Metaverse Technology for Teacher Training Programmes in Higher Learning Institutions: Perceptions of Teacher Trainees

Nurshamshida Md Shamsudin[1*], Teoh Sian Hoon[2], Sharipah Ruzaina Syed Aris[3], Melor Md Yunus[4]

[1 2 3]Faculty of Education, Universiti Teknologi MARA,
UiTM Puncak Alam Campus, 42300 Puncak Alam, Selangor, Malaysia
nurshamshida@uitm.edu.my
teohsianhoon@yahoo
sruzaina@uitm.edu.my
[4]Faculty of Education,Universiti Kebangsaan Malaysia,
43600 UKM Bangi, Selangor, Malaysia
melor@ukm.edu.my
[*]Corresponding Author

https://doi.org/10.24191/ajue.v20i3.27852

Received: 11 September 2023
Accepted: 27 June 2024
Date Published Online: 28 October 2024
Published: 28 October 2024

Abstract: The integration of innovative technologies in teacher education is crucial for preparing future educators to harness the potential of technology in their teaching practices. The metaverse, a collective virtual shared space created by the convergence of physical and virtual reality, offers promising opportunities for enhancing teacher training programs at universities. This study aims to explore the perceptions of teacher trainees regarding the implementation of metaverse technologies in their training programs at higher education institutions. A mixed-methods approach was employed, involving a survey administered to 300 teacher trainees, followed by in-depth interviews with a selected group of participants. The findings reveal a generally positive perception of the metaverse as an innovative and engaging learning environment that can enhance interactivity, collaboration, and real-world simulation in teacher training. However, concerns were raised regarding the technical challenges, learning curve, and potential distractions associated with the metaverse. Additionally, participants expressed the need for adequate training and support to effectively integrate metaverse technologies into their teaching practices. The study concludes with recommendations for universities and teacher training institutions to provide the necessary infrastructural, technical, and pedagogical support to facilitate the successful implementation of metaverse technologies in teacher training programs. Further research is suggested to explore the long-term impacts of metaverse integration on the teaching practices and professional development of trainee teachers

Keywords: Metaverse, Teacher Trainee, Virtual Reality

1. Introduction

The COVID-19 pandemic, declared in 2020, mandated a shift from face-to-face interactions to virtual engagements in various aspects of daily life (Koo, 2021; Kye et al., 2021; Kim et al., 2022; Lee et al., 2022 Mohtar et al., 2022). Activities such as telecommuting, online meetings, distance learning, and online shopping became integral components of human life (Chung et.al., 2020, Igai et.al., 2022. This transition accelerated the desire to expand the physical world's boundaries, leading to an increased demand for a more advanced virtual world (Suzuki et al., 2020). The advancement of technologies like

VR (virtual reality), AR (augmented reality), AI (artificial intelligence), and blockchain facilitated the emergence of the metaverse, a 3D digital space where virtual and real boundaries converge Sim et.al., 2021) and Artificial Intelligence such as ChatGPT (Plata, 2023). The metaverse has gained immense attention as the next generation of the Internet (Hwang and Chien, 2022), poised to revolutionise our interaction with the world.(Ismayatim et al.,2019).

The year 2021 marked the inception of the metaverse era (Zhang et al., 2022a). With the global surge in metaverse research, it has been heralded as a future education trend with immense potential (Choi and Kim, 2017; Dwivedi et al., 2022; Gartner, 2022; Guo and Gao, 2022; Hwang and Chien, 2022; Park and Jeong, 2022; Park and Kim, 2022; Rospigliosi, 2022; Shin, 2022; Tlili et al., 2022). The development of the metaverse is often associated with the integration of multiple new technologies (Kang, 2021). However, existing literature predominantly focuses on metaverse-related technologies in education, neglecting a holistic perspective of the metaverse in education. This gap in knowledge leaves many educational researchers unfamiliar with the metaverse, its components, and its applicability in the educational domain. Hence, this research paper aims to review several seminal articles to provide a comprehensive overview of the metaverse in education, particularly focusing on teacher training programs. The intention is to elucidate the concept of the metaverse, its integral components, and its potential applications in teacher education, thereby equipping educational researchers and practitioners with the knowledge necessary to harness the metaverse's potential in shaping the future of education. (Jamrus & Razali,2021).

In recent times, the concept of the Metaverse has captured the attention of educators worldwide. This heightened interest was further fueled by Facebook's announcement of its rebranding to Meta, a move that sparked a surge of enthusiasm and curiosity in the fields of computer science and education. The Metaverse, an immersive digital universe that leverages cutting-edge technologies such as extended reality (XR) and the Internet of Everything (IoE), offers a plethora of educational applications that have the potential to revolutionise future research in this domain. These technologies not only facilitate the creation of interactive and engaging learning environments but also promise to significantly transform educational services in the Metaverse, ultimately reshaping the future landscape of teaching and learning.

The Metaverse's potential as an educational tool extends beyond merely providing a novel platform for instruction. It fosters a more interactive and immersive learning experience, facilitating greater engagement and retention of knowledge. Moreover, the integration of XR and IoE technologies enables the creation of personalised learning experiences, catering to the unique needs and preferences of individual learners. This has the potential to democratise education, making it more accessible and inclusive for learners worldwide. As the Metaverse continues to evolve, it is crucial for educators, researchers, and policymakers to understand its capabilities and limitations fully. This will ensure that the Metaverse is harnessed effectively to enhance educational outcomes and pave the way for the future of teaching and learning.

The adoption of new technologies often entails a prolonged and arduous process and long acceptance as mentioned by Abdullah et al. (2023) a phenomenon well articulated by Rogers' (2012) Diffusion of Innovations theory. This theory delineates the mechanisms by which new ideas permeate a society, explicating the reasons and pace of this diffusion. Rogers (2012) posits that the adoption or rejection of an innovation hinges on users' perceptions of five key variables: relative advantage, compatibility, complexity, trialability, and observability. Rogers also contends that an innovation's adoption is not a simultaneous occurrence among all users in a social system; rather, it follows a bell-shaped curve distribution, categorising users into five distinct groups: innovators, early adopters, early majority, late majority, and laggards. Each group exhibits unique characteristics, as outlined below:
Innovators: Comprising the initial 2.5%, these individuals actively seek and embrace innovations, demonstrating a willingness to undertake risks. They serve as gatekeepers and are prompt in experimenting with innovations (Miller, 2015; Ucus & Acar, 2018).

Early Adopters: Constituting the subsequent 13.5%, these individuals wield significant influence within their social systems, inspiring others to adopt new innovations. They command respect from their peers and exercise discernment in their decisions regarding innovations (Rogers, 2012).

Early Majority: Representing the following 34%, these individuals exhibit a cautious and deliberate demeanour, demonstrating a reluctance to expend time or other resources frivolously. Although they follow the early adopters, they necessitate robust evidence of benefits before embracing new technology (Wani & Ali, 2016).

Late Majority: Accounting for another 34%, these individuals harbour scepticism and are inclined to adopt an innovation once it has become established in the field. Peer pressure may also sway their adoption decisions.

Laggards: Encompassing the final 16%, these traditionalists exhibit scepticism towards novel ideas and are hesitant to adopt changes unless compelled by necessity

Upon encountering an innovation, individuals commence the adoption process, transitioning from awareness and interest in the innovation to information gathering and potential experimentation to ascertain if the adoption effort is justifiable in terms of time and other resources. It could be contended that the incorporation of metaverse into school instruction is in its nascent stages of the adoption process, with educators currently utilising or advocating for its use belonging to the Innovator or Early Adopter categories In the educational realm, the adoption of a technology tool is not solely contingent on its novelty and innovativeness but also its efficacy in captivating and motivating students and fostering a pleasurable learning ambiance. Therefore, this paper aims to scrutinise the viewpoints of Innovator and Early Adopter educators employing metaverse and to examine the degree to which they perceive it as engendering innovative learning environments. This research was steered by the ensuing research questions: (1) What are the perceptions of educators towards learning interest and engagement when utilizing the metaverse in the classroom?, and (2) What obstacles or challenges do educators encounter when incorporating the metaverse into their classroom instruction?

2. Literature Review

The concept of the metaverse has recently emerged as a topic of significant interest and discussion, especially in the context of higher education. The metaverse, often described as a collective virtual shared space created by the convergence of physical and virtual reality, offers a myriad of possibilities for transforming the educational landscape. As the next generation of the internet, the metaverse has the potential to revolutionise how we interact, collaborate, and learn, thereby holding immense promise for higher education.

In recent years, there has been a surge in literature exploring the potential applications and implications of the metaverse for higher education. This literature encompasses a range of topics, including the use of virtual reality (VR), augmented reality (AR), and mixed reality (MR) in educational settings, the development of virtual campuses and classrooms, and the utilisation of the metaverse for collaborative learning and research (Hashim et al., 2022. Additionally, scholars have also examined the challenges and barriers associated with the implementation of metaverse technologies in higher education, such as technical issues, accessibility concerns, and the need for digital literacy training for both students and faculty.

This literature review aims to provide a comprehensive overview of the current state of research on the metaverse in higher education. It will explore the potential benefits and challenges associated with the implementation of metaverse technologies in higher education institutions, as well as the implications for teaching and learning practices. Moreover, this review will also highlight gaps in the existing literature and suggest directions for future research in this rapidly evolving field.

The technological tools and features of the Metaverse have profoundly enhanced both pedagogical and technical support in education, leading to a notable increase in student motivation (Tlili et al., 2022). These technologies and tools can be categorised into seven distinct groups: wearable devices, immersive technologies, instructional tools, modelling and simulation tools, mobile devices, sensors, and artificial intelligence (AI). The Metaverse facilitates an immersive direct experience for students, fostering teamwork, skill development, and multifaceted engagement in the classroom (Tarouco et al., 2013; Erturk & Reynolds, 2020). This immersive experience is achieved through the

integration of various virtual technologies, such as Virtual Reality (VR), Multi-User Virtual Environments (MUVE), Mixed Reality (MR), and Augmented Reality (AR), all of which are crucial for attaining a fully immersive state. The necessity of these technologies as gateways into the Metaverse environments underscores the importance of multimodal immersion.

This multifaceted immersive experience not only enhances student engagement in the classroom but also promotes collaborative learning and skill development. The integration of these technologies enables students to interact with virtual environments and digital objects in real-time, thereby facilitating active participation and hands-on learning. Additionally, the Metaverse provides a platform for students to collaborate and engage in teamwork, as they can work together to solve problems, complete tasks, and create virtual projects. This collaborative and interactive learning environment ultimately contributes to the development of essential skills, such as critical thinking, problem-solving, and digital literacy.

The integration of the Metaverse in education involves the amalgamation of various platforms such as the Learning Management System (LMS), MOOC, Moodle and Sloodle. For example, the advent of Web 2.0 has enabled Massive Open Online Courses (MOOCs) to provide students with access to social networks. This access, facilitated by the Metaverse and MOOCs, allows many students to access subject information for free, and online courses further enable them to expand their knowledge base (Wagner et al., 2013). Courses in engineering, mathematics, and natural sciences often utilise virtual learning laboratories. The Virtual Learning Laboratory (VLL) provides students with a dynamic, interactive, and collaborative study environment, thereby boosting their motivation and overall quality of education (Tarouco et al., 2013). For example, a virtual environment created using Moodle allows the university's online learning platform to share user data, link user profiles between platforms, and make presentations (Lucas, Benito & Gonzalo, 2013).

Mobile technologies are particularly predominant in the Metaverse as they facilitate the connection between the medium and the student through the use of mobile devices and geographic mobility. The learning process is enhanced when students use their avatars in the Metaverse on mobile devices. Sensors and wearables, such as Microsoft HoloLens 2 smart glasses and eye blinking, fall under a category of technology that enables teachers to monitor student dynamics by evaluating their behavior.Using HoloLens 2 smart glasses, students can interact with content and issue commands in the virtual world (Siyaev & Jo, 2021b). Another widely used tool in the Metaverse is the blinking system, which employs specialised software to record the blinking times of students. The system records more blinks when a student is emotionally unstable, allowing teachers to assess the student's behaviour more accurately

At the heart of the Metaverse is the analysis of complex data for understanding, regulating, and planning. The development of artificial intelligence serves as a foundation for processing this data (Duan et al., 2021). Neuro-symbolic AI combines neural networks with traditional symbolic reasoning to provide feedback on user data using automatic voice recognition metrics (Siyaev & Jo, 2021a).

The Metaverse provides students with a fully immersive educational journey, enhancing their learning by visualising concepts that were once abstract or confined to textbooks. For example, when learning about planets, the Metaverse can depict the entire galaxy, allowing learners to zoom in and out, observing the textures and features of the cosmos in detail. Similarly, while studying ancient architecture, learners can virtually travel back in time to examine the intricate elements of the architecture firsthand (Ning et al., 2021). The Metaverse can be understood as a space where virtual reality complements the physical world, encompassing four distinct types: Augmented Reality, Lifelogging, Mirror World, and Virtual Reality (Kye et al., 2021). In this setup, the real world is either intertwined with virtual reality or transmuted into a different environment within virtual reality. From an evolutionary standpoint, the Metaverse represents a world that has expanded and evolved in response to the COVID-19 pandemic, melding the accelerated innovations of 5G and virtual convergence technology (Sun et al., 2022).

This evolution in response to the pandemic marks a significant leap in human interaction with technology, reshaping how we perceive and interact with the world around us. As the world grapples with the challenges posed by the pandemic, the Metaverse has emerged as a potent tool for overcoming physical limitations and fostering a sense of connection and engagement in an increasingly digital world. The integration of 5G technology further amplifies the capabilities of the Metaverse, enabling

seamless, real-time interactions in a virtual environment, thus creating a more realistic and engaging experience for users (Mohammad, 2023). Ultimately, the Metaverse represents the next frontier in digital innovation, offering exciting possibilities for enhancing education and other aspects of human life.

3. Methodology

This research employed both quantitative and qualitative methodologies to evaluate the perceptions of teachers and administrators regarding the impact of metaverse integration on student engagement and interest, its applications, and the challenges encountered. Ensuring reliability is crucial when analysing data (Efron & Ravid, 2013), encompassing the methods and tools used for data collection. Online surveys are an effective way to collect data, enabling a broader reach and participation from educators. This study involved sending surveys to teachers currently using Metaverse in their classrooms to assess their attitudes and perceptions towards its implementation. The respondents provided insights into the metaverse types used, its implementation, and the challenges encountered.

Survey Instrument

The survey consisted of 20 questions divided into three sections: the first section (8 questions) gathered demographic information, the second section assessed teacher perceptions of engagement and interest in the metaverse, and the third section included open-ended questions about their metaverse experiences. The perception questions utilised a Likert scale ranging from 1 to 5, where 1 indicated Strongly Disagree and 5 indicated Strongly Agree. Efron and Ravid (2013) highlighted that Likert-type scales are frequently used for rating purposes. Respondents' answers spanned from Strongly Disagree to Strongly Agree. Additionally, participants provided brief responses to three open-ended questions.
To validate the survey instrument, experts from the field were consulted. These experts, who had significant experience and knowledge in educational technology and survey design, reviewed the questions for clarity, relevance, and comprehensiveness. They provided feedback on the appropriateness of the Likert scale items, ensuring that the questions accurately captured the teachers' perceptions and experiences. The experts also evaluated the open-ended questions to ensure they were clear and capable of eliciting detailed and meaningful responses. Based on their feedback, necessary revisions were made to the survey to enhance its validity and reliability.

To expand further, the research aimed to understand the intricacies of Metaverse usage in classrooms from the educators' perspective. The survey aimed to collect comprehensive data, encompassing demographic details, perceptions of metaverse impact on engagement, and firsthand experiences with metaverse, including the challenges faced. The broad age range and professional background of the respondents ensured diverse perspectives. While most respondents were experienced educators with advanced technology skills, their sporadic use of metaverse indicated that it is not yet a regularly integrated tool in classrooms. This detailed survey provided valuable insights into the current state of metaverse usage in education, highlighting areas for improvement and further research.

4. Results and Discussions

To gain insight into teacher perceptions regarding the metaverse on student interest and engagement, a survey, categorised under three main headings: Expertise, Learning Engagement, and Interest.

Statistical Analysis: Various ANOVA analyses were performed to discern if there were any significant differences among the groups identified. A total of 300 respondents participated in the survey, out of which 235 disclosed their gender .The analysis began with the completion of Levene's test, which established the equality of error variances, thereby allowing the ANOVA to be conducted despite the absence of a normal distribution.

Gender Analysis: On analysing the variable of 'total expertise,' there was no significant difference found between genders, $F = .02$, $p = .92$, $p\eta2 = .00$, indicating a negligible effect size. Similarly, for the 'total student engagement' variable, there was no significant gender difference found, $F = .19$, $p = .67$, $p\eta2 = .01$, indicating a small effect size. Lastly, for the 'total student interest' variable, the hypothesis of gender differences was not rejected, $F = .06$, $p = .82$, $p\eta2 = .00$, indicating a negligible effect size.

Age Analysis: The respondents were also categorised based on their age range: 26-40 years (79 respondents), 41-55 years (96 respondents), and 56 years or older (60 respondents), totaling 35 respondents. Although Levene's test showed unequal error variances for 'total expertise,' the normal distribution allowed the ANOVA to be conducted, revealing no significant age differences, $F = 1.41$, $p = .26$, $p\eta2 = .08$, with a moderate effect size. Similarly, for 'total student engagement,' there was no significant difference found between age groups, $F = .99$, $p = .38$, $p\eta2 = .06$, with a moderate effect size. Lastly, for 'total student interest,' the hypothesis of age differences was not rejected, $F = .56$, $p = .58$, $p\eta2 = .03$, indicating a small effect size.

Educational Assignment Analysis: The respondents were further categorised based on their educational assignments: Higher Education (230 respondents), Administration (2 respondents), and Technology (3 respondents). Despite the absence of a normal distribution, Levene's test established the equality of error variances, allowing the ANOVA to be conducted for 'total expertise.' However, no significant differences were found between educational assignments, $F = 1.72$, $p = .17$, $p\eta2 = .20$, indicating a large effect size. Similarly, for 'total student engagement,' despite unequal error variances, the ANOVA revealed no significant differences between educational assignments, $F = .91$, $p = .47$, $p\eta2 = .12$, indicating a large effect size. Lastly, for 'total student interest,' the hypothesis of differences between educational assignments was not rejected, $F = 2.54$, $p = .06$, $p\eta2 = .27$, indicating a large effect size.

In summary, the analyses conducted on various demographic factors, such as gender, age, educational assignment, and area, did not reveal any significant differences in trainee teacher perceptions regarding the metaverse on learning interest and engagement. This indicates that these demographic factors do not play a significant role in shaping future teacher perceptions on this matter. The analysis of the survey results was used to address and expand upon the following research questions:

4.1 How do teachers perceive their engagement and interest in the metaverse?

The survey included a dedicated section to assess teacher perceptions of engagement and interest in the metaverse, using a Likert scale from 1 to 5, with 5 representing Strongly Agree and 1 representing Strongly Disagree. This scale allowed for a nuanced understanding of teacher attitudes, as it could capture varying degrees of agreement or disagreement. The responses provided insight into how teachers perceive the metaverse as an educational tool, their level of interest in integrating it into their teaching practices, and their overall engagement with this emerging technology.

4.2 What are the demographic characteristics of teachers who are interested in the metaverse?

The first section of the survey collected demographic information, including age, gender, years of teaching experience, and subject area. By analysing this data, researchers could identify trends and correlations between demographic factors and interest in the metaverse. For instance, they could determine if younger teachers or those with more experience were more inclined to explore the metaverse, or if certain subject areas showed higher levels of interest. This information is crucial for understanding the profile of teachers who are more likely to adopt and engage with the metaverse.

4.3 What experiences have teachers had with the metaverse in their educational practices?

The final section of the survey consisted of open-ended questions that allowed teachers to share their experiences with the metaverse in their own words. These qualitative responses provided rich, detailed insights into how teachers have utilised the metaverse in their classrooms, the challenges they faced, and the successes they achieved. This section aimed to capture the practical application of the metaverse in education, offering real-world examples and anecdotes that could inform future research and practice.

4.4 What are the barriers and facilitators to teachers' use of the metaverse?

The open-ended responses also shed light on the barriers and facilitators to the use of the metaverse in education. Teachers could discuss obstacles such as lack of resources, technical difficulties, or resistance to new technologies, as well as factors that supported their use of the metaverse, such as institutional support, professional development opportunities, or positive student feedback. Understanding these factors is essential for developing strategies to overcome challenges and enhance the adoption of the metaverse in educational settings.

By analysing the survey results in the context of these research questions, the study was able to provide a comprehensive understanding of teachers' perceptions, experiences, and challenges related to the metaverse. Therefore, the following discussion aims to answer the research questions;

What are the perceptions of educators towards learning interest and engagement when utilising the metaverse in the classroom?

It is indicated that implementation of metaverse in science and mathematics subjects, specifically for examining body systems and space exploration, as well as for problem-solving in mathematics. While most responses revolved around using pre-existing metaverse, a few participants mentioned creating their content using smartphone applications. Additionally, the teaching methods and strategies they employed alongside metaverse Many used to introduce new concepts, establish a learning context, or activate prior knowledge. It is also found metaverse to be beneficial for visualising structures or places otherwise inaccessible, like outer space. Metaverse was also utilised for gamification, such as organising scavenger hunts, and as a tool for students to demonstrate their knowledge by creating interactive bulletin boards or virtual gallery walks.However, there was some confusion between MV, AR and Virtual Reality (VR).

What obstacles or challenges do educators encounter when incorporating the metaverse into their classroom instruction?

It is identified cost as the most significant challenge when using Metaverse, followed by inadequate technology, limited availability of equipment, time constraints, and a limited selection of applications or devices. Interestingly, responses reveal that Metaverse has been integrated into various subjects and teaching methods, there are still notable challenges and confusions. The mix-up between MV, AR and VR indicates a need for clearer understanding and distinction between the two technologies. Moreover, the challenges cited, particularly the cost, inadequate technology, and limited availability of equipment and apps, suggest that there are still significant barriers to the widespread adoption of metaverse in classrooms. Additionally, the observation that students sometimes went off-task suggests that while metaverse can be engaging, it also requires careful planning and management to ensure it enhances learning rather than becoming a distraction. Despite these challenges, the creative uses of metaverse mentioned by the participants, from animating drawings to creating virtual galleries, indicate the vast potential of Metaverse as a tool for enhancing learning and teaching in various subject areas.

5. Conclusions

In the context of education, the introduction of the metaverse represents a revolutionary shift from existing educational technologies. As previously mentioned, the metaverse has the potential to usher in significant opportunities and innovations in the educational sector, potentially overcoming numerous challenges and limitations currently faced by the educational system.

In light of this potential, exploring the perceptions of educators regarding learning interest and engagement when utilising the metaverse in the classroom is crucial. Understanding educators' perspectives on how the metaverse can enhance student engagement and interest will provide valuable insights into its practical benefits and applications in educational settings. Furthermore, investigating the obstacles or challenges educators encounter when incorporating the metaverse into their classroom instruction will be essential to developing effective strategies for integration and addressing any potential barriers.

More importantly, the ongoing interest in the metaverse highlights its potential to shape the future direction of education (Park and Jeong, 2022). Consequently, it is anticipated that a growing number of educational researchers will actively participate in studies exploring the role of the metaverse in education in the coming years. By addressing these research questions, the educational community can better understand the transformative potential of the metaverse, paving the way for innovative educational practices and enhanced learning experiences.

6. Suggestions

To elaborate further, the metaverse, being a relatively new concept in education, presents a plethora of opportunities for overcoming existing challenges. For instance, it could facilitate immersive learning experiences, breaking down geographical barriers, and providing a more interactive and engaging learning environment. Moreover, the metaverse could also enable new forms of collaboration and social interaction, fostering a sense of community among learners from different parts of the world. Furthermore, the metaverse could also provide a platform for innovative teaching and learning methods, potentially revolutionising the way education is delivered and experienced. The ongoing interest and discussions surrounding the metaverse indicate its potential to significantly impact the future of education, suggesting that it could become a key focus area for educational research in the coming years. Therefore, it is crucial for educational researchers, policymakers, and practitioners to actively engage in exploring the potential benefits, challenges, and implications of the metaverse in education to harness its full potential and shape the future of education.

The current study suffers from some limitations which may limit the generalizability of our findings. First, our small sample size of educators who use Metaverse limited our ability to detect differences among the groups. With a larger sample in the future, we may be able to detect differences which could lead to a greater understanding of their significance. Educators in this study were self-described users of metaverse in instruction. Future studies may want to include some mechanism for verifying their status. The positive outcomes from using metaverse outweigh the issues that currently exist. Using the metaverse technology in classrooms will facilitate and improve the learning process for students. Learning engagement in the classroom has been an issue for teachers from the beginning and finding innovative ways to engage them in the content is crucial. As technology continues to improve, metaverse will have a positive influence in education to improve student engagement. This study will give an understanding to school districts, from the future teacher's point of view, on how metaverse impacts and improves learning engagement.

Based on the the most crucial factors that have been identified in this study, please suggest the new direction, new objectives, and new method for a similar study in the future.

7. Co-Author Contribution

The authors affirmed that there is no conflict of interest in this article. Author 1 carried out the fieldwork, prepared the literature review and overlooked the writeup of the whole article. Authors, 2, 3 and 4 carried out the analysis and interpretation of the results.

8. Acknowledgements

This paper is funded by grant 600-UITMSEL (PI. 5/4) (122/2022) for providing the necessary funding for this research project. This grant has enabled us to conduct extensive research on Metaverse technology applications among STEM teachers' training programs and has contributed greatly to the advancement of knowledge in this field.

9. References

Abdullah, H., Sahudin, Z., Bahrudin, N. Z., Bujang, I., & Khalid, K. (2023). Determinants of Educational Technology Acceptance: An Integration of TAM and UTAUT. *Asian Journal of University Education*, *19*(4), 638-650.

Chen, Y.-C., Chi, H.-L., Hung, W.-H., and Kang, S.-C. (2011). Use of tangible and augmented reality models in engineering graphics courses. *Journal of Professional Issues in Engineering Education and Practice*, 137, 267–276. doi: 10.1061/(asce)ei.1943-5541.0000078

Choi, H., and Kim, S. (2017). A content service deployment plan for metaverse museum exhibitions—centering on the combination of beacons and HMD. *Int. J. Inf. Manag.* 37, 1519–1527. doi: 10.1016/j.ijinfomgt.2016.04.017

Chung, E., Subramaniam, G., & Dass, L. C. (2020). Online learning readiness among university students in Malaysia amidst COVID-19. *Asian Journal of University Education*, *16*(2), 45-58.

Davis, A., Murphy, J., Owens, D., Khazanchi, D., and Zigurs, I. (2009). Avatars, people, and virtual worlds: foundations for research in metaverses. *J. Assoc. Inf. Syst.* 10, 90–117. doi: 10.17705/1jais.00183possibilities. *ACM Comput. Surv.* 45, 1–38.
doi: 10.1145/2480741.2480751

Gartner. (2022). *Predicts 2022: 4 Technology Bets for Building the Digital Future*. https://www.businesswire.com/news/home/20220207005085/en. (Accessed August 06, 2022).

Genay, A. C. S., Lecuyer, A., and Hachet, M. (2021). Being an avatar "for real": a survey on virtual embodiment in augmented reality. *IEEE Trans. Vis. Comput. Graph.* 1–2. doi: 10.1109/tvcg.2021.3099290

Guo, H., and Gao, W. (2022). Metaverse-powered experiential situational English-teaching design: an emotion-based analysis method. *Front. Psychol.* 13:859159. doi: 10.3389/fpsyg.2022.859159

Hashim, Haida Umiera, Melor Md Yunus, & Helmi Norman. (2022)."'AReal-Vocab': An Augmented Reality English Vocabulary Mobile Application to Cater to Mild Autism Children in Response towards Sustainable Education for Children with Disabilities." *Sustainability* 14.8: 4831.

Huang, H., Hwang, G.-J., and Chang, S.-C. (2021). Facilitating decision making in authentic contexts: an SVVR-based experiential flipped learning approach for professional training. *Interact. Learn. Environ.*, 1–17. doi: 10.1080/10494820.2021.2000435

Hwang, G.-J., and Chien, S.-Y. (2022). Definition, roles, and potential research issues of the metaverse in education: an artificial intelligence perspective. *Comput. Educ. Artif. Intell.* 3:100082. doi: 10.1016/j.caeai.2022.100082

Hwang GJ, Chien SY. 2022. Definition, roles, and potential research issues of the Metaverse in education: an artificial intelligence perspective. *Computers and Education:*

Ismayatim, W. F. A., Yunus, M. M., Zamri, N. A., Nazri, N. D. M., & Hashim, H. (2019). Enhancing 21st century students listening skills via augmented reality and mobile applications. *International Journal of Innovation, Creativity and Change*.

Jamrus, M. H. M., & Razali, A. B. (2021). Acceptance, readiness and intention to use augmented reality (AR) in teaching English reading among secondary school teachers in Malaysia. *Asian Journal of University Education*, *17*(4), 312-326.

Jeon, J. H. (2021). A study on the principle of Metaverse composition with a focus on Roblox. *Korean Assoc. Vis. Cult.* 38, 257–279. doi: 10.21299/jovc.2021.38.10

Kang, Y. (2021). Metaverse framework and building block. *J. Korea Inst. Inf. Commun. Eng.* 25, 1263–1266. doi: 10.6109/JKIICE.2021.25.9.1263

Kim, J. H., Lee, B. S., and Choi, S. J. (2022). A study on metaverse construction and use cases for non-face-to-face education. *J. Converg. Cult. Technol.* 8, 483–497. doi: 10.17703/JCCT.2022.8.1.483

Keshavarzi, M., Yang, A.Y., Ko, W., & Caldas, L. (2020). Optimization and manipulation of contextual mutual spaces for multi-user virtual and augmented reality interaction.

Kim, C., & Park, J. (2022). An exploratory study on the production of Metaverse ethics education contents for adolescents. Easy Chair

Kim, S., Song, K., Lockee, B., & Burton, J. (2018). *Gamification in learning and education*. New York: Springer.

Koo, H. (2021). Training in lung cancer surgery through the Metaverse, including extended reality, in the smart operating room of Seoul National University Bundang Hospital, Korea. *Journal of Educational Evaluation for Health Professions* 18:33

Ko, H., Jeon, J., and Yoo, I. (2022). Metaverse platform-based flipped learning framework development and application. *J. Korean Assoc. Inf. Educ.* 26, 129–140. doi: 10.14352/jkaie.2022.26.2.129

Kocur, M., Graf, S., and Schwind, V. (2020). *The Impact of Missing Fingers in Virtual Reality. 26th ACM Symposium on Virtual Reality Software and Technology*. doi: 10.1145/3385956.3418973

Koenen, A.-K., Dochy, F., and Berghmans, I. (2015). A phenomenographic analysis of the implementation of competence-based education in higher education. *Teach. Teach. Educ.* 50, 1–12. doi: 10.1016/j.tate.2015.04.001

Koo, H. (2021). Training in lung cancer surgery through the metaverse, including extended reality, in the smart operating room of Seoul National University Bundang hospital, Korea. *J. Educ. Eval. Health Prof.* 18:33. doi: 10.3352/jeehp.2021.18.33

Kye, B., Han, N., Kim, E., Park, Y., & Jo, S. (2021). Educational applications of Metaverse: possibilities and limitations. *Journal of Educational Evaluation for Health Professions* 18:32

Kye, B., Han, N., Kim, E., Park, Y., and Jo, S. (2021). Educational applications of metaverse: possibilities and limitations. *J. Educ. Eval. Health Prof.* 18:32. doi: 10.3352/jeehp.2021.18.32

Marini, A., Nafisah, S., Sekaringtyas, T., Safitri, D., Lestari, I., Suntari, Y., Umasih, Sudrajat, A., & Iskandar R. (2022). Mobile augmented reality learning media with Metaverse to improve student learning outcomes in science class. *International Journal of Interactive Mobile Technologies* 16(7):99-115

Mohammad, S. N., Yusof, M. K. T. M., Puaad, M. B. F. M., Jamal, M. H., & Wee, L. S. (2023). Investigating students' perception and preferences of online learning in UiTM Pasir Gudang Campus. *Asian Journal of University Education*, *19*(1), 223-234.

Mohtar, M., & Md Yunus, M. (2022). A systematic review of Online Learning during COVID 19: Students' motivation, Task Engagement and Acceptance. *Arab World English Journal (AWEJ) 2nd Special Issue on Covid*, *19*

Nordin, N., Embi, M. A., & Yunus, M. M. (2010). Mobile learning framework for lifelong learning. *Procedia-Social and Behavioral Sciences, 7,* 130-138.

Park, J. (2021). Exploring the possibility of using metaverse in Korean language education. *J. Int. Netwk Korean Lang. Cult.* 18, 117–146. doi: 10.15652/ink.2021.18.3.117

Park, J.-Y., and Jeong, D.-H. (2022). Exploring issues related to the metaverse from the educational perspective using text mining techniques - focusing on news big data. *J. Ind. Converg.* 20, 27–35. doi: 10.22678/jic.2022.20.6.027

Park, S.-M., and Kim, Y.-G. (2022). A metaverse: taxonomy, components, applications, and open challenges. *IEEE Access* 10, 4209

Plata, S., De Guzman, M. A., & Quesada, A. (2023). Emerging research and policy themes on academic integrity in the age of chat GPT and generative AI. *Asian Journal of University Education*, *19*(4), 743-758.

Taylor, S., and Soneji, S. (2022). Bioinformatics and the metaverse: are we ready? *Front. Bioinformatics* 2:863676. doi: 10.3389/fbinf.2022.863676

Thomason, J. (2022). Metaverse, token economies, and chronic diseases. *Global Health J.* doi: 10.1016/j.glohj.2022.07.001

Tlili A, Huang R, Shehata B, Liu D, Zhao J, Metwally AHS, Wang H, Denden M, Bozkurt A, Lee L-H+11 more. (2022). Is Metaverse in education a blessing or a curse: a combined content and bibliometric analysis? *Smart Learning Environments* 9(1):1-3

Tlili, A., Huang, R., Shehata, B., Liu, D., Zhao, J., Metwally, A. H. S., et al. (2022). Is Metaverse in education a blessing or a curse: a combined content and bibliometric analysis. *Smart Learn. Environ.* 9, 1–31. doi: 10.1186/s40561-022-00205-x

Tong, X., Gupta, A., Lo, H., Choo, A., Gromala, D., & Shaw, C.D. (2017). Chasing lovely monsters in the wild, exploring players' motivation and play patterns of Pokémon go: Go, gone, or go away?

Toquero CM. (2020). Challenges and opportunities for higher education amid the COVID-19 pandemic: the Philippine context. *Pedagogical Research* 5(4):em0063

Sim, S. P. L., Sim, H. P. K., & Quah, C. S. (2021). Online learning: A post COVID-19 alternative pedagogy for university students. *Asian Journal of University Education, 16*(4), 137-151.

Shen, B., Tan, W., Guo, J., Zhao, L., and Qin, P. (2021). How to promote user purchase in metaverse? A systematic literature review on consumer behavior research and virtual commerce application design. *Applied Sciences* 11:11087. doi: 10.3390/app112311087

Shin, D. (2022). The actualization of meta affordances: conceptualizing affordance actualization in the metaverse games. *Comput. Hum. Behav.* 133:107292. doi: 10.1016/j.chb.2022.107292

Sparkes, M. (2021). What is a metaverse. *New Scientist.* 251:18. doi: 10.1016/s0262-4079(21)01450-0Stanford University. (2021). Comm 166/266.
Available at: https://stanfordvr.com/comm166/ (Accessed August 03, 2022)

Suzuki, S., Kanematsu, H., Barry, D. M., Ogawa, N., Yajima, K., Nakahira, K. T., et al. (2020). Virtual experiments in Metaverse and their applications to collaborative projects: the framework and its significance. *Procedia Comput. Sci.* 176, 2125–2132. doi: 10.1016/j.procs.2020.09.249

World Economic Forum. 2019. We all have a 'hierarchy of needs'. But is Technology Meeting Them?

Zallio, M., & Clarkson, P.J. (2022). Designing the Metaverse: a study on inclusion, diversity, equity, accessibility and safety for digital immersive environments. *Telematics and Informatics, 75*(1, 4):101909

Zhang, W., Han, B., Hui, P. (2022). SEAR: scaling experiences in multi-user augmented reality.

Zhao, Y., Jiang J, Chen Y, Liu R, Yang Y, Xue X, Chen S. (2022). Metaverse: perspectives from graphics, interactions, and visualization. *Visual Informatics 6*(1):56-67