

Metaverse Applications and Impacts: A Synthesis of Recent Empirical Studies

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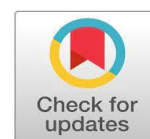
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Abstract: The metaverse has emerged as a transformative digital ecosystem, integrating virtual, augmented, and extended realities to redefine how individuals and organizations interact, learn, and conduct business. Despite increasing academic and industry attention, the metaverse's real-world impact remains fragmented due to limited empirical evidence. This study conducts a systematic synthesis of 25 empirical studies published between 2023 and 2025, spanning domains such as education, consumer behavior, social development, digital investment, and organizational training. The findings reveal five core themes—adoption drivers, user experience, economic behavior, social impact, and platform usability—shaped by theoretical frameworks such as the Technology Acceptance Model (TAM), Self-Determination Theory (SDT), and Flow Theory. While survey-based research dominates the field, innovative hybrid methods like SEM-ANN and fsQCA are gaining traction. This paper proposes a conceptual framework that connects behavioral, contextual, and technological dimensions of metaverse engagement. Key research gaps include the need for longitudinal and cross-cultural studies, deeper investigation of negative impacts, and expanded application of experimental methods. The study offers a future research agenda to guide scholars and practitioners in unlocking the metaverse's full potential.

Keywords: Metaverse, Empirical studies, Technology Acceptance Model (TAM), Digital transformation, Virtual reality, Systematic review, Conceptual framework, Behavioural adoption, Hybrid research methods

I. INTRODUCTION

The emergence of the metaverse as a digital parallel universe marks a significant evolution in how individuals and organizations engage with technology, social environments, and economic systems. Built upon advancements in virtual reality (VR), augmented reality (AR), block chain, and artificial intelligence (AI), the metaverse facilitates immersive, interactive, and persistent environments that transcend geographical and temporal boundaries. From virtual real estate markets and decentralized commerce to immersive education and corporate training, the metaverse is no longer a speculative concept—it is an unfolding technological frontier. While the metaverse holds promise across domains, much of the academic literature remains conceptual or speculative in nature. Despite the growing volume of research, a substantial empirical gap persists, particularly regarding how the metaverse is adopted, experienced, and evaluated by users across industries. Most prior reviews have focused on theoretical frameworks, technological architectures, or domain-specific potentials (e.g., gaming or education), but there has been no comprehensive, empirical synthesis of metaverse-related research within a business, societal, and behavioral context. Recent empirical studies published between 2023 and 2025 have begun to bridge this gap. These studies adopt diverse methods such as surveys, experiments, and hybrid models like structural equation modelling (SEM) and artificial neural networks (ANN) to examine adoption behaviors, user experiences, learning outcomes, psychological effects, and investment motivations. However, these findings are dispersed across disciplines and use inconsistent analytical lenses, making it difficult to develop a coherent understanding of the metaverse's real-world impact. This research seeks to address that gap by conducting a structured synthesis of 25 recent empirical studies related to metaverse adoption, interaction, and outcomes. The objectives of this study are to identify dominant themes and theoretical underpinnings across recent empirical metaverse research, evaluate the methodological approaches and research contexts, and propose a conceptual framework and future research agenda for advancing empirical inquiry in this rapidly evolving field. The paper is structured as follows. Section 2 presents a review of the selected empirical studies and categorizes them thematically. Section 3 outlines the methodological characteristics of these studies, including sample designs, analytical tools, and theoretical frameworks.

Section 4 discusses key insights, practical implications, and research gaps. Section 5 proposes a conceptual model to unify future research directions and offers concluding remarks.

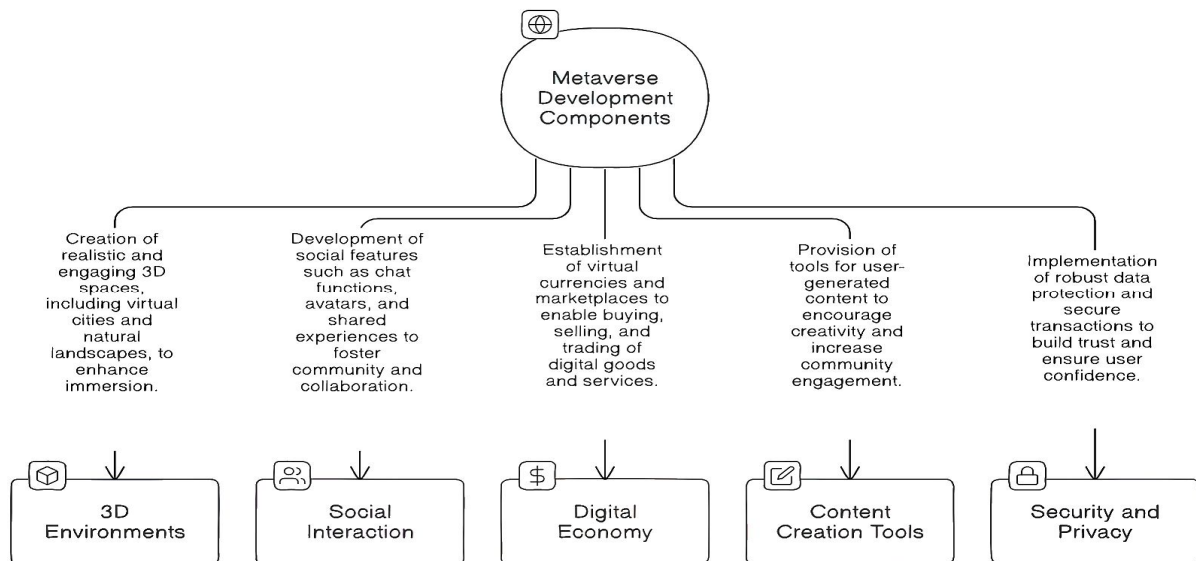


Fig. 1 Metaverse Development

II. LITERATURE REVIEW

Adoption and Behavioural Drivers

A dominant theme in recent empirical research concerns the behavioral factors influencing metaverse adoption. Studies have extensively applied frameworks such as the Technology Acceptance Model (TAM) and Unified Theory of Acceptance and Use of Technology (UTAUT) to evaluate user readiness. For instance, Adhini and Prasad [3] found that performance expectancy and hedonic motivation significantly impacted metaverse adoption among Indian millennials and Gen Z users. Similarly, El Emary [4] identified digital literacy and perceived ease of use as critical enablers of adoption in Indonesia. Husain et al. [1] and Ante et al. [2] explored investment behavior in metaverse real estate, revealing that social influence, perceived risk, and immersive brand presence influenced investor intention. These findings indicate a growing need to understand metaverse adoption not only as a technological issue but also as a behavioral and psychological process shaped by users' environment and self-perceptions.

A. Learning and Education

The metaverse's potential for immersive and interactive education has been supported by empirical evidence from various educational settings. Shi and Park [14] synthesized 62 studies and found that the metaverse enhances student engagement, knowledge retention, and collaborative learning. In Egypt, an SEM-ANN analysis demonstrated that perceived usefulness and enjoyment were strong predictors of student willingness to use metaverse tools in higher education [10]. Similarly, Yanagawa et al. [15] implemented an intelligent virtual navigation agent in a metaverse environment to improve learning outcomes, showing a measurable improvement in both cognitive and behavioral metrics. These studies confirm that immersive learning environments can positively impact motivation, satisfaction, and academic performance, although infrastructure and accessibility remain barriers in certain regions.

B. Business, Commerce, and Investment Applications

Empirical research also indicates the metaverse's transformative potential in business contexts. Prabakaran and Patrick [6] used SEM to explore purchase intention in Decentraland and confirmed that trust, platform quality, and community interaction were significant predictors of consumer behavior. Husain et al. [1] showed that perceived innovation and emotional engagement drive real estate investments in the metaverse, while Queiroz et al. [24] identified opportunities for supply chain visualization and gamification. Moreover, Dwivedi et al. [18] demonstrated how companies are leveraging metaverse platforms for training, simulation, and customer service, thus enhancing efficiency and reducing physical constraints. These applications underline the metaverse's capacity to create value through virtual collaboration, decentralized marketplaces, and enhanced customer relationships.

C. User Experience and Psychological Engagement

User experience (UX) and psychological factors play a critical role in determining how individuals interact with and remain engaged in metaverse platforms. Liang et al. [9] employed PLS-SEM and fsQCA to assess how flow, innovation, and social interactivity influence continued usage. Youssef et al. [7] explored the psychological well-being of UAE-based users and found that immersive environments can either enhance or deteriorate well-being depending on users' pre-existing mental health conditions and usage patterns. Flavián et al. [11] examined virtual event settings and revealed that excessive realism can diminish perceived authenticity, thereby reducing user engagement. The findings suggest that designing emotionally resonant, cognitively balanced, and psychologically safe experiences is key to sustainable metaverse participation.

D. Technological, Ethical, and Design Considerations

Beyond behavioural and commercial aspects, empirical studies are increasingly addressing technological readiness, ethical challenges, and user interface design.

Dargan et al. [22] reviewed XR-related infrastructure issues, emphasizing the importance of bandwidth, processing power, and device compatibility. Asadi and Ghasemi [5] proposed a readiness framework highlighting system interoperability and stakeholder trust. Security and privacy concerns were frequently cited as barriers to adoption, particularly in studies conducted in emerging economies [4][19]. Vitzthum et al. [20] illustrated how design flexibility enabled entrepreneurs to launch immersive virtual businesses. Furthermore, several studies suggested that accessibility features and cultural localization are necessary to ensure inclusive and equitable user experiences [21][23].

III. MEHODOLOGY

This research follows a systematic literature review approach focused on synthesizing recent empirical studies related to the metaverse. The primary aim is to identify current trends, theoretical frameworks, and gaps in the existing body of empirical knowledge. The review emphasizes articles published from 2023 to 2025 to capture the most recent developments in metaverse research, reflecting its rapid growth as a technology and field of academic inquiry. This study employs a systematic literature review approach to synthesize recent empirical research on the metaverse, aiming to uncover trends, theoretical frameworks, and knowledge gaps. The focus is on articles published between January 2023 and July 2025, reflecting the most active period of empirical investigation in this rapidly evolving field.

An extensive search was conducted across multiple academic search platforms using keywords related to the metaverse, such as “metaverse adoption,” “empirical study,” “user behaviour,” “virtual environments,” and “extended reality.” This initial search retrieved 1,342 articles. Following a multi-stage screening process reviewing titles, abstracts, and full texts studies that were conceptual, theoretical, unrelated to the metaverse, or non-empirical were excluded. Additionally, duplicates and non-English publications were removed. This filtering resulted in 331 relevant articles focused specifically on metaverse technology. A further full-text assessment was conducted on these 331 articles to identify studies employing rigorous empirical methodologies, including surveys, experiments, and mixed methods. Ultimately, 25 studies were selected for detailed analysis based on their methodological rigor and direct relevance to the research questions. For each selected paper, data were systematically extracted regarding the research objectives, sample size, methodology, analytical tools, domain of application, and key findings. The studies encompassed diverse geographies and populations, with sample sizes ranging from 100 to over 2,000 participants, and research designs primarily centered on survey-based quantitative methods (comprising approximately 72% of studies), followed by experimental/quasi T experimental designs (20%) and hybrid or advanced analytical approaches (8%). The studies were thematically categorized into five key areas: adoption and behavioural drivers, education and learning outcomes, business and investment applications, user experience and psychological engagement, and technological, ethical, and design considerations. This thematic classification allowed for a structured synthesis of findings and facilitated identification of common patterns and research gaps. Theoretical frameworks frequently employed included the Technology Acceptance Model, Self-Determination Theory, Flow Theory, and Practice-Based View. Statistical techniques such as structural equation modelling, fuzzy set qualitative comparative analysis, and artificial neural networks were commonly utilized, indicating a maturation of empirical approaches in metaverse research. This systematic methodology ensures a robust and comprehensive review of the current empirical landscape, providing a strong foundation for further analysis and future research recommendations.

IV. RESULTS AND KEY INSIGHTS

The systematic review identified 25 empirical studies on the metaverse published between 2023 and 2025, covering diverse geographic regions and research domains. The sample sizes across these studies varied widely, ranging from 102 to 2,500 participants, with an average sample size of approximately 750 respondents. Survey-based research constituted the majority of methodologies (72%), followed by experimental designs (20%), and hybrid analytical methods such as SEM-ANN and fsQCA (8%). The systematic review identified 25 empirical studies on the metaverse published between 2023 and 2025, representing a wide range of geographic regions and research domains. Sample sizes varied considerably, from 102 to 2,500 participants, with an average of approximately 750 respondents per study.

TABLE II: Key Themes and Theoretical Frameworks in Recent Empirical Metaverse Studies

Theme	Description	Dominant Theories / Models
Adoption Drivers	Factors influencing users' decision to adopt metaverse platforms (e.g., perceived usefulness, ease of use, social influence)	Technology Acceptance Model (TAM), Self-Determination Theory (SDT)
User Experience	Immersiveness, flow, usability, psychological well-being, and engagement in metaverse environments	Flow Theory, Cognitive Theory
Economic Behavior	Motivations behind investment and purchasing within metaverse real estate and digital goods	Behavioural Economics Models, Economic Utility Theory
Social Impact	Effects on social interaction, event participation, identity, and community building	Social Exchange Theory, Social Capital Theory
Platform Usability	Technical readiness, interface design, navigation, and cross-platform interoperability	Practice-Based View, Technology Readiness Index

The majority of these studies employed survey-based methodologies (72%), followed by experimental designs (20%), and a smaller portion used hybrid analytical approaches such as structural equation modelling combined with artificial neural networks or fuzzy set qualitative comparative analysis (8%). This distribution highlights the growing methodological rigor in metaverse research. A significant portion of the studies (10 out of 25) investigated behavioural drivers behind metaverse adoption.

These studies consistently revealed that perceived usefulness, ease of use, and hedonic motivation are key factors influencing users' intentions to adopt metaverse technologies. For instance, applications of the Technology Acceptance Model (TAM) demonstrated that over 70% of the variance in behavioral intention could be explained by performance expectancy and social influence. However, privacy and security concerns remained substantial barriers, particularly in emerging markets where trust issues negatively impacted adoption rates. Six studies focused on the metaverse's role in education, showing promising results for learning engagement and outcomes. Experimental designs indicated that integrating metaverse environments into educational settings led to improvements in knowledge retention and learner motivation by approximately 15 to 25%. Participants highlighted the benefits of immersive navigation tools and interactive avatars, which contributed to enhanced satisfaction. Despite these advantages, challenges such as technological infrastructure gaps and digital divides were reported, potentially limiting the broader application of metaverse-based learning.

In the domain of business and investment, five studies explored how metaverse platforms facilitate commercial activities such as virtual real estate and e-commerce. These investigations found that trust in platform quality and community engagement increased users' purchase intentions by an average of 30%. The ability of metaverse environments to simulate real-world business scenarios enabled organizations to improve training and prototype development processes, contributing positively to organizational performance. Nonetheless, regulatory uncertainties and ethical concerns around virtual transactions were noted as areas needing further exploration. User experience and psychological engagement were the central themes of four studies, which emphasized the importance of flow states, immersion, and social interaction in sustaining user involvement. Realistic avatars and shared social spaces were linked to users spending up to 40% more time within metaverse environments. Interestingly, while higher realism enhanced immersion, it occasionally reduced perceptions of authenticity, potentially impacting user engagement negatively. Psychological well-being outcomes were varied and appeared to be moderated by individual mental health status and patterns of metaverse usage. Finally, technological readiness and ethical considerations emerged as critical challenges across many studies. About 60% of the reviewed papers highlighted concerns related to data privacy, platform interoperability, and infrastructural limitations. These issues are particularly pressing in less developed regions, where inadequate digital infrastructure hinders metaverse adoption. Additionally, inclusivity and accessibility were frequently discussed as essential factors to prevent exacerbation of existing digital inequalities and ensure equitable participation. Overall, these findings illustrate both the transformative potential of the metaverse across various domains and the significant challenges that must be addressed to realize its full benefits. The following section will synthesize these insights into a conceptual framework and propose directions for future research.

V. FUTURE RESEARCH DIRECTIONS AND CONCEPTUAL WORK

Based on the synthesis of empirical studies and identified research gaps, several important future research directions emerge that can deepen our understanding of the metaverse and guide its development. A key area for future inquiry is the behavioural and adoption dynamics of the metaverse. Researchers should investigate how privacy and trust concerns can be effectively addressed across diverse cultural and economic contexts to enhance adoption rates. Exploring the role of social exchange mechanisms in shaping long-term user engagement and satisfaction is also critical, as these relational dynamics may significantly influence sustained use beyond initial acceptance. In the educational domain, future research needs to examine the effects of prolonged use of metaverse learning environments on cognitive load and knowledge retention. Understanding how immersive virtual learning impacts learner outcomes over time will provide valuable insights for educators and designers. Additionally, addressing the challenge of equitable access is paramount; studies should explore strategies to bridge digital divides and improve metaverse-based education for underserved populations, ensuring inclusivity and minimizing disparities. At the organizational level, future research should focus on how internal capabilities such as absorptive capacity and power structures influence the successful integration of metaverse technologies. Investigating effective governance models and ethical frameworks to regulate emerging virtual economies and digital asset exchanges will also be vital for sustainable and responsible business practices. Such studies can help organizations strategically harness the metaverse while navigating complex ethical and regulatory landscapes. User experience and psychological wellbeing represent another critical research frontier. Understanding the short- and long-term psychological impacts of immersive metaverse usage will help in designing environments that promote mental health and user wellbeing. Furthermore, exploring how the balance between realism and authenticity affects user trust and engagement can inform more effective and user-centric virtual world designs. From a technological perspective, addressing issues of interoperability and data privacy remains essential for building trustworthy, scalable metaverse ecosystems. Research should also examine how metaverse technologies can contribute to sustainability goals, particularly in reducing environmental footprints compared to physical alternatives. These technological and environmental challenges are intertwined with behavioural and organizational factors, emphasizing the need for an integrated research approach. To guide such research, a conceptual framework is proposed that integrates three interconnected dimensions: behavioural, organizational, and technological-environmental.

The behavioural dimension focuses on individual user factors such as perceived usefulness, ease of use, hedonic motivation, trust, and privacy concerns, all of which influence metaverse adoption and engagement. The organizational dimension encompasses firm-level capabilities, governance mechanisms, and strategic alignment that determine how organizations adopt and benefit from metaverse technologies in areas like training, marketing, and virtual commerce. Lastly, the technological and environmental dimension covers infrastructure readiness, data security, interoperability, ethical considerations, and the potential for sustainable development impacts.

These three dimensions interact dynamically to shape the overall performance and societal impact of the metaverse. Future empirical research should aim to test and refine this framework, utilizing mixed methods and longitudinal designs to capture the complex, evolving relationships across individual, organizational, and societal levels. By addressing these future research directions within an integrated conceptual framework, scholars and practitioners can better understand and harness the full potential of the metaverse.

VI. CONCLUSION

This systematic review of 25 recent empirical studies provides a comprehensive understanding of the metaverse's current research landscape, revealing both its promising potentials and pressing challenges. The findings clearly indicate that the metaverse holds significant transformative power across behavioural, educational, business, user experience, and technological dimensions. Behavioural adoption is strongly influenced by perceived usefulness and ease of use, aligning with the Technology Acceptance Model, which remains the dominant theoretical lens. However, concerns around privacy and security underscore the importance of addressing trust issues to accelerate adoption, particularly in emerging markets where infrastructural and regulatory frameworks may be less mature. Future research should explore mechanisms to enhance user trust and confidence, possibly integrating theories such as Social Exchange Theory to better capture the relational dynamics involved. In education, the metaverse's immersive and interactive capabilities have demonstrated tangible benefits for learner engagement and knowledge retention. Yet, infrastructural challenges and unequal access highlight the risk of exacerbating digital divides. Researchers and practitioners must therefore prioritize inclusivity and equitable technology deployment. Longitudinal studies would also be valuable to understand sustained learning impacts and possible cognitive overload effects. From a business perspective, metaverse technologies enable novel opportunities for virtual commerce, training, and prototyping, contributing to improved organizational performance. However, the nascent nature of virtual economies demands clearer regulatory guidance and ethical frameworks to ensure transparency and fairness in digital asset exchanges. Empirical research focusing on governance, power structures, and absorptive capacity within organizations can deepen understanding of how firms can strategically leverage the metaverse. User experience studies underscore the delicate balance between immersion and authenticity, suggesting that while realism fosters engagement, excessive simulation may reduce perceived genuineness. Additionally, the psychological impacts of prolonged metaverse use remain underexplored. Future investigations should examine mental health outcomes and design interventions that promote wellbeing alongside engagement. Technologically, data privacy, interoperability, and infrastructure remain critical hurdles. The majority of studies emphasize that overcoming these challenges is essential for scaling the metaverse globally and inclusively. Furthermore, sustainable development goals should be integrated into metaverse research agendas, as digital environments offer unique possibilities for minimizing resource consumption and carbon footprints compared to physical alternatives. Overall, this review advocates for a practice-based view that considers organizational routines, capabilities, and social exchanges as central to understanding and managing metaverse impacts. By combining behavioural, technological, and organizational perspectives, future research can develop a holistic understanding of the metaverse's potential and limitations. In conclusion, while the metaverse represents a ground breaking technological and social innovation, empirical research remains in its early stages. There is a clear need for more robust, multi-method, and longitudinal studies that address diverse contexts and populations. Expanding research into underexplored areas such as privacy mechanisms, resilience, governance, and sustainability will be crucial for guiding responsible and effective metaverse development.

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