

Virtual Frontiers: A Systematic Literature Review of Factors Shaping the Metaverse Readiness in Higher Education

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Abstract

The potential of the Metaverse to create immersive learning spaces in higher education is promising, but the implementation complexities pose an enormous challenge. Currently, there is little to no research concerning the Metaverse component readiness gap. Most existing studies focus either on the technological factors in isolation, such as VR/AR extensions, or user attitudes, without merging the technological, organizational, and environmental dimensions into a unified framework. Following the guidelines of the PRISMA methodology, 32 documents indexed in Scopus, were systematically identified to address this gap. A thematic analysis synthesized 55 distinct readiness factors into ten clusters, which were then mapped to the Technology-Organization-Environment (TOE) framework. The identified themes include Immersive Learning Experience (ILE), System & Service Quality (SQ), Perceived Performance Value (PPV), Ease Simplicity and Learnability (ESL), Risk, Security and Concerns (RSC), Personal Readiness (PR), Affective & Motivational Factors (AMF), Pedagogical & Knowledge Competence (PKC), Social Influence & Norms (SIN), and Institutional Support & Facilitating Conditions (ISFC). The findings reveal a dominance of quantitative research in current literature, highlighting a critical need for future mixed methods approaches to capture the qualitative experiences of stakeholders. Practically, this study provides educational leaders and policymakers with a robust, multi-dimensional framework to assess institutional capabilities, prioritizing not just hardware, but the realignment of human capital and governance required for a sustainable Metaverse transition.

Keywords: Higher Education, Metaverse, PRISMA, Readiness Model, Systematic Literature Review, TOE Framework.

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1. Introduction

According to extant literature, the Metaverse is considered to be the next major leap in the evolution of the Internet, where the digital and the physical world will be integrated into a stimulating and interactive 3D environment, in which customers and suppliers will be able to engage with the environment in various ways (Buhalis et al., 2023; Hwang & Chien, 2022; Lee et al., 2021). Various technologies, such as Virtual Reality (VR), Augmented Reality (AR), Internet of Things (IoT), Artificial Intelligence (AI), and blockchain, allows the users to interact with different worlds of the Metaverse through their avatars. On some platforms, users can also design digital assets that can be moved and used in different places every time they visit the platform (Dwivedi et al., 2022; Zhang et al., 2022; Wei, 2022).

Higher Education has utilized the Metaverse in many sectors, such as education (Kye et al., 2021; Mystakidis, 2022), finance (Belk et al., 2022), and in healthcare and retail (Bansal et al., 2022; Dwivedi et al., 2022). Concerning higher education, the Metaverse has great prospects to enhance changes in teaching, learning, and experiences throughout the multi-dimensional campus and academic settings (López Belmonte et al., 2022; Prieto et al., 2022). Within the Metaverse, the vision to create and integrate 3D environments in which students and instructors can communicate as avatars to perform 3D problem-solving, learning activities, and construct different types of simulations which may be difficult, dangerous, or too expensive to use in the real world (Han, 2020).

However, research on the Metaverse has not been commensurate with the growing necessity for conceptual and empirical understanding regarding the readiness of e-learning, digital platforms, and immersive technologies. The majority of existing studies characterize the Metaverse merely as an extension of generic VR/AR or the development of 3D graphical environments. Furthermore, many studies examine isolated factors such as technology access, user

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attitudes, or infrastructure, without systematically integrating technological, organizational, and environmental dimensions into a unified model (Dwivedi et al., 2022; Hwang & Chien, 2022). Consequently, higher education institutions lack clear, evidence-based guidelines on how to assess their readiness for the Metaverse, as well as which indicators must be prioritized to ensure an equitable and sustainable implementation (Al-Adwan, 2020). Therefore, there is an imperative need to empirically develop and validate a multidimensional Metaverse readiness framework to guide policymakers and practitioners in preparing for its implementation in higher education (Dwivedi et al., 2022; Prieto et al., 2022). Based on this background, this review aims to address the following research questions:

RQ1: What are the factors and aspects of Metaverse readiness in higher education, as outlined in the extant literature?

RQ2: How can the synthesized readiness components be constructed into a multidimensional framework to assess Metaverse readiness in higher education?

This article has the following structure: the explanation of the methodology of the systematic literature review will be presented in Section 2. Findings from the systematic literature review will be presented and analyzed in Section 3, from there a discussion and the implications of the study will follow in Section 4. Lastly, Section 5 will provide some concluding remarks, and will finish with the study's limitations and suggestions for future work.

To guide the analysis, several key constructs are used to explain how higher education institutions assess their readiness for Metaverse integration. This readiness is shaped by three main dimensions: technological readiness, organisational readiness, and environmental readiness (Tornatzky & Fleischer, 1990). To ensure analytical rigor and practical validity, this study adopts a systematic approach that conceptualizes these three dimensions into an integrated multi-dimensional readiness framework.

2. Methods

This section outlines the review process to achieve the research objective. In order to enhance the transparency and reliability of the selection, assessment, and synthesis of the studies, we followed the PRISMA framework on study selection and synthesis (Albhirat et al., 2024). In alignment with the review process PRISMA, we conducted the review in three phases. The first involved the selection and identification of pertinent studies. The second involved the assessment of the relevance and the quality of the studies. The last phase involved the extraction and synthesis of the data. Each of these phases is elaborated in the following subsections.

1) Step 1: Identification and selection of relevant studies

The first phase entailed a systematic literature search within the Scopus database (January 2012 – July 2025), chosen for its comprehensive indexing of high-standard academic literature. Prioritizing Scopus over individual publisher searches serves as a robust search strategy that not only ensures a wide selection of reliable sources and accurate results but also guarantees the methodological replicability required for a rigorous review. The review utilized the following search string: (“Metaverse” OR “Virtual Reality” OR “Augmented Reality” OR “XR”) AND (“readiness” OR “preparedness” OR “framework”) AND (“higher education” OR “university”). This initial identification process yielded a total of 2,898 documents. To refine this extensive pool, an initial screening of titles, abstracts, and keywords was conducted, reducing the dataset to 356.

2) Step 2: Assessment of Quality and Relevance of Studies

The 356 studies retained from the preliminary screening were subjected to a rigorous, multi-stage assessment process to ensure alignment with the study's objectives. First, indexing inconsistencies and duplicates (n=58) were removed, and specific exclusion criteria (Table 1) were applied to filter out non-higher education contexts or purely technical papers. This resulted in 79 articles being selected for full-text eligibility assessment.

In the final screening round, a complete paper review was conducted by a team of four authors. At this stage, articles that failed to address readiness dimensions or focused solely on technical specifications were excluded. This cumulative process, moving from the initial 2,898 documents through multiple screening rounds resulted in a final inclusion of 32 articles. These 32 documents form the basis of the systematic review and the subsequent thematic analysis. Figure 1 is the complete protocol showing the flowchart for the literature review.

Table 1. Selection criteria of the SLR

Criterion	Criterion Values
Period of publication	January 2012 to July 2025
Language	English
Study Type	Peer-reviewed journal articles (except review papers), conference proceedings.
Population	Higher education institutions
Concept	Readiness frameworks, models, indicators for Metaverse or immersive tech (AR/VR/XR)
Context	Higher education settings globally
Content	Not primary and secondary education Not general digital transformation models unrelated to Metaverse Not non-educational or purely technical papers Not Opinion papers, blogs, news articles

3) Step 3: Data extraction and synthesis

For data extraction, a structured spreadsheet was utilized to organize metadata including authors, publication year, country, research design, and theoretical constructs. To ensure methodological rigor and minimize subjective bias, the review protocol was collaborative. The authors collectively delineated and discussed the findings to synthesize the data into emerging themes. A consensus-based approach was adopted to validate the coding process; specifically, any differences in interpretation regarding the categorization of readiness factors were discussed and reconciled among the researchers until an agreement was reached. This collaborative verification process ensured the validity of the final 55 readiness factors and 10 themes presented in the findings.

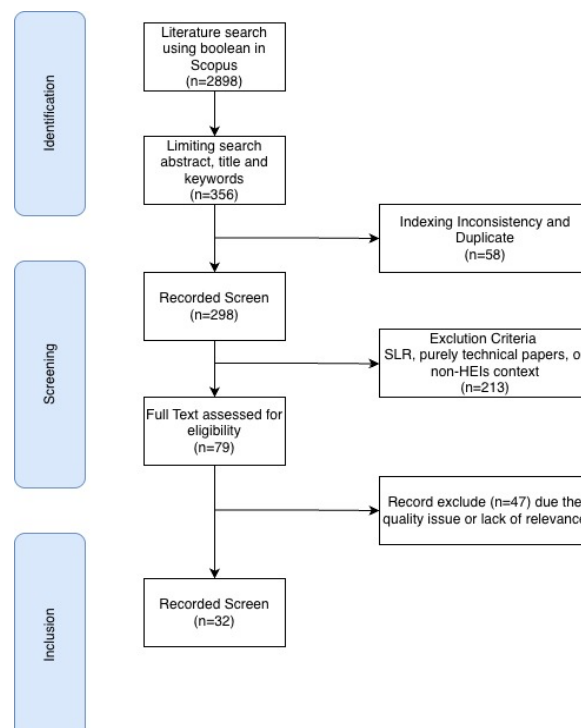


Fig. 1. Step of systematic literature review (Page et al., 2021)

3. Results

3.1. Current state of research on Metaverse Readiness

Although the search spanned the period from January 2012 to July 2025, studies specifically focusing on Metaverse Readiness only began to emerge in 2022 (Fig. 2). Subsequently, this trajectory has demonstrated a significant upward trend, as evidenced by a 71.875% increase in publication volume over the past two years (2023–2024).

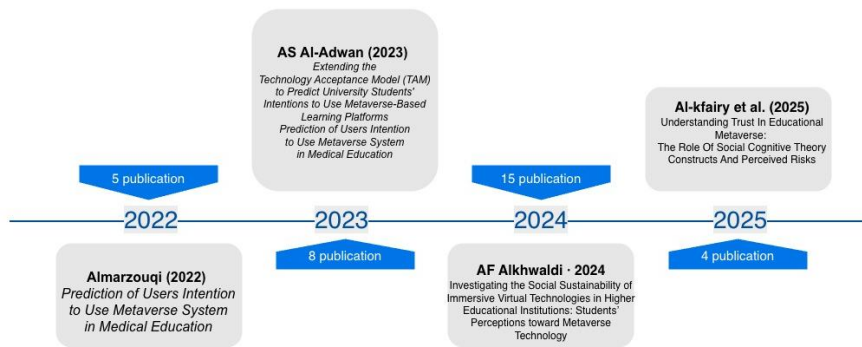


Fig. 2. Timeline of empirical studies on Metaverse readiness

Based on 32 studies, United Arab Emirates and Jordan dominate the studies with 14 (44%), establishing the Middle East and North Africa (MENA) region as the precedence of Metaverse readiness research with higher education. It is followed by the Asia-Pacific region with 8 studies (25%), wherein China and India each contributed 3 studies (9.4%), and Indonesia and Oman each had 2 studies (6.3%). Altogether, Asia-Pacific and MENA regions contributed 56.3% of the studies. Europe contributed 9.4%, the Americas 6.3%, cross-country collaborations 3.1%, and the rest of MENA regions with 9 other countries each having single contributions (totaling 3.1%). Figure 3 offers an elaborate visualization of the distribution of literature.

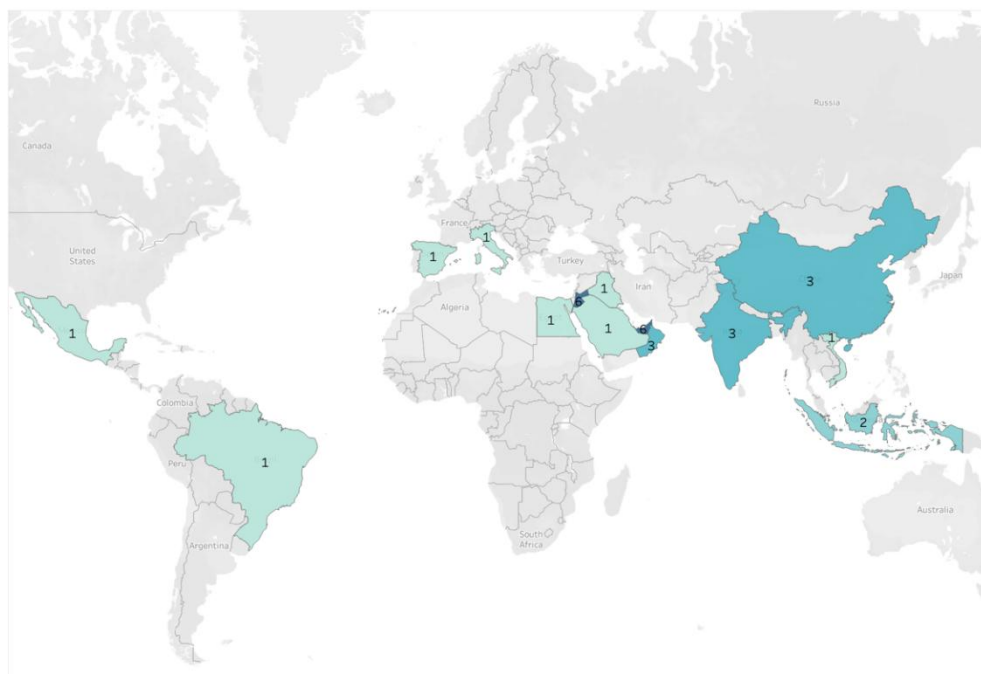


Fig. 3. Distribution of studies on Metaverse readiness

Influential articles (shown in fig 2) in the the field of Metaverse Readiness are dominated by publications originating from the United Arab Emirates and Jordan, as evidenced by high citation counts that demonstrate a significant and

continued upward trajectory (see Table 2). These findings underscore the region's position as a global hub for the development of Metaverse readiness research.

Table 2. List of journals and proceeding

No	Journal/ Proceeding	Count
1	Education and Information Technologies	4
2	Heliyon	3
3	Sustainability	2
4	Computers & Education	2
5	Frontiers in Psychology	2
6	IEEE Access	1
7	Informatics in Medicine Unlocked	1
8	Kybernetes	1
9	Contemporary Educational Technology	1
10	Electronics	1
11	Computers and Education: AI	1
12	International Journal of Organizational Analysis	1
13	Smart Learning Environments	1
14	International Journal of Data & Network Science	1
15	South Eastern European Journal of Public Health	1
16	Journal of Applied Research in Higher Education	1
17	Emerging Science Journal	1
18	Journal of Social Studies Education Research	1
19	Journal of Computers in Education	1
20	PeerJ Computer Science	1
21	Technology Forecasting and Social Change	1
22	Discover Sustainability	1
23	Information Technology for Education and Society	1
24	Minia Journal of Tourism and Hospitality Research	1
25	2024 2nd Intl Conf Intelligent Metaverse Technologies	1
26	Current and Future Trends on Intelligent Tech	1
27	Strategies & Opportunities for Technology in 4IR	1

The strong influence of research in the area is supported by the impact of the solid coverage of publications in various recognized research outlets. The literature on Metaverse readiness consists of statistically 29 journal articles (90.6%), two book chapters (6.3%), and one conference proceeding (3.1%). The publications are distributed in a wide variety of journals and most of these journals contain a single publication. The exceptions are Education and Information Technologies which is most dominant with four publications and Heliyon with three, while Sustainability, Computers & Education, and Frontiers in Psychology have two publications each.

In terms of research design, the dominance of quantitative methods stands at 93.75%, while both qualitative and mixed methods occupy only 3.1% each. Statistical analyses in the quantitative approaches made it possible to evaluate and compare student readiness and behavioral intentions, as well as identify patterns among various educational settings. Most of the studies collected data through the surveys so as to facilitate the findings, which increased their generalizability. The predominant data analysis methods used to explore the socio-psychological factors of acceptance of the Metaverse across different fields, including medicine, sports, science, and TESOL, were Structural Equation Modeling (SEM) and Partial Least Squares (PLS-SEM) Modeling. Additionally, eight studies combined different liacross NE) and other machine learning (ML) or artificial intelligence (AI) methods (e.g., artificial neural networks (ANN), random forest, and decision trees) to improve their forecasting ability and to better explain patterns of Metaverse Readiness, including lower levels of readiness. A detailed account of these various data analysis methods can be found in Table 3.

Table 3. Statistics of data analytics techniques

No	Data Analytics Technique	Percentage
1	SEM	78.1
2	SEM-ML	6.3
3	PLS-SEM+ML	3.1
4	SEM-ANN	6.3
5	PLS-SEM	3.1
6	Expert-based descriptive	3.1

In line with the widespread use of quantitative approaches and the utilization of SEM technologies for examining psychological factors, many of these studies use existing models of technology readiness to build their theoretical and methodological frameworks. Fig. 4 displays that the Technology Acceptance Model (TAM) is the most influential theoretical model used and is used in 10 papers followed by the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) in 9 papers and the Extended TAM in 8 papers. Furthermore, several studies have begun to integrate education-specific models, for example TPACK and Task-Technology Fit (TTF), to take the analysis to even greater depth regarding alignment of Metaverse technological capability with pedagogical requirements. This use of theories illustrates further that evaluating Metaverse readiness in higher education is still mainly concerned with the aspects of how people perceive it that may be perceived as easy or useful.

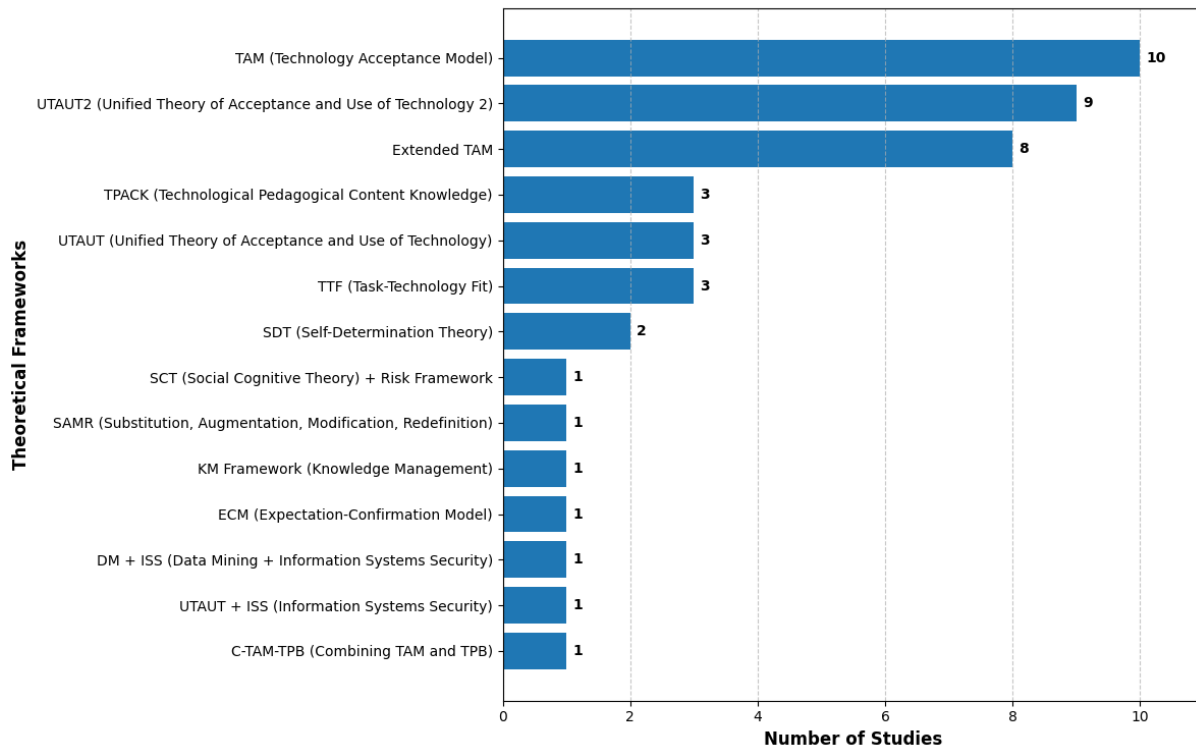


Fig. 4. Distribution of theoretical frameworks in Metaverse readiness studies

3.2. Thematic analysis

To address the first research question, Appendix 1 summarizes the focus and conceptual frameworks of the systematically reviewed studies. Collectively, the 32 analyzed articles provide a comprehensive overview of the readiness components for Metaverse integration in higher education. This iterative literature review highlights commonalities, overlaps, and divergences across the studies. The diversity of factors and operational definitions present in the literature facilitates the identification of readiness components and establishes a unified understanding of the Metaverse Readiness Model. A detailed list of the factors emerging from the 32 analyzed articles is presented in Table 4.

3.3. Factor of Metaverse Readiness in Higher Education Institutions

In this study, the analysis proceeded in three distinct stages. First, 55 readiness factors were extracted from the existing literature (see Table 4). Second, an inductive approach was employed to analyze these factors, clustering them into emerging readiness themes based on their conceptual similarities. Finally, a deductive approach was applied to categorize these themes within the Technology-Organization-Environment (TOE) framework.

Table 4. Identification of factors in selected literature

Factor	References
Age	(Al-Adwan & Al-Debei, 2022; Venkatesh et al., 2003)
Autonomy	(Galindo-Manrique et al., 2024)
Behavioral Control	(Ren et al., 2022)
Behavioral Intention	(Dang, Tran & Nguyen, 2023; Al-Adwan et al., 2023; Castro-López et al., 2024; Alshammari et al., 2024; de Brito, Oliveira & da Graça, 2024)
Collaborative Learning	(Abdulmuhsin et al., 2024)
Communication Factors	(Sediyaningsih et al., 2023)
Compatibility	(Wang, Chung & Yeoh, 2023; Al-Marroof et al., 2024)
Competence	(Galindo-Manrique et al., 2024)
Continuance Behavior	(de Brito, Oliveira & da Graça, 2024)
Continuance Intention	(Di Natale et al., 2024)
Continuous Usage	(Ali et al., 2025)
Digital Divide	(Shwedeh, 2024)
Digital Literacy	(Shwedeh, 2024)
Digital Readiness	(Shwedeh, 2024)
Effort Expectancy	(Salloum et al., 2023; Al-Adwan et al., 2024; Yang et al., 2022; Al-Adwan & Al-Debei, 2022; Shwedeh, 2024; Venkatesh et al., 2003; Wang, Chung & Yeoh, 2023; Aideed et al., 2024; Ali et al., 2025; Aburayya et al., 2022; Alawadhi et al., 2022; Galindo-Manrique et al., 2024; Chanda et al., 2024; Alshammari et al., 2024)
Engagement	(Rojas et al., 2023)
Environmental Sustainability	(Alkhwaldi et al., 2024)
Equity	(Alkhwaldi et al., 2024)
Facility Condition	(Thohir et al., 2023)
Facilitating Conditions	(Salloum et al., 2023; Al-Adwan et al., 2024; Yang et al., 2022; Shwedeh, 2024; Alkhwaldi et al., 2024; Venkatesh et al., 2003; Abdulmuhsin et al., 2024; Aburayya et al., 2022; Alawadhi et al., 2022; Mehta et al., 2025; Alshammari et al., 2024)
Faculty Support	(Mehta et al., 2025)
Fear of Loss	(Al-kfairy et al., 2024)
Gender	(Al-Adwan & Al-Debei, 2022)
Gender Differences	(Wardat et al., 2025)
Habit	(Chanda et al., 2024)
Hedonic Motivation	(Salloum et al., 2023; Yang et al., 2022; Al-Adwan & Al-Debei, 2022; Aideed et al., 2024; Chanda et al., 2024)
Information Quality	(Di Natale et al., 2024; Sediyaningsih et al., 2023)
Infrastructure Support	(Shwedeh, 2024)
Institutional Support	(Almarzouqi, 2022; Salloum et al., 2023)
Knowledge Sharing	(Abdulmuhsin et al., 2024)
Knowledge Sharing Intentions	(Almarzouqi, Aburayya & Salloum, 2024)

Factor	References
Learning Effectiveness	(Chatterjee et al., 2024; Castro-López et al., 2024; Al-Marroof et al., 2024)
Learning Outcomes	(Al-Adwan et al., 2023; Farhi et al., 2024)
Motivation	(Alawadhi et al., 2022; Alshammari et al., 2024)
Pedagogical Application	(Farhi et al., 2024)
Perceived Behavioral Control	(Wang, Chung & Yeoh, 2023)
Perceived Ease of Use	(Dang, Tran & Nguyen, 2023; Almarzouqi, 2022; Ren et al., 2022; Di Natale et al., 2024; Al-Adwan et al., 2023; Wardat et al., 2025; Sediyaningsih et al., 2023; Almarzouqi, Aburayya & Salloum, 2024; Castro-López et al., 2024; Al-Marroof et al., 2024)
Perceived Quality	(Almarzouqi, Aburayya & Salloum, 2024)
Perceived Usefulness	(Dang, Tran & Nguyen, 2023; Almarzouqi, 2022; Ren et al., 2022; Di Natale et al., 2024; Al-Adwan et al., 2023; Mehta et al., 2025; Wardat et al., 2025; Sediyaningsih et al., 2023; Almarzouqi, Aburayya & Salloum, 2024; Castro-López et al., 2024; Al-Marroof et al., 2024;)
Performance Expectancy	(Salloum et al., 2023; Al-Adwan et al., 2024; Yang et al., 2022; Al-Adwan & Al-Debei, 2022; Shwedeh, 2024; Alkhwalidi et al., 2024; Wang, Chung & Yeoh, 2023; Abdulmuhsin et al., 2024; Chatterjee et al., 2024; Ali et al., 2025; Aburayya et al., 2022; Alawadhi et al., 2022; Mehta et al., 2025; Chanda et al., 2024; Alshammari et al., 2024; Al-kfairy et al., 2024; Galindo-Manrique et al., 2024)
Personal Innovativeness	(Al-Adwan & Al-Debei, 2022)
Price Value	(Salloum et al., 2023; Al-Adwan et al., 2024; Yang et al., 2022; Al-Adwan & Al-Debei, 2022; Aideed et al., 2024; Chanda et al., 2024)
Protective Motivation	(Al-kfairy et al., 2024)
Relatedness	(Galindo-Manrique et al., 2024)
Relative Advantage	(Wang, Chung & Yeoh, 2023)
Risk Perception	(Al-kfairy et al., 2024)
Satisfaction	(Di Natale et al., 2024; Ali et al., 2025; de Brito, Oliveira & da Graça, 2024)
Self-Efficacy	(Almarzouqi, 2022; Salloum et al., 2023; Chatterjee et al., 2024; Al-Adwan et al., 2023; Alawadhi et al., 2022; Alshammari et al., 2024; Al-kfairy et al., 2024)
Social Influence	(Salloum et al., 2023; Al-Adwan et al., 2024; Yang et al., 2022; Al-Adwan & Al-Debei, 2022; Shwedeh, 2024; Alkhwalidi et al., 2024; Venkatesh et al., 2003; Ren et al., 2022; Abdulmuhsin et al., 2024; Aburayya et al., 2022; Alawadhi et al., 2022; Chanda et al., 2024; Alshammari et al., 2024; Almarzouqi, Aburayya & Salloum, 2024; Galindo-Manrique et al., 2024)
Social Interaction	(Alkhwalidi et al., 2024; Abdulmuhsin et al., 2024)
Social Readiness	(Chatterjee et al., 2024)
Student Engagement	(Farhi et al., 2024)
Student Perception	(Rojas et al., 2023)
Subjective Norm	(Wang, Chung & Yeoh, 2023)
System Accessibility	(Sediyaningsih et al., 2023)
System Quality	(Di Natale et al., 2024; de Brito, Oliveira & da Graça, 2024)
Task-Technology Fit	(Aideed et al., 2024)
Technical Issues	(Rojas et al., 2023)
Technological Knowledge	(Mishra & Koehler, 2006)
Technological Pedagogical Content Knowledge	(Thohir et al., 2023)

Factor	References
Technological Readiness	(Mehta et al., 2025)
Technology Acceptance Model Constructs	(Thohir et al., 2023)
Technology Anxiety	(Wardat et al., 2025)
Technology Characteristics	(Farhi et al., 2024)
Technology Readiness	(Dang, Tran & Nguyen, 2023; Salloum et al., 2023; Chatterjee et al., 2024; Aburayya et al., 2022)
Trust	(Al-kfairy et al., 2024)
Usefulness	(Rojas et al., 2023)
User Experience	(Rojas et al., 2023; Farhi et al., 2024)

3.4. Multi-Dimension Metaverse Readiness Model

While UTAUT and TAM are effective in delineating individual behavior (Venkatesh et al., 2003, 2012), they are deemed insufficient for elucidating institutional contexts (Oliveira & Martins, 2011). Consequently, to address RQ2, we applied a deductive mapping approach to integrate and synthesized readiness factors at the individual and institutional levels using the Technology-Organization-Environment (TOE) framework (Tornatzky & Fleischer, 1990). To characterize drivers of systemic readiness towards Metaverse readiness, the trio of technology, organization, and environment (TOE) dimensions were synthesized (Baker, 2012). We summarized the coded data into readiness themes related to these three specific dimensions (Parasuraman, 2000; Snyder Halpern, 2001), ensuring that a stepwise development from codes to analytical themes and dimensions renders the findings in a systematic, coherent, and concise manner (Miles & Huberman, 1994)

3.4.1 Technology Readiness Dimension

The Technology Dimension, as listed in Table 5, provides a comprehensive overview of the technical aspects and infrastructure that are required for higher education institutions to support interactive and immersive virtual learning ecosystems and is based on the TOE framework along with metaverse technology characteristics. Metaverse platforms differentiate themselves from the conventional e-learning systems by integrating multiple enabling technologies (VR, AR, XR, IoT, AI, and blockchain) that enable seamless, real-time interaction between the domain of physical and virtual learning (Dwivedi et al., 2022; Zhang et al., 2022). The technological dimension hence also evaluates whether the institutions have the requisite hardware and network structure, and well-integrated systems that meet the standards of quality, reliability, and are designed for user, effective teaching and learning.

Table 5. Technology readiness dimension

Theme	Description	Factors
Immersive Learning Experience (ILE)	Capturing the depth and quality of immersion, user control, flow states, and natural interaction affordances that distinguish metaverse from flat, screen-based platforms.	Immersion, Controlled Immersion, Flow Experience, Natural Interaction, Context Awareness, Ubiquity, Satisfaction and Fun.
System & Service Quality (SQ)	Reflecting the technical robustness, reliability, and responsiveness of the metaverse infrastructure and support services.	System Quality, Service Quality, Information Quality, Perceived System Quality, Perceived Usability, and Observability.
Perceived Performance Value (PPV)	Assessing users' beliefs about whether the metaverse will enhance learning outcomes and task performance.	Perceived Usefulness, Performance Expectancy, Anticipated Benefits, and Task-Technology Fit.
Ease, Simplicity & Learnability (ESL)	Measuring the extent to which users perceive the metaverse as intuitive, easy to navigate, and quickly learnable.	Perceived Ease of Use, Effort Expectancy, Perceived Simplicity of Use, and Trainability.

Theme	Description	Factors
Risk, Security & Concerns (RSC)	Capturing inhibiting factors such as perceived cybersecurity risks, data privacy concerns, and user anxiety regarding technical or social challenges within immersive environments	Perceived Cyber Risk, Cybersecurity Risk Perceptions, Perceived Risk, and Computer Anxiety.

3.4.2 Organisation Readiness Dimension

The Organisational Dimension includes human, pedagogical, and organisational structures. Based on the TOE framework, it emphasizes that technological readiness is fundamentally a human and structural challenge (Oliveira & Martins, 2011; Tornatzky & Fleischer, 1990). In higher education, Metaverse integration requires multi-level transitions: students must acquire digital presence skills, faculty must adapt pedagogical methods for immersive learning, and institutional leaders must foster supportive cultures and policies (Salloum et al., 2021). These findings are consistent with the factors listed in Table 6.

Table 6. Organisation readiness dimension

Theme	Description	Factors
Personal Readiness (PR)	Capturing individual psychological dispositions toward technology readiness, including motivating factors (innovativeness, optimism, curiosity, self-efficacy) and inhibiting factors (computer anxiety, discomfort) that together shape predisposition toward embracing metaverse systems.	Self-efficacy, Technology Self-Efficacy, Personal Innovativeness, Technology Optimism, Curiosity, and Student Autonomy
Affective & Motivational Factors (AMF)	Reflecting the intrinsic and experiential drivers of metaverse use.	Hedonic Motivation, Hedonic Gratification, Flow Experience, Attitudes, and Habit.
Pedagogical & Knowledge Competence (PKC)	Assessing educators' readiness to integrate metaverse affordances into curriculum design, including technological pedagogical content knowledge (TPACK), ability to facilitate peer collaboration and social learning, capacity to generate and share knowledge within virtual spaces, and trust in platform reliability for educational outcomes.	TPACK, Knowledge Sharing, Knowledge Generation, Technology Trust.

3.4.3 Environment Readiness Dimension

The Environment Dimension is a collection of contextual factors that we cannot control directly but which can contribute to shaping education through institutional, regulatory, and societal factors (Tornatzky & Fleischer, 1990). Significant aspects (as illustrated in Table 7) are those involving social and peer relationships, organized institutional support, and the competitive industry landscape for skills in the Metaverse (Dwivedi et al., 2022). This dimension ultimately characterizes the institutional ecosystem where cohesive policies uphold the environment, enabling the smooth integration of Metaverse technology within the educational framework.

Table 7. Environment readiness dimension

Theme	Description	Factors
Social Influence & Norms (SIN)	Identifies how social proof and peer expectations drive metaverse engagement. It integrates key psychological concepts such as subjective norms, where users act based on the perceived opinions of important figures, and herd behaviour, where individuals align their readiness patterns with their peers. Such conformity underscores the importance of institutional and community contexts in shaping technology acceptance.	Social Influence, Subjective Norm, and Herd Behaviour.

Theme	Description	Factors
Institutional Support & Facilitating Conditions (ISFC)	Encompassing administrative foundations (policies, funding, and training). It also accounts for external competitive pressures that drive institutional commitment, ensuring that the necessary tangible and intangible assets are in place for a successful transition.	Facilitating Conditions, Environmental/Institutional support

4. Discussion

This section discusses the current state of research on metaverse integration readiness in higher education institutions, highlights key dimensions influencing institutional preparedness, and elaborates on the theoretical and practical implications of the integrated three-dimensional framework. The discussion situates the findings within existing literature on technology readiness, organizational change, and environmental readiness, while highlighting their potential implications for institutional policy development, strategic planning, and future research in educational technology innovation.

4.1 Current state of Metaverse readiness research in higher education

This systematic literature review is guided by two interconnected research questions: (1) What are the factors and aspects of readiness for Metaverse in higher education, as outlined in the extant literature (2) How can the synthesized readiness components be constructed into a multidimensional framework to assess Metaverse readiness in higher education? To the best of our knowledge, no systematic review has considered metaverse integration readiness with an integrated multi-dimensional approach from the perspective of organizational theory. This review aims to fill such a gap by collecting, synthesizing and offering for theoretical integration, and discussing 32 higher education metaverse readiness studies, in order to conceptually develop and provide research and practice recommendations pertaining to the readiness of the Metaverse in higher education.

Research findings indicate a significant gap in the analysis of Metaverse component readiness. Existing studies predominantly focus on the technological aspects of the Metaverse (such as extensions of generic VR/AR or the development of 3D graphical environments) or examine isolated factors like technological access, user attitudes, or infrastructure, without systematically integrating technological, organizational, and environmental dimensions into a unified model. Consequently, higher education institutions lack clear, evidence-based guidelines on how to assess their Metaverse readiness, specifically regarding which indicators should be prioritized to ensure equitable and sustainable implementation.

4.2 Factors influencing Metaverse integration readiness in higher education

This study outlines three dimensions that emerge from the criteria required to implement the metaverse in higher education. These are: technological, organisational, and environmental readiness. Each of these dimensions contains the relevant interconnected clusters of themes.

There are five thematic areas in the Technological Dimension, each of which is concerned with a different aspect of readiness. The Immersive Learning Experience (ILE) highlights the need for different platforms to offer a fully immersive interaction experience with sufficient levels of depth, flow, and user satisfaction. The System and Service Quality (SSQ) deals with the systems-supporting infrastructure, the information systems, and the level of responsiveness, which all need to demonstrate technical excellence in order for users to gain the confidence needed. The Perceived Performance Value (PPV) focuses on the value associated with the experience from various stakeholders, and whether that value justifies an improvement in the learning experience and the learning outcomes. The Ease, Simplicity and Learnability (ESL) focus area is concerned with pedagogy having an effective, intuitive, and uncomplicated system with straightforward operational and navigational features. The Risk, Security and Concerns (RSC) is concerned with the user's apprehension and anxiety regarding the systems, cyber security, data privacy, and the system's security, which the stakeholders and institutions must address and mitigate.

The organisational dimension comprises three themes which pertain to the human and institutional aspects of the organisational readiness. Personal Readiness (PR) concerns the individual attributes pertaining to the technology readiness, e.g., self-efficacy, technology optimism, and risk-taking disposition. The Affective and Motivational Factors

(AMF) concerns the hedonic motivation, flow experience, and positive feelings toward the readiness of the metaverse. The Pedagogical Knowledge and Competence (PKC) pertains to pedagogical competence, teaching transformation, and implementation confidence; of critical importance is the link faculty have to the pedagogical and technological effectiveness.

The environmental dimension comprises two themes related to readiness contexts. The Social Influence and Norms (SIN) theme encompasses subjective norms and the expectations of peers and stakeholders within a specific social setting. Meanwhile, the Institutional Culture and Support (ICS) theme focuses on aligning institutional values, leadership advocacy, and change management capacity with metaverse readiness in relation to the institution's mission and strategic goals.

The integration of the evidence presents an integrated framework grounded on the Technology, Organisation, and Environment (TOE), which organises the 55 factors of institutional readiness into three dimensions and 10 thematic group. The framework encompasses the theories of TAM, UTAUT2, and TOE, thus offering a conceptual framework. The institutional readiness construct provides a starting point, but it is recommended that future studies build on it through the collection of primary data involving institutional stakeholders (i.e., surveys and or interviews involving administrators, faculty, and students), to determine the key readiness factors and predictors of readiness. To support future empirical investigations based on the proposed framework (Fig 5), we present a set of propositions derived from each factor, as summarized in Table 8.

Table 8. Future empirical studies based on conceptual framework

No	Theme/ Group of Factor
1	Immersive Learning Experience (ILE)
2	System and Service Quality (SSQ)
3	Perceived Performance Value (PPV)
4	Ease, Simplicity, and Learnability (ESL)
5	Risk, Security, and Concerns (RSC)
6	Personal Readiness (PR)
7	Affective and Motivational Factors (AMF)
8	Pedagogical Knowledge and Competence (PKC)
9	Social Influence and Norms (SIN)
10	Institutional Culture and Support (ICS)

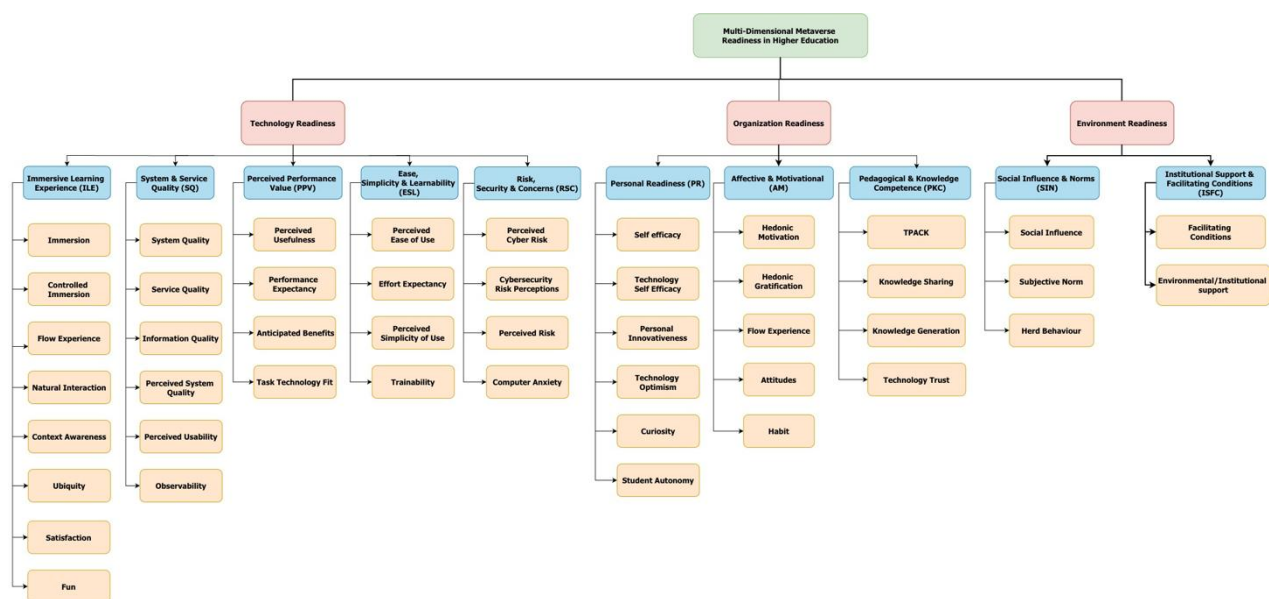


Fig. 5. Multi-dimensional readiness conceptual framework

4.3 Theoretical contribution

This study extends the emerging literature on metaverse readiness in higher education by proposing a conceptual framework that integrates technological, organizational, and environmental dimensions. Previous literature has mostly centred on individual-level acceptance models, such as the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT), focusing on parameters of perceived usefulness, perceived ease of use, and behavioural intention, while this study focuses on broader parameters, such as the robustness of metaverse-related infrastructure, pedagogical capacity, organisational culture, policy and regulatory alignment, equity, and other factors that are important for readiness of the metaverse in higher education. This study builds the groundwork for understanding the interplay of technology, organisation, and environment in determining readiness to integrate the Metaverse into higher education. The proposed framework and its derived propositions will guide further empirical validation, model enhancement, and theory development in the areas of educational technology readiness, institutional readiness, and environment readiness.

4.4 Practical Implication

University leaders, IT departments, and policymakers will operationalize Metaverse initiatives specifically, integrated policy and infrastructure innovation will help institutions remain agile with the evolving tech. Focus should be on strategically realigning human capital rather than simply acquiring new hardware.

Along with this shift will be the empowerment of faculty (through immersive and collaborative learning) to foster a spirit of pedagogical innovation. Nonetheless, this shift will need to be accompanied by a digital governance model that addresses the privacy, ethical, and digital divide concerns of the new tech to mitigate the potential of the new technologies to deepen institutional gaps.

In terms of action, this model of readiness aligns with a practical framework of analysis to assess their organizational, technological, and environmental states. Using this, decision-makers will be able to set actionable, sequenced, and prioritized plans, such as starting pilot projects in the units that are ready, while also balancing supportive actions in units that are less ready.

5. Conclusion

This systematic literature review addresses a significant void in the research surrounding frameworks for Metaverse readiness by consolidating various readiness components into a comprehensive multidimensional framework designed to evaluate Metaverse readiness in higher education. By conducting a thorough examination of 32 indexed and peer-reviewed studies following the PRISMA guidelines, this review identifies 55 distinct readiness factors and integrates them into a cohesive Metaverse Implementation Readiness Model rooted in the Technology–Organization–Environment (TOE) framework. This model illustrates that Metaverse readiness transcends mere technological considerations; it is an interrelated structural process that requires simultaneous progress across three interconnected dimensions: technological, organizational, and environmental readiness, to successfully integrate the Metaverse within higher education.

Nonetheless, considerable research gaps persist in the current context. The dominance of quantitative research, often limited to specific geographic areas, masks the intricate dynamics of readiness factors across varied institutional, geographical, and disciplinary settings. Future investigations should adopt mixed-methods approaches to explore how readiness elements evolve during institutional transformation while also examining the qualitative experiences of stakeholders engaged with Metaverse readiness. Additionally, empirical validation of this framework through primary data collection would enhance causal insights and provide a practical diagnostic tool for assessment within higher education.

In conclusion, this review presents a robust framework for educational leaders, policymakers, and researchers to systematically assess institutional capabilities. Rather than focusing solely on hardware acquisition, stakeholders must prioritize the strategic realignment of human capital and the development of digital governance models that address privacy and ethical concerns. By leveraging these insights, institutions can support a sustainable transition toward an immersive, collaborative, and pedagogically sound learning ecosystem based on the Metaverse in higher education.

Conflicts of Interest: The authors declare that they have no conflicts of interest to report regarding the present study.

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APPENDIX 1. Systematic literature review data extraction

Author & Year	Context/Subject	Theory/Model	Independent Variable	Methodology	Primary Finding
Aburayya et al., 2022	Adoption of metaverse in higher education	SEM-Machine Learning Hybrid Model	Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions, Technology Readiness	Quantitative - Hybrid SEM-ML with predictive analysis	Hybrid approach identifies key adoption drivers; machine learning improves prediction accuracy for institutional planning
Alawadhi et al., 2022	Medical students' acceptance of metaverse in medical training	Extended UTAUT	Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions, Motivation, Self-Efficacy	Quantitative - Survey & SEM	Medical context-specific; performance expectancy and facilitating conditions particularly influential in medical education
Almarzouqi, 2022	Medical students' intention to use metaverse system in medical training	Hybrid SEM-ML (Machine Learning)	Perceived Usefulness, Perceived Ease of Use, Self-Efficacy, Institutional Support	Quantitative - Hybrid SEM-ML approach	Machine learning improves prediction accuracy; perceived usefulness and self-efficacy are strong predictors in medical context
Ren et al., 2022	Chinese college students' metaverse use for basketball learning	Extended TAM	Perceived Usefulness, Perceived Ease of Use, Performance Expectancy, Social Influence, Behavioral Control	Quantitative - Survey & SEM	Extended TAM effective for sports context; behavioral control and peer influence strongly predict adoption
Yang et al., 2022	College students' intention to use metaverse for basketball learning	UTAUT2	Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions, Hedonic Motivation, Price Value	Quantitative - Survey & SEM	UTAUT2 effectively predicts behavioral intention; hedonic motivation particularly influences sports learning adoption
Al-Adwan & Al-Debei, 2022	Gen Z metaverse adoption in higher education	UTAUT2 & Personal Innovativeness in IT (PIIT)	Performance Expectancy, Effort Expectancy, Social Influence, Hedonic Motivation, Price Value, Personal Innovativeness, Age, Gender	Quantitative - Survey & SEM	Gen Z's adoption strongly influenced by hedonic motivation and social influence; personal innovativeness moderates adoption intention

Author & Year	Context/Subject	Theory/Model	Independent Variable	Methodology	Primary Finding
Al-Adwan et al., 2023	University students' intention to use metaverse-based learning platforms	Extended TAM	Perceived Usefulness, Perceived Ease of Use, Self-Efficacy, Learning Outcomes, Behavioral Intention	Quantitative - Survey & SEM	Extended TAM applicable to platform adoption; perceived usefulness and learning outcomes critical for platform acceptance
Alkhwaldi et al., 2023	Digital issues in metaverse adoption in higher education	UTAUT Extended Model	Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions, Digital Literacy, Digital Divide	Quantitative - Survey & SEM	Digital divide and literacy barriers hinder adoption; infrastructure and training essential for institutional success
Dang, Tran & Nguyen, 2023	Readiness for metaverse adoption in higher education	Integrated PLS-SEM & ANN (Artificial Neural Network)	Technology Readiness, Perceived Usefulness, Perceived Ease of Use, Behavioral Intention	Quantitative - Dual approach PLS-SEM & Machine Learning	Predictive accuracy improved with ANN; students' readiness depends on technology perception and institutional support
Rojas et al., 2023	Student perception of metaverses for online learning	Qualitative & Quantitative Mixed-Methods	Student Perception, Usefulness, Engagement, Technical Issues, User Experience	Mixed-Methods - Survey & Focus Groups	Student perception mixed; while hopeful about potential, technical barriers and usability concerns persist
Salloum et al., 2023	Metaverse adoption in higher education	UTAUT2 Extended Model	Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions, Hedonic Motivation, Price Value	Quantitative - Survey & PLS-SEM	Sustainability of continuous intention to use metaverse is significantly influenced by UTAUT2 constructs; social influence and hedonic motivation are key drivers
Salloum et al., 2023	Adoption of metaverse in medical training	Machine Learning & SEM Hybrid Model	Perceived Usefulness, Institutional Support, Technology Readiness, Self-Efficacy	Quantitative - Hybrid SEM-ML with feature importance analysis	Novel approach combining SEM and ML reveals non-linear relationships; institutional support critical for medical adoption

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Sediyaningih et al., 2023	Metaverse usage in digital library services	De-contextual Communication Framework & TAM	Perceived Usefulness, Perceived Ease of Use, Communication Factors, Information Quality, System Accessibility Technological Pedagogical Content Knowledge, Facility Condition, Technology Acceptance Model Constructs Performance	Quantitative - Survey & SEM	De-contextual communication influences library adoption; contextual factors impact information service acceptance TPACK and facility conditions significantly affect VR acceptance; teacher preparedness is critical for technology integration
Thohir et al., 2023	Preservice teachers' acceptance of VR in science education	TPACK & TAM & Facility Condition Model	Expectancy, Effort Expectancy, Subjective Norm, Perceived Behavioral Control, Relative Advantage, Compatibility Knowledge Sharing, Collaborative Learning, Social Interaction, Performance Expectancy, Facilitating Conditions Performance Expectancy, Effort Expectancy, Social Influence, Hedonic Motivation, Price Value, Task-Technology Fit Performance Expectancy, Effort Expectancy, Social Influence, Hedonic Motivation, Price Value, Task-Technology Fit	Quantitative - Survey & SEM	Hybrid approach shows compatibility as key factor; behavioral control significantly affects adoption intention
Wang, Chung & Yeoh, 2023	Intention to adopt metaverse using extended models	Hybrid C-TAM-TPB & IDT (Innovation Diffusion Theory)	Performance	Quantitative - Survey & SEM-ANN Hybrid	Knowledge-driven approach emphasizes learner-centric assessment; collaborative learning significantly impacts adoption
Abdulmuhsin et al., 2024	Knowledge-driven metaverse adoption in higher education	Knowledge Management Framework & UTAUT	Performance	Quantitative - Survey & SEM	Task-technology synergy model extends UTAUT-2 effectiveness; transformative education through aligned technology fit
Aideed et al., 2024	Metaverse adoption through UTAUT-2 and task-technology synergy	Extended UTAUT-2 & Task-Technology Fit (TTF)	Performance	Quantitative - Survey & SEM	Future learning unlocked through metaverse adoption; facilitating conditions and performance expectancy as primary predictors
Al-Adwan et al., 2024	Meta-education adoption intentions in higher education	UTAUT2 & Technology Acceptance Model	Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions, Price Value	Quantitative - Survey & SEM	

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Al-Marouf et al., 2024	Metaverse acceptance in medical education	Extended TAM	Perceived Usefulness, Perceived Ease of Use, Compatibility, Learning Effectiveness, Behavioral Intention	Quantitative - Survey & SEM	Extended TAM applicable to medical context; compatibility and learning effectiveness key factors for medical adoption
Alkhwaldi et al., 2024	Social sustainability of immersive VR technologies in higher education	Social Sustainability Framework & UTAUT	Social Interaction, Environmental Sustainability, Equity, Performance Expectancy, Social Influence	Quantitative - Survey & SEM	Social sustainability aspects significantly impact student perceptions; equity in access is crucial for inclusive adoption
Almarzouqi, Aburayya & Salloum, 2024	Metaverse adoption for knowledge sharing in higher education	Extended TAM & Knowledge Sharing Model	Perceived Usefulness, Perceived Ease of Use, Knowledge Sharing Intentions, Social Influence, Perceived Quality	Quantitative - Survey & SEM	Knowledge sharing intentions significantly enhance adoption; collaborative learning frameworks support technology integration
Alshammari et al., 2024	Behavioral intention using extended UTAUT	Extended UTAUT Model	Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions, Self-Efficacy, Motivation	Quantitative - Survey & SEM	Extended UTAUT effective in educational context; all constructs significantly predict behavioral intention in Saudi Arabia
Castro-López et al., 2024	Metaverse adoption through extended TAM	Extended TAM with Institutional Factors	Perceived Usefulness, Perceived Ease of Use, Institutional Support, Learning Effectiveness, Behavioral Intention	Quantitative - Survey & SEM	Institutional support moderates TAM relationships; comprehensive framework needed for university adoption
Chanda et al., 2024	Metaverse adoption through extended UTAUT2 (Multi-group Analysis)	Extended UTAUT2 with Multi-group Analysis	Performance Expectancy, Effort Expectancy, Hedonic Motivation, Price Value, Social Influence, Habit	Quantitative - Survey & Multi-group SEM	Group differences significant; customized adoption strategies needed for different student populations

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Chatterjee et al., 2024	Student readiness for immersive technologies in higher education	Integrated Critical Factors Model & UTAUT	Technology Readiness, Learning Effectiveness, Social Readiness, Self-Efficacy, Performance Expectancy	Quantitative - Survey & SEM	Comprehensive readiness model; integration of critical determinants improves prediction of adoption readiness
de Brito, Oliveira & da Graça, 2024	Continuance intention in immersive learning technologies (Mixed-methods)	Continuance Model & TAM Integration	Satisfaction, System Quality, Perceived Usefulness, Behavioral Intention, Continuance Behavior	Mixed-Methods - Survey & Interviews	Mixed-methods reveals satisfaction as primary factor; sustained adoption requires continuous improvement and support
Di Natale et al., 2024	Acceptance and continuance intention in VR/metaverse learning environments	TAM Extended Model & Continuance Model	Perceived Usefulness, Perceived Ease of Use, Satisfaction, System Quality, Information Quality, Continuance Intention	Quantitative - Survey & SEM	Satisfaction predicts continuance; system quality and information quality critical for sustained adoption in universities
Galindo-Manrique et al., 2024	Metaverse adoption through UTAUT and SDT	Extended UTAUT & Self-Determination Theory (SDT)	Performance Expectancy, Effort Expectancy, Social Influence, Autonomy, Competence, Relatedness	Quantitative - Survey & SEM	SDT integration reveals psychological factors; intrinsic motivation through autonomy support enhances adoption
Al-kfairy et al., 2024	Risk perception and trust in metaverse adoption	Protective Motivation Theory & Risk Framework	Risk Perception, Trust, Self-Efficacy, Fear of Loss, Performance Expectancy, Protective Motivation	Quantitative - Survey & SEM	Risk perception and trust balance crucial; protective motivation theory explains resistance; transparency improves adoption

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Ali et al., 2025	Continuous intention to use metaverse in higher education	Dual SEM-ANN Model	Performance Expectancy, Effort Satisfaction, Behavioral Intention, Continuous Usage	Quantitative - Survey & Dual SEM-ANN Approach	Dual-staged SEM-ANN reveals non-linear patterns; satisfaction strongly predicts continuous intention over time
Mehta et al., 2025	Professor acceptance of metaverse in immersive classes	SAMR Model & UTAUT Integration	Perceived Usefulness, Technological Readiness, Faculty Support, Performance Expectancy, Facilitating Conditions	Quantitative - Survey & SEM	Faculty acceptance crucial for adoption; professor willingness influenced by institutional support and perceived usefulness
Wardat et al., 2025	Gender differences in VR adoption in higher education	TAM with Gender Analysis	Perceived Usefulness, Perceived Ease of Use, Behavioral Intention, Gender Differences, Technology Anxiety	Quantitative - Survey & Comparative SEM	Significant gender differences emerge; technology anxiety affects women more; targeted support needed for equity