Journal of Education and Practice
ISSN 2222-1735 (Paper) ISSN 2222-288X (Online)
Vol.17, No.5, 2026

Institutional Readiness for Inclusive Metaverse-Based Education: A Document Analysis of King Saud University

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Abstract

This study examines the readiness of King Saud University (KSU) to adopt inclusive Metaverse-based education through a qualitative systematic document analysis. Drawing on 22 institutional and national policy documents, the study evaluates regulatory frameworks, digital infrastructure, accessibility provisions, and governance mechanisms using an integrated analytical framework that combines inclusive education principles, Universal Design for Learning (UDL), and Metaverse adoption perspectives. The findings indicate that KSU demonstrates a clear institutional commitment to inclusive education and digital transformation; however, this readiness remains largely indirect in relation to immersive learning environments. Specifically, the analysis reveals the absence of an explicit Metaverse strategy, limited documentation of immersive infrastructure readiness, and a lack of a formally articulated UDL-aligned framework for inclusive digital learning. While accessibility support and assistive technologies are present, they are primarily oriented toward conventional e-learning rather than immersive environments. The study identifies a strategic gap between policy intentions and operational readiness, highlighting the need for structured governance, institutional alignment, and measurable inclusion indicators. In response, the study proposes an initial, evidence-informed conceptual vision outlining key principles, enabling conditions, and phased readiness for integrating inclusive Metaverse education at KSU. The study contributes to the emerging discourse by offering a policy-oriented and context-sensitive perspective on inclusive immersive learning in higher education.

Keywords: Metaverse in education; Immersive learning; Digital accessibility; Inclusive education; Universal Design for Learning (UDL); Higher education.

DOI: 10.7176/JEP/17-5-13
Publication date: May 30th 2026

1. Introduction

Inclusive Education (IE) has emerged as a cornerstone of contemporary international educational systems, evolving from a mere strategy for integrating students with disabilities into a comprehensive pedagogical philosophy. This philosophy aims to redesign educational environments to accommodate human diversity and ensure equal opportunities for all. Within the context of Saudi higher education, Madhesh (2023) indicates that while the concept of inclusive education is witnessing significant growth, there remains a conceptual ambiguity among academics, often confusing "inclusion" with traditional "integration" or "placement." This necessitates the adoption of more flexible and innovative educational models that align with the goals of Saudi Vision 2030.

Despite the rigorous efforts made by the Kingdom to enhance the reality of inclusive education, local literature, such as the study by AlSufyani (2021), emphasizes that the experience still faces challenges related to influencing forces and the need for more explicit legislation to ensure nationwide application. Furthermore, Aldousari and Dunn (2022) argue that meeting the needs of students with learning disabilities in university settings requires moving beyond conventional methods. It demands the exploration of advanced technological alternatives that can foster active participation and overcome the physical and methodological barriers these learners encounter.

In this light, Metaverse technologies emerge as a gateway to an immersive educational future that transcends the boundaries of physical classrooms. According to Alfarani and Alghamdi (2024), the Metaverse offers promising opportunities to improve learning outcomes and expand the scope of interaction through three-dimensional virtual environments. This role extends beyond technical aspects to encompass "social sustainability" and inclusivity. Yeganeh et al. (2025) suggest that advanced Metaverse models, such as (Meta-MILE), enable the creation of "multi-layered" classrooms that ensure universal access and personalized learning tailored to each student's individual capabilities.

Consequently, bridging the gap between the philosophy of inclusive education and the potential of the Metaverse is no longer a technological luxury but a strategic necessity for achieving equitable and sustainable education. Given the rapid digital transformation within Saudi academic institutions, particularly at King Saud University, there is an urgent need to analyze current regulations and documents to explore their readiness for adopting this inclusive virtual space, ensuring that technological challenges are transformed into real opportunities for empowering all learners without exception.

To ensure conceptual clarity and terminological consistency throughout this study, several key terms are defined as they are used within the scope of this research. The Metaverse is understood as a persistent, immersive, multi-user digital ecosystem that connects physical and virtual environments and enables real-time interaction through avatars and multisensory technologies (Bazargani et al., 2025; Othman et al., 2024). Within this broader ecosystem, extended reality (XR) is used in this study as an umbrella term for immersive technologies such as virtual reality (VR), augmented reality (AR), and mixed reality (MR), which support different degrees of interaction between digital and physical environments (Büyüközkan & Mukul, 2024; Song, 2023). Accordingly, XR is treated as a technological enabler of Metaverse-based education rather than as a synonym for the Metaverse itself.

In parallel, the study adopts the Universal Design for Learning (UDL) framework, which promotes equitable learning through multiple means of engagement, representation, and action/expression (CAST, 2024). Given the study's focus on inclusive education, it is also essential to distinguish between inclusion and integration. Inclusion refers to the systematic redesign of learning environments, curricula, policies, and digital practices to enable the full and equitable participation of all learners. By contrast, integration typically refers to placing students with disabilities within mainstream educational settings without necessarily transforming the curriculum, pedagogy, or institutional environment to accommodate learner diversity (Madhesh, 2023). This distinction is particularly relevant in the Saudi context, where conceptual ambiguity between inclusion, integration, mainstreaming, and placement has been documented. Together, these definitions establish the conceptual foundation for the present study and guide the subsequent review of the literature.

2. Statement of The Problem

Despite the global and local shift toward inclusive education as a fundamental right, the transition within higher education institutions remains fraught with conceptual and operational challenges. In Saudi Arabia, specifically at King Saud University, there is a noticeable reliance on traditional digital learning management systems (e.g., Blackboard) which, while functional, often fail to provide the "immersive" and "personalized" environments necessary for true inclusion, particularly for students with disabilities.

The problem of this study is manifested in the existence of a "Strategic and Operational Gap"; while the university's high-level goals align with Saudi Vision 2030's digital and inclusive mandates, the current regulatory frameworks and documents may not yet recognize or integrate the transformative potential of Metaverse technologies. As indicated by Madhesh (2023), there is a persistent conceptual ambiguity among academics regarding inclusion, which is often compounded by a lack of clear policies for adopting immersive Web 3.0 technologies. Without a clear analytical vision, the university risks a digital divide where emerging technologies are adopted as "technical luxuries" rather than "inclusive tools" that dismantle physical and methodological barriers for all learners.

Therefore, this study seeks to analyze the current institutional landscape at King Saud University to envision a future where Metaverse technologies are not just tools, but the foundation for a sustainable, inclusive educational ecosystem.

3. Research Questions

To address this problem, the study seeks to answer the following questions:

Main Question:

What is the proposed future vision for inclusive education at King Saud University through the adoption of

Metaverse-based learning environments?

Sub-Questions:

1. To what extent do the current academic regulations, bylaws, and strategic documents at King Saud University provide a supportive framework for the adoption of Metaverse technologies in an inclusive manner?
2. How far do KSU's documented digital infrastructure and e-learning provisions align with UDL and accessibility requirements for immersive 3D learning?
3. What are the specific policy and operational gaps that hinder the transition from traditional integration to a fully inclusive "Metaverse-based" model at King Saud University?
4. What are the essential components, requirements, and suggested phases of the proposed vision for a Metaverse-driven inclusive education at the university?

4. Research Significance

The significance of this study lies in addressing a critical yet under-explored intersection in Saudi higher education: the ways in which Metaverse technologies can be leveraged to advance inclusive education at King Saud University. Theoretically, the study contributes by assessing regulatory readiness and documenting policy-to-practice gaps that shape the transition beyond conventional e-learning. Practically, it offers a set of UDL-based accessibility and inclusion indicators and proposes an initial, evidence-informed conceptual framework—derived from systematic document analysis—to guide future policy updates and institutional planning. By aligning these outputs with Saudi Vision 2030, the study supports decision-makers in treating emerging immersive technologies as inclusive enablers rather than technical add-ons.

5. Research Objectives

The primary objective of this study is to develop an initial, evidence-informed guiding vision for advancing inclusive education at King Saud University (KSU) through Metaverse technologies. Specifically, the study aims to:

1. Evaluate Regulatory Readiness: Analyze KSU's current academic regulations, bylaws, and strategic documents to determine their support for immersive virtual learning environments.
2. Assess Accessibility Standards: Examine how the university's digital infrastructure aligns with Universal Design for Learning (UDL) and accessibility requirements for students with disabilities.
3. Identify Strategic Gaps: Pinpoint the legislative and operational barriers in official documents that hinder the transition from traditional e-learning to an inclusive Metaverse model.
4. Propose a Preliminary Future Vision: Develop a preliminary, guiding conceptual framework (roadmap) that outlines the requirements and suggested phases for establishing a sustainable, inclusive Metaverse ecosystem at KSU.

6. Expected Results

The study aims to produce the following outcomes:

1. A Regulatory Gap Analysis: A concise report identifying specific gaps in King Saud University's current academic bylaws that may hinder the transition to inclusive Metaverse environments.
2. A Set of Strategic Indicators: A defined list of accessibility and inclusion indicators for Metaverse applications, derived from the Universal Design for Learning (UDL) framework.
3. A Proposed Conceptual Framework: A streamlined roadmap outlining the essential regulatory and technical requirements for integrating Metaverse technologies into KSU's inclusive education model as an initial guiding framework (not a fully tested implementation model).
4. A Policy Alignment Summary: A brief guide for decision-makers at KSU on how to align future digital initiatives with the inclusion mandates of Saudi Vision 2030.

7. Literature Review and Theoretical Framework

7.1. Literature Review

7.1.1. Inclusive Education in the Saudi Context

Inclusive education (IE) is widely understood as a rights-based reform that moves beyond placing students with disabilities in mainstream settings toward redesigning educational environments to ensure equity, participation, and meaningful access. Within the Saudi context, AlSufyani (2021) provides an early local account indicating that inclusive education implementation remains developing and uneven, and that clearer enabling policy and regulatory arrangements are needed to support consistent practice. Although the study primarily addresses the

broader Saudi experience, it remains policy-relevant to higher education because it highlights that inclusion depends on explicit governance and implementation conditions—not only on general commitments.

Operational evidence further suggests that inclusion is constrained by institutional capacity and service conditions, particularly for learners with learning disabilities. Aldousari and Dunn (2022) report that teachers perceive special education services as beneficial but identify persistent barriers—such as unsuitable curricula, weak parent–teacher relationships, insufficient administrative support, and inadequate training—that limit appropriate provision. This evidence is significant for higher education because it frames inclusion as an institutional challenge (resources, training, and support systems), rather than a purely pedagogical preference.

In the higher-education setting, conceptual clarity remains a major barrier to progress. Madhesh (2023) documents persistent ambiguity among academics, where "inclusion" is often conflated with "integration," "mainstreaming," or "placement." Such conceptual confusion can translate into fragmented institutional approaches and limit movement toward a genuinely inclusive model, especially when institutional policies fail to distinguish inclusion as systemic redesign rather than placement-based practice.

7.1.2. Metaverse in Education: Concept, Core Features, and Educational Uses

The Metaverse is commonly described as an immersive, persistent digital environment that enables real-time, multi-user interaction—often through avatar-based presence—and is supported by enabling technologies such as extended reality (XR), artificial intelligence, and networked 3D spaces. Conceptual analyses frame the Metaverse as a socio-technical environment that blurs physical and virtual boundaries, implying that educational value depends on both technological affordances and institutional arrangements (Sá & Serpa, 2023).

Within the education domain, early ecosystem work emphasizes that Metaverse-based learning should be approached as an integrated system rather than a standalone platform. Wang et al. (2022) propose an "Edu-Metaverse ecosystem" perspective, highlighting that educational Metaverse environments involve interconnected components and require attention to infrastructure readiness, equitable access, and governance considerations such as user rights, privacy, and data security. This perspective provides a structured way to understand how immersive learning environments may be institutionalized in higher education settings.

As research matured, systematic and framework-oriented studies synthesized common educational uses of the Metaverse, including simulations, virtual laboratories, immersive field trips, collaborative learning spaces, and experience-based training. For example, Bazargani et al. (2025) review the literature and propose a framework for education in the Metaverse, organizing key elements across learners, instructors, and institutions. These educational uses indicate potential value for engagement and experiential learning, yet they also imply institutional requirements for content development, staff readiness, and sustainable operational planning.

7.1.3.Metaverse-Enabled Inclusive Education: Bridging Inclusion and Immersive Design

Despite the growing body of Metaverse-in-education research, inclusion-focused evidence remains limited. Tlili et al. (2022) highlight a notable absence of studies explicitly focusing on learners with disabilities, suggesting that accessibility and inclusive design are still underdeveloped in immersive learning scholarship. This gap is particularly relevant in Saudi higher education, where inclusive education itself remains conceptually contested and operationally constrained (Al-Sufyani, 2021; Aldousari & Dunn, 2022; Madhesh, 2023). This observation is further supported by recent research emphasizing the limited empirical exploration of Metaverse applications for students with disabilities and the need for more inclusive policy-oriented approaches (Song, 2023).

Empirical evidence nevertheless suggests that immersive learning can support educational outcomes when inclusive design and governance requirements are addressed. Villegas-Ch et al. (2024) report improvements in knowledge retention, student engagement, and user satisfaction in Metaverse-based learning, while emphasizing that accessibility and inclusive design—alongside privacy and security—are essential to ensure equal learning opportunities. Complementary studies highlight the importance of incorporating user-centered design considerations, particularly for students with disabilities, including engagement, empowerment, privacy, and safety (Mogavi et al., 2023). At the institutional level, adoption research in higher education further indicates that sustained implementation depends on facilitating conditions and user readiness (Salloum et al., 2023), and that regulatory and contextual factors shape effective adoption and may mitigate risks such as the digital divide (Shwedeh, 2024).

These findings highlight the need to move beyond general notions of inclusion toward structured and measurable design frameworks. To operationalize "inclusion" as measurable requirements rather than a general aspiration, this study adopts the Universal Design for Learning (UDL) framework as a design-based lens for inclusive

learning environments. Accordingly, CAST (2024) provides a recognized foundation for defining indicators of inclusive design through multiple means of engagement, representation, and action/expression. In addition, recent theoretical work emphasizes that accessibility in the Metaverse requires a comprehensive and multi-layered approach that integrates user-centered design, assistive technologies, and governance mechanisms (Othman et al., 2024). Sustainability-oriented perspectives further highlight that immersive learning environments can contribute to social sustainability goals (e.g., equitable engagement opportunities and diversity management) when institutions provide appropriate support and governance (Alkhwaldi, 2024).

Taken together, the literature indicates that while Metaverse environments offer promising educational uses and emerging frameworks (Wang et al., 2022; Bazargani et al., 2025), a clear gap remains regarding how Saudi universities operationalize inclusive Metaverse-based education through explicit policies, documented infrastructure readiness, and explicitly articulated and UDL-aligned accessibility indicators. While existing practical implementations demonstrate the potential of immersive platforms to support inclusive participation through accessibility tools such as speech-to-text and text-to-speech systems (Madhubala et al., 2025), these efforts remain fragmented and lack institutional integration. This justifies the present analytical study at King Saud University, which seeks to map regulatory readiness, identify policy-to-practice gaps, and propose an initial guiding conceptual roadmap aligned with UDL principles and Saudi Vision 2030.

7.2. Synthesis and Research Gap

The literature shows that inclusive education in Saudi Arabia is still developing and faces conceptual and operational constraints in higher education (Al-Sufyani, 2021; Aldousari & Dunn, 2022; Madhesh, 2023). At the same time, the Metaverse is increasingly framed as an immersive educational environment, yet effective adoption requires institutional readiness and governance (Wang et al., 2022; Bazargani et al., 2025). Critically, disability-focused accessibility remains limited in Metaverse education research, indicating that inclusion in immersive learning cannot be assumed and must be operationalized through standards such as UDL (Tlili et al., 2022; CAST, 2024; Villegas-Ch et al., 2024). Accordingly, a clear gap remains regarding how Saudi universities' regulations and strategic documents translate inclusive education goals into measurable requirements for Metaverse-based learning. This study addresses this gap through a document-based analysis at King Saud University, producing a regulatory gap assessment, UDL-informed indicators, and an initial guiding conceptual roadmap aligned with Saudi Vision 2030 (Salloum et al., 2023; Shwedeh, 2024; Alkhwaldi, 2024).

7.3. Theoretical Framework (integrated lens for the current study)

This study adopts an integrated framework that links inclusive education and Metaverse adoption through a document-based governance lens. It consists of three complementary lenses:

- Inclusive education as institutional responsibility: Inclusion requires clear definitions, roles, and enforceable procedures beyond traditional integration/placement approaches (Al-Sufyani, 2021; Madhesh, 2023).
- UDL as the operational design lens: UDL translates inclusion into assessable criteria through multiple means of engagement, representation, and action/expression (CAST, 2024).
- Metaverse adoption as a socio-technical transition: Metaverse-enabled education requires alignment between technology and governance, with explicit attention to accessibility (given limited disability-focused evidence), privacy, and institutional enabling conditions (Wang et al., 2022; Tlili et al., 2022; Salloum et al., 2023; Alkhwaldi, 2024; Shwedeh, 2024; Yeganeh et al., 2025; Bazargani et al., 2025).

7.4. Resulting Analytical Dimensions

Accordingly, KSU documents will be analyzed across four dimensions: (1) regulatory and strategic readiness, (2) documented infrastructure and accessibility readiness, (3) UDL alignment, and (4) implementation/adoption/sustainability governance. These dimensions support the study outputs: a regulatory gap analysis, UDL-based indicators, and an initial guiding conceptual roadmap for inclusive Metaverse adoption at KSU.

Figure 1 visually summarizes this analytical logic by illustrating how the study's theoretical lenses, data sources, document analysis process, analytical dimensions, and expected outputs are connected within one integrated framework.

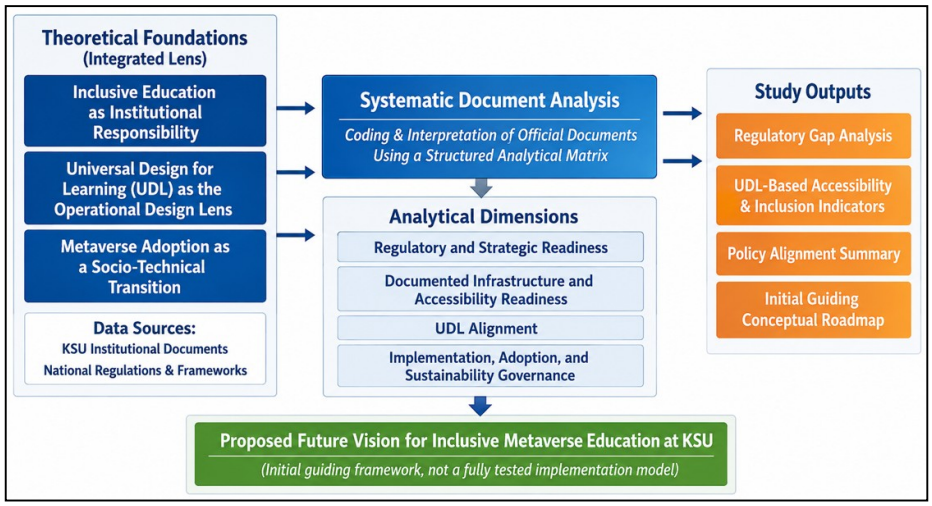

Figure 12 :Conceptual Framework of the Study

8. Research Methodology

8.1. Research Design

This study adopts a qualitative research design based on systematic document analysis (Bowen, 2009) to examine King Saud University's documented readiness to integrate Metaverse technologies into its inclusive education system. This design is appropriate because the study focuses on interpreting official institutional documents, including regulations, bylaws, strategic plans, e-learning materials, and accessibility-related documents. Through this approach, the study seeks to identify policy and operational gaps and assess the extent to which these documents align with Universal Design for Learning (UDL) principles. Since the study is concerned with analyzing institutional texts rather than measuring variables or testing hypotheses, qualitative document analysis provides the most appropriate methodological foundation.

8.2. Participants / Sampling

As this study does not involve human participants, the target population consists of official institutional and national policy documents related to inclusive education, digital accessibility, and digital transformation in higher education. The unit of analysis is the individual document. A purposive, criterion-based sampling strategy was used to select documents relevant to the research questions. The final sample included 22 key documents drawn from King Saud University and relevant national bodies, including regulations, policies, strategic plans, accessibility guidelines, and e-learning frameworks.

8.3. Data Collection Tools

The study utilizes document analysis as the primary data collection method. The main data sources consist of publicly available institutional and national documents obtained from official websites and digital repositories of King Saud University, the Ministry of Education, and the National eLearning Center.

These documents include strategic plans, academic regulations, accessibility policies, e-learning regulations, standards, and frameworks. Since these materials are official policy and regulatory documents, they are considered reliable and authoritative sources of data, reflecting formal institutional practices and regulatory expectations.

To systematically extract relevant information, a structured document analysis matrix was developed to systematically extract and organize data across all selected documents. The matrix included key components such as document identification, analytical dimensions, indicators, extracted evidence, interpretive notes, and identified gaps. This structured tool ensured consistency and rigor in data extraction across all documents.

8.4. Procedures

The research was conducted through a structured, multi-step process. First, relevant documents were identified through systematic searching of official institutional and national platforms. Keywords such as "inclusive education," "accessibility," "e-learning," and "digital transformation" were used to locate relevant materials.

Second, an initial screening process was carried out to assess the relevance and eligibility of the documents based on the predefined selection criteria. Irrelevant or overly general documents were excluded.

Third, the final set of documents was compiled and organized according to their source (institutional or national) and type (regulations, policies, frameworks, or guidelines).

Fourth, each document was carefully reviewed and coded using the document analysis matrix. Key sections were examined to identify evidence related to the study dimensions.

Finally, findings were synthesized across documents to identify patterns, strengths, and gaps in institutional readiness for integrating inclusive and technology-enhanced learning environments.

8.5. Data Analysis Methods

The data were analyzed using qualitative document analysis informed primarily by deductive coding, with limited inductive coding used to capture emerging themes. Initial codes were derived from the study framework and applied across four analytical dimensions: regulatory and strategic readiness, digital infrastructure and accessibility, UDL alignment, and implementation and governance. Relevant excerpts were then grouped into broader categories to identify recurring patterns, gaps, and areas of alignment across institutional and national documents.

9. Findings and Analytical Results

This section presents the findings derived from the qualitative systematic document analysis of the selected institutional and national documents relevant to inclusive education, digital accessibility, and Metaverse-related readiness at King Saud University. The analysis was conducted in line with the study's analytical framework and organized across four main dimensions: (1) regulatory and strategic readiness, (2) documented infrastructure and accessibility readiness, (3) UDL alignment, and (4) implementation, adoption, and sustainability governance. The purpose of this section is to identify the extent of documented readiness, highlight areas of alignment, and reveal the major policy and operational gaps that may affect the future integration of Metaverse technologies within an inclusive higher education model at KSU.

9.1. Regulatory and Strategic Readiness

The analysis of regulatory and strategic readiness indicates that King Saud University has a broad institutional foundation that may support future movement toward inclusive Metaverse-based education, but this readiness remains largely indirect rather than explicitly institutionalized. The KSU Strategic Plan provides a general strategic basis through its emphasis on academic quality, innovation, supportive governance, human-capital development, community service, and institutional development. These priorities are relevant to future immersive education because Metaverse-based learning requires strategic commitment, institutional coordination, and quality-oriented transformation. However, the plan does not explicitly refer to Metaverse-based learning, XR-supported environments, immersive 3D education, or inclusive virtual learning ecosystems. Thus, the strategic plan supports the general conditions for future adoption, but it does not constitute a direct Metaverse strategy.

This indirect readiness is also reflected in KSU's academic and regulatory documents. The KSU Academic and Study Regulations recognize multiple learning modes, including face-to-face, blended, distance, e-learning, self-learning, and other modes of learning. This flexibility provides an important regulatory basis for technology-enhanced education. Similarly, the Universities Law and the E-Learning Regulation provide a broader governance context for digital learning by supporting institutional autonomy, quality assurance, licensing, and technical integration with national e-learning systems. However, these documents remain oriented toward established forms of digital and electronic learning. They do not explicitly address immersive virtual classrooms, avatar-based participation, XR-supported learning, accessibility in 3D environments, or the governance of Metaverse-based academic delivery.

At the national and inclusion-related levels, the National AI in Digital Learning Framework offers strong alignment with the governance needs of emerging technologies by emphasizing leadership, curriculum and content design, teaching and learning, assessment, ethical and responsible use, privacy, security, learner support,

professional development, and continuous improvement. These principles are relevant to Metaverse-based education because immersive environments require ethical safeguards, personalization, data protection, and equitable access. In parallel, KSU's disability-related policies and the Educational and Academic Services Unit within the Universal Access Program demonstrate an institutional commitment to equal opportunities, non-discrimination, academic accommodations, and support for students with disabilities. Nevertheless, both the national AI framework and KSU's disability-related documents remain broader in scope and do not specify how inclusion should be operationalized in Metaverse-based environments, such as accessible avatars, alternative interaction modes, assistive technologies within virtual classrooms, or UDL-aligned immersive learning design. Accordingly, KSU appears to possess a foundational but indirect policy base for inclusive digital transformation; however, readiness for Metaverse adoption remains implicit rather than explicitly institutionalized.

9.2. *Documented Infrastructure and Accessibility Readiness*

The analysis of documented infrastructure and accessibility readiness shows that King Saud University has an established foundation for conventional digital accessibility and assistive support, but the evidence remains limited in relation to immersive Metaverse-based infrastructure. The KSU Technical Configuration Unit for the Electronic Environment provides a direct institutional indication of attention to digital accessibility. It emphasizes the importance of preparing the university's electronic environment to interact with assistive technologies, devices, and software that facilitate access for students with disabilities to university electronic services. This suggests that KSU has recognized the technical dimension of accessibility and has begun to address barriers in digital service delivery. However, the document remains focused on accessible electronic services and assistive technologies in general; it does not provide evidence of readiness for immersive 3D platforms, XR hardware and software ecosystems, interoperable virtual learning spaces, or accessibility protocols for Metaverse-based classrooms.

KSU's Students with Disability Services Policies and Procedures further support this dimension by documenting institutional services, eligibility procedures, confidentiality principles, responsibilities, and support mechanisms for students with disabilities. These provisions demonstrate that the university has an operational basis for accommodation-oriented support and student access to services. In addition, the Ministry of Education's page on students with disabilities in higher education indicates that Saudi universities provide programs and facilitation measures to support the enrollment of students with disabilities, including environmental adaptation, support services, and awareness efforts. These documents strengthen the conclusion that accessibility is formally recognized within the Saudi higher education context. Nevertheless, the evidence remains primarily connected to physical, academic, and conventional digital accessibility rather than to immersive learning environments. The documents do not specify requirements for accessible avatars, alternative modes of interaction, sensory customization, virtual mobility support, or assistive technologies embedded within Metaverse-based learning spaces.

At the national level, the Universal Access Guidelines for Persons with Disabilities in Educational Environments provide a broader and more structured accessibility reference. The guide covers educational, environmental, and technical domains of universal access and includes sections related to access to the general curriculum, accommodations, assistive tools, universal design for learning in higher education, responsibilities, and technical accessibility standards. Similarly, the NELC Digital Content Development Standards contribute to infrastructure and accessibility readiness by emphasizing the quality of digital content, technical quality, design quality, and artistic quality, while also highlighting the role of artificial intelligence in improving digital content development. These standards are relevant because inclusive Metaverse-based education would require accessible, high-quality, and technically reliable digital learning content. However, both documents remain broader accessibility and digital content references rather than Metaverse-specific infrastructure frameworks. They do not explicitly address immersive content standards, 3D accessibility requirements, XR interoperability, or technical specifications for inclusive virtual environments.

Overall, the reviewed documents indicate that KSU and the national higher education ecosystem possess a documented basis for conventional digital accessibility, assistive technologies, and learner support. However, this readiness remains under-documented for immersive Metaverse infrastructure. The available evidence supports accessibility in existing electronic services and digital learning environments, but it does not yet demonstrate a clear institutional readiness for XR-supported platforms, immersive content delivery environments, interoperability standards, or accessibility-by-design requirements for Metaverse-based education. Accordingly, KSU shows documented readiness for conventional digital accessibility and assistive support, but readiness for immersive Metaverse infrastructure remains operationally incomplete.

9.3. UDL Alignment

The analysis of UDL alignment indicates that the reviewed documents demonstrate partial and implicit consistency with Universal Design for Learning principles, but not a fully institutionalized UDL framework. The Universal Access Guidelines for Persons with Disabilities in Educational Environments provide the strongest foundation for this dimension, as they address access to the general curriculum, accommodations and adaptations, assistive tools, universal access principles in higher education, responsibilities, and technical accessibility standards. These elements are consistent with the UDL logic of reducing barriers and enabling diverse learners to access educational content through flexible and supportive arrangements. However, the guide remains a broad accessibility reference rather than a university-wide UDL framework tailored to immersive or Metaverse-based learning environments.

At the institutional level, KSU's Guidelines and Procedures on Academic Accommodations for Students with Disabilities support this partial alignment by defining academic accommodations, clarifying procedures for obtaining them, and explaining the role of course instructors in activating such accommodations. These provisions are particularly relevant to the UDL principle of action and expression, as they allow students to participate and demonstrate learning through alternative arrangements. Similarly, the Ministry of Education page on students with disabilities in higher education and KSU's Educational and Academic Services Unit indicate broader attention to support services and appropriate educational environments. Nevertheless, these documents mainly emphasize individual accommodations after students' needs are identified, rather than proactively designing learning environments from the outset according to UDL principles. This distinction is important because Metaverse-based learning environments are not inherently inclusive; they become inclusive only when accessibility and UDL principles are embedded in their design from the beginning.

The NELC Digital Content Development Standards and the E-Learning Evaluation Framework add further evidence of UDL-consistent practices through their emphasis on digital content quality, course design, e-learning practices, assessment, technology, student support, training, and continuous improvement. These dimensions relate to UDL principles such as representation, engagement, and action/expression. However, they remain general e-learning quality frameworks and do not provide explicit UDL-based criteria for immersive learning design, such as accessible 3D content, multiple modes of interaction in virtual environments, adaptive sensory settings, or inclusive assessment within Metaverse-based learning spaces. Accordingly, the reviewed documents support a practical accommodation-oriented model and some UDL-consistent practices, but they do not yet demonstrate a fully systematized UDL architecture for future immersive inclusive learning.

9.4. Implementation, Adoption, and Sustainability Governance

The analysis of implementation, adoption, and sustainability governance indicates that Saudi national digital learning frameworks provide a strong governance foundation that applies to higher education institutions, including King Saud University. The NELC E-Learning Standards establish requirements related to approved governance structures, clear roles and responsibilities, decision-making authorities, coordination mechanisms, quality control, stakeholder rights, complaint-handling procedures, and periodic review of policies and practices. They also require strategic and operational planning, capacity building, professional development, performance indicators, and regular review. These requirements are relevant to Metaverse-based education because immersive learning environments would require clear accountability, technical coordination, risk management, and continuous quality assurance.

The E-Learning Regulation and its Executive Rules further support this governance dimension by regulating e-learning activity, requiring licensing, defining recognized e-learning modes, and emphasizing compliance with national standards. Similarly, the National Digital Education Index provides a maturity-oriented perspective by measuring digital education across dimensions such as trust, efficiency, and innovation, including governance, compliance, technical integration, data sharing, sustainability, and AI use. Together, these documents show that the national ecosystem provides mechanisms for regulating, monitoring, and improving digital learning maturity. However, they remain focused on digital and e-learning systems broadly, rather than on immersive 3D learning environments or Metaverse-specific adoption models.

The National AI in Digital Learning Framework and the guidelines for using generative AI tools add an ethical and operational governance layer through their emphasis on responsible use, privacy, security, learner support, professional development, compliance, review, and role-specific responsibilities. These principles are relevant to Metaverse adoption because immersive environments may involve AI-supported personalization, learner data, virtual interaction, and automated content generation. Nevertheless, they do not directly address Metaverse-

specific issues such as avatar governance, safety in virtual environments, immersive data tracking, XR-related risks, or accessibility governance in 3D spaces.

At the KSU level, disability support and educational service documents indicate the existence of institutional roles and service procedures for supporting students with disabilities. These documents are important because inclusive Metaverse adoption should build on existing inclusion and student-support structures. However, the reviewed KSU-specific documents do not yet show how national digital learning and AI governance requirements are translated into a localized roadmap for inclusive Metaverse adoption. In particular, they do not provide evidence of pilot implementation plans, evaluation criteria, scaling mechanisms, risk management procedures, data governance arrangements, faculty readiness plans, or long-term sustainability planning for Metaverse-based education. Accordingly, while national frameworks provide a strong governance basis for digital learning, the reviewed KSU-specific documents do not yet evidence a localized roadmap, accountability structure, or phased adoption model for inclusive Metaverse-based education.

Following the document-level analysis presented above, Table 1 provides a consolidated summary of the findings across the four analytical dimensions. The table highlights the key documents analyzed, the main documented evidence, the identified gaps, and the analytical implications for inclusive Metaverse adoption at KSU.

Table 2: Analytical Summary of Documented Readiness for Inclusive Metaverse Adoption at King Saud University

Dimension	Key analyzed documents	Synthesized documented evidence	Main gap identified	Analytical implication
Regulatory and Strategic Readiness	KSU Strategic Plan; KSU Academic and Study Regulations; KSU Students with Disabilities Policies and Procedures; KSU Educational and Academic Services Unit; National AI in Digital Learning Framework; Universities Law; E-Learning Regulation.	The reviewed documents indicate a **general institutional commitment**to academic quality, innovation, supportive governance, and student inclusion. KSU disability-related policies also reflect a **non-discrimination orientation** and a commitment to enabling students with disabilities to access university programs and services. At the national level, the AI and digital learning framework adds a policy-oriented emphasis on **fairness, transparency, privacy, and ethical governance** in technology-enhanced education.	The reviewed KSU documents do **not yet provide an explicit university-level policy** for Metaverse-based learning supported by XR technologies, nor a clearly articulated strategic framework that links inclusive education directly to immersive virtual learning environments.	KSU appears to possess a **foundational but indirect policy base** for inclusive digital transformation; however, readiness for Metaverse adoption remains **implicit rather than explicitly institutionalized**.
Documented Infrastructure and Accessibility Readiness	KSUT echnical Configuration Unit for the Electronic Environment; KSU Students with Disabilities Policies and Procedures; Universal Access Guide for Persons with Disabilities in Educational Environments; NELC Digital Content Development Standards; Ministry of Education	The documents show evidence of **existing accessibility-oriented support structures**, including assistive technologies, adapted university websites, technical accommodations, note-taking support, hearing-assistive devices, and broader environmental accessibility considerations. National	The current corpus does **not document clear institutional readiness for immersive 3D infrastructure**, such as XR hardware/software ecosystems, interoperability requirements, immersive content delivery environments, or technical standards	KSU shows **documented readiness for conventional digital accessibility and assistive support**, but readiness for immersive Metaverse infrastructure remains **under-documented and operationally**

	disability support page; Learning Management System Framework.	standards also emphasize that digital systems should support **personalization**, multi-device access, and accessibility for learners with disabilities.	specific to Metaverse-based learning.	**incomplete**.
UDL Alignment	NELC Digital Content Development Standards; E-Learning Evaluation Framework; KSU Academic Accommodation Guidelines; Ministry of Education page on accommodations in higher education; KSU Educational and Academic Services Unit; Universal Access Guidelines for Persons with Disabilities	The reviewed documents reflect partial alignment with UDL principles, particularly across the three dimensions of engagement, representation, and action/expression, through references to personalized content, accessibility for learners with disabilities, varied instructional supports, adapted presentation of information, alternative assessment arrangements, extended time, reduced-distraction environments, and assistive communication support. National digital content standards explicitly reference UDL and emphasize designing content for diverse learner needs.	No clear evidence was found of a **formal university-wide UDL framework**embedded across KSU programs, nor of explicit UDL-based criteria tailored to immersive or Metaverse learning design.	The documents support a **practical accommodation-oriented model**and some UDL-consistent practices, but they do not yet demonstrate a **fully systematized UDL architecture** for future immersive inclusive learning.
Implementation, Adoption, and Sustainability Governance	NELC E-Learning Standards; National AI in Digital Learning Framework; KSU disability support and educational service documents; National Digital Education Index; Executive Rules of E-Learning Regulation; AI Usage Guidelines	The reviewed documents reflect several governance-related elements, including roles and responsibilities, compliance expectations, learner support, professional development, data protection, and continuous improvement. These elements are especially visible in the national frameworks and standards.	The reviewed KSU documents do not yet show how national digital learning and AI governance requirements are translated into a localized institutional roadmap for piloting, evaluating, scaling, and sustaining inclusive Metaverse-based education. They also do not provide a university-specific governance model for immersive learning risks, data governance, accessibility, or long-term sustainability.	National frameworks provide a strong governance basis for digital learning that applies to KSU; however, the reviewed KSU-specific documents do not yet evidence a localized roadmap, accountability structure, or phased adoption model for inclusive Metaverse-based education.

Overall, the analysis indicates that KSU has a documented foundation for inclusive education, accessibility, digital learning, and student support. However, readiness for inclusive Metaverse-based education remains largely indirect, as the reviewed documents do not yet provide a localized institutional roadmap, immersive infrastructure standards, or a fully articulated UDL-based framework for Metaverse learning environments.

10. Proposed Initial Guiding Framework for Inclusive Metaverse Education at KSU

In response to the document-level findings and the gaps summarized in Table 1, this study proposes an initial, evidence-informed guiding framework for inclusive Metaverse-based education at King Saud University. Since

the study is based on systematic document analysis rather than technical implementation or empirical testing, the proposed framework should be understood as a conceptual and policy-oriented guide, not as a fully operational or technical implementation model. Its purpose is to translate the identified regulatory, accessibility, UDL, and governance gaps into broad institutional directions that may inform future planning, policy development, and exploratory initiatives.

The proposed framework is organized around four interrelated components: policy alignment, inclusive infrastructure readiness, UDL-based immersive learning design, and implementation governance. The first component, policy alignment, emphasizes the need to connect KSU's existing commitments to inclusive education, digital transformation, and national e-learning regulations with a clearer institutional direction for immersive learning environments. This requires moving from general support for digital learning toward explicit institutional recognition of Metaverse-based education as a possible inclusive learning pathway.

The second component, inclusive infrastructure readiness, focuses on ensuring that future immersive environments are designed with accessibility requirements from the outset. This includes attention to XR-supported platforms, assistive technologies, accessible interfaces, alternative modes of interaction, sensory customization, and compatibility with diverse learner needs. In this respect, Metaverse adoption should not be treated as a purely technical initiative, but as an accessibility-sensitive transformation that builds on KSU's existing digital accessibility and student-support structures.

The third component, UDL-based immersive learning design, highlights the importance of embedding Universal Design for Learning principles into any future Metaverse-based learning environment. In line with UDL, inclusive design should provide multiple means of engagement, representation, and action/expression, enabling students to access content in different formats, interact through varied modalities, and demonstrate learning through flexible assessment options (CAST, 2024). This component is particularly important because Metaverse environments are not inherently inclusive; they become inclusive only when accessibility and UDL principles are embedded in their design from the beginning. It also reflects the importance of engagement, empowerment, privacy, and safety as key considerations in inclusive Metaverse learning environments (Mogavi et al., 2023).

The fourth component, implementation governance, emphasizes the need for a phased and accountable adoption process. This includes developing a localized roadmap, identifying responsible units, defining evaluation criteria, managing data privacy and ethical risks, preparing faculty and technical staff, and establishing mechanisms for continuous review and improvement. Rather than focusing on specific technologies alone, the framework emphasizes enabling conditions that support gradual and responsible integration of immersive learning environments. This perspective aligns with recent studies that call for holistic and multi-layered approaches to Metaverse-based education, integrating accessibility, personalization, and institutional support structures (Yeganeh et al., 2025; Othman et al., 2024).

To support future adoption, the framework suggests a phased approach to institutional readiness. The first phase focuses on strategic preparation, including awareness-building, policy alignment, and capacity development. The second phase involves exploratory pilot initiatives aimed at testing immersive learning applications in selected contexts. The final phase emphasizes evaluation, refinement, and potential scaling based on institutional priorities and evidence of effectiveness. This staged approach reflects the experimental and evolving nature of Metaverse technologies in education.

Overall, the proposed framework does not aim to present a definitive model for Metaverse implementation at KSU. Rather, it offers an initial guiding structure that translates the findings of the document analysis into actionable institutional considerations. By linking policy alignment, inclusive infrastructure readiness, UDL-based immersive learning design, and implementation governance, the framework provides a foundation for future institutional planning and supports a gradual, responsible, and inclusive transition toward Metaverse-based education.

11. Discussion

The findings of this study indicate that, while the reviewed institutional documents demonstrate a clear commitment to inclusive education, accessibility, and digital learning support, they do not yet provide explicit evidence of readiness for Metaverse-based education. In particular, gaps were identified in relation to the absence of a dedicated Metaverse policy, limited documentation of immersive infrastructure readiness, the lack of a university-wide UDL-based pedagogical framework, and the absence of a structured governance model for immersive learning adoption. This suggests that institutional readiness for Metaverse-based education remains largely implicit rather than systematically articulated.

One practical explanation for this strategic gap is that conventional e-learning has reached a higher level of institutional maturity than Metaverse-based learning. Learning management systems and established e-learning platforms are already embedded in university operations, supported by quality assurance procedures, national e-learning regulations, and accumulated user experience. This is consistent with e-learning adoption literature, which shows that students' acceptance of e-learning is shaped by factors such as system quality, information quality, content quality, accessibility, computer self-efficacy, and perceived ease of use (Salloum et al., 2019). By contrast, Metaverse-based education remains a more complex socio-technical transition, requiring not only digital platforms but also XR infrastructure, immersive content development, specialized technical expertise, accessibility-by-design standards, faculty readiness, and new governance arrangements.

Several barriers may therefore explain why institutional documents remain more explicit about conventional e-learning than immersive environments. Previous research on Metaverse adoption in higher education identifies accessibility, affordability, adaptability, limited institutional support, lack of educator awareness, technical infrastructure requirements, hardware demands, privacy, cybersecurity, and policy readiness as major challenges (Shwedeh, 2024). Similarly, a systematic review of Metaverse adoption in education shows that adoption is influenced not only by technical prerequisites, but also by psychological, motivational, quality-related, social, and inhibiting factors (Maghaydah et al., 2024). These findings suggest that the absence of a localized Metaverse roadmap in the reviewed KSU documents should not be interpreted simply as a lack of innovation, but rather as evidence that immersive learning adoption requires a higher level of institutional coordination, investment, technical capacity, faculty development, and ethical governance than conventional e-learning.

This interpretation shifts the identified gap from a purely technological issue to a broader challenge of institutional change. For KSU, moving toward inclusive Metaverse-based education would require a gradual and evidence-informed transition, beginning with policy alignment, awareness-building, faculty and technical training, limited pilot initiatives, and systematic evaluation before large-scale implementation. Such a phased approach is particularly important because inclusive Metaverse environments involve sensitive learner data, avatar-based interaction, behavioral tracking, accessibility risks, and new forms of digital participation. Therefore, the university's current emphasis on conventional e-learning can be understood as a stable and regulated starting point, while inclusive Metaverse adoption represents a future-oriented transformation that requires stronger governance, cultural readiness, and sustainability planning.

Beyond these implementation barriers, the findings also have important pedagogical implications. In relation to UDL, the findings indicate partial and implicit alignment with its three core principles—engagement, representation, and action/expression—rather than a formally articulated institutional framework for immersive inclusive learning. This reflects the document-based evidence identified across the analyzed dimensions, where accessibility and accommodation practices are present, but not yet translated into a proactive UDL-based design framework for Metaverse learning environments.

These results are consistent with the broader literature, which highlights the transformative potential of immersive technologies while emphasizing the need for more comprehensive and institutionally integrated implementation models. For instance, the Meta-MILE model presents a multi-layered Metaverse classroom framework that integrates immersive infrastructure, AI-driven personalization, accessibility, collaboration, and scenario-based assessment within a cohesive learning environment (Yeganeh et al., 2025). Similarly, frameworks on accessible Metaverse environments stress the importance of embedding accessibility, ethical considerations, and user-centered design as foundational elements rather than optional features (Othman et al., 2024). However, when compared with the document-based findings of the present study, such approaches appear not yet consistently translated into institutional policies or practices.

In the context of inclusive education, the findings further align with studies that emphasize the critical role of assistive technologies and Universal Design for Learning (UDL) in supporting diverse learners. Research suggests that immersive technologies under the XR umbrella may enhance engagement and provide flexible, multisensory learning experiences; however, their inclusive value depends on integration with pedagogical frameworks such as UDL and accessibility principles (Poggianti et al., 2025). At the same time, studies focusing on students with disabilities highlight the importance of key design considerations such as engagement, empowerment, privacy, and safety in shaping inclusive Metaverse environments (Mogavi et al., 2023). Despite these insights, the literature also suggests that empirical research on Metaverse applications for students with disabilities remains limited and is still in early developmental stages.

Taken together, these findings and the reviewed literature highlight a clear gap between conceptual advancements in inclusive Metaverse education and the current state of institutional readiness. While prior

research provides valuable insights into design principles, technological possibilities, and inclusive frameworks, it does not offer a comprehensive, context-sensitive roadmap for institutional adoption. In this regard, the present study contributes to the literature by providing a document-based assessment of institutional readiness and by translating analytical findings into a structured conceptual framework that integrates policy, accessibility, UDL alignment, and governance considerations into a unified institutional perspective.

Overall, the study underscores that the successful adoption of inclusive Metaverse-based education requires more than technological readiness; it necessitates coordinated institutional transformation. This includes the development of explicit policies, the alignment of pedagogical practices with inclusive design principles, and the establishment of governance mechanisms that ensure ethical, equitable, and sustainable implementation.

12. Conclusion

This study examined institutional readiness for inclusive Metaverse-based education at King Saud University through systematic document analysis. The findings show that KSU has a documented foundation for inclusive education, accessibility, and digital learning support; however, this readiness remains largely indirect in relation to Metaverse adoption. The reviewed documents do not yet demonstrate an explicit institutional strategy for immersive learning environments, a clearly documented immersive infrastructure base, a university-wide UDL-aligned design framework, or a localized governance model for Metaverse implementation.

The original contribution of this study lies in providing one of the first document-based assessments of institutional readiness for inclusive Metaverse-based education in the Saudi higher education context. Unlike studies that approach the Metaverse primarily as a technological innovation, this study frames Metaverse adoption as a policy, governance, and institutional readiness issue. By integrating public administration concerns—such as regulatory alignment, institutional accountability, governance structures, and implementation readiness—with educational technology policy and UDL-based inclusion principles, the study advances a more comprehensive understanding of how immersive learning can be responsibly introduced within higher education institutions.

This contribution is particularly relevant for Saudi universities because national digital transformation goals and inclusive education commitments require more than general technological adoption. They require localized institutional strategies, measurable accessibility indicators, and governance mechanisms that ensure ethical, equitable, and sustainable implementation. In this sense, the study offers a context-sensitive analytical foundation for policymakers, university leaders, and educational technology planners seeking to translate national digital learning ambitions into inclusive and governable Metaverse-based learning environments.

13. Recommendations

Based on the document-based findings, several recommendations are proposed to support the gradual, responsible, and policy-aligned adoption of inclusive Metaverse-based education in higher education institutions:

- Develop an explicit institutional strategy for Metaverse-based education that aligns with national digital transformation goals and clearly defines objectives, priorities, and implementation pathways.
- Align institutional policies with UDL principles by translating inclusion into measurable indicators related to engagement, representation, and action/expression within digital and immersive learning environments.
- Strengthen governance and ethical frameworks by addressing key considerations such as data privacy, accessibility standards, and equitable participation in immersive environments.
- Support exploratory pilot initiatives that allow institutions to test immersive learning applications in controlled contexts before large-scale adoption.
- Enhance institutional capacity through faculty development programs focused on inclusive digital pedagogy and emerging immersive technologies.
- Promote integration of assistive technologies within immersive platforms to ensure that students with disabilities can fully participate in learning activities.
- Encourage interdisciplinary collaboration between educators, technologists, and policymakers to ensure that Metaverse adoption reflects both pedagogical and societal considerations.

14. Limitations of the Study

This study is limited to qualitative document analysis of publicly available institutional and national documents. Therefore, it reflects formal policies and documented readiness rather than actual implementation, internal practices, or stakeholder experiences. It also focuses on one institutional case, King Saud University, which may limit generalizability. In addition, the rapidly evolving nature of Metaverse technologies means that the findings

may require future updating.

15. Future Research Directions

Future studies should examine the perspectives of students, faculty, administrators, and policymakers regarding inclusive Metaverse-based education. Further research could also assess pilot implementations, compare readiness across Saudi universities, and develop UDL-based indicators specifically designed for immersive learning environments.

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