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Immersive Metaverse Technologies for Education and Training in Tourism and Hospitality

Abstract

Purpose

This study explores the potential for tourism and hospitality education and training through immersive Metaverse learning. It examines familiarity levels, perceived benefits, and challenges, and proposes a framework for Metaverse adoption in education and training.

Design/methodology/approach

Grounded in Diffusion of Innovation (DOI) Theory, this qualitative study analyses 45 in-depth interviews with students and academics in Saudi Arabia. The thematic analysis identifies adoption stages and factors influencing Metaverse readiness in tourism education.

Findings

Whilst Metaverse can enhance engagement in skill development, it may also include barriers such as accessibility, data privacy, and technical readiness. Adoption varies by generation and digital proficiency. Younger students and early-career academics embrace its experiential benefits, while senior academics cite cost, infrastructure, and complexity concerns. This study develops a DOI-based framework to evaluate Metaverse adoption in Tourism education.

Research limitations/implications

Findings are context-specific and qualitative. Future research should validate the proposed model across different educational and cultural contexts using longitudinal and mixed-method approaches.

Practical implications

The Metaverse Integration Framework (MIF) provides actionable guidance for educators, policymakers, and institutional leaders. It supports phased integration, risk mitigation, and alignment with governance structures, while addressing issues such as digital equity, funding, and compliance.

Social implications

Metaverse technologies offer opportunities to democratise access to high-quality, immersive education, particularly in under-resourced or remote regions, thereby enhancing employability and workforce resilience.

Originality/value

This research contributes to the literature on Metaverse adoption in tourism and hospitality training and education by introducing a DOI Theory-informed framework. Findings offer theoretical insights that bridge technology adoption models with educational practice, providing a foundation for future digital education and training research.

Keywords: Metaverse, immersive learning, Diffusion of Innovation, experiential education, tourism training, hospitality education, institutional readiness, educational technology, stakeholder engagement, MIF framework, digital adoption

1. Introduction

Technological advancements continue to reshape industries, enhancing efficiency, productivity, and user engagement (Buhalis *et al*., 2024; Dwivedi *et al*., 2023). Metaverse merges virtual and physical realities through immersive digital platforms, integrating Extended Reality (XR), Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR) to create interactive digital environments (Buhalis *et al*., 2023a; Chen, 2025; Dwivedi *et al*., 2022). Recognised for its transformative potential across entertainment, travel, education, and professional training, the Metaverse enables dynamic, experiential learning experiences (Deng *et al*., 2024; Prados-Castillo *et al*., 2025) raising significant interest and optimism for industry applications. The Metaverse facilitates virtual tours, immersive customer experiences, and virtual events, enhancing consumer decision-making and marketing (Buhalis *et al*., 2023a, 2023b; Gursoy *et al*., 2023). Research has predominantly centred on marketing and consumer engagement, leaving its potential in professional education and training underexplored (Chen, 2024; Prados-Castillo *et al*., 2025; Wong *et al*., 2024). While existing studies apply general technology adoption models such as TAM, UTAUT, and TPB, these frameworks offer limited sector-specific guidance for practical implementation (Al-Adwan *et al*., 2023; Gupta *et al*., 2024).

The integration of immersive technologies into tourism education and training holds significant promise. While traditional e-learning models and isolated VR applications offer benefits, they often lack the highly interactive, real-world training experiences essential for skill development in tourism (Marougkas *et al.,* 2023). Metaverse-based training aligns with the preferences of young, digital natives who thrive in interactive, technology-driven learning environments (Chen, 2024). Barriers to adoption, including the lack of tailored frameworks (Buhalis *et al.,* 2024), governance standards (Wong *et al.*, 2024), and practical models for operational integration (Gupta *et al*., 2024) only focus on student perspectives, overlooking faculty education and industry workforce requirements (Akyürek *et al*., 2024), restricting a holistic view of adoption. Limited studies examine how VR learning theories can systematically implement Metaverse technologies in tourism education institutions (Beck *et al*., 2019; Shen *et al*., 2022).

This study examines Metaverse familiarity among students and educators, adoption challenges, and introduces the Metaverse Integration Framework (MIF)—a structured, multi-stage roadmap grounded in Diffusion of Innovation (DOI) Theory. MIF supports Metaverse adoption across individual, institutional, and policy levels, integrating Constructivism, Experiential Learning, and Gamification to improve training quality, cost-efficiency, and scalability. The study is situated in Saudi Arabia, where tourism growth under Vision 2030 drives the demand for innovative, scalable workforce training solutions

2. Metaverse adoption of technological innovations for education and training

Metaverse is "an evolving paradigm of the next-generation Internet, aims to build a fully immersive, hyper spatiotemporal, and self-sustaining virtual shared space for humans to play, work, and socialize." (Wang *et al.*, 2023). Metaverse effectively develops virtual environments where users can interact, collaborate, and engage in activities that parallel or expand upon real-world experiences (Dwivedi *et al.*, 2022). These environments offer autonomy and realism, enhancing user interaction and engagement (Koohang *et al*., 2023; Zhang *et al*., 2024) through advanced VR headsets, providing enriched digital experiences for many users (Deng *et al*., 2024). As an educational platform, the Metaverse enhances learning by providing interactive, experiential, and gamified environments (Mitra, 2023; Teng *et al*., 2022). It promotes deeper engagement particularly, in vocational training and upskilling employees. Onu et al. (2023) outline key benefits, including increased accessibility, flexibility, and personalised learning whilst identifying challenges, including technical limitations, privacy and security concerns, and the need for digital literacy skills. To explore the transformative potential of the Metaverse, it is crucial to explore the underlying interaction and enabling technologies that make this digital frontier possible.

2.1 Metaverse and the Supportive Technological Innovations

The Metaverse relies on immersive technologies (VR, AR, MR, and XR), enabling technologies (Artificial Intelligence [AI], blockchain, Internet of Things [IoT]), and advanced networking (Buhalis, 2020; Buhalis *et al*., 2023b).These elements facilitate immersive learning environments that connect physical and digital realms, enhancing scalability and real-time interactivity (Wang *et al*., 2022) and are essential for professional training in tourism and hospitality (Dwivedi *et al*., 2022; Jung *et al*., 2024).

Immersive technologies provide the infrastructure for highly interactive and multisensory virtual spaces, bridging the gap between the physical and digital worlds (Buhalis, 2020). **VR** facilitates immersive simulations through head-mounted displays (HMDs), enables varying levels of immersion—non-immersive, semi-immersive, and fully immersive—supporting scenario-based experiential learning (Beck *et al*., 2019; Lui and Goel, 2022). **AR** overlays digital elements onto the real world, enabling interactive experiences such as visualising anatomical structures in real-time, facilitating hands-on training and exploratory activities (Al-Ansi *et al*., 2023; Loureiro *et al*., 2020) and supporting experiential learning and training. However, high costs and technical barriers hinder adoption, requiring pilot programs to bridge the gap (Omran *et al*., 2024). **MR** combines elements of VR and AR, supporting applications empowering dynamic physical and digital interactions (Buhalis and Karatay, 2022). **XR** is an umbrella term encompassing any combination of VR, AR, and MR (Loureiro *et al*., 2020). These technologies can enhance industrial training and emergency response simulations, through controlled safe environments for trainees to develop and refine their skills without real-world risks (Doolani *et al*., 2020). Implementation costs and complex system requirements hinder adoption.

Advanced networking technologies such as IoT, 5G/6G, and edge computing enable the Metaverse's seamless connectivity and data integration (Esmat *et al*., 2023). These technologies connect physical devices with sensors, facilitating real-time data collection and exchange, enhancing realism in engineering, medicine, and training simulations. Incorporating environmental factors such as temperature, sound, and lighting enhances learning realism and improves simulation-based training. This is valuable in hospitality education, where authentic sensory experiences enhance skill acquisition and decision-making (Maheswari *et al*., 2022). High-speed 5G connectivity supports bandwidth-intensive applications (Tychola *et al*., 2023), while Software-Defined Networking (SDN) enables dynamic, scalable data traffic management (Esmat *et al*., 2023). Edge computing further reduces latency, improving engagement in remote learning environments, supporting remote education and tourism training, improving engagement and learning outcomes (Jiang *et al*., 2023).

AI encompasses machine learning, deep learning, Natural Language Processing (NLP), computer vision, and generative AI, each contributing to personalised learning, predictive analytics, and immersive training (Huang *et al*., 2022 Dwivedi *et al*., 2023). Machine learning adapts training content to individual needs, enhancing decision-making and user engagement in education. **NLP** facilitates human-computer interactions, powering virtual assistants and chatbots to create personalised learning environments. Computer vision enables computers to interpret visual information, enabling gesture recognition, object detection, and facial analysis, and supporting role-playing, customer interactions, virtual concierge services, and security training (Buhalis *et al*., 2024). Generative AI creates original content, enhancing scalability, interactivity, and engagement (Dwivedi *et al*., 2023). However, challenges concerning data privacy, algorithmic bias, cultural sensitivity, and ethical governance persist (Huang *et al*., 2022; Huang *et al*., 2023). Complexities such as real-time processing, algorithmic bias, ethical automation, computational limits, cultural context, authenticity, data fidelity, and content governance demand resolution, particularly regarding user privacy, contextual nuance, and ethical accountability (Huang *et al*., 2023; Wang, 2024).

Digital twins are virtual replicas of physical entities, enabling digital representations of hospitality and tourism environments and destination previews (Deng *et al*., 2024; Litavniece *et al*., 2023). They facilitate smart cities and immersive training for skill development (Lui and Goel, 2022), though adoption depends on resolving interoperability and resource limitations. **Avatars** are digital representations of users, allowing for customisation and the creation of digital identities. In interactive hospitality contexts, such as virtual hotel services and role-based simulations, they enhance user engagement, simulate real-world expertise, and authenticate perceptions of professionalism. By embodying roles like general managers or receptionists, avatars facilitate human-computer interactions, aligning with users' expectations for realistic and professional experiences (Choi *et al*., 2020). By bridging physical and digital realms, avatars integrate personalisation with intelligent systems. **Blockchain** enhances data security, privacy, and ownership in Metaverse (Truong *et al.*, 2023). However, challenges such as high energy consumption, scalability issues, and interoperability constraints must be resolved. As these technologies mature, the Metaverse continues to shape various industries, demonstrating its transformative potential across multiple domains.

2.2 Metaverse education and training innovations across industries

Metaverse technologies propel a range of transformations across multiple industries through innovative illusive and immersive solutions. Through Rogers' (2003) framework, this paper examines their application in five sectors, namely: tourism and hospitality, healthcare, engineering, entertainment and gaming, and education. Key attributes, including relative advantage, compatibility, complexity, trialability, observability, perceived risk, and immersion, are used to investigate their adoption.

Tourism and Hospitality can experience a great transformation by integrating Metaverse to enhance tourist experiences and enable innovative training (Akyürek *et al.*, 2024; Buhalis *et al.*, 2023c). Metaverse captivates consumers with immersive previews, heightening interest, and travel intent (Buhalis *et al.,* 2023b, Rather, 2023; Wong *et al.*, 2024). The Metaverse enables experience co-creation, adding new dimensions of value beyond traditional interactions (Buhalis *et al.*, 2023b) through reshaping and deepening user engagement. This complements, rather than replaces, in-person travel, enhancing real-world appeal (Akyürek *et al.*, 2024; Assiouras *et al.*, 2024). Mihalic (2024) introduces "Metaversal sustainability" proposing that virtual tourism offers an eco-friendly alternative by enabling destination digital exploration. These technologies contribute to cultural heritage preservation and immersive virtual experiences while reducing the environmental impact associated with mass tourism (Omran *et al.*, 2024). Zaman *et al*. (2025) indicate that virtual experiences can benefit the luxury hotel industry, reduce marketing costs, generate new revenue streams, and enhance accessibility for a broader audience, without carbon emissions, reducing environmental impact (Assiouras *et al.*, 2024). For digital natives, VR's appeal lies in its autonomy and enjoyment, significantly influencing travel decisions (Zhang *et al.*, 2024). In tourism and hospitality education and training, Metaverse-based learning environments foster self-directed learning, teamwork, and problem-solving skills, making them effective for hospitality training and professional development (Akyürek *et al.*, 2024). Especially when travel is restricted or expensive (Shen *et al.*, 2022) they can enable virtual collaboration and distance learning and training, broadening interdisciplinary knowledge in the sector (Gursoy *et al.*, 2022; Gursoy *et al.*, 2023; Koohang *et al.*, 2023).

Healthcare has embraced VR as a transformative tool for medical training and patient care, offering immersive environments that enhance clinical treatments and skill development (Moore *et al.*, 2024). VR simulations improve stress management and technical competence in high-pressure settings like intensive care (Weiß *et al.*, 2022). Its compatibility with interactive, hands-on learning methods makes it valuable for fostering confidence among healthcare providers. VR increases technical competence and helps reduce anxiety, benefiting providers and patients (Chiang *et al.*, 2022). As VR avatars are capable of expressing pain in real-time can revolutionise nursing and care training, but achieving this requires further advancements in realism and interaction fidelity (Weiß *et al.*, 2022). Developing a comprehensive framework that addresses these barriers while focusing on long-term efficacy and scalability is essential for realising VR's full potential in healthcare education. However, the high costs and technical demands of VR training remain significant barriers (Moore *et al.*, 2024; Weiß *et al.*, 2022).

Engineering education has long faced challenges in translating theoretical knowledge into practical skills. VR immerses learners in realistic simulations by transforming engineering concepts into life in ways traditional methods cannot achieve (Zontou *et al.*, 2024). Immersive experiences bring abstract engineering concepts into tangible, accessible formats, promoting independent thinking and critical analysis. VR allows learners to interact cost-effectively with intricate mechanical and control systems within safe, controlled environments, offering relative advantages over traditional methods (Xie *et al.*, 2023). Thus, VR enhances practical skills and fosters deeper cognitive engagement with engineering principles, facilitating the understanding of complex engineering concepts. Substantial barriers hinder VR's adoption. Learner reluctance to depart from traditional learning methods, combined with inconsistent content quality and high implementation costs, limits its reach and effectiveness. Sustainable VR integration and institutional support are essential for maximising its impact on engineering education (Zontou *et al*., 2024).

Entertainment and Gaming are also reshaped by drawing users into immersive worlds where real-time interaction and advanced haptic feedback create a deeper emotional impact (Dwivedi *et al*., 2022; Salim *et al*., 2024). They enhance social connections in multiplayer games and live events, and they show potential in therapy by providing controlled environments that help reduce anxiety (Kunz *et al.*, 2022). Gamification keeps users engaged, making it a valuable tool for learning across different areas (Salim *et al*., 2024). Although VR sets new standards in entertainment, its full potential will only be realised if challenges around accessibility, energy efficiency, and technical performance are addressed (Dwivedi *et al*., 2022). Bandwidth and latency issues disrupt immersion, as delays interrupt the flow essential for user engagement in live and multiplayer settings (Kunz *et al.*, 2022).

Education and training benefit by immersing learners in environments that enhance engagement and understanding, particularly in complex subjects (Leong *et al.,* 2023). Metaverse technologies enable blended learning environments that integrate digital twins, AI, and immersive simulations for personalised learning, collaboration, and skill development (Mitra, 2023; Onu *et al*., 2023). Their ability to simulate real-world scenarios supports experiential learning and brings abstract concepts to life. By offering personalised and remote learning opportunities, particularly for dangerous contexts such as military tasks, culinary arts and firefighting training, Metaverse can address geographic barriers for isolated students

(Camilleri, 2024; Harris *et al.*, 2023). However, its reliance on high-speed internet and costly equipment exacerbates educational inequalities in underfunded schools (Esmat *et al.*, 2023). Without targeted policy interventions, Metaverse education risks reinforcing—rather than reducing—educational inequities, as economic and technical barriers continue to restrict access and widen the digital divide (Onu *et al.*, 2023). Data privacy and AI in personalised learning also raise ethical considerations that must be addressed to ensure responsible use (Leong *et al.*, 2023) as well as well-being (Camilleri, 2024). VR lacks the interpersonal dynamics essential for developing communication and teamwork skills, requiring a costly overhaul of pedagogical strategies, substantial teacher training, and curriculum adjustments for effective implementation (Lui and Goel, 2022; Shen *et al.*, 2022). Without resolving these challenges, VR's educational potential may remain inaccessible to many, limiting its transformative impact (Gupta *et al.*, 2024).

Significant challenges remain including high costs, complex maintenance, and infrastructure requirements that create accessibility barriers, potentially widening the digital divide (Akyürek *et al.*, 2024; Buhalis *et al.*, 2023a; Wang *et al.*, 2022). Privacy and ethical issues, such as data security and user consent, also limit widespread adoption (Huang *et al.*, 2023; Wang *et al.*, 2023; Wong *et al.*, 2024). Addressing these barriers requires strategic planning and collaboration across industry stakeholders (Go and Kang, 2023; Omran *et al.*, 2024). Research should investigate the Metaverse impacts on diverse demographics and its role in fostering loyalty and sustainable tourism practices. A strategic and ethically informed approach is essential to maximise their potential (Akyürek *et al.*, 2024; Buhalis *et al.*, 2024).

2.3 Metaverse and Diffusion of Innovations Theory (IDT)

Research on Metaverse adoption in education relies on models like the Technology Acceptance Model (TAM) (Al-Adwan *et al.*, 2023), the Unified Theory of Acceptance and Use of Technology (UTAUT) (Teng *et al.*, 2022), and the Theory of Planned Behavior (TPB) (Albayati *al.*, 2023). While these models prioritise individual-level factors—such as perceived usefulness, social influence, trust, and market perception—they often overlook institutional and contextual dimensions (Albayati et al, 2023; Alfaisal *et al.*, 2024). Akour *et al*. (2022) argue that institutional adoption requires structured, process-driven approaches that traditional models fail to address. In tourism education, adoption is shaped by academic environments and industry collaboration, necessitating a comprehensive framework to integrate both educational and professional contexts (Al-Kfairy *et al.*, 2024). While research highlights factors like perceived enjoyment, risk, and innovativeness (Al-Adwan *et al.*, 2023; Teng *et al.*, 2022), institutional readiness and workforce development remain underexplored.

A core component of IDT is the classification of adopters into five categories based on their innovation readiness: innovators, early adopters, early majority, late majority, and laggards (Scheuer, 2021). These categories offer a nuanced understanding of varying adoption rates and strategies needed to address these differences. **Innovators**, comprising 2.5% of adopters, are characterised by their venturesomeness and enthusiasm for experimentation. They are often well-resourced, risk-tolerant individuals capable of understanding complex technologies. Their cosmopolitan social networks and willingness to explore new ideas propel them as the first to adopt innovations, even in the face of occasional failures. **Early adopters**, (13.5%) serve as opinion leaders who refine innovations to enhance contextual applicability, particularly within educational environments (Basileo and Lyons, 2024). Their credibility and influence within social systems make them key targets for change agents aiming to accelerate diffusion. The early majority (34%) adopts innovations prior to the average individual but tends to deliberate extensively before making decisions. They function as intermediaries between early and late adopters. The late majority (34%) adopts primarily in response to economic pressures, social norms, and visible utility, often requiring reassurance through peer validation (Becker *et al.*, 2023). **Laggards** (16%) are deeply conservative, rely on past experiences, and are resistant to change. Their delayed adoption is typically driven by necessity rather than willingness, often occurring after technologies have become standard practice (Scheuer, 2021).

IDT further outlines five innovation attributes that significantly influence adoption: relative advantage, compatibility, complexity, trialability, and observability (Huang *et al.*, 2022).

Relative Advantage is "the degree to which an innovation is perceived as being better than the idea it supersedes" (Rogers, 2003, p. 216). The Metaverse offers substantial educational advantages, particularly for tourism and hospitality training. Its capacity to deliver immersive simulations supports experiential learning and skill acquisition in safe, controlled environments. Gamified and emotionally engaging experiences enhance learner motivation and retention, generating impactful outcomes for digital-native cohorts (Akyürek *et al.*, 2024; Camilleri, 2024). Moreover, the Metaverse's global reach and cost efficiency reduce reliance on physical infrastructure, positioning it as a transformative tool for decentralised education (Weiß *et al.*, 2022).

Compatibility is "the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters" (Rogers, 2003, p. 217), which is key to adopting Metaverse technologies. Their success hinges on aligning with user values and organisational goals (Gupta *et al.*, 2024). Metaverse is particularly appealing to the digital-native generations who value autonomy, gamification, and personalisation (Zhang *et al.*, 2024). However, traditional work environments and training programmes may require substantial adaptation.

Complexity reflects "the degree to which an innovation is perceived as relatively difficult to understand and use" (Rogers, 2003, p. 234), represents a major barrier. Despite the availability of some user-friendly platforms, effective operation of VR devices often requires specialised development and delivery skills, particularly in hospitality training programs (Alfaisal *et al.*, 2024). Technical infrastructure requirements—

including high-speed internet, sophisticated hardware, and financial investment—further constrain widespread adoption, especially among for smaller businesses (Koohang *et al.*, 2023).

Trialability is defined as “the degree to which an innovation may be experimented with on a limited basis” (Rogers, 2003, p. 217), plays a pivotal role in reducing uncertainty. Pilot initiatives—such as small-scale VR simulations—allow stakeholders to assess feasibility, pedagogical value, and cost-effectiveness before broader implementation (Assiouras *et al.*, 2024; Mambile and Ishengoma, 2024).

Observability refers to “the degree to which the results of an innovation are visible to others” (Rogers, 2003, p.218). The attribute of observability has been termed alternately as visibility or result demonstrability (Huang *et al.*, 2022). Observable outcomes—such as improved customer satisfaction, employee productivity, and learner performance—can drive adoption through positive word-of-mouth and institutional benchmarking. Case studies highlighting successful VR-based interventions in hospitality training underscore these tangible benefits and contribute to broader diffusion. Moreover, features such as immersive virtual tours, real-time collaboration tools, and customised learning paths further enhance user engagement and satisfaction (Assiouras *et al.*, 2024; Huang *et al.*, 2022; Mambile and Ishengoma, 2024).

IDT represents valuable lens for analysing Metaverse adoption in tourism education and professional training. This study applies IDT to assess user familiarity (Objective 1), examine benefits and challenges (Objective 2), and develop an implementation framework (Objective 3). By analysing adoption patterns, this research provides insights into Metaverse integration within Saudi Arabia’s tourism education and training sector, ensuring alignment with cultural and technological needs.

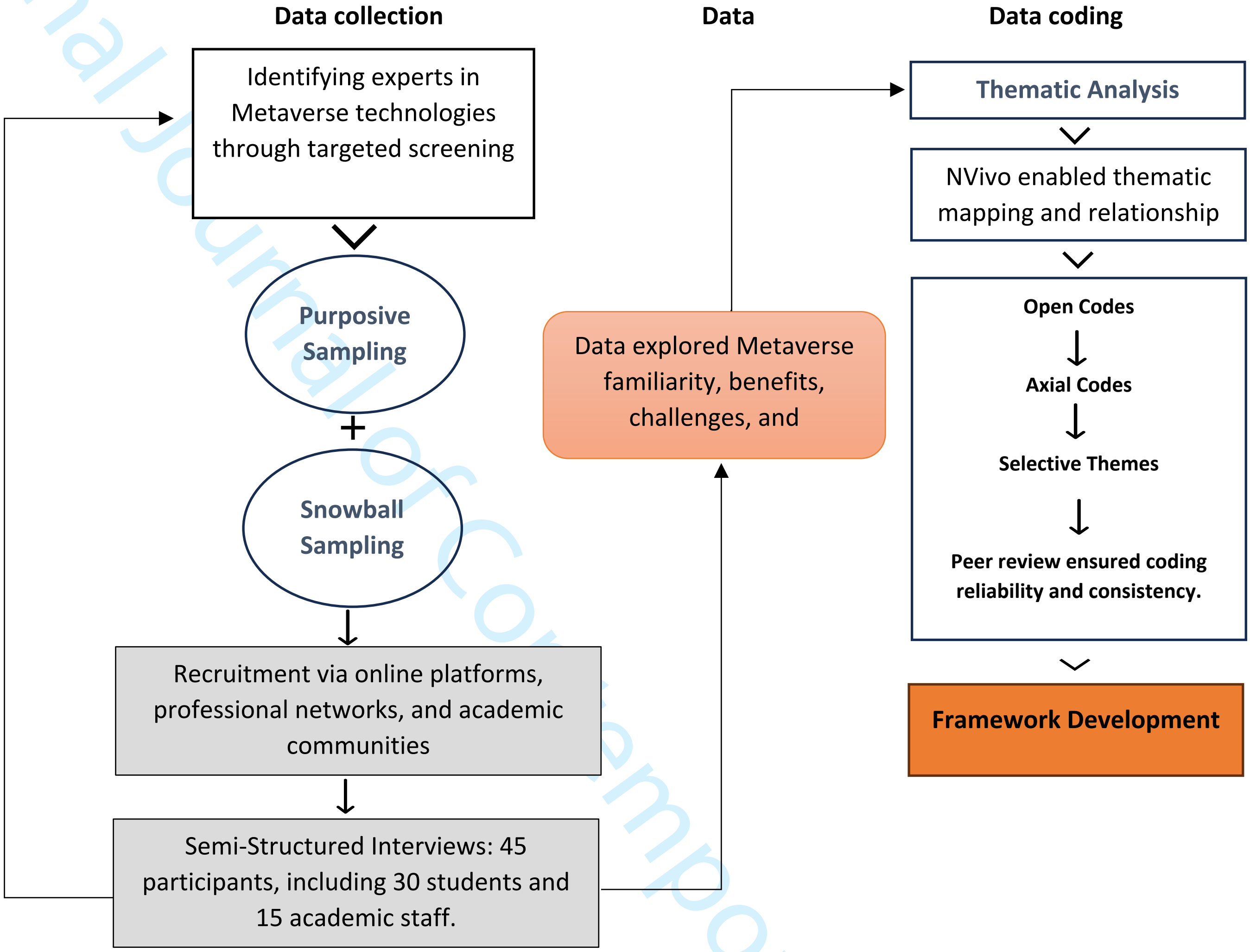
3. Methodology: Metaverse adoption for education and training

This study explored Metaverse adoption in tourism and hospitality education using a qualitative, inductive approach grounded in interpretivism. Grounded theory enabled themes to emerge from participant data without predefined frameworks (Saunders *et al*., 2023). This approach suited the investigation of emerging educational technologies through participants' lived experiences (Laachach *et al.*, 2024). The design combined purposive and snowball sampling, semi-structured interviews, and thematic analysis appropriate for exploring complex, under-researched phenomena (Saunders *et al*., 2023). Semi-structured interviews encouraged participants to express their thoughts freely, fostering a conversational dynamic and uncovering in-depth insights. Grounded theory guided iterative data collection and analysis, allowing concepts to develop progressively (Laachach *et al.*, 2024; Saunders *et al*., 2023). Thematic analysis was utilised to identify patterns in responses and to develop an interpretive framework for understanding Metaverse adoption. Rogers' Theory (IDT) guided the formulation of interview questions and the thematic analysis process as IDT's key attributes—relative advantage, compatibility, complexity, trialability, and observability—were used to structure the analysis. Figure 1 represents the flow chart of the research design employed.

Participants were recruited through digital platforms and academic networks. Purposive sampling targeted individuals with relevant experience; snowballing extended participation (Saunders *et al*., 2023). This dual approach enhanced diversity in the sample, capturing a broad range of perspectives across age, gender, and professional backgrounds. Invitations were extended to those meeting at least one of the following inclusion criteria: (1) familiarity with Metaverse technologies, (2) active involvement in academic or training settings, and (3) the ability to articulate experiences with Metaverse adoption. The final sample included 45 participants (30 students, 15 academics) from Saudi Arabia, with diverse demographic and professional profiles (Table 1). Sample size aligned with saturation thresholds: thematic saturation typically occurs within 9–17 interviews, and theoretical saturation between 20–30 (Hennink and Kaiser 2022). Given the diversity of contexts, a larger sample enhanced depth, variability, and credibility (Saunders *et al*., 2023).

Ethical approval was obtained from Bournemouth University's Research Ethics Committee by institutional and international guidelines. Participants provided informed consent, and all data were securely stored and used exclusively for academic purposes. A pilot study involving three participants, refining interview questions for clarity and alignment with research objectives and the IDT framework, resulting in minor adjustments.

Figure 1. Flow chart for research design



Source: Created by the authors

Table 1 Demographic profile of the participants.

Category	Students (n=30)	Academic Staff (n=15)	Total (N=45)
Age			
20-29	23	0	23
30-39	7	10	17
40-49	0	5	5
Education			
Undergraduate	23	0	23
Master's	7	6	13
PhD	0	4	4
Professor	0	5	5
Experience with VR/AR Tools			
Yes	28	10	38
No	2	5	7

Source: Created by the authors

Interviews were conducted online via Zoom or Telegram, lasting approximately 40 minutes each. Participants were invited to choose the platform they were most comfortable with. Interviews comprised two thematic sections, focusing on Metaverse adoption in education and guided by Rogers' theory (2003). For students, questions addressed learning preferences, prior exposure to Metaverse tools, virtual skill acquisition, and perceived challenges—aligned with compatibility (learning fit), trialability (exposure), and relative advantage (perceived benefit). For academic staff, questions examined educational benefits, integration strategies, and barriers—corresponding to relative advantage (instructional improvement), complexity (implementation challenges), and observability (visible success cases). Interviews were recorded, transcribed verbatim, and translated from Arabic where applicable. Anonymised codes (A1–A15 for academics, S16–S45 for students) ensured confidentiality.

Data were analysed using a structured, three-stage coding process guided by Rogers' framework. Following Naeem *et al.*'s (2023), the first stage, **open coding,** identified raw data on participants' familiarity and adopter categorisation (e.g., early adopters showed digital fluency and openness; late adopters relied on peer behaviour). No innovators emerged—consistent with literature placing educators and students as adopters, not pioneers. In the second stage, **axial coding** grouped similar codes under Rogers' five attributes. "Interactive simulations" and "enhanced engagement" reflected Relative Advantage; "training needs" and "infrastructure demands" captured Complexity. In the third stage, Selective coding synthesised categories into core themes: Familiarity and Perceptions of the Metaverse, Advantages of Metaverse Integration, and Barriers to Adoption. These themes informed a final framework proposing strategies to support early adopters, align tools with institutional goals, enhance infrastructure, and build trust through pilot initiatives and success stories. Data were transcribed, organised in Excel, and coded in NVivo, supporting visualisation and thematic mapping. Bias was reduced through iterative code reviews, reflective memos, and member checking to confirm accuracy.(Saunders *et al.*, 2023). Peer review validated the coding structure to ensure consistency and rigour.

4. Findings and Discussion

This section presents findings through Rogers' framework, addressing the research questions. Five themes emerged from the thematic analysis: (1) Familiarity and Perceptions of the Metaverse, (2) Advantages of Metaverse Integration, (3) Challenges and Barriers to Adoption, (4) Testing Effectiveness and Demonstrating Value, and (5) Developing a Framework for Adoption.

4.1 Familiarity and Perceptions of the Metaverse: Generational divide

A clear generational and professional divide emerged in Metaverse familiarity, aligning with the **Knowledge stage** in Rogers' framework. Younger participants—mainly students—were more familiar with and positive toward immersive technologies. Two key factors explain this. First, as digital natives, students have engaged with technology from an early age. Exposure to interactive gaming, virtual simulations, and digital learning tools fosters comfort and enthusiasm for immersive technologies. Their gamified experiences with VR and AR shape the Metaverse as a natural digital extension. These patterns align them with Rogers' "Innovators" or "Early Adopters".

> *"I tried VR glasses… it was an exciting experience, and I plan to repeat it."* S16

> *"I've used VR gloves… The experience was amazing."* S23

Second, students' cultural and educational experiences—especially in globalised contexts—enhance their openness to Metaverse adoption. Studying abroad fosters appreciation for VR's educational value, aligning with trends in advanced learning environments where immersive tools are integrated into training and skill development.

> *"I used virtual reality glasses to train in flying, which gave me a glimpse into how such technology might enhance education."* A6

These findings position students as proactive advocates of the Metaverse, particularly in education and training. Their familiarity and willingness to experiment reflect the critical role they play in accelerating adoption, particularly in hospitality and tourism.

In contrast, educators and senior academics show lower familiarity and some scepticism toward the Metaverse. Older respondents report limited exposure to VR and AR, which shapes constrained perceptions. Associating immersive technologies with entertainment rather than education deepens this divide. Educators often align with Rogers' "Late Majority" or "Laggards," reflecting hesitation to adopt new tools (Mitra, 2023). Their limited engagement highlights the need for targeted initiatives to bridge this gap. Such scepticism reflects broader patterns of technological resistance among older professionals (Cham et al., 2024). Without intervention, this divide may impede Metaverse integration in education and training.

> *"It's a new concept I heard that's used in games."* A2

“I was unfamiliar with the concept before this discussion,” A3

*" Well, I never heard of it before "*S19

These findings underscore a generational divide in Metaverse familiarity. Students, as digital natives, are natural adopters (Akyürek *et al.,* 2024), while educators’ limited familiarity reflects broader resistance (Cham *et al.,* 2024; Mitra, 2023). Bridging this gap requires participatory strategies that engage both groups and support balanced adoption.

4.2 Advantages of Metaverse Integration

The Metaverse offers clear advantages in tourism education by enabling experiential learning and simulation-based training. Students widely acknowledged its role in bridging theory and practice. Immersive environments enhance engagement, retention, and skill development through realistic, hands-on experiences. Examples included language learning, tour guiding, and crowd management training. Students valued these simulations for developing communication skills and professional expertise. These insights highlight the Metaverse’s potential to replicate real-world challenges through lifelike educational experiences.

“The Metaverse can simulate scenarios for crowd management,” S16

“Learning English… can be better taught in a virtual environment… enhancing the ability to use the language fluently and confidently in real-life situations.” S21

“We can practice our skills as a tour guide in a virtual environment, learning how to lead a group and interact with 'tourists' from different backgrounds.” S18

“It can transform my astronomy studies into an unprecedented immersive and interactive experience… allowing me to see stars and galaxies up close.” S44

“This environment provides opportunities to simulate real-life scenarios… allowing for the development of communication skills.” S31

“Being able to virtually construct and test mechanisms could greatly enhance understanding.” S17

“The Metaverse makes abstract concepts more interactive and relatable, helping students connect theory to practice.” S18

These findings align with Akyürek *et al*. (2024), Buhalis *et al*. (2023a), and Shen *et al*. (2022), who highlight immersive simulations’ role in enhancing engagement and retention. Students saw the Metaverse as versatile, supporting both subject-specific and transferable skills like communication and problem-solving. Educators expressed mixed views, recognising its value as a supplement “cannot replace them.”

for traditional methods (S4). Concerns about oversimplifying real-world complexity echoed those of Wong *et al*. (2024), Camilleri (2024), and Buhalis *et al.* (2023a), who emphasise balancing innovation with pedagogical depth.

These insights illustrate the Metaverse's potential while acknowledging limitations. The results support arguments by Assiouras *et al*. (2024), Akyürek *et al.* (2024), and Dwivedi *et al.* (2022) for integrating traditional and emerging methods—ensuring the Metaverse enhances, rather than disrupts, tourism and hospitality training.

4.3 Challenges and Barriers to Adoption of the Metaverse for training and education

The *Complexity* dimension of Rogers' framework underscores the significant challenges perceived by participants, which may impact the adoption rates of the Metaverse. Table 2 summarises the key barriers identified by staff and students regarding the adoption of the Metaverse in hospitality and tourism education. These challenges are categorised into three primary barriers: technological, institutional, and attitudinal.

Table 2: Barriers to Metaverse Adoption in Hospitality and Tourism Education

Category	Staff (N=15)	Students (N=30)	Total (N=45)	Key Themes
Technological	**11 mentions**	**19 mentions**	**30 mentions**	High cost of devices, poor internet connectivity, lack of access, technical training gaps
Institutional	**9 mentions**	**6 mentions**	**15 mentions**	Curriculum integration, lack of institutional support, financial constraints
Attitudinal	**10 mentions**	**9 mentions**	**19 mentions**	Resistance to change, scepticism toward effectiveness, concerns about social isolation

Source: Created by the authors

Technological barriers emerged as a dominant concern, particularly the substantial infrastructure costs and the steep learning curve associated with immersive technologies. Staff and students identified internet quality and cost as critical constraints; however, staff emphasised the need for educator training, while students underscored affordability and device access. These concerns resonate with findings Akyürek *et al*. (2024), who reported similar stakeholder concerns in tourism education, and by Koohang *et al*. (2023), who identified resource constraints in underfunded institutions as a key obstacle to adopting advanced technologies.

> *"The technological infrastructure needed to support such immersive experiences can be substantial."* A2

> *"The Metaverse requires high-quality internet connectivity and the design of specialised educational environments."* A6

"One of the main challenges is the availability of high-quality and continuous internet, as well as the lack of suitable devices..." S25

Institutional rigidity further complicates Metaverse adoption, with inflexible curricula and insufficient institutional support for innovation acting as critical impediments. Staff face bureaucratic resistance in policymaking and curriculum integration, while students highlight resource inequalities. This reflects the difficulty of aligning emerging tools with established educational benchmarks and the financial constraints faced by some institutions. Such institutional inertia prioritises traditional approaches, slowing the integration of innovative technologies.

"Integrating it into the curriculum content to ensure educators' utilisation and maintain quality is crucial but challenging." A4

"I don't see Metaverse technology implementation in Saudi classes anytime soon due to the high costs involved." A5

"Tools and technologies used in virtual learning environments may not be easily accessible to everyone. Not all institutions have the resources to implement Metaverse learning. " S23

Attitudinal barriers were particularly pronounced among senior educators, many of whom expressed scepticism regarding the Metaverse's educational relevance. Hence there is resistance from educators and students.

"The immersive nature of the Metaverse might lead students to become more interested in the novelty… than the learning content." A1

"A significant challenge lies in the resistance from some educators and students to adopting this new technology." A10

"Some students may not be receptive to using technology in education." S38

These perspectives align with those who observed broader patterns of scepticism towards unfamiliar technologies (Zhang *et al.*, 2024), particularly among those more accustomed to traditional teaching methods. These findings provide critical insights into challenges and barriers to adopting the Metaverse for training and education and emphasise the systemic challenges to Metaverse adoption. Addressing these barriers requires infrastructure investments, policy reforms, and professional development programs to build trust and familiarity. A collaborative approach involving stakeholders across all levels is essential to align technological advancements with institutional goals policy reforms, and professional development programs to build trust and familiarity. Consistent with (Buhalis *et al.*, 2024).

4.4 Trialability and Observability: Testing Effectiveness and Demonstrating Value

Rogers's concepts of trialability and observability emphasise the necessity of testing innovations in controlled settings and showcasing measurable outcomes to drive adoption. Participants stressed the need for robust evaluation metrics to assess the effectiveness of these trials and underscored the importance of ongoing assessment.

> *"Phased and controlled trials would allow us to gauge its effectiveness in specific subjects or school levels before full implementation."* A3
>
> *"Start small, with controlled trials in specific departments or subjects."* A10
>
> *"Continuously studying how effective this content is will help refine Metaverse applications for education."* A8

This theme outlines practical steps for Metaverse implementation. Pilot studies with robust evaluation metrics—such as performance data and feedback surveys—can demonstrate tangible value and address scepticism (Jung *et al*., 2024; Shen *et al*., 2022). Simulating real-world scenarios like event management, these programs build institutional confidence by delivering measurable outcomes, including improved engagement and retention. This approach aligns with Camilleri (2024), who advocate for incremental adoption.

Hence, a generational and professional divide remains evident. Students showed strong enthusiasm and understanding, valuing the Metaverse's immersive, gamified nature for bridging theory and practice (Jung *et al*., 2024; Shen *et al*., 2022). In contrast, educators often lacked exposure and expressed scepticism about its relevance. They questioned its compatibility with traditional methods, often viewing it as a supplement rather than a replacement. It is important to incorporate practice trials and peer influence in facilitating Metaverse adoption as an innovative approach to training (Camilleri, 2024).

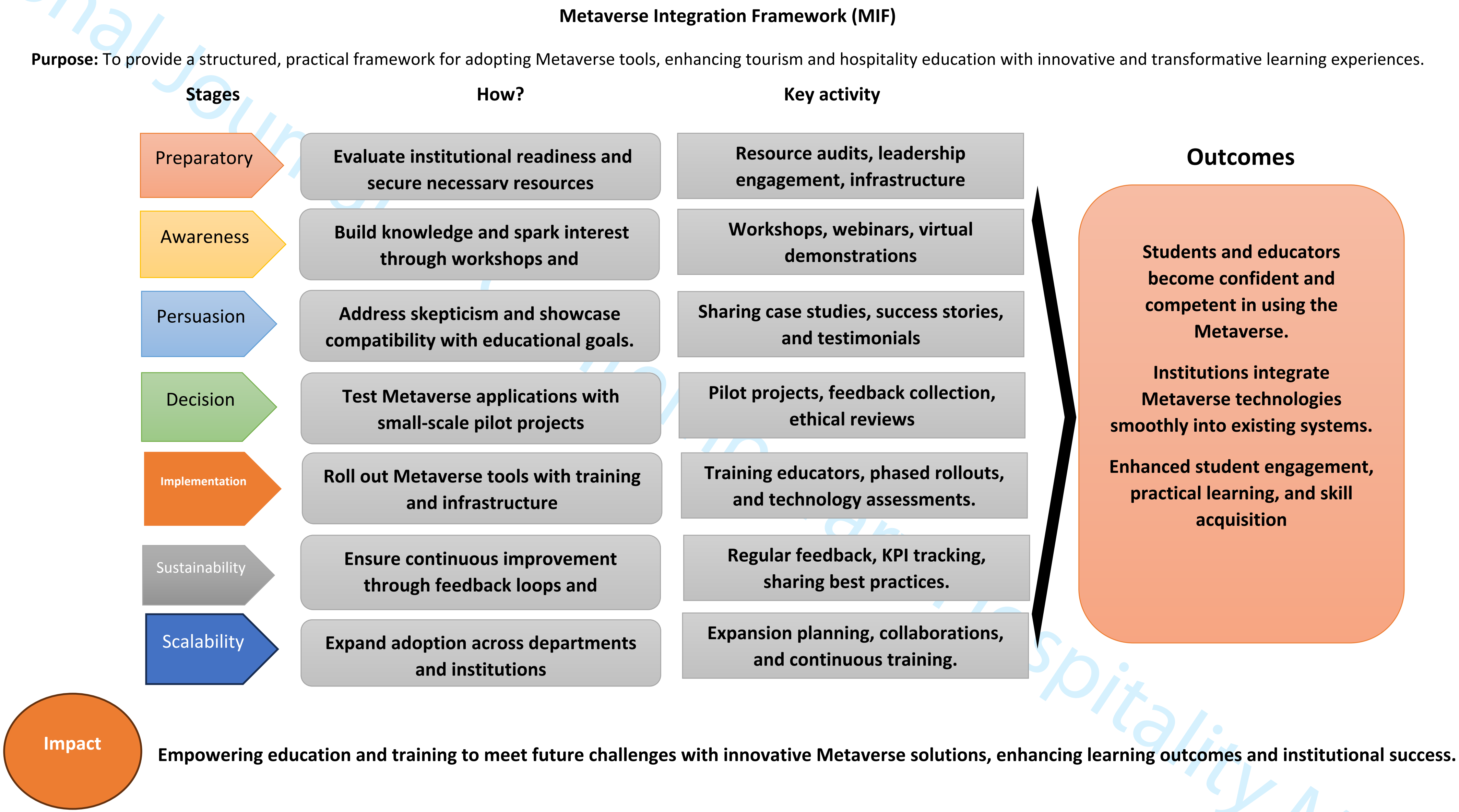
4.5 Metaverse Adoption in tourism and hospitality education and training

The Metaverse Integration Framework (MIF) (Figure 2) provides a structured roadmap for hospitality and tourism institutions adopting Metaverse technologies. Built on DOI theory, it extends traditional models by addressing psychological, social, and institutional complexities in immersive technology adoption This synthesis aligns with Al-Adwan *et al*. (2023), who highlight personal and perceptual enablers in educational Metaverse adoption, and Gupta et al. (2024), who reveal structural and behavioural barriers through TOE and Force Field lenses. Unlike conventional educational technologies, Metaverse adoption requires multi-layered engagement, institutional transformation, and regulatory adaptation. While DOI principles guide MIF's five core stages, Metaverse adoption demands a more transformative, dynamic, and interconnected approach that considers infrastructure readiness, pedagogical adaptation, and scalability. To address this, MIF introduces a Multi-Level Adoption Dynamics (MLAD) perspective, ensuring alignment across individual, institutional, and policy levels.

MIF introduces a Multi-Level Adoption Dynamics (MLAD) perspective, ensuring alignment across individual, institutional, and policy levels. It comprises seven stages: Preparatory, Awareness, Persuasion, Decision, Implementation, Sustainability, and Scalability. These stages extend core DOI attributes by incorporating sector-specific considerations such as immersive learning readiness, accreditation needs, and inter-institutional collaboration.

The MIF begins with the **Preparatory Stage**, which ensures institutional readiness by addressing key factors early. This includes auditing resources, assessing infrastructure (e.g., VR equipment, bandwidth), and securing leadership support to align priorities. Financial constraints and governance issues often hinder early adoption (Gupta *et al.,* 2024), making this stage essential for setting clear guidelines. In the **Awareness Stage**, stakeholders are introduced to the Metaverse through workshops, demonstrations, and campaigns to build foundational understanding and interest. Given ongoing uncertainty among tourism educators (Cham *et al*., 2023), this stage helps clarify its potential benefits. The **Persuasion Stage** tackles resistance by aligning the Metaverse with existing practices and demonstrating value through case studies, testimonials, and targeted showcases. Organisational support and leadership commitment are central to reducing scepticism (Mitra, 2023). The **Decision Stage** focuses on pilot testing, faculty training, and IT optimisation to reduce barriers such as technical complexity and infrastructure gaps (Akyürek *et al*., 2024; Gupta *et al.,* 2024). Feedback collection is key to refining implementation strategies. The **Implementation Stage** involves a phased rollout with emphasis on educator preparedness and robust digital infrastructure, both essential for smooth integration (Onu *et al*., 2023). This stage ensures smooth integration and reduces disruptions. The **Sustainability Stage** focuses on maintaining long-term success through continuous feedback, performance monitoring, and refinement. Research highlights that institutional support, engagement strategies, and structured faculty development are essential for sustaining Metaverse adoption (Buhalis *et al.,* 2024). Sharing success stories builds confidence and fosters collaboration Finally, the **Scalability Stage** supports expansion across courses, departments, and institutions. Standardised governance, infrastructure readiness, and professional development ensure quality is maintained at scale (Gupta *et al.,* 2024). This stage promotes inter-institutional collaboration and ensures professional development for staff as adoption grows.

Figure 2: Metaverse Integration Framework for Tourism and Hospitality Training and Education Source: Created by the authors



5. Discussion and Conclusions

Adopting Metaverse technologies in tourism education depends on institutional readiness, stakeholder perceptions, and contextual challenges. The MIF Framework, grounded in DOI theory, provides a structured approach to evaluate and implement immersive technologies through seven key stages, including preparatory assessments, stakeholder engagement, pilot testing, phased implementation, and long-term scalability. Together, the seven stages provide a comprehensive, practical framework for institutions to adopt the Metaverse effectively and sustainably. The MIF offers a flexible and adaptable roadmap for adopting Metaverse technologies. New adopters may focus on the Awareness and Persuasion stages to build familiarity and trust, while experienced institutions with strong resources may prioritise Implementation and Sustainability to optimise and scale their systems. This flexibility ensures the MIF is applicable across a range of educational and professional settings, enabling institutions to tailor strategies to their specific contexts and needs as well as "glocalise" offerings to reflect the local context within the global needs.

Theoretical contributions to DOI theory include the MIF's illumination the MLAD, aligning adoption processes across individual, institutional, and policy levels. This multi-layered approach addresses psychological, social, and structural barriers, enhancing DOI's applicability to emerging technologies. The framework also advances constructivist educational theory by demonstrating how experiential, risk-free digital environments can bridge the gap between theoretical instruction and practical application. By embedding trialability, observability, and continuous feedback mechanisms, the MIF strengthens institutional readiness and supports scalable, evidence-based adoption strategies. Through the integration of DOI principles with applied implementation models, the framework enables resistance management, sustained integration, and institutional scalability through governance alignment, faculty training, and long-term planning.

Practical Implications include a structured approach for integrating Metaverse technologies into tourism and hospitality education, offering actionable insights for institutions, policymakers, and industry stakeholders. Metaverse is a powerful tool for improving understanding and enabling innovative thinking, particularly by providing immersive and interactive environments for training, learning and experimentation. Successful adoption requires infrastructure investment and governance frameworks that address funding, data privacy, and digital equity. Smaller institutions can implement phased integration strategies, leveraging open-access platforms and industry partnerships to mitigate resource constraints. Pilot programs are essential for evaluating cybersecurity risks, regulatory compliance, and accessibility challenges before large-scale deployment. For the industry, Metaverse adoption presents economic benefits, including reduced training costs, new revenue opportunities, and enhanced workforce preparedness. Industry-academic collaborations can align digital skill development with sector demands, improving graduate employability and long-term industry competitiveness.

Future research should validate the MIF across diverse cultural and institutional contexts and evaluate its longitudinal impact on learning outcomes. Mixed-method approaches and partnerships with industry practitioners can further enhance the model's applicability and effectiveness. The MIF offers a foundational structure to support readiness assessment, strategy development, and the sustainable integration of immersive technologies into tourism education. Advancing governance mechanisms and deepening stakeholder collaboration will be critical to maximising the Metaverse's long-term role in education and workforce development.

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