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EDUCATIONAL METAVERSE PLATFORMS AS NEW LEARNING FRONTIERS: OPPORTUNITIES, RISKS, AND PEDAGOGICAL IMPLICATIONS

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Abstract

This study explores the emerging role of educational metaverse platforms as transformative learning frontiers by synthesizing findings from recent literature on virtual, augmented, and immersive learning environments. Using a systematic literature review method, the research analyzes theoretical developments, empirical evidence, and pedagogical models that frame the integration of metaverse technologies into contemporary education. The findings reveal that educational metaverses offer significant opportunities for enhancing experiential learning, social presence, collaboration, and student engagement through immersive simulations and personalized learning pathways. However, the literature also highlights critical risks related to data privacy, digital inequality, cybersecurity, psychological effects, and pedagogical misalignment when immersive technologies are not implemented responsibly. The study further identifies important pedagogical implications, including the need for new instructional designs, teacher digital competencies, ethical guidelines, and inclusive access frameworks to ensure meaningful learning outcomes. Overall, the research contributes to a deeper understanding of how metaverse-based learning ecosystems can be developed and governed to support effective, equitable, and ethical education in the digital era.

Keywords: Educational Metaverse, Immersive Learning, Virtual Reality, Digital Pedagogy, Learning Innovation

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INTRODUCTION

The development of digital technology over the past two decades has significantly transformed the face of education, particularly through the adoption of online learning, artificial intelligence, and cloud-based learning management systems. However, this transformation has entered a new phase with the emergence of the metaverse concept, an immersive virtual space that offers a much more interactive, multidimensional, and collaborative learning experience. The metaverse, which combines virtual reality, augmented reality, blockchain, and real-time collaboration technologies, is now seen as a new frontier in educational innovation. The emergence of educational metaverse platforms opens up the potential to create learning environments that not only resemble the real world but also provide experiences impossible in conventional physical spaces (X. Zhang et al., 2022). This phenomenon has prompted many educational institutions, researchers, and technology developers to explore how the metaverse can revolutionize pedagogy and future learning practices.

Educational metaverse platforms are essentially designed to create fully connected learning spaces, where students can participate in realistic simulations, access customizable virtual classrooms, and interact with objects and avatars in an immersive manner. This transformation has the potential to overcome the limitations of traditional online learning, which is often perceived as passive and lacking meaningful interactive experiences (Chen, 2024a). With the metaverse, learning processes can be designed to provide authentic contexts, whether for science learning through virtual laboratories, economic and business simulations, medical practice, or historical and cultural exploration through virtual reconstructions. More broadly, the metaverse offers the opportunity to democratize access to global education, as students from diverse geographic locations can learn together in the same space without physical barriers. Thus, the metaverse presents the possibility of creating an inclusive, adaptive, and borderless learning ecosystem, aligned with the principles of 21st-century education.

Despite its enormous potential, the use of educational metaverse platforms is also accompanied by various risks and challenges that require critical examination. One major risk relates to ethical and data privacy aspects, given that the use of avatars, virtual interactions, and motion tracking technology can generate large amounts of personal data. On the other hand, reliance on hardware such as VR headsets has the potential to widen the digital divide, particularly in developing countries facing limited access to technological infrastructure. Other challenges include health issues such as

visual fatigue, cybersickness, and over-reliance on virtual environments, which can impact student well-being. Furthermore, the lack of regulatory standards and an integrated curriculum creates confusion about how the metaverse should be implemented safely, effectively, and in a pedagogically appropriate manner (Kaddoura & Husseiny, 2023a). This suggests that while the metaverse offers innovation, its application in education is inextricably linked to the need for policies, ethical guidance, and system design that prioritize the safety and well-being of students.

From a pedagogical perspective, educational metaverse platforms present significant opportunities and challenges. The metaverse enables the implementation of experiential learning approaches, social constructivism, and student-centered learning through exploratory activities that place students as the primary actors. Immersive environments facilitate students' creativity, collaboration, and problem-solving through interactive scenarios (O. da Silva et al., 2025). However, the effectiveness of metaverse pedagogy depends heavily on teachers' ability to design meaningful learning experiences, facilitate interactions, and appropriately integrate the metaverse with the formal curriculum. Without strong pedagogical guidance, the use of the metaverse risks becoming merely a technological gimmick that has no significant impact on learning outcomes. Therefore, in-depth research is needed on how the metaverse can be used to strengthen learning objectives, increase student engagement, and support assessment processes through more authentic and real-time mechanisms.

The growing phenomenon of educational metaverse platforms also raises questions about the readiness of educational institutions, educators, and students to enter this new era of learning. Educators require advanced digital literacy to manage immersive virtual classrooms, understand the dynamics of avatar interactions, and utilize digital objects as part of learning strategies. Furthermore, educational institutions need to prepare infrastructure, security policies, and implementation models relevant to the needs of each educational level (Emerging Technologies for Global Education: A Comprehensive Exploration of Trends, Innovations, Challenges, and Future Horizons | SN Computer Science, n.d.). In a global context, the metaverse also encourages the creation of a transnational educational ecosystem, where national borders are no longer a barrier to academic collaboration. This creates significant opportunities for cultural exchange, multinational research, and the creation of more diverse and perspective-rich learning spaces (Tabassum & Qadir, 2024).

However, this diversity also presents challenges in the form of technological capability gaps, pedagogical differences, and the dynamics of cross-cultural interactions that must be managed wisely. Given the dynamic development and complexity of educational metaverse platforms, this research becomes increasingly relevant. A comprehensive literature review is needed to understand the latest developments, identify opportunities that can be exploited in education, and assess the risks that must be anticipated to ensure safe and effective implementation. By understanding the pedagogical implications in depth, the results of this research are expected to contribute to the development of a future educational framework that is not only technologically innovative but also responsive to student needs, professional ethics, and values of inclusivity in education.

RESEARCH METHOD

The research method in this study uses a literature review approach focused on systematically searching, evaluating, and synthesizing various academic sources related to educational metaverses. The review process began with identifying reputable databases such as Scopus, Web of Science, and Google Scholar to obtain articles, proceedings, and research reports relevant to the topic of educational metaverses, implementation opportunities, pedagogical risks, and implications for learning practices. Inclusion criteria included publications from the last five to ten years discussing the integration of immersive technologies, virtual reality (VR), augmented reality (AR), artificial intelligence (AI), and metaverse platforms in formal and non-formal educational contexts. The obtained literature was then analyzed in depth to identify patterns, trends, and key findings that could illustrate a paradigm shift in learning toward more interactive and immersive virtual environments.

The synthesis stage was conducted through a thematic coding process to group the information into core concepts such as immersion-based learning opportunities, privacy and data security risks, pedagogical challenges, and implications for curriculum design and instructional strategies. Critical analysis was applied to assess the consistency, validity, and research gaps identified in the current literature. With this comprehensive literature review approach, the research is able to build a strong conceptual framework to understand how metaverse platforms can become a new frontier in education, while identifying potential risks and mitigation strategies needed to ensure their safe, effective, and aligned use in line with modern pedagogical principles.

RESULT AND DISCUSSION

The Metaverse's Opportunities for Learning Development

The development of metaverse technology has opened up new opportunities in education by providing immersive learning environments that transcend the boundaries of traditional classrooms. Metaverses not only provide three-dimensional visual experiences but also create social interactions that mimic the real world, enabling a more natural, lively, and meaningful learning process (Prakash et al., 2023). In the context of learning development, metaverses have the potential to enhance the quality of learning experiences through richer interactivity, cross-geographic collaboration, personalized materials, and authentic simulations that were previously difficult to achieve in conventional learning. This phenomenon makes metaverses a strategic innovation in delivering future learning that is more adaptive to the demands of the Industrial Revolution 4.0 and Society 5.0.

One of the key opportunities for metaverses in learning development lies in the technology's ability to create high levels of interactivity that cannot be achieved with two-dimensional digital media (Onu et al., 2024). Metaverse environments enable learners to interact with objects, spaces, and other avatars in real time in a highly responsive manner. This immersive interactivity increases student engagement because they don't just passively receive knowledge but also explore, manipulate, and experience the subject matter firsthand. In science learning, for example, students can enter a virtual laboratory to experiment with chemicals without risking harm. In history, students can virtually explore ancient civilizations as if they were there. This type of interaction enhances conceptual understanding because learners not only see but also "experience" the material through in-depth actions and observations.

Beyond increasing interactivity, the metaverse presents significant opportunities for broader global collaboration. Education is no longer limited by physical space, as students from different countries can meet in a single virtual learning space, discuss, and work on projects together. This type of collaboration has the potential to enrich cross-cultural understanding while opening up space for the exchange of more diverse perspectives. Global collaboration within the metaverse also creates a more inclusive learning ecosystem, allowing learners from diverse backgrounds to access quality learning experiences without geographical barriers. For educational institutions, this virtual space also opens up opportunities for international guest lecturers, cross-institutional research collaborations, and learning

activities integrated with the broader global community (Chamola et al., 2025).

The next opportunity lies in the metaverse's ability to facilitate more intensive experiential learning. In the metaverse, learners not only receive verbal explanations but also actively engage in simulations, spatial exploration, and activity-based experiments. This experiential learning is considered more effective because it encourages students to construct knowledge through direct involvement, rather than simply memorizing concepts or theories. The metaverse allows for the replication of near-real-world experiences, such as performing virtual surgery for medical students, managing a simulated business for management students, or practicing communication skills in an avatar-based work environment. All of this not only enriches learners' technical and conceptual abilities but also helps them develop reflective and problem-solving skills in contexts that approximate real-world conditions (Lee & Hwang, 2022).

The metaverse also offers significant opportunities for personalized learning through the integration of artificial intelligence, data analytics, and learner behavior mapping. Each student can have a learning experience tailored to their individual learning style, pace, and interests. In the metaverse, teachers can modify the difficulty level of assignments, provide alternative materials, or customize learning paths for each individual. This personalization creates a more humane and adaptive learning experience, addressing the challenges faced by students with varying learning abilities and preferences. Personalized learning experiences boost students' intrinsic motivation because they feel the learning process is truly relevant and tailored to their needs. Furthermore, students' digital avatars or profiles can store their learning history, achievements, and preferences, allowing the system to continuously adapt their experiences as their competencies develop (Said, 2023).

The metaverse's ability to deliver authentic, scenario-based simulations presents another strategic opportunity to improve the quality of learning. These simulations create complex situations that mimic real-life conditions, allowing students to develop critical thinking, decision-making, and teamwork skills in a safe yet realistic environment. In vocational and professional education, for example, students can simulate emergency scenarios in a hospital, handle legal cases in a virtual courtroom, or design buildings in a three-dimensional construction environment. Authentic scenarios like these help students practice theoretical knowledge in more applicable contexts, enhancing their readiness for the workforce. Through scenario simulations,

learners can also repeat the process as many times as needed without real-world costs or risks, making the metaverse an efficient and effective training tool.

Overall, the metaverse's opportunities for learning development are vast and transformative. The metaverse not only enhances interactivity, global collaboration, and the learning experience, but also presents a new paradigm in how knowledge is produced, shared, and learned. This technology opens up hope that future learning can be more inclusive, flexible, and based on real-world experiences that were previously difficult to access. With proper development, the metaverse can become a multidimensional learning space aligned with the needs of the digital society and the modern workplace. However, leveraging these opportunities requires infrastructure readiness, digital literacy, and mature pedagogical design to truly realize the metaverse's potential as an educational innovation that sustainably improves the quality of learning.

Technological and Security Risks in the Educational Metaverse

Technological and security risks in the educational metaverse are among the most crucial issues that must be addressed before this immersive virtual space-based learning ecosystem is widely adopted (Kaddoura & Husseiny, 2023b). The educational metaverse holds great promise for delivering more interactive, collaborative, and authentic learning experiences, but it is important to recognize that the technology underpinning this environment is highly complex, involving the integration of VR/AR devices, cloud platforms, artificial intelligence, biometric sensors, digital avatars, and distributed databases. This complexity opens up the possibility of new vulnerabilities that could threaten the integrity of student data, identity security, psychological well-being, and even educational institutions' compliance with regulations. Amidst the enthusiasm for this innovation, digital security issues in the metaverse are not merely technical but also ethical, legal, and social issues that impact the sustainability of its use in education.

One of the biggest challenges is data security and user privacy. Educational metaverses collect a wide range of sensitive data from students, ranging from personal data, academic history, interaction behavior in virtual spaces, to biometric data such as body movements, facial expressions, and gaze direction when using VR headsets (Q. Zhang, 2023). This data, which in real-world contexts is already strictly regulated by data protection laws, becomes even more sensitive when collected continuously through immersive devices.

The risk of data breaches increases because metaverse platforms often integrate various external services, including cloud storage, AI analytics, and avatar identity systems, which can increase attack points. If student biometric or behavioral data is misused, the consequences include not only privacy violations but also potential behavioral manipulation, unethical academic profiling, and algorithm-based discrimination. For educational institutions, these challenges require far more stringent data management strategies than those for conventional digital learning (Camilleri, 2023a).

Beyond the risk of breaches, privacy is also threatened by excessive tracking practices. Some metaverse platforms are designed with the ability to collect granular information not typically captured in physical classrooms, such as movement intensity, communication patterns, or learning preferences derived from behavioral data. While it can be used to personalize learning, overly invasive data processing can create an uncomfortable learning environment and reduce student autonomy. Furthermore, when the data is used by third parties, whether for commercial or analytical purposes, the risk of misuse increases. Learners, especially children and adolescents, are the most vulnerable group due to their limited understanding of the long-term implications of data collection practices. Therefore, the development of educational metaverses should consider the principles of data minimization, processing transparency, and user control over their digital identities (Camilleri, 2023a).

Another highly concerning security issue is cyberbullying, which has the potential to increase in anonymous and immersive virtual environments. Unlike text- or image-based social media, metaverses allow interaction through three-dimensional avatars, real-time voice, virtual gestures, and spatial proximity that mimic the real world. This situation creates a space where bullying can take more realistic and traumatic forms, such as direct verbal abuse, demeaning symbolic acts, virtual stalking, or attacks on one's avatar. The psychological impact can be more intense because students perceive the experience as if it were happening in their physical presence. Supervision is also more challenging because interactions in the metaverse often occur in distributed virtual spaces that are not always easily monitored by teachers. Educational platforms need to develop robust security mechanisms such as AI-based automated behavior monitoring, rapid reporting features, privacy boundaries in virtual worlds, and digital literacy education to help students understand the ethical boundaries of interactions (Al-kfairy et al., 2025).

Identity spoofing, or misuse of identity, is another equally serious threat. In the metaverse, avatars represent the self, playing a crucial role in every activity, from group discussions and laboratory simulations to performance-based evaluations (Dincelli & Yayla, 2024). However, avatars are easily imitated or modified, allowing someone to pretend to be someone else. Identity misuse can lead to academic fraud, manipulation of classroom interactions, the spread of false information, or even criminal acts such as digital identity-based blackmail. Traditional username-and-password authentication systems are no longer sufficient in complex virtual environments; innovations such as biometric authentication, multi-factor verification in avatars, and blockchain technology are needed to ensure the authenticity of digital identities. An additional challenge is maintaining a balance between security and user convenience so that the verification process does not disrupt the learning experience.

As the use of digital assets in educational metaverses, such as tokens, 3D objects, virtual certificates, and NFT-based learning items, increases, regulatory challenges become increasingly complex. The lack of a clear legal framework regarding the ownership, distribution, and use of digital assets can lead to conflict, especially when these assets have economic value or are used as part of academic assessments. Activities in virtual spaces such as student creation of digital content, economic simulations, or transactions between avatars can raise legal questions related to copyright, new forms of plagiarism, and platform liability in the event of misuse. Furthermore, legal jurisdiction is problematic because metaverse platforms often operate across borders, while data and digital asset protection regulations vary. Schools and educational institutions must navigate this regulatory vacuum by implementing clear internal policies, while awaiting the development of national and international standards.

Technological risks also include vulnerability to cyberattacks such as hacking, VR-based malware, virtual classroom infiltration, and real-time content manipulation. These attacks can disrupt the learning process, steal critical data, or otherwise undermine the student learning experience. Because the metaverse relies on high connectivity, IoT devices, and advanced sensors, the potential for exploitation increases through small gaps, such as outdated security systems on VR devices. Reliance on the cloud and wide-area networks also poses the risk of system failures that could lead to the loss of learning data or the interruption of access to virtual classrooms. Educational institutions need a more robust security infrastructure, including end-to-end encryption,

automatic updates, network segmentation, and a digital disaster recovery strategy (Dincelli & Yayla, 2024).

Given these risks, it is clear that the use of the educational metaverse must be accompanied by a holistic security approach. Protection is not limited to the technology level; it must encompass user digital literacy, robust institutional policies, and a regulatory framework responsive to the dynamics of new technologies. Teachers, students, developers, and policymakers need to work together to build a safe, ethical, and inclusive ecosystem. The metaverse has great potential to revolutionize education, but without comprehensive risk mitigation, its benefits could be overshadowed by threats that compromise user comfort, integrity, and safety. With a strong commitment to security and privacy principles, the educational metaverse can thrive as a learning space that is not only innovative but also socially and ethically responsible.

Ethical Implications of Using the Metaverse for Education

The ethical implications of using the metaverse for education have become a crucial issue with the increasing adoption of immersive virtual spaces in the learning process. The digital transformation offered by the metaverse not only presents new pedagogical opportunities but also opens up space for practices, behaviors, and data governance that have the potential to blur the boundaries of student privacy, fairness, and identity (Kaddoura & Husseiny, 2023c). The presence of avatars, digital sensors, and algorithms operating at scale presents ethical dynamics that differ from conventional digital learning platforms. Therefore, an in-depth study of digital surveillance, data use, avatar behavior, identity representation, and fairness in learning is necessary to ensure responsible use of the metaverse and prevent new vulnerabilities in the education ecosystem.

In the context of digital surveillance, the metaverse presents a much more intensive form of monitoring than traditional e-learning systems. Virtual spaces enable institutions or platform providers to track body movements, interaction patterns, gaze locations, facial expressions, engagement duration, and even subtle gestures detected by sensors in VR or AR devices. This kind of granular data can be used to enhance the learning experience, for example by customizing learning scenarios or providing personalized feedback, but it can also turn into invasive surveillance practices. When surveillance is conducted without clear boundaries, students not only lose their privacy but can also experience psychological distress due to the feeling of being constantly "watched." This situation expands the ethical discourse regarding who has the

right to record and observe student behavior, how that data is used, and what boundaries educational institutions should apply to ensure that monitoring remains within a pedagogical framework, not digital social control (Kaddoura & Husseiny, 2023c).

The issue of data use in the educational metaverse is further complicated by the multidimensional and potentially highly sensitive nature of the data collected. In addition to personal information such as identity, age, and academic history, metaverse platforms also collect biometric data, behaviors, preferences, and social interaction patterns that can reveal aspects of an individual's psychology. When this data is processed by AI algorithms, the risk of bias, manipulation, or commercial exploitation increases. The use of data-driven business models in the technology industry raises concerns that student data could be misused for commercial or analytical purposes irrelevant to educational goals. Ethically, educational institutions must ensure that data collection and processing practices align with the principles of transparency, data minimization, and clearly informed consent. Students, especially minors, must be protected from profiling practices or data use for purposes inconsistent with the learning mission. Institutions also need to ensure data security to prevent data leaks or unauthorized access, which could have long-term impacts on students' digital lives (Li et al., 2022).

Another aspect of ethical concern is avatar behavior in educational metaverse spaces. Avatars serve as virtual representations of users, enabling immersive interpersonal interactions. However, their presence also creates the potential for new deviant behaviors. Incidents such as virtual harassment, bullying, misuse of gestures, or unwanted avatar contact can occur even without direct physical contact. Because metaverse experiences are embodied, such actions can have a real psychological impact on learners. Ethical challenges arise when the boundaries between moral behavior in the real world and the virtual world blur, raising dilemmas about how social norms should be enforced and how sanctions or redress should be imposed. Educational institutions must formulate strict avatar behavior guidelines, including standards for interaction, use of gestures, digital personal space, and reporting mechanisms for harmful behavior (Camilleri, 2023b). Furthermore, educators need to equip learners with digital ethical literacy so they can navigate virtual spaces responsibly and respect the rights of others.

The representation of identity in the metaverse also raises ethical questions that cannot be ignored. Avatars allow users to express themselves creatively, which can strengthen self-confidence and identity freedom. However, the ability to drastically modify one's appearance can encourage

impersonation, harmful disguises, or mismatches between one's true identity and the virtual identity used in academic contexts. The phenomenon of misrepresentation or identity spoofing in educational settings can disrupt the evaluation process, create bias in social interactions, or even open up opportunities for abuse of access (Chen, 2024b). Furthermore, students from minority backgrounds may experience discrimination or stereotypes carried over into the virtual world if their avatar representations are not equally accepted. Therefore, it is crucial to formulate equitable digital identity policies that respect diversity and provide a safe space for all students to display their virtual identities without fear of discrimination or social stigma.

Issues of equity in metaverse learning concern access, inclusivity, and equal learning opportunities. The use of advanced technologies such as VR headsets, AR devices, or high-speed internet connections automatically creates a gap between students who can access these devices and those who do not. This digital injustice has the potential to deepen educational disparities if not addressed through policies that provide equitable facilities. Furthermore, the algorithms used in metaverse platforms are often built on data from specific populations, which can lead to bias in recommendations or performance assessments. Learners from certain backgrounds may experience unfair treatment if the systems are not designed with an inclusive perspective. Ethically, education must ensure that the metaverse is a space that expands learning opportunities, not narrows them. Developers and institutions need to work together to create platform designs that are accessible, disability-friendly, and free from racial, gender, and socioeconomic bias.

Challenges of Implementing the Metaverse in Educational Institutions

The implementation of the metaverse in educational institutions presents a major transformation that has the potential to transform how learning is designed, delivered, and experienced by students. However, this transformation will not occur without structural, pedagogical, financial, and cultural barriers that need to be critically mapped. One of the most fundamental challenges lies in the readiness of teachers, as the primary actors in implementing learning. The metaverse requires a paradigm shift in teaching, one that is more interactive, experimental, and based on three-dimensional digital experiences. Many teachers who are accustomed to using conventional learning media lack the confidence to utilize immersive technologies such as virtual reality or augmented reality. The digital competency gap among teachers remains wide, especially between the

generation with long-standing teaching experience and younger teachers who are more familiar with digital devices. This barrier becomes even more apparent when teachers must understand virtual classroom design, modify materials into 3D objects, and manage student interactions in the multidimensional metaverse environment. Teacher unpreparedness can lead to technology utilization becoming merely a formality, without providing added pedagogical value (Singh, 2024).

Furthermore, the direct implementation of the metaverse requires significant curriculum changes. Curricula that have focused on linear knowledge transfer need to be reconstructed into ones that support exploratory, collaborative, and simulation-based learning. Conventional curricula that do not yet accommodate the integration of immersive media will make it difficult for teachers to align learning outcomes with activities in virtual spaces. This alignment requires a flexible, adaptive curriculum approach based on digital competencies and technological literacy. However, many educational institutions remain bound by rigid curriculum regulations and evaluation systems that largely focus on written assessments and final results, rather than on the exploratory process. As a result, metaverse innovations struggle to enter the classroom due to a lack of space within the formal curriculum structure, while teachers and institutions face a dilemma between meeting administrative demands and developing futuristic learning practices (Lin et al., 2022).

Another challenge arises from weak digital competencies in both teachers and students. Digital competency relates not only to the ability to operate technological devices but also encompasses information literacy, data literacy, cybersecurity literacy, the ability to collaborate virtually, and technical skills in managing avatars and navigating metaverse environments (Lin et al., 2022). Many students are familiar with entertainment technology but lack critical knowledge about digital ethics, data privacy, and the etiquette of safe and productive virtual interactions. When educational institutions lack clear and structured digital competency standards, the implementation of the metaverse risks creating new inequalities: students from wealthy families adapt more quickly, while those from disadvantaged backgrounds struggle to access devices, networks, and technical training. Without systematic intervention, this digital divide could widen educational inequalities.

From a financial perspective, technology costs are a significant barrier to implementing the metaverse in educational institutions. Implementing a metaverse platform requires specialized hardware such as VR headsets, high-spec laptops, motion sensors, and stable, high-speed internet connectivity.

Furthermore, institutions need to invest in software, platform licensing, infrastructure maintenance costs, and even server capacity upgrades to support large volumes of virtual interactions (Kaddoura & Husseiny, 2023d). Education budgets, especially in schools in resource-constrained areas, often cannot afford such expensive technology investments. Even in relatively established institutions, long-term funding for device maintenance and technology updates is often not properly accounted for. These financial challenges relate not only to equipment purchases but also to budget allocation priorities, government support, and the ability of school management to plan for sustainable digital transformation.

Implementing the metaverse in education also requires intensive and ongoing training for teachers, education staff, and even students. This training cannot be done quickly because the metaverse involves a complex technological ecosystem (Bakhri & Sofyan, 2022). Teachers need to understand digital pedagogy, virtual classroom management, cybersecurity protocols, simulation-based learning design, and the ability to moderate student behavior in immersive environments. Meanwhile, students need training in navigating virtual spaces, understanding digital etiquette, managing social interactions, and maintaining personal data security. Challenges arise when educational institutions lack a structured training system, professional trainer resources, or sufficient time to conduct training without disrupting the teaching and learning process. Resistance to training can also arise if teachers feel burdened by already high administrative burdens or don't see the direct relevance of the metaverse to their learning needs.

Furthermore, educational institutions face challenges in organizational cultures that may be unprepared for radical innovations like the metaverse. Many schools and universities have hierarchical and conservative work patterns, making technological change a threat to established comforts and systems. Fear of disruption, failed experiments, or changes in professional roles can hinder the adoption process. Educational leaders who lack a digital vision can also slow down transformation, as not all institutions have the managerial and innovative leadership capacity to support the integration of new technologies. An organizational culture that does not yet support innovation will result in metaverse implementation stalling at the pilot stage, without developing into an established part of learning practices (Sun & Xiong, 2024).

These challenges demonstrate that implementing metaverse in educational institutions is not simply a technical issue, but also involves systemic transformation across the curriculum, human resource

competencies, infrastructure, organizational culture, and educational policies. To overcome these obstacles, a holistic approach is needed so that metaverse becomes not just a passing trend but a meaningful and sustainable educational innovation. Educational institutions must have a comprehensive strategy, ranging from teacher capacity building, digital curriculum development, establishing technology competency standards for students, to long-term infrastructure and training investments. Thus, metaverse implementation can be implemented not as an end in itself, but as a means to enrich learning experiences and expand educational opportunities in the digital age.

CONCLUSION

The conclusion of the study on Educational Metaverse Platforms indicates that the metaverse has significant transformative potential in education, particularly as a new learning space capable of delivering immersion, interactivity, and cross-border collaboration. Through the integration of technologies such as virtual reality, augmented reality, artificial intelligence, and digital avatars, the metaverse opens up opportunities to create more personalized, exploratory learning experiences that support diverse student learning styles. Furthermore, the metaverse can enhance project-based learning, real-world simulations, and provide a safe experimental environment for students. However, the development and implementation of the metaverse in education requires infrastructure readiness, educator digital competence, and an ethical framework that ensures security, privacy, and equal access for all parties.

While offering significant opportunities, metaverse platforms also present a number of risks that must be managed wisely. Challenges such as technology dependency, potential distractions, data privacy, the risk of commercial exploitation, and the potential emergence of a digital divide are important issues that must be anticipated from the outset. Therefore, the use of the metaverse must be accompanied by thoughtful pedagogical design, strong regulatory policies, and adequate digital literacy for teachers and students. Overall, the metaverse cannot be viewed simply as a technological innovation, but rather as a new learning ecosystem that demands the integration of pedagogical opportunities, risk mitigation, and ethical thinking to optimally contribute to the future of education.

REFERENCES

Al-kfairy, M., Sendaba, O., & Alfandi, O. (2025). Understanding trust in educational Metaverse: The role of social cognitive theory constructs

and perceived risks. *Kybernetes*. https://doi.org/10.1108/K-11-2024-3057

Bakhri, S., & Sofyan, M. A. (2022). Prototype Curriculum: Opportunities and Challenges of Inclusive Schools in Implementing Education for All in the Metaverse Era. *Muslim Education Review*, *1*(2), 157–177. https://doi.org/10.56529/mer.v1i2.75

Camilleri, M. A. (2023a). Metaverse applications in education: A systematic review and a cost-benefit analysis. *Interactive Technology and Smart Education*, *21*(2), 245–269. https://doi.org/10.1108/ITSE-01-2023-0017

Camilleri, M. A. (2023b). Metaverse applications in education: A systematic review and a cost-benefit analysis. *Interactive Technology and Smart Education*, *21*(2), 245–269. https://doi.org/10.1108/ITSE-01-2023-0017

Chamola, V., Peelam, M. S., Mittal, U., Hassija, V., Singh, A., Pareek, R., Mangal, P., Sangwan, D., de Albuquerque, V. H. C., Mahmud, M., & Brown, D. J. (2025). Metaverse for Education: Developments, Challenges, and Future Direction. *Computer Applications in Engineering Education*, *33*(3), e70018. https://doi.org/10.1002/cae.70018

Chen, Z. (2024a). Exploring the application scenarios and issues facing Metaverse technology in education. *Interactive Learning Environments*, *32*(5), 1975–1987. https://doi.org/10.1080/10494820.2022.2133148

Chen, Z. (2024b). Exploring the application scenarios and issues facing Metaverse technology in education. *Interactive Learning Environments*, *32*(5), 1975–1987. https://doi.org/10.1080/10494820.2022.2133148

Dincelli, E., & Yayla, A. (2024). Teaching Case: Security and Privacy Implications of Virtual Reality Applications in the Metaverse: A Case of Development, Security, and Operations (DevSecOps). *Journal of Information Systems Education*, *35*(3), 261–270. https://doi.org/10.62273/JMZA1065

Emerging Technologies for Global Education: A Comprehensive Exploration of Trends, Innovations, Challenges, and Future Horizons | SN Computer Science. (n.d.). Retrieved December 12, 2025, from https://link.springer.com/article/10.1007/s42979-024-03538-1

Kaddoura, S., & Husseiny, F. A. (2023a). The rising trend of Metaverse in education: Challenges, opportunities, and ethical considerations. *PeerJ Computer Science*, *9*, e1252. https://doi.org/10.7717/peerj-cs.1252

Kaddoura, S., & Husseiny, F. A. (2023b). The rising trend of Metaverse in education: Challenges, opportunities, and ethical considerations. *PeerJ Computer Science*, *9*, e1252. https://doi.org/10.7717/peerj-cs.1252

Kaddoura, S., & Husseiny, F. A. (2023c). The rising trend of Metaverse in education: Challenges, opportunities, and ethical considerations. *PeerJ Computer Science*, *9*, e1252. https://doi.org/10.7717/peerj-cs.1252

Kaddoura, S., & Husseiny, F. A. (2023d). The rising trend of Metaverse in education: Challenges, opportunities, and ethical considerations. *PeerJ Computer Science*, *9*, e1252. https://doi.org/10.7717/peerj-cs.1252

Lee, H., & Hwang, Y. (2022). Technology-Enhanced Education through VR-Making and Metaverse-Linking to Foster Teacher Readiness and Sustainable Learning. *Sustainability*, *14*(8), 4786. https://doi.org/10.3390/su14084786

Li, Y., Wei, W., & Xu, J. (2022). The Exploration on Ethical Problems of Educational Metaverse. In L.-J. Zhang (Ed.), *Metaverse – METAVERSE 2022* (pp. 29–38). Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-23518-4_3

Lin, H., Wan, S., Gan, W., Chen, J., & Chao, H.-C. (2022). Metaverse in Education: Vision, Opportunities, and Challenges. *2022 IEEE International Conference on Big Data (Big Data)*, 2857–2866. https://doi.org/10.1109/BigData55660.2022.10021004

O. da Silva, M. M., X. N. Teixeira, J. M., F. F. Peres, F., & R. M. Maurício, C. (2025). Learning in the Metaverse: Reflections on Potential Benefits, Possibilities and Challenges. *Digital Society*, *4*(2), 60. https://doi.org/10.1007/s44206-025-00217-3

Onu, P., Pradhan, A., & Mbohwa, C. (2024). Potential to use metaverse for future teaching and learning. *Education and Information Technologies*, *29*(7), 8893–8924. https://doi.org/10.1007/s10639-023-12167-9

Prakash, A., Haque, A., Islam, F., & Sonal, D. (2023). Exploring the Potential of Metaverse for Higher Education: Opportunities, Challenges, and Implications. *Metaverse Basic and Applied Research*, *2*(0), 13.

Said, G. R. E. (2023). Metaverse-Based Learning Opportunities and Challenges: A Phenomenological Metaverse Human–Computer Interaction Study. *Electronics*, *12*(6), 1379. https://doi.org/10.3390/electronics12061379

Singh, M. (2024). Exploring the possibilities to implement metaverse in higher education institutions of India. *Education and Information Technologies*, *29*(15), 20715–20728. https://doi.org/10.1007/s10639-024-12691-2

Sun, W., & Xiong, P. (2024). Educational Metaverse: Opportunities and Challenges for Application-oriented Undergraduate Colleges to Break Through Difficulties. *Proceedings of the 2024 International Symposium on Artificial Intelligence for Education*, 219–223. https://doi.org/10.1145/3700297.3700335

Tabassum, A., & Qadir, J. (2024). A CRITICAL AI APPROACH FOR MANAGING THE RISKS IN EDUCATIONAL METAVERSES. *EDULEARN24 Proceedings*, 9578–9586. 16th International Conference on Education and New Learning Technologies. https://doi.org/10.21125/edulearn.2024.2318

Zhang, Q. (2023). Secure Preschool Education Using Machine Learning and Metaverse Technologies. *Applied Artificial Intelligence*, *37*(1), 2222496. https://doi.org/10.1080/08839514.2023.2222496

Zhang, X., Chen, Y., Hu, L., & Wang, Y. (2022). The metaverse in education: Definition, framework, features, potential applications, challenges, and future research topics. *Frontiers in Psychology*, *13*. https://doi.org/10.3389/fpsyg.2022.1016300