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# *The Model of Metaverse in Higher Education: A Systematic Literature Review*

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**Abstract:** The advancement of modern technology has accelerated the emergence of the metaverse, allowing it to surpass physical constraints and facilitate the distribution and exchange of high-quality educational content. This progression has generated growing interest in integrating metaverse technology within the domain of higher education. Although scholarly attention to this field is increasing, the majority of existing research centres predominantly on user experience within metaverse-enhanced educational settings. However, there remains a marked deficiency in literature that explores the developmental and structural design of metaverse platforms. Therefore, the present study seeks to examine metaverse modelling in higher education, with particular focus on theoretical underpinnings and system architecture. This investigation adopted the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) protocol to carry out a systematic review. Relevant publications were sourced from the Web of Science (WoS) and Scopus databases, specifically targeting studies concerning the utilisation of the metaverse in higher education contexts. Out of the initial literature pool, eight studies satisfied the inclusion criteria and were subjected to detailed examination. Analysis of these works identified nine fundamental elements integral to metaverse modelling in higher education: Infrastructure, Immersive Technologies, Interaction, Access Equipment, 3D Learning Scenario, Learning Task, Instructional Design, Pedagogy, and Associated Theories. This study underscores a substantial gap in research relating to the design and development aspects of metaverse applications in higher education. It is recommended that future inquiries prioritise these dimensions to facilitate the creation of robust models and conceptual frameworks that underpin effective pedagogical practices in metaverse-supported learning environments.
**Keywords:** Metaverse, Higher Education, Universities/Colleges, Model/Framework, PRISMA.

## 1. Introduction

With Facebook's transformation into Meta, the concept of the metaverse has gained substantial recognition. Originally coined by American author Neal Stephenson (Liu et al., 2017), the term currently lacks a universally accepted, logically structured definition (Zhang et al., 2022). Broadly, the metaverse may be characterised as a real-time, threedimensional virtual environment that facilitates synchronised, continuous, and collective forms of interaction and collaboration (Sayyed et al., 2024). It integrates a broad array of emerging technologies, including augmented reality (AR), virtual reality (VR), extended reality (XR), mixed reality (MR), fifth-generation (5G) communication networks, artificial intelligence (AI), blockchain, and data processing tools (Prieto et al., 2022; Wang et al., 2022; Wu et al., 2024). The convergence of these technological advancements positions the metaverse as a transformative entity with considerable educational potential, particularly in promoting innovative pedagogical practices and enhancing learner engagement.

Consequently, the education sector stands to benefit significantly from the integration of metaverse technologies (Ren et al., 2022). Scholars have highlighted education as one of the most promising application domains for the metaverse, offering considerable potential to enrich the learning environment (Prieto et al., 2022; Rospigliosi, 2022; Suzuki et al., 2020). It enables experiences that blend the elements of physical classrooms with fully virtual learning settings, offering more engaging alternatives compared to conventional online platforms or traditional classroom formats (Rafiq et al., 2021; Tlili et al., 2022). These advances signal a paradigm shift in education, potentially setting new standards for accessibility, interactivity, and immersion for learners globally.

As the integration of metaverse technologies becomes increasingly prevalent within the broader educational landscape, their application in higher education is also expanding and diversifying. Various institutions are actively developing initiatives aimed at enhancing instructional effectiveness and improving student learning outcomes through immersive digital experiences. For example, the Hong Kong University of Science and Technology (HKUST) established MetaHKUST in September 2022 as Asia's pioneering metaverse-based university campus. This digital twin platform enables students from geographically dispersed locations to participate in a shared course experience, conducted as if in a single physical classroom. Users in MetaHKUST can generate content such as avatars and non-fungible tokens (NFTs), and benefit from integrated tools for communication and administration (Wu et al., 2024).

During the COVID-19 pandemic, the University of Salford introduced a course titled Virtual Humans, led by Professor Jeremy Bailenson, which successfully overcame spatial and temporal barriers for both instructors and students, thereby facilitating educational continuity (Rebolj & Menzel, 2004). Similarly, the Case Western Reserve University School of Medicine has adopted metaverse platforms in its instructional strategies. Utilising the Hololens, students can navigate virtual environments and engage with digital anatomy models, thereby enriching specialised learning experiences (Gsaxner et al., 2023). On the ENGAGE platform, created by the Irish firm VR Education Holding, ten digitised versions of U.S. university campuses—referred to as Metaversities—have been developed. These were established through collaboration between the Meta Immersive Learning Project and the virtual reality company VictoryXR. Through VR headsets, educators and students can participate in immersive teaching and learning within these Metaversities. New Mexico State University has even announced its intention to offer accredited degrees through this platform by 2027 (Kshetri, 2023). These examples illustrate how educational institutions are leveraging cutting-edge technologies to address pressing challenges by fostering inclusive, engaging, and adaptive learning ecosystems.

Among the various possible uses of metaverse technologies, their integration within higher education has had profound implications, influencing nearly every aspect of academic delivery. It has redefined instructional modalities through the incorporation of multimedia-rich environments. Nonetheless, a critical review of current literature reveals a predominant emphasis on user-centred perspectives. Existing studies largely explore variables such as users' willingness to adopt metaverse systems (Al-Adwan et al., 2023; Di Natale et al., 2024; Farhi, 2024), factors influencing user access (Al-Adwan et al., 2023, 2024), and support mechanisms for students with disabilities (AbuKhousa et al., 2023; Segura et al., 2023). In contrast, limited research has examined the architectural and developmental aspects underlying the implementation of metaverse technologies in higher education. There exists a conspicuous gap in understanding the components and design considerations essential for developing these platforms. This study aims to address this shortfall by systematically analysing existing literature on metaverse models and frameworks in higher education. The research is guided by the following key questions:

RQ1: In which years and countries have metaverse models or frameworks been studied within the context of higher education?
RQ2: What are the documented motivations for researching metaverse models or frameworks in higher education?
RQ3: What objectives underpin the study of such models or frameworks?
RQ4: What design elements and components have been identified in existing literature as crucial to the development of higher education metaverse platforms?

This investigation is structured around these four questions, with the objective of synthesising previous studies to construct a more comprehensive understanding of current modelling efforts. The ultimate aim is to provide actionable insights for educators, developers, and policymakers to support the strategic development and effective design of metaverse-enhanced educational environments.

## 2. Methodology

A literature review serves as a critical instrument for tracing the developmental trajectory of a specific research domain and for clarifying its conceptual foundations. When conducted systematically, this process minimises potential bias and enhances the reliability and validity of findings, thereby supporting sound decision-making (Mukherjee et al., 2022). Systematic reviews are widely recognised within the academic community as a rigorous methodological approach. Their significance is reflected in the existence of specialised journals and thematic issues dedicated to publishing such reviews. In this study, a systematic review approach was adopted, guided by the PRISMA framework, to identify and assess relevant literature concerning metaverse modelling in the context of higher education. The PRISMA protocol is structured around four sequential phases: identification, screening, eligibility assessment, and final inclusion.

### *2.1. PRISMA*

PRISMA is extensively adopted within educational research due to its structured and transparent procedural framework (Ramalingam et al., 2022). It delineates each phase of the review in a systematic manner, typically illustrated through a flowchart, thereby enhancing the clarity and organisation of the review process. According to Page et al. (2021), this methodology supports comprehensive reporting, allowing for straightforward replication of the review by other researchers. Through its standardised protocol, PRISMA promotes reproducibility and transparency, facilitating the identification, appraisal, and synthesis of relevant academic literature. In the context of exploring metaverse modelling within higher education institutions, PRISMA serves as an effective methodological tool. When compared to approaches such as narrative reviews, its protocol-driven nature significantly reduces bias and strengthens the reliability of findings (Mingyu et al., 2024). Overall, PRISMA provides a consistent and efficient framework for examining complex, interdisciplinary areas such as the educational applications of the metaverse in higher education settings.

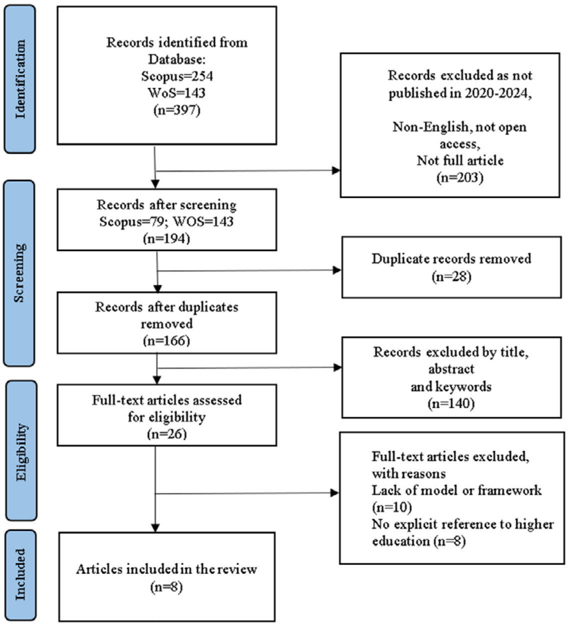
### *2.2. Resources*

The study utilised Web of Science (WoS) and Scopus for the literature search. These databases offer wide coverage across subject areas, article types, languages, research years, and keywords, allowing for refined search results to identify the most relevant studies. They are also considered reliable due to their extensive indexing and the credibility of included publications. However, grey literature and conference proceedings were excluded, as the study focused solely on peer-reviewed sources to ensure the credibility and comprehensiveness of the selected articles.

### *2.3. Selection Process*

The selection procedure was conducted in accordance with the PRISMA protocol. This process is structured into four key stages: identification, screening, eligibility, and inclusion (Rafiq et al., 2021). Each stage serves to progressively refine and narrow the collection of articles. This ensures that only the most relevant and high-quality studies are included in the review. Figure 1 presents the PRISMA flowchart that outlines this process.

Figure 1: PRISMA Flowchart Representing Selection of Final Set of Articles.



### 2.3.1. Identification

The initial stage, identification, involves locating articles relevant to the research domain. This requires the use of Boolean operators and phrase combinations to capture variations, related terms, and synonyms of the defined keywords. In this study, the selected keywords relate to the metaverse, model, and higher education. Once suitable articles are identified, they are examined to develop a deeper understanding of the subject. Following this, the keywords and their synonyms are entered as search strings into the WoS and Scopus databases, employing different field codes. The search string used is detailed in Table 1, and a total of 397 articles were retrieved.

Table 1: Search Formula for Identification.

| Database | Search Formula |
|---|---|
| WoS | TS= ((model OR framework) AND ("* metaverse" OR "metaverse *") AND ((higher AND education) OR college OR university OR students)) |
| Scopus | TITLE-ABS-KEY ((model OR framework) AND ("* metaverse" OR "metaverse *") AND ((higher AND education) OR college OR university OR students)) |

### 2.3.2. Screening

The second phase involves screening. Initially, Boolean logic was applied to filter the literature, yielding 143 records from WoS and 254 from Scopus, amounting to a total of 397 articles. The preliminary screening was conducted using specific criteria, including publication period (2020–2024), language (English), availability of the full text, open access status, and other relevant parameters. Based on these filters, 203 articles were excluded for not fulfilling the inclusion requirements. This left 143 articles from WoS and 79 from Scopus, bringing the total to 194. In the next step, 28 duplicate entries were removed from the combined dataset, reducing the number to 166. A subsequent screening was carried out by evaluating the titles, abstracts, and keywords, leading to the exclusion of 140 studies deemed unrelated to the research focus. As a result, 26 articles were retained for further assessment. With this refined list, the next stage involved systematically examining the remaining studies for eligibility.

### 2.3.3. Eligibility

After thoroughly reviewing the remaining 26 studies, 18 were excluded on the grounds that they did not align with the research objectives. The rationale for these exclusions is categorised into two main groups, as outlined in Table 2. As shown in Table 2, a significant number of the excluded papers lacked a specific focus on models or frameworks related to the metaverse. Instead, they adopted a broader perspective, referring generally to digital learning environments or virtual reality. Additionally, several studies did not explicitly address higher education contexts, which was a necessary criterion for inclusion in this research. These exclusions highlight a clear gap in the literature concerning the metaverse within higher education, thereby justifying its central focus in this study.

Table 2: The Exclusion Reason of the Articles.

| Exclusion Reason | Exclusion Numbers |
|---|---|
| Lack of Model or Framework | 10 |
| No Explicit Reference to Higher Education | 8 |

### *2.3.4. Included*

Upon completion of the preceding stages and adherence to the defined selection criteria, a total of 8 studies were ultimately selected for inclusion in this review. An overview of the fundamental details of these articles is provided in Table 3.

Table 3: Basic Information on the Article.

| Authors | National | Major | Technology Type | Research Population | Access Equipment | Theoretical Foundation |
|---|---|---|---|---|---|---|
| (Ryu et al., 2024) | South Korea | Nursing | Not mention | 10 University Students from Nursing | PC/Pad | Not Mentioned |
| (Bobko et al., 2024) | USA | Not Mentioned | VR/AR | Not Mention | PC/Pad/ VR Headset | Not Mentioned |
| (Yuan et al., 2023) | China | English | VR | 134 University Students | VR Headset | Constructivism Theory, Multi-Modal Teaching Theory |
| (Sopher & Lescop, 2023) | France | Architectural Design | Not mentioned | 46 University Students from Three Universities | PC and Headset | Situated Learning Theory |
| (Sin et al., 2023) | China | Game Development and Design | VR | Fresh Students from University | Oculus Quest 2 HMD | Constructivism Theory, Immersive Learning, Visual Literacy, Collaborative Learning |
| (Shu & Gu, 2023) | China | Not Mentioned | VR | 60 University Students | VR Glass | Theories of Fow Experience and Embodied Cognition |
| (Chen et al., 2023) | China | Not Mentioned | VR | 22 Undergraduate Students | PC/Android/ Headset | Not Mentioned |
| (AbuKhousa et al., 2023) | UAE | Not Mentioned | XR | Not Mentioned | Not mentioned | Social Constructivism and Experiential Learning |

## 3. Discussion

This study investigates the distribution of research on metaverse frameworks in higher education by year and country. Secondly, it explores the underlying motivations for examining such frameworks. Thirdly, it offers a synthesis of the metaverse frameworks identified within higher education contexts. Lastly, the study concludes that the elements and components identified through a literature-based inductive summary have been considered in the development and design of higher education metaverse applications.

**RQ1:** In which years and countries have metaverse models or frameworks been studied within the context of higher education?

The study focused on research published between 2020 and 2024, revealing that none of the 8 selected articles on metaverse models or frameworks in higher education were published between 2020 and 2022. Six articles were released in 2023, while the remaining two appeared in 2024, as illustrated in Figure 2. Regarding geographical distribution, four of the selected studies originated from China, with one each from Korea, the United States, France, and the UAE, as depicted in Figure 3.

Figure 2: Year of Publication of the Article.

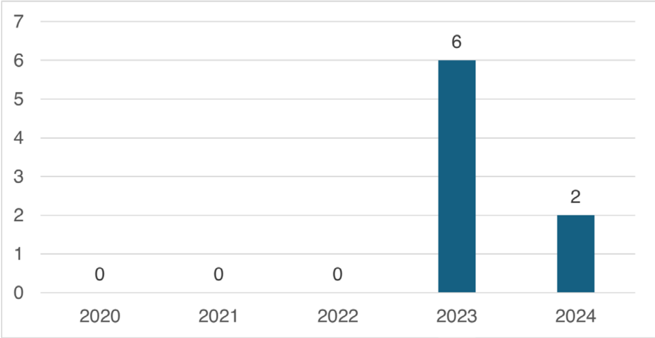
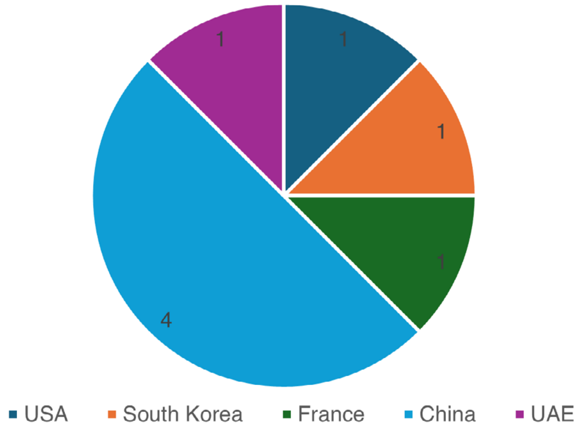



Figure 3: Countries of the Articles.




The findings suggest that scholarly attention to metaverse models or frameworks in higher education has primarily emerged within the past two years. Given that this review was conducted in late May 2024, it is possible that additional relevant studies will appear in subsequent publications. Furthermore, analysis revealed that four out of the eight selected articles originated from China, suggesting that China demonstrates greater involvement in research related to metaverse modelling and framework development in higher education compared to other countries.

**RQ2:** What are the documented motivations for researching metaverse models or frameworks in higher education?

The analysis showed that five out of the eight selected studies explicitly identified the global COVID-19 pandemic as a key motivation for exploring metaverse modelling or framework development in higher education. In contrast, the remaining three articles did not specify any rationale for their investigations (see Table 4). It can therefore be inferred that the impact of the pandemic on higher education remains evident, having to some extent accelerated research into the application of the metaverse within this sector. Simultaneously, countries such as China, South Korea, the United States, and France are actively pursuing improvements in their higher education systems to better prepare for potential future disruptions of a similar nature.

Table 4: Research Reason for Articles.

| Authors | Reasons for Research |
|---|---|
| (Ryu et al., 2024) | COVID-19 |
| (Bobko et al., 2024) | COVID-19 |
| (Yuan et al., 2023) | Not Mentioned |
| (Sopher & Lescop, 2023) | COVID-19 |
| (Sin et al., 2023) | Not Mention |
| (Shu & Gu, 2023) | COVID-19 |
| (Chen et al., 2023) | COVID-19 |
| (AbuKhousa et al., 2023) | Not Mentioned |

**RQ3:** What objectives underpin the study of such models or frameworks?

The analysis found that all eight reviewed articles explicitly referred to frameworks related to the metaverse in higher education. Of these, three studies developed and constructed their models from a broad, institutional perspective. The remaining five articles proposed frameworks tailored to specific disciplines, including nursing, English language instruction, architectural design, and game design. Based on this analysis, it can be concluded that the majority of existing metaverse models or frameworks in higher education are either designed at a general institutional level or tailored to specific academic disciplines. However, there appears to be a limited number of frameworks developed specifically for individual courses. This represents a notable gap in the literature, offering a potential avenue for future research.

Table 5: Research Aim of Articles.

| Authors | Research Aim |
|---|---|
| (Ryu et al., 2024) | This study developed and evaluated an online learning platform within a metaverse environment, specifically for nursing education, aiming to enhance virtual teaching and student learning outcomes. |
| (Bobko et al., 2024) | This research explored how an ecosystem model aligns with instructional and learning activities through 3D modelling and practical experimentation in authentic metaverse contexts. It also aimed to contribute to the creation of inclusive and sustainable virtual learning environments. |
| (Yuan et al., 2023) | The study introduced a wisdom-oriented instructional paradigm that utilises VR for English instruction in open universities, examined through the lens of the metaverse. |
| (Sopher & Lescop, 2023) | This work proposed the Immersive Atelier Model (IAM), a pedagogical strategy designed for remote architectural studios in higher education, intended to sustain high-quality virtual teaching practices. |
| (Sin et al., 2023) | The objective of this study was to present a constructivist-based learning theory tailored to the Educational Metaverse, with specific application in game design education, and to establish a comprehensive Edu-Metaverse framework. |
| (Shu & Gu, 2023) | This research aimed to enhance students' academic performance by constructing a smart learning model underpinned by Educational Metaverse technologies. |
| (Chen et al., 2023) | The authors developed a five-tier framework—comprising physical, computational, data, application, and interaction layers—designed for the Educational Metaverse, supported by institutional governance and incentive mechanisms. |
| (AbuKhousa et al., 2023) | This study proposed the Metaverse-Intensive Learning Experience (MiLEx) platform, intended to foster collective intelligence and develop future-ready professional competencies through immersive learning. |

**RQ4:** What design elements and components have been identified in existing literature as crucial to the development of higher education metaverse platforms?

This study identified ten component categories essential for constructing a metaverse model tailored to higher education. These categories include Infrastructure, Immersive Technologies, Interaction, Access Equipment, 3D Learning Scenario, Learning Task, Instructional Design, Pedagogy, Multimedia Educational Resources, and Related Theories. A detailed breakdown of each category is presented in Table 6.

**Infrastructure:** This refers to the foundational systems required for developing a metaverse model within higher education. Half of the eight analysed studies emphasised the relevance of elements such as networks, 5G, computing capabilities, and AI (Lee et al., 2020; Liu & Lai, 2023). The results suggest that building a stable and efficient infrastructure positively influences the implementation of metaverse models in this context.

**Immersive Technologies:** Within the metaverse, immersive systems are collectively referred to as XR, which encompasses VR, AR, and MR (Hwang & Chien, 2022; Mystakidis & Lympouridis, 2024; Ritterbusch & Teichmann, 2023; Zhang et al., 2022). Seven of the eight studies reviewed in this research explicitly reference immersive technologies, all of which acknowledged VR. Furthermore, four of the eight studies developed prototypes based on their respective models, and in each case, VR was the selected platform (Chen et al., 2023; Shu & Gu, 2023; Sin et al., 2023; Sopher & Lescop, 2023). These findings indicate that VR is currently the most utilised immersive technology in metaverse applications for higher education.

VR's dominance over AR and MR may be attributed to its ability to construct fully virtual environments, whether real or imagined, while AR and MR require integration with existing physical spaces. Research has shown that applying VR in specific educational scenarios can lead to reduced instructional costs, lower teaching risks, and expanded learning environments. Examples include museums, pyramids, and vocational training in construction fields (Lee et al., 2020; Ali, 2023; Liu & Lai, 2023). These findings suggest that further exploration into AR and MR is warranted. Future studies could investigate these technologies to expand their applicability within higher education settings.

**Interaction:** Seven out of the eight studies reviewed identified the Avatar as a key element for facilitating interaction in educational metaverse environments. In these virtual settings, avatars act as digital counterparts of the users, playing a central role in fostering student engagement (Tinmaz & Singh Dhillon, 2024). Interaction between users and their avatars, represented graphically, contributes to the development of a psychological connection, wherein users perceive their avatars as extensions of themselves. The ability to customise and control avatars allows individuals to curate their presence in the virtual environment. Unlike manually modelled avatars, modern 3D reconstruction methods utilising computer vision technologies enable the generation of avatars with real-time sensory synchronisation (Chen et al., 2023).

Seven of the analysed studies underscored that avatar development within higher education metaverse environments contributes positively to communication effectiveness and leaves favourable impressions on users (AbuKhousa et al., 2023; Bobko et al., 2024; Chen et al., 2023; Ryu et al., 2024; Shu & Gu, 2023; Sin et al., 2023; Sopher & Lescop, 2023). All seven papers acknowledged the functional role of avatars in facilitating virtual engagement and interaction; however, only one study offered an explicit account of the design criteria for avatars (Chen et al., 2023), indicating a significant research gap worthy of further investigation.

**Access Equipment:** Access to the metaverse learning environment necessitates the availability of suitable hardware. The reviewed literature confirmed the importance of a variety of devices, including mobile phones, personal computers, tablets, and head-mounted displays (HMDs), each supporting varying degrees of immersion (Xu et al., 2024). Although HMDs offer heightened immersion, their relatively high cost and potential for user discomfort following prolonged usage present accessibility challenges. Consequently, more affordable alternatives such as PCs or tablet devices are commonly preferred in academic settings (Bobko et al., 2024; Ryu et al., 2024). Technological advancements are expected to address these limitations by improving HMD portability, realism, AI integration, and wireless functionality (Monolith Research and Training Labs, 2024), potentially enhancing their adoption within educational contexts.

**Learning Scenario (3D):** The construction of immersive 3D learning scenarios was highlighted in 90% of the reviewed papers. Sopher and Lescop (2023) reported that 61% of students (n = 525) believed 3D environments significantly enhanced their understanding of spatial scale compared to 2D formats. Sin et al. (2023) emphasised the shift from traditional flat-content viewing mediums to interactive 3D content in virtual spaces, which presents a fundamentally new mode of content engagement. Chen et al. (2023) further illustrated the capabilities of computer vision-based 3D reconstruction technologies in synchronising avatars with sensory feedback in real time. Development tools such as Unity and Unreal Engine are most frequently used in building such scenarios, enabling the simulation of environments, avatar animation, and user interaction.

**Learning Task:** Except for one, all reviewed articles addressed the integration of learning tasks within the metaverse. Although users may face usability challenges when interacting with metaverse platforms like Gather and AltSpace, clear instructions and avatar-mediated communication significantly improve learners' willingness to participate in and complete educational activities (Li et al., 2024). In higher education, virtual learning environments benefit from structured tasks aligned with learners' needs, thereby supporting both teaching effectiveness and learner engagement (Yuan et al., 2023). However, there remains a lack of detailed discussion regarding the underlying principles of learning task design. Future research could therefore explore the specific instructional strategies that shape effective learning task construction within the metaverse.

**Instructional Design:** Among the selected studies, only one explicitly discussed instructional design. Yuan et al. (2023) employed the ICARE model, originally developed by Hoffman and Ritchie in 1998, to underpin the instructional framework for a VR-based English language course. The ICARE model supports the design of structured distance learning experiences and facilitates cognitive reconstruction by enabling learners to relate new information to prior knowledge and experiences. Salyers et al. (2010) note that the ICARE framework is particularly suited to technology-mediated learning environments due to its structured yet adaptable nature. This finding underscores the need for broader exploration of instructional design models tailored for immersive metaverse-based education.

**Pedagogy:** Only one article highlighted the role of pedagogical strategy in the development of a higher education metaverse model (Shu & Gu, 2023). This study advocated for the integration of intelligent pedagogical techniques, AI-powered assessment tools, and diversified teaching resources. These innovations, when combined, can elevate learning outcomes by personalising instruction and supporting real-time learner analytics (Gligorea et al., 2023). The synergy between AI and pedagogy thus facilitates data-driven teaching adjustments, enhances problem-solving competencies, and promotes critical thinking—skills essential for modern higher education.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**Multimedia Educational Resources**: Multimedia content is instrumental in enhancing learner immersion within higher education metaverses. Yuan et al. (2023) and Ryu et al. (2024) demonstrated its effectiveness in improving engagement and learning outcomes in English language and nursing education, respectively. VR and AR technologies are central to this transformation, allowing for highly interactive and realistic simulations (Shu & Gu, 2023). Frameworks proposed in these studies integrate virtual avatars, learning materials, and contextualised teaching environments (Chen et al., 2023). Despite these advancements, challenges persist in ensuring equitable access, ethical utilisation, and sustained educational impact (Sin et al., 2023). The concept of the Edu-Metaverse remains promising but requires careful execution and ongoing validation.

**Related Theories:** Five of the eight reviewed studies grounded their frameworks in theoretical constructs, citing nine different theories: Constructivism, Multi-modal, Situated Learning, Immersive Learning, Visual Literacy, Collaborative Learning, Flow Experience, Embodied Cognition, and Experiential Learning.

Constructivist theory, featured in three studies, is a well-established instructional paradigm frequently attributed to Jean Piaget (Efgivia et al., 2021; Bada & Olusegun, 2015). It identifies four core learning attributes: context, collaboration, dialogue, and meaning construction. In VR-based environments, learners assume an active role in knowledge creation, while educators become facilitators and guides (Orak & Al-khresheh, 2021). Rather than delivering content directly, instructors design situations where knowledge is acquired through experience and social interaction. This aligns with Sin et al. (2023), who recommend that immersive learning, visual literacy, and collaborative learning be integrated within a constructivist framework. They also propose eight guiding principles for metaverse-based learning derived from these theoretical underpinnings.

The emergence of blended metaverse platforms, combining online and offline learning modes, represents a promising educational innovation (Matusitz & Dacas, 2024). These approaches accommodate diverse learning styles, foster digital literacy, and prepare students for hybrid professional environments. Through such convergence, institutions can deliver skill development and flexibility in curricula. Situated Learning, as discussed by Spector et al. (2014) and further elaborated by Morley and Jamil (2021), posits that effective learning occurs in contexts mirroring real-world applications. This approach helps learners transition from theoretical abstraction to experiential practice. Within the metaverse, such realism can foster collaborative problem-solving and enhance student preparedness for future professional settings.

Theoretical contributions from Flow Experience and Embodied Cognition were also highlighted in Shu and Gu (2023). Csikszentmihalyi's (1975) Flow Theory underlines the importance of full engagement, which, when applied to educational metaverses, increases learner immersion and cognitive presence (Kye et al., 2021). These theories inform the development of intelligent education models aimed at creating tangible and meaningful digital learning experiences. Finally, integrating constructivism with other theoretical models may yield novel conceptual frameworks for future metaverse research. As exemplified by Sin et al. (2023), combining immersive, visual, collaborative, and constructivist perspectives enables the development of comprehensive learning principles. Future scholars are encouraged to pursue interdisciplinary theoretical syntheses to inform more effective design and implementation of metaverse frameworks in higher education.

Table 6: Summary of Elements/Components of the Metaverse Model Applied to Higher Education.

| Category | Infrastructure | | | | Immersive Technologies | | | Interaction | | Access Equipment | | Learning Scenario (3D) | Learning Task | Instructional Design | Pedagogy | Multimedia Educational Resources | Related Theories | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sub-Category | Network | (5G) | Computing | AI | VR | AR | MR | Avatar | Mouse/ Keyboard/ Headset | Wearable Device | PC/Pad | | | | | | Constructivism | Multi-modal | Situated Learning | Immersive learning | Visual Literacy | Collaborative Learning | Flow Experience | Embodied Cognition | Experiential Learning |
| (Ryu et al., 2024) | N/A | | | | N/A | | | ✓ | | x | ✓ | x | ✓ | N/A | N/A | ✓ | N/A | | | | | | | | |
| (Bobko et al., 2024) | N/A | | | | ✓ | ✓ | N/A | ✓ | N/A | ✓ | ✓ | ✓ | N/A | N/A | N/A | N/A | N/A | | | | | | | | |
| (Yuan et al., 2023) | N/A | | | | ✓ | N/A | | N/A | N/A | ✓ | ✓ | ✓ | ✓ | ✓ | N/A | ✓ | ✓ | ✓ | x | | | | | | |
| (Sopher & Lescop, 2023) | N/A | | | | ✓ | x | | ✓ | ✓ | x | ✓ | ✓ | ✓ | N/A | N/A | ✓ | x | | ✓ | x | | | | | |
| (Sin et al., 2023) | ✓ | | | | ✓ | x | x | ✓ | x | ✓ | x | ✓ | ✓ | N/A | N/A | ✓ | ✓ | x | | ✓ | ✓ | ✓ | x | | |
| (Shu & Gu, 2023) | ✓ | | | | ✓ | | | ✓ | N/A | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | x | | | | | | ✓ | ✓ | ✓ |
| (Chen et al., 2023) | ✓ | | | | ✓ | N/A | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | N/A | N/A | ✓ | N/A | | | | | | | | |
| (AbuKhousa et al., 2023) | ✓ | | | | ✓ | | | ✓ | N/A | ✓ | N/A | ✓ | ✓ | N/A | N/A | ✓ | ✓ | x | | | | | | | ✓ |

Overall, the synthesis of components associated with higher education metaverse frameworks reveals a disproportionate emphasis on technology-oriented elements compared to education-centric ones. The findings suggest that while substantial attention has been directed towards technological aspects such as infrastructure, immersive technologies, avatars, HMDs, and 3D virtual environments, there remains limited integration of pedagogical constructs.

## 4. Limitations

Despite the application of a robust and systematic approach to identify relevant literature, certain pertinent studies might have been unintentionally excluded. Several limitations associated with this investigation have thus been acknowledged.

**Time Limitation:** The current study restricted its review to literature published within the five-year period from 2020 to 2024, in order to capture the most recent developments concerning metaverse frameworks in higher education. However, this temporal constraint may have resulted in the omission of newly published findings or foundational studies that predate the selected timeframe. Future research may benefit from broadening the temporal scope to gain a more comprehensive overview of the evolution of metaverse frameworks in higher education.

**Database Limitation:** This review was confined to two major academic databases, Scopus and WoS. Although these are well-regarded for their reliability and coverage, future studies might enhance the breadth and diversity of their literature pool by incorporating additional databases such as Google Scholar, ScienceDirect, Springer Link, and others, thereby improving the representativeness of the findings.

**Keyword Limitation:** The exclusion of search terms such as VR, AR, and MR may have limited the retrieval of relevant literature, particularly where such terminology is used in place of 'metaverse'. Furthermore, Boolean logic was applied solely to keywords rather than combining both keywords and phrases. This decision was made to maintain the precision of search outcomes, as incorporating both could have broadened the results excessively and compromised the specificity required to effectively address the stated research questions. To strengthen future inquiries into higher education metaverse modelling, it is advisable to expand the search duration, utilise a wider range of databases, and adopt a more comprehensive keyword strategy.

## 5. Conclusion

This study explored existing research concerning metaverse models or frameworks in higher education. The primary objective was to identify the core components required to construct an effective higher education metaverse model and to remain informed about the most recent developments within this emerging field. Through the application of the PRISMA methodology, eight eligible studies were selected from two academic databases. The findings highlight which elements have been most commonly considered in previous research when formulating or implementing higher education metaverse models. The analysis indicates notable advancements in the development of such models. However, critical gaps persist, particularly in areas such as avatar design criteria, the application of AR and MR, and the formulation of structured learning tasks. Addressing these deficiencies is essential for enhancing the educational value of metaverse technologies. It is evident that for higher education institutions to effectively integrate these tools into their pedagogical frameworks, comprehensive evaluation of their educational impact is crucial. This integration will be instrumental in transforming the metaverse into a technology-enabled environment conducive to learning and academic development.

The present study contributes meaningfully to the understanding and construction of higher education metaverse frameworks. It offers practical insights for developers and instructional designers seeking to create immersive and functional educational environments within the metaverse. In doing so, it bridges theoretical knowledge and practical application, thus supporting the development of more robust and pedagogically sound models. While the technological capabilities of metaverse platforms hold substantial promise for higher education, their adoption necessitates the establishment of ethical standards and regulatory frameworks to protect users, particularly students. Future research could explore the design of course-specific metaverse frameworks in higher education, incorporating principles related to avatar development, instructional strategies, pedagogical methodologies, and curriculum integration. Such efforts will be essential for producing well-rounded models that reflect both technological advancement and educational integrity.

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