefulness, ease of use, and compatibility are expected to be significant factors that influence educators' and students' acceptance of the metaverse. The study also reveals that educators who have prior experience in using virtual worlds are more likely to accept and use metaverse in their teaching practice. The findings of this study will have practical implications for educators and students who are interested in promoting the use of metaverse in teaching and learning.

Keywords: Metaverse Technology, Teaching and Learning, Technology Acceptance Model, Educational Technology.

INTRODUCTION

The concept of Metaverse is relatively new and is gaining popularity because of recent advances in these technologies. The Metaverse is a term used to describe a virtual reality space or universe where users can interact with a computer- generated environment and other users in a three-dimensional, immersive world [1]. It is essentially an advanced version of the internet, where instead of simply browsing web pages, users can enter a virtual world and interact with it more naturally and intuitively. Users can engage in real-time with virtual objects and the environment in this virtual setting. The metaverse can be utilized in education to create immersive learning and teaching environments that go beyond the traditional classroom [2].

In many ways, using the metaverse for educational purposes can be seen as an addition to the well-established concepts of virtual learning, or eLearning. Since the metaverse education platforms are made to give such chances, these notions center on delivering learning opportunities in a virtual environment [3]. In metaverse education, avatars which are known as the virtual representations of real people are frequently used by students to interact with one another [4]. With the ability to easily alter the surrounding virtual environment to fit the lessons being taught, it is possible to create a classroom setting within a virtual learning environment by allowing educators to interact within these digital learning spaces using their avatars.

Other than that, metaverse can be used to arrange virtual field trips, allowing students to travel anywhere in the globe to see museums, famous sites, career simulation and other attractions. Additionally, it can be utilized for

project-based learning and collaborative learning, enabling students from various regions to collaborate on projects and communicate with one another in real-time. The metaverse has the power to transform education by increasing learning interactivity, interest, and accessibility [2].

LITERATURE REVIEW

The efficient role of technological innovation in facilitating the lives of individuals has been a critical need since the beginning of the technological revolution. Three significant waves of technological innovation have been identified from the end-user perspective: the introduction of the internet, computers, and mobile devices. The technologies that underpin the current fourth wave of computing innovation are virtual reality and augmented reality [5]. Metaverse technology is poised to play a role in the next wave. The concept of a metaverse was first introduced in the 1992 science fiction novel Snow Crash by US writer Neal Stephenson. In Snow Crash, players become avatars and work in a 3D virtual reality known as the "metaverse." The metaverse has been defined as "virtual reality that exists outside the real world" [6].

The metaverse is a shared, persistent, and immersive virtual world where users can interact, work, play, and socialize across interconnected platforms. It blends technologies like virtual reality (VR), augmented reality (AR), blockchain, and artificial intelligence (AI) to create dynamic digital environments that continue to evolve even when users log off. As an open ecosystem, it enables seamless movement between different virtual spaces, offering limitless opportunities for industries such as gaming, education, remote work, healthcare, retail, real estate, finance, and entertainment. Though still in its early stages, the metaverse has the potential to transform how people engage with digital content, conduct business, and experience social interactions, shaping the future of human connectivity in a borderless digital world [7] [8].

Application of Metaverse Platform in Education

The metaverse is a highly immersive environment, which can help to keep students motivated. For example, the metaverse can be used to create virtual classrooms as shown in Table I below.

Table I: List of Universities that applied Metaverse

Name of University	Country	Metaverse Application	Details
RI-YAZ College	Malaysia	META UNICAMPUS	• Collaboration with Metaverse Universal Holding (MVU). • Provide immersive metaverse campus and teaching experience [13]
SEGi University and Colleges	Malaysia	SEGi MetaCampus	• Collaboration with Magnus Games Studio [14]. • Integrated access to SEGi's online learning system [15].
Phoenix Asia Academy of Technology	Malaysia	Phoenix Asia Rebirth Campus	• Phoenix Asia Rebirth Campus on metaverse platform. • Provide the experience of visiting the campus.
Hong Kong University of Science and Technology	China	MetaHKUST	• Self-development application. • Provide an immersive study experience. • Holistic platform for education [16].
Soon Chun Hyang University	South Korea	Jump VR	• Partnership with SK Telekom. • Hold a virtual entrance ceremony for new students [17].
Stanford University	United States	Virtual Human Interaction Lab	• Allow students to overcome physical space limitations. • "Classroom" can be a museum, lab, underwater, etc. [18].

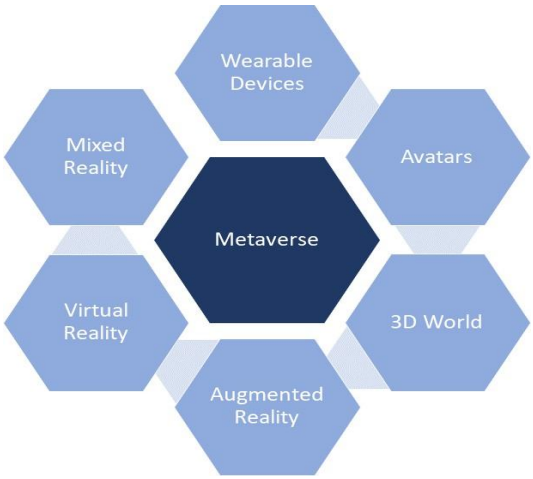

Fig. 1: Other technological elements that build Metaverse Technology.

The words meta (prefix meaning beyond) and the universe are combined to form the term "metaverse," which combines a variety of virtual environments (a blend of virtual and augmented reality) to express real life using avatars [5]. Although the entire metaverse does not yet exist, there are elements that resemble it on many virtual reality platforms, including PUBG and Fortnite, where players can create avatars that can be used in the metaverse, host in-game events, and create virtual economies [9]. When new technology is introduced, it is important to assess how users accept and interact with it, as this can influence its success and adoption. This includes exploring factors like usefulness, ease of use, and relevance to user needs. Fig 1 above illustrates the concept of metaverse technology, highlighting its immersive features.

Metaverse in Education Field

The use of metaverse technology in education is a promising area of research. While there is no specific reference on its application yet, related technologies and apps are developing and have the potential to have a significant impact in the future. The advancement of good human- machine interaction and the realization of virtual reality also have made real-time interaction between virtual avatars possible in many domains, including education and medicine. The use of augmented reality makes online learning and interaction with real people more concrete and vivid [10].

Metaverse, which has gradually advanced towards artificial intelligence in the field of educational technology, allows students to experience a virtual classroom with actual classroom components [11]. This is more engaging than traditional online learning. Lifelogging Metaverse, which combines augmented reality and traditional communication, is a useful tool for enhancing students' conventional classroom communication skills. Moreover, the use of metaverse technology in blended learning for aircraft maintenance, voice interaction modules, and blended interaction has also produced significant benefits in education and training [12].

These virtual classrooms can provide a flexible and inclusive learning space that transcends physical boundaries, allowing students from different locations to engage in real-time learning experiences [19]. In disciplines that require hands-on training, such as science, engineering, and medicine, the metaverse can offer simulations and virtual laboratories [20]. These realistic virtual environments enable students to conduct experiments, practice skills, and analyze data in a safe and cost-effective manner [21]. By providing access to virtual laboratories, students can gain practical experience and develop critical skills necessary for their future careers.

The increasing popularity of the metaverse has led to growing recognition of its potential for education. Some colleges and universities have begun to experiment with metaverse-based curricula to test these assumptions [22]. These experiments aim to improve academic retention and educational efficiency through immersive experiences. By integrating virtual classrooms and real-time collaboration, institutions are reshaping how students engage with content. This transformation signals a shift toward more flexible and experiential learning environments in higher education.

Learning Features Afforded by The Metaverse Platform

The proposed metaverse in the education framework suggests that learning in the metaverse will be more comprehensive than traditional classroom learning or screen- based video conferencing. Metaverse-based learning is likely to overcome the limitations of both screen-based remote learning and in-person and online learning. Each feature and its significance will be discussed in greater detail in Table II below.

Table II: Features of Metaverse Platform for Learning and Teaching Session.

Learning Feature	Description
The Flexibility of Time and Space	The metaverse liberates educators and students from geographical and time restrictions, allowing for various delivery methods and flexible participation [23].
Immersive Avatar Experience	Students use avatars to attend classes, providing a personalized and immersive experience in the metaverse [24].
Enhanced Social Interactions	The metaverse enables students to interact with avatar teachers and peers, offering individualized support and fostering cognitive and social development [25].
Immersive and Stimulating Learning Environments	Virtualized learning scenarios in the metaverse provide immersive and visually stimulating environments, enhancing the learning experience [22].
Visualized and Interactive Learning Resources	Learning materials in the metaverse are visualized and decentralized, allowing for greater engagement and collaboration among learners [26].
Contextualized Learning Activities	The metaverse offers vibrant and rich learning environments, allowing for contextualized learning activities and real-time collaboration among students [26].
Diverse Learning Activities and Higher-Order Thinking Skills	The metaverse facilitates a variety of learning activities, such as group projects and inquiry-based learning, promoting the application and development of higher-order thinking skills [27].
Comprehensive Learning Tracking and Analysis	The metaverse enables thorough tracking and analysis of student performance, going beyond traditional evaluation methods and emphasizing learners' development [26].

learner collaboration and decentralize content delivery [26]. Contextualized learning activities within the metaverse support authentic, real-time collaborative experiences [26], while diverse instructional strategies, such as inquiry-based and project-based learning, cultivate higher-order thinking skills [28]. Moreover, the metaverse affords comprehensive learning analytics capabilities, enabling detailed tracking of learner performance and progression [26].

METHODOLOGY

The research design for this study used a survey approach to gather quantitative data on student and teacher acceptance of metaverse during teaching and learning. The survey instrument was developed based on metaverse learning features gathered from the literature review and adopted Technology Acceptance Model (TAM). TAM is a well-established model that has been used to study the acceptance of various technologies, including virtual reality. The model posits that the acceptance of a technology is influenced by three factors: perceived usefulness, perceived ease of use, and compatibility.

The survey instrument was developed to measure three primary factors: perceived usefulness, perceived ease of use, and attitude toward usage, along with other relevant constructs such as perceived enjoyment, social influence, compatibility, and facilitating conditions, which may significantly affect the acceptance of metaverse technology in educational settings. This comprehensive design aims to capture a more holistic view of the various elements that influence how users engage with and adopt new immersive technologies in learning environments.

The survey was administered to a targeted sample comprising both students and teachers who had prior experience utilizingmetaverse platforms in teaching and learning contexts, ensuring that respondents were able to provide informed feedback based on actual usage. The quantitative data collected through this instrument was analyzed using appropriate statistical methods to identify the key determinants influencing user acceptance of the metaverse in education.

The results revealed meaningful patterns and correlations, offering valuable insights into how this emerging technology can and interactive learning experiences Furthermore, the study support and enhance educational delivery through immersive highlighted the importance of user experience, peer interaction, accessibility, and motivational factors in shaping positive perceptions of metaverse-based learning, which ultimately contributes to more effective, engaging, and future-ready educational practices for both educators and learners.

The metaverse introduces a spectrum of pedagogical affordances that significantly enhance the teaching and learning experience within virtual environments. It facilitates temporal and spatial flexibility, enabling both educators and learners to engage in instructional activities beyond traditional constraints of location and scheduling [23]. Through immersive avatar-based representations, learners can participate in classes in a highly personalized and engaging manner [24]. The platform also fosters enriched social interactions, promoting cognitive and emotional development through real-time communication with instructors and peers [25]. Furthermore, the incorporation of immersive and visually stimulating environments contributes to deeper cognitive engagement and improved knowledge retention [22]. Visualized and interactive learning resources enhance

Fig. 2: Example of student's work presented on Mitoworld.io.

The survey was performed on a group of 60 students taking a Virtual Reality (VR) course at the Fakulti Teknologi Maklumat dan Komunikasi, Universiti Teknikal Malaysia Melaka. As part of the course evaluation, students were tasked to create a VR application that would contribute positively to the environment such as preserving animals and addressing issues related to water, global warming, rubbish and many more. As for the presentation part, this is where the adoption of the metaverse lies on. Instead of just normal presentation, a metaverse technology known as Mitoworld.io is being leveraged as shown in Fig 2 above. The students were instructed to control the avatar around the metaverse while explaining and showcasing their various VR elements such as concept board, design board, storyboard, 3D models and finally the demo video of their VR application. The evaluation of the students' work was based on how well the VR applications addressed the issues and delivered their intended message. Another evaluation component was based on the creativity and organization demonstrated in the metaverse presentations, emphasizing the students' ability to effectively communicate their

ideas in this virtual environment. By using this technology, students can engage in more exciting and imaginative learning experiences, which can enhance their understanding of complex topics and promote creativity in problem solving for real-world issues.

DISCUSSION

This section will explain the findings of the study. Table III below presents the mean value and standard deviation (SD) values for each survey question related to the acceptance of metaverse technology in teaching and learning. The minimum value represents the lowest score given by the respondents for each question, while the standard deviation indicates the level of variability or dispersion of responses around the mean for that specific question.

Table III: Results of the Effectiveness of Metaverse on Teaching and Learning

Question	Mean	Standard Deviation
Engagement and Interactivity		
Q1	4.34	0.72052
Q2	4.41	0.65441
Q3	4.39	0.67900
Q4	4.34	0.69483
Learning Outcomes		
Q5	4.21	0.73148
Q6	4.14	0.77292
Accessibility and User-Friendliness		
Q7	4.11	0.92792
Q8	4.07	0.84975
Q9	4.18	0.81144
Q10	4.18	0.78872
Q11	4.23	0.80884
Realism and Immersion		
Q12	4.23	0.71328
Q13	4.23	0.68732
Flexibility and Personalisation		
Q14	4.20	0.79589
Q15	4.18	0.74118
Satisfaction		
Q16	4.13	0.74009

The questions related to engagement and interactivity (Q1, Q2, Q3, and Q4) have high mean values, ranging from 4.34 to

4.41. This indicates that the respondents perceived metaverse technology as highly engaging and interactive in the context of teaching and learning. The relatively low standard deviation values (ranging from 0.65441 to 0.72052) suggest that there is a high level of agreement among respondents regarding the positive impact of

metaverse on engagement and interactivity. The questions related to learning outcomes (Q5 and Q6) have mean values of 4.21 and 4.14, respectively. These scores indicate that the respondents believe that metaverse technology positively affects learning outcomes. The standard deviation values for these questions are moderate (0.73148 and 0.77292).

The questions related to accessibility and user-friendliness (Q7 to Q11) have mean values ranging from 4.07 to 4.23. This indicates that the respondents perceive metaverse technology as accessible and user-friendly in the teaching and learning process. However, the relatively high standard deviation values (ranging from 0.80884 to 0.92792) suggest some variability in respondents' opinions on these aspects. The questions related to realism and immersion (Q12 and Q13) both have a mean value of 4.23. This indicates that the respondents believe that metaverse technology provides a high level of realism and immersion in educational experiences.

The questions related to flexibility and personalisation (Q14 and Q15) have mean values of 4.20 and 4.18, respectively. This suggests that the respondents perceive metaverse technology as offering flexible and personalised learning experiences. The standard deviation values for these questions are moderate (0.79589 and 0.74118), indicating some variation in respondents' opinions on these aspects. Lastly, the question related to satisfaction (Q16) has a mean value of 4.13, indicating a high level of satisfaction with the use of metaverse technology in teaching and learning. The standard deviation value (0.74009) suggests some variability in respondents' satisfaction levels.

Table IV shows the results on metaverse technology acceptance in teaching and learning using the TAM model, covering key factors like usefulness, ease of use, attitude, intention, benefits, barriers, satisfaction and comparison to traditional methods.

Table IV: Results of the Acceptance of Metaverse on Teaching and Learning.

Question	**Min**	**Standard Deviation**
Perceived Usefulness		
Q1	4.36	0.61581
Q2	4.34	0.64036
Perceived Ease of Use		
Q3	4.20	0.74881
Q4	4.20	0.72412
Attitude Towards Metaverse		
Q5	4.32	0.63553
Q6	4.38	0.64842
Intention to Use		
Q7	4.34	0.66815
Q8	4.36	0.69879
Perceived Benefits		
Q9	4.38	0.61975
Q10	4.39	0.65167

Perceived Barriers		
Q11	4.05	0.98016
Q12	4.09	0.87960
Satisfaction		
Q13	4.30	0.71146
Q14	4.27	0.67396
Comparison to Traditional Methods		
Q15	4.25	0.81646
Q16	4.30	0.76085

The questions related to perceived usefulness (Q1 and Q2) have high mean values of 4.36 and 4.34, respectively. This suggests that both educators and students perceive metaverse technology as highly useful in the context of teaching and learning. The standard deviation values for these questions are relatively low (0.61581 and 0.64036), indicating a high level of agreement among respondents on the usefulness of the metaverse. Similarly, the questions related to perceived ease of use (Q3 and Q4) have mean values of 4.20 for both educators and students. This suggests that respondents find the metaverse technology easy to use in the educational setting. The standard deviation values for these questions are moderate (0.74881 and 0.72412), indicating some variability in respondents' opinions on the ease of use.

The questions related to attitude towards the metaverse (Q5 and Q6) have mean values of 4.32 and 4.38, respectively. This indicates that both educators and students have a positive attitude towards the adoption of metaverse technology in teaching and learning. The standard deviation values for these questions are relatively low (0.63553 and 0.64842), indicating a high level of agreement among respondents on their attitude towards the metaverse. Moreover, the questions related to intention to use (Q7 and Q8) have mean values of 4.34 and 4.36, respectively. This suggests that both educators and students have a strong intention to use metaverse technology in their teaching and learning practices. The standard deviation values for these questions are moderate (0.66815 and 0.69879), indicating some variation in respondents' intentions.

The questions related to perceived benefits (Q9 and Q10) have high mean values of 4.38 and 4.39, respectively. This indicates that both educators and students perceive numerous benefits in using metaverse technology for teaching and learning. The standard deviation values for these questions are relatively low (0.61975 and 0.65167), suggesting a high level of agreement among respondents on the benefits. On the other hand, the questions related to perceived barriers (Q11 and Q12) have mean values of 4.05 and 4.09, respectively. These scores indicate that both educators and students perceive some barriers to the adoption of metaverse technology in education, although the mean values are still relatively high, suggesting a moderate level of perceived barriers. The standard deviation values for these questions are higher (0.98016 and 0.87960), indicating more variation in respondents' perceptions of the barriers.

The questions related to satisfaction (Q13 and Q14) have mean values of 4.30 and 4.27, respectively. This indicates that both educators and students are generally satisfied with the use of metaverse technology in teaching and learning. The standard deviation values for these questions are moderate (0.71146 and 0.67396), suggesting some variation in respondents' satisfaction levels. Lastly, the questions related to comparison to traditional methods (Q15 and Q16) have mean values of 4.25 and 4.30, respectively. This suggests that both educators and students perceive metaverse technology as comparable or superior to traditional teaching methods.

As summary, the findings indicate a positive acceptance of metaverse technology in teaching and learning by students and teachers. They perceive it as useful, easy to use, and intend to incorporate it into their educational practices. Participants recognize various benefits, including enhanced engagement, improved learning outcomes,

and flexibility. However, there are perceived barriers, such as technological complexities, that need to be addressed to fully utilize metaverse's potential in education. The findings suggest that metaverse technology holds promise in revolutionizing teaching and learning experiences, with opportunities for immersive and interactive education. Addressing identified barriers can lead to successful implementation and integration into educational settings. Overall, the results highlight the growing readiness of educators and learners to embrace innovative technologies that transform the learning environment, paving the way for a more dynamic, inclusive, and future-ready education system that bridges physical and virtual learning spaces.

CONCLUSION

In conclusion, the metaverse is still a new technology, but it has the potential to revolutionize education. By providing more engaging and interactive learning experiences, the metaverse could help students learn more effectively. In addition to the benefits mentioned in this paper, the metaverse could also help to address some of the challenges that education is facing today. For example, the metaverse could be used to provide students with access to high-quality education, regardless of their socioeconomic status. It could also be used to help students with special needs learn more effectively. Indeed, the metaverse is a nascent technology with the potential to transform the way we interact with the world around us. It has the potential to transform not just education but also healthcare, business, and entertainment, among other fields.

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