RESEARCH ARTICLE

Unveiling the potential of metaverse in project management education

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Abstract

The Fourth Industrial Revolution (4IR), driven by technological advancements such as Artificial Intelligence (AI), has transformed industries, reshaping the skills required in the workforce. Project management education must adapt to these changes by integrating innovative teaching methods to prepare future professionals. This study explores the potential of the metaverse, an immersive virtual environment, to revolutionize project management education. By offering interactive, real-time simulations and personalized learning experiences, the metaverse enables learners to engage with complex project management scenarios beyond the limitations of traditional classrooms. This research combines a literature review and qualitative analysis of project managers' perspectives to assess the benefits and challenges of incorporating the metaverse into educational curricula. The findings highlight the potential for enhanced engagement and the barriers to adoption, including technology access and learning curve concerns. The study concludes by proposing future research directions and addressing limitations regarding the scalability and effectiveness of metaverse-driven education in diverse project management contexts.

1. Introduction

The Fourth Industrial Revolution (4IR), characterized by the convergence of technologies like artificial intelligence (AI), big data, automation, and the metaverse, fundamentally reshapes industries globally. In today's dynamic business and technological landscape, the ability to enhance information systems (IS) provides a crucial competitive edge (Varajão et al., 2021). This transformation necessitates a parallel evolution in educational systems to equip the workforce with the requisite skills and competencies. This need is particularly pronounced in project management (PM), a field increasingly reliant on digital tools, virtual collaboration platforms, and agile methodologies. Traditional, face-to-face learning approaches are becoming insufficient to prepare project managers for the demands of this rapidly digitizing landscape.

The emergence of the metaverse, an interconnected and immersive virtual world, presents a compelling opportunity to revolutionize PM education. By offering interactive, hands-on learning experiences that closely simulate real-world project scenarios, the metaverse has the potential to bridge the gap between theory and practice. This immersive environment can foster enhanced student engagement, promote the development of crucial skills like decision-making, communication, and leadership within virtual teams, and facilitate a deeper understanding of complex project dynamics. As highlighted by Schwab (2017), the convergence of 4IR technologies demands a holistic approach to workforce preparation, extending beyond AI to encompass digital literacy, systems thinking, and proficiency in emerging digital tools. The metaverse offers a platform to cultivate these broader skill sets within a dynamic and engaging context.

However, the integration of the metaverse into PM education is not without its challenges. Technological limitations, accessibility concerns, the learning curve associated with new digital tools, and the need for curricular adjustments pose significant hurdles. Furthermore, as projects increasingly involve geographically dispersed teams operating in fully digital environments, understanding the nuances of virtual team dynamics within the metaverse becomes crucial. Dispersed teams are spread across different locations but may still use traditional communication methods like email or phone, occasionally meeting in person. Virtual teams, however, operate fully in digital environments, relying entirely on tools like video conferencing and messaging for collaboration, with no in-person meetings. The increasing prevalence of virtual and hybrid work models underscores the critical need for virtual teams (VTs) to effectively communicate, collaborate, and deliver projects. Therefore, VTs must understand the unique challenges and success factors of virtual project execution, and may require additional training to adapt to these new working methods (Swart et al., 2022). This study differentiates between dispersed teams, which may utilize traditional communication methods alongside digital tools, and virtual teams, which operate exclusively within digital spaces. The focus here is on virtual teams, recognizing the metaverse's unique capacity to foster immersive, real-time collaboration irrespective of physical location.

This paper investigates the potential of the metaverse to enhance PM education, exploring its applications, impact on learning outcomes and student engagement, and the challenges associated with its implementation. It also considers the evolving nature of project management frameworks and standards in response to digital transformation. By examining the perspectives of project management practitioners, this study aims to contribute to the development of innovative training tools, environments, and approaches that effectively prepare future project managers for the demands of the 4IR. Specifically, this research addresses the following key questions:

(RQ1) How can the metaverse enhance student engagement and learning outcomes in PM education?

(RQ2) What are the benefits and challenges of using metaverse technologies in PM training, according to educators and industry professionals?

(RQ3) How can the metaverse support the development of essential project management skills?

(RQ4) What are the practical and technological barriers to implementing metaverse-based education, and how can they be addressed?

(RQ5) How can the metaverse be integrated into existing curricula to offer a blended learning experience?

To meet the research objectives, this study adopted an exploratory approach involving project managers across various industries. Participants were engaged in a virtual task designed to simulate real-world project management scenarios within a metaverse environment. This task enabled project managers to collaborate, make decisions, and experience immersive project simulations, providing valuable insights into the practical applications of metaverse technologies in professional settings. Through this design, the study aimed to explore how the metaverse can enhance learning, engagement, and skills development within project management education. The findings from this case study will guide the future implementation of metaverse technologies in both educational and professional environments.

This paper is organized into five distinct sections. Firstly, it provides a comprehensive background on metaverse technology, emphasizing its relevance within the educational and project management domains. Secondly, it outlines the research methodology and describes the implementation of the metaverse-based task. Subsequently, it presents and analyzes the results and findings derived from the project managers' experiences. The fourth section critically discusses the implications of these findings for contemporary project management education. Finally, the paper concludes by exploring future opportunities and offering valuable recommendations for the successful adoption of metaverse technologies within educational frameworks.

2. Literature Review

The accelerating pace of technological innovation, particularly within the framework of the Fourth Industrial Revolution (4IR), has initiated profound shifts across various sectors, including project management. These technological advancements have not only transformed industrial practices but have also redefined educational methodologies, demanding a reassessment of traditional pedagogical approaches. In particular, the emergence of the metaverse as an immersive virtual environment has introduced new possibilities for enhancing the teaching and learning of project management. This literature review aims to critically examine existing scholarship on digital transformation, virtual learning environments, and their pedagogical applications, with a specific focus on how immersive technologies such as the metaverse can reshape project management education. By synthesizing current research, this section seeks to identify the theoretical underpinnings, practical benefits, and challenges associated with integrating the metaverse into educational frameworks, thereby offering insights into future research directions and potential pedagogical innovations.

2.1. Transformation of project management environment: Virtuality

The concept of virtuality has become increasingly central to project management due to the rise of geographically dispersed teams and reliance on digital communication technologies. Virtuality, as defined in the literature (Adams & Adams, 1997; Khazanchi & Zigurs, 2005; Krill & Juell, 1997), encompasses various dimensions of dispersion, including time, organizational affiliation, culture, team continuity, experience, availability, and technology variability. Even individuals within the same physical location may engage in virtual projects due to scheduling conflicts, highlighting the communication and team-building challenges associated with increased distance (Adams & Adams, 1997). A virtual project is essentially a collaborative effort conducted remotely to achieve a shared goal (Krill & Juell, 1997), involving virtual teams that operate across space, time, and organizational boundaries, connected through communication technologies and engaging in interdependent tasks with a common purpose (Hofer, 2009; Lipnack & Stamps, 2008). This shift towards virtual teams necessitates the integration of virtuality and a heavy reliance on communication technologies, challenging traditional team structures to adapt to modern workplaces. As highlighted by Hofer (2009), virtual teams represent an innovative organizational paradigm characterized by flexibility and responsiveness, where technology plays a pivotal role in managing geographically dispersed projects. In this context, virtuality can be understood through three dimensions: spatial virtuality (working from different locations using digital tools), temporal virtuality (asynchronous work across time zones), and technological virtuality (leveraging advanced digital platforms for communication, resource

sharing, and project tracking). This study focuses on this shift towards technology-enabled, distributed teams, positioning the metaverse as a potential solution for enhancing collaboration and engagement within immersive 3D environments.

2.2. Competencies for project management in 4IR: Navigating success

The growing importance of project management (PM) has led to increased resource allocation, project-based work organization, more projects, stronger links between projects and strategy, and greater PM scope and complexity (Micán et al. 2020). Project managers play a crucial role in ensuring project success (Chen et al., 2019; Ekrot et al., 2016; Irfan et al., 2021; Karanja & Malone, 2021). Given the reported high project failure rates (Chen & Bozeman, 2012; Pfeifer, 2011), identifying the essential competencies for project managers has become a key area of research. The Project Management Institute (PMI) also highlights a growing gap between job growth and the availability of qualified professionals (PMI, 2021). Project managers navigate ambiguous situations, uncertainty, and conflicting demands (Sandberg et al., 2022), necessitating agility and creativity to overcome the resulting environmental and technical challenges (Pires & Varajão, 2024).This necessitates a combination of both soft skills (communication, negotiation, leadership, team building, and contextual awareness) and hard skills (domain-specific knowledge and technical expertise in scope, time, cost, and quality management) (Atkinson, 1999; Pant & Baroudi, 2008). While both skill sets are important, soft skills are often considered more influential in achieving successful project outcomes (Alvarenga et al., 2019; De Araújo & Pedron, 2015; Moradi et al., 2020; Ramazani & Jergeas, 2015). Therefore, project management training programs must consider this comprehensive skill set to foster proficiency at individual, team, organizational, and societal levels (Gareis & Huemann, 2007).

2.3. Project management education and training: Addressing the discrepancies

The rise of project-based work and digital transformation has created a project management talent shortage (Cabot & Gagnon, 2021). The increasing demand for skilled project management professionals has led to the development of various educational and developmental programs (Umpleby & Anbari, 2004). This has included the rise of formal undergraduate and graduate programs in project management (Bredillet et al., 2013; Lloyd-Walker et al., 2016). While recognized standards from organizations like PMI, APM, and IPMA provide essential core concepts and principles (Delle-Vergini et al., 2023), criticisms persist regarding the effectiveness of current project management education. Scholars argue for a paradigm shift to better align education with practical application (Atkinson, 2008; Egginton, 2012; Ojiako et al., 2011), as current approaches are deemed insufficient to meet the needs of modern organizations in the face of high project failure rates and increasing global complexity (Córdoba & Piki, 2012; Ojiako et al., 2011). Traditional project management education often relies on lecture-based instruction, textbook learning, and limited integration of digital tools, emphasizing standardized frameworks like the PMBOK® Guide and focusing on theoretical knowledge and technical skills (Mason et al., 2009; Ramazani & Jergeas, 2015; Thomas & Mengel, 2008; Tumpa et al., 2023). This approach often neglects practical application, digital collaboration tools, and essential soft skills (Cicmil et al., 2006; Ewin et al., 2017; Pant & Baroudi, 2008; Winter et al., 2006). As industries evolve due to technological advancements and the shift to remote teams, these outdated models are increasingly inadequate. There is a recognized need for a shift in teaching and learning approaches to address the gap between current educational practices and the demands of contemporary businesses (Córdoba & Piki, 2012; Karanja & Malone, 2021; Thomas & Mengel, 2008). While project management education varies across industries, there is a growing emphasis on digital skills to manage increasingly digital, virtual, and dispersed teams. Identifying the most vital competencies for project management students and graduates entering the workforce is crucial (Kearney et al., 2024).

2.4. Past and future of education

The evolution of the education context encompasses various changes and developments over time (Table 1). This includes shifts in teaching methods, technological advancements influencing learning environments, changes in educational policies, and adaptations to meet the evolving needs of learners and society.

Table 1. Evolution of education context

Era	Educational Changes	Project Management Era
1st Industrial Revolution (Empirical Stage)	The evolution of labor specializations marked a shift towards specialized skills. Subsequently, trade schools were established to provide targeted vocational training. The establishment and growth of technical universities further solidified the formal education system in specialized technical and scientific fields.	Project Management 1.0
2nd Second Industrial Revolution (Gannt Chart)	The establishment of a multi-level training system for industry marked a strategic approach to workforce development. This included the standardization of training procedures, contributing to a more uniform and quality educational experience. Consequently, these efforts played a crucial role in elevating the reputation of technical education.	Project Management 2.0
3rd Third Industrial Revolution (CPM, PERT, GERT, EVM)	The integration and globalization of education have led to the development of academic mobility, fostering the movement of students and professionals across borders. This transition is accompanied by the adoption of international education standards. Additionally, in response to global trends, there is an increasing emphasis on training specialists for service-oriented fields.	Project Management 3.0
4th Industrial Revolution (AI, Machine Learning, IoTs)	The individualization and virtualization of education reflect a shift towards personalized learning experiences and digital platforms. This transformation also involves reinforcing the project-based and multidisciplinary nature of technical education, emphasizing practical and collaborative aspects. Furthermore, the development of interactive educational resources enhances engagement and facilitates dynamic learning environments.	Project Management 4.0

Source: Compiled from the studies of references Bühler et al., 2022 and Aliu et al., 2023

The historical progression of industrial revolutions has significantly shaped the landscape of education. The first industrial revolution, fueled by the steam engine, led to the emergence of labor specializations, trade schools, and the development of technical universities. In the second industrial revolution, powered by electricity, multi-level training systems for industry were established, training became standardized, and the prestige of engineering education soared (Bühler et al., 2022). The third industrial revolution, driven by information technology, brought about the integration and globalization of education, increased academic mobility, and the development of international educational standards (Sakhapov & Absalyamova, 2018). Considering the profound changes brought by the 4IR, the training requirements for the technical profession are expected to undergo substantial transformation (Goldin & Katz, 2018). According to Schwab (2017), the 4IR is fundamentally altering the way we live, work, and learn, creating an urgent need for educational reforms to prepare the workforce for a future defined by complex technologies and innovative business models. In the context of project management education, Gonçalves et al. (2023) emphasize that traditional curricula are increasingly seen as insufficient, as they do not adequately reflect the technological and collaborative skills required in modern project environments. According to a recent study by Fernández-Sánchez et al. (2022), the curricular integration of digital technologies in teaching has become a critical factor for modernizing education, particularly at non-university levels. This shift is crucial for enabling educators to equip students with the skills necessary to navigate the digital landscape effectively. In alignment with this, educational reforms need to focus not only on the adoption of digital tools but also on the development of teachers' digital competencies and ongoing professional training. To effectively address the challenges posed by an increasingly complex and hyper-connected world, there is a collective need to fundamentally rethink or even reinvent the project management

profession and the underlying education system. In the recent era of the 4IR, creative convergence education has witnessed notable trends, prompting a surge in studies proposing educational models aimed at fostering students' creative and critical meaning-making processes (Kettler et al., 2021). In the current modern era, it is crucial to utilize innovative approaches within the field of project management education (Carreiro & Oliveira, 2018; Hunady et al., 2022; Oliveira et al., 2020).

2.5. Traditional vs Metaverse-based education

The evolution of education has been significantly shaped by successive industrial revolutions (Bühler et al., 2022; Carreiro & Oliveira, 2018; Goldin & Katz, 2018; Kettler et al., 2021; Oliveira et al., 2020; Sakhapov & Absalyamova, 2018). The pandemic-driven adoption of collaboration technologies, coupled with metaverse advancements, has increased comfort with advanced online learning tools, and this, along with the 4IR, requires a rethinking of project management and its education (Mitchell, 2024). Traditional education and metaverse-based education are distinct paradigms, each with unique advantages and limitations. While traditional education often relies on hierarchical classroom structures, lectures, and memorization, contemporary project management curricula incorporate interactive techniques like workshops, case studies, and simulations. However, traditional education still faces limitations in preparing students for the technology-driven landscape of modern project management. The metaverse offers an evolution in digital learning environments, providing immersive, interactive experiences with realistic simulations, global collaboration, and enhanced engagement and retention. A comparison of both approaches according to their basic characteristics is given in Table 2.

Table 2. Traditional education vs. metaverse-driven education

Aspect	Traditional Education	Metaverse-based Education
Access	Limited Access	Enhanced Access
Location	Physical classrooms	Unrestricted by geographical/physical constraints
Interaction	Limited	Increased
Collaboration	Limited opportunities	Enhanced opportunities
Learning Materials	Traditional (textbooks and physical resources)	Digital learning materials
Personalization	Limited	Customized/adaptive learning
Flexibility	Fixed schedules and rigid structures	Flexible schedules and structures
Immersive Learning	Limited	Enhanced
Social Interaction	Limited	Increased
Teacher-Student Relationship	Physical presence	Virtual presence
Cost	Traditional education expenses	Reduced costs for infrastructure and commuting
Global Collaboration	Limited opportunities	Enhanced global collaboration
Teaching Form	One-to-many	One-to-many, One-to-one
Educator	Teacher	Knowledge sharer
Learner Identity	Authentic identity	Tailored and digital identity
Time	At a scheduled time by the class timetable	Without being limited by time
Learners Interact with	Genuine instructors and classmates	Authentic educators and fellow students in physical form, or virtual educators and peers
Learning Scene	Authentic learning environments	Virtual learning environments
Learning Resource	Printed or multimedia learning resources that learners usually cannot interact with (book, pen, whiteboard, smartboard, etc.)	Visualized or decentralized learning resources that allow learners to interact (human-computer interface, wearable devices)
Learning Activity	Lecture-oriented with opportunities for learner engagement through a series of activities and collaboration with peers	Predominantly composed of contextualized learning activities within 3D learning environments, enabling learners to engage in virtual learning activities

Aspect	Traditional Education	Metaverse-based Education
Learning Objective	To develop low-order cognitions	To develop high-order cognitions, achieve more comprehensive learning objectives
Learning Assessment	Learning outcomes derived from summative data, relying on traditional exams and assessments.	Integrate formative and summative data, prioritizing learners' growth, and employ diverse assessment methods with real-time feedback.

Source: Compiled from the studies of references Alfiras et al., 2023; Zhang et al., 2022; Lin et al., 2022; Rohan et al., 2023

Compared to platforms like Moodle, which offer primarily passive learning experiences, the metaverse provides real-time, interactive simulations and collaboration in 3D spaces. While traditional education excels in foundational knowledge, metaverse-based education offers immersive, interactive, and personalized learning, addressing many of the limitations of traditional approaches (Meena et al., 2023; Soni & Kaur, 2023). However, challenges such as technological barriers, digital fatigue, learning curves, and potential social isolation must be addressed.

To sum up, traditional education excels in discipline and foundational knowledge but may limit critical thinking and practical application. Metaverse-based education, marked by immersion, interactivity, and personalization, signifies a paradigm shift addressing traditional education's limitations. It introduces innovative learning approaches, enhancing engagement, interactivity, and accessibility, thereby reshaping the educational experience.

2.6. Metaverse for project management education

The metaverse, a collective, virtual shared space combining virtual and physical reality, offers significant opportunities for project management education. It allows for immersive learning and simulations, enhanced collaboration and communication, virtual project scenarios and role-playing, real-time data and project monitoring, and global team management. By integrating the metaverse, educators can enhance engagement, collaboration, and personalized learning. Designing metaverse-driven education requires a diverse set of competencies, including technical proficiency, pedagogical expertise, instructional design skills, creativity, and adaptability. While AI can assist in certain aspects of course design, human course authors remain essential for crafting meaningful and engaging learning experiences. The metaverse can provide significant gains in project management education (Table 3).

Table 3. Strategies and tools for maximizing the metaverse in project management education

Approach/Tool	How to use	Possible Gains
Increased Engagement Through Immersive Learning	Create virtual 3D classrooms within the metaverse where students can immerse themselves in project management scenarios.	The immersive environment allows students to explore and interact with 3D objects and avatars, enhancing engagement and making learning more captivating.
Expanded Access and Collaborative Learning	Leverage the metaverse for collaborative learning, allowing students worldwide to participate in virtual classes and engage in real-time project collaboration.	This fosters diversity and inclusivity, breaking down geographic barriers and promoting global collaboration among students.
Personalized Learning with Competence-Based Education	Leverage the metaverse's ability to analyze data on student performance and behavior for personalized learning experiences.	The metaverse adjusts to individual student needs, providing tailored feedback and content. Competence-based education in the metaverse ensures a focus on essential skills for project management.
Innovative Assessment Methods	Explore new assessment methods in the metaverse, such as simulations and games, to evaluate student learning	These assessments, reflective of real-world scenarios, can be more engaging and offer a comprehensive understanding of students' project management skills.

Approach/Tool	How to use	Possible Gains
Integration of Advanced Technologies	Incorporate virtual reality, augmented reality, and artificial intelligence into the metaverse learning environment	These advanced technologies enhance personalization and adaptability, helping students grasp complex project management concepts, develop critical skills, and prepare for real-world scenarios.
Blended Learning and Interdisciplinary Approach	Embrace blended learning by combining traditional open learning with online training within the metaverse	The metaverse breaks down subject barriers, promoting interdisciplinary learning, essential for a holistic understanding of project management.
Seamless Integration of Physical and Virtual Learning	Integrate virtual reality with traditional learning methods	This seamless integration caters to various learning styles and provides personalized support, overcoming the limitations of traditional teaching methods.
Promoting Social Connection and Collaboration	Leverage the social aspects of the metaverse to enhance collaboration and group interaction.	Learning environments within the Metaverse cultivate a community atmosphere, promoting the exchange of ideas and facilitating collaborative problem-solving—a fundamental aspect of developing essential skills for project management.
Utilizing Metaverse for Specialized Training	Explore the metaverse's potential for specialized training programs that may be challenging or dangerous in the real world	Overcome limitations such as time, space, or safety concerns, providing effective training programs for project management skills.
Addressing Challenges and Ethical Considerations	Acknowledge challenges in creating and implementing the metaverse in education, including technological limitations and ethical considerations	A proactive approach to addressing challenges ensures a more sustainable and ethical implementation of metaverse-based project management education.

Source: Compiled from the studies of Ho & Lee, 2023; Soni & Kaur, 2023; Cui et al., 2023; Raj et al., 2023; Hwang & Chien, 2022

Course authors designing metaverse-driven education for project management will need a diverse set of competencies. First, they must have technical proficiency to understand the technologies behind virtual environments, such as metaverse platforms and immersive simulations. This includes knowledge of tools used for creating 3D models and interactive virtual spaces. Additionally, pedagogical expertise is essential, as authors must adapt traditional project management concepts to virtual formats while ensuring the content is engaging and promotes critical thinking. Instructional design skills will also be crucial, as authors will need to create learner-centered curricula that integrate immersive simulations, role-playing, and real-time decision-making exercises. Creativity and adaptability are equally important, as course authors will need to design innovative learning experiences and adapt quickly to new technological advancements. Collaboration with technologists and game designers will also be necessary to develop realistic and interactive virtual project environments. As for whether AI will replace course authors, while AI can assist in certain aspects of course design, such as content generation, grading, or personalizing learning paths, it is unlikely to fully replace human authors. AI can streamline tasks and enhance educational efficiency, but course authors bring critical pedagogical insight, creativity, and the ability to contextualize learning within specific industries or educational settings. While AI will play an increasingly supportive role, course authors will remain essential for crafting meaningful, nuanced, and engaging learning experiences.

In conclusion, the metaverse presents a transformative opportunity to enhance project management education by providing immersive, interactive, and collaborative learning experiences that address the evolving demands of the 4IR. But in addition to the issues of accessibility and technical barriers, there are concerns about the over-reliance on technology in educational settings. Prolonged engagement in virtual environments may contribute to digital fatigue, and the lack of face-to-face interaction could lead to a decrease in empathy and interpersonal communication skills, which are essential for project managers.

Moreover, while the metaverse offers exciting possibilities for immersive learning, there is the risk that it could reinforce isolation, especially for students who already struggle with the lack of in-person contact in online learning environments. It is essential for educators to recognize these challenges and develop strategies to ensure that metaverse-based education does not replace, but rather complements, the social and interactive aspects of traditional learning methods.

3. Research Methodology

This study employed a qualitative research design to explore project managers' perspectives on the potential of the metaverse in project management education. This approach allowed for a rich understanding of their experiences, insights, and opinions regarding this emerging technology.

3.1. Participants

A total of 32 project managers participated in the study. Participants were selected using a combination of convenience and snowball sampling techniques. Initial contacts were made through professional networks, including LinkedIn and project management forums, with subsequent referrals from initial participants expanding the pool. This sampling strategy facilitated access to a diverse range of perspectives from professionals with varying backgrounds and experiences. The participant group represented a range of industries, including IT (10 participants), engineering and construction (8), finance and banking (5), healthcare (4), manufacturing (3), and other sectors (2). This industry diversity ensured a broad perspective on the applicability of the metaverse across different project contexts. Participants also represented both small-to-medium enterprises (SMEs, 14 participants) and large multinational corporations (MNCs, 18 participants), providing insights from different organizational scales. Geographically, the majority of participants were based in North America (12) and Europe (10), with smaller representations from Asia (6) and other regions (4). Participants' project management experience ranged from 5 to 20 years, with 10 having 5-10 years, 12 having 10-15 years, and 10 having 15-20 years of experience. This range allowed for the capture of both recent and more established perspectives on project management practices and educational needs. Notably, 15 participants were involved in project management education in some capacity (e.g., as trainers, mentors, or in academia), while 17 were not directly involved. In terms of familiarity with the metaverse, 8 participants were highly familiar (having used VR tools or metaverse platforms), 14 were moderately familiar (with basic knowledge but limited practical experience), and 10 were not familiar. This distribution allowed for an assessment of the metaverse's potential from varying levels of exposure.

3.2. Data Collection

Data was collected through semi-structured interviews conducted online via Zoom and Microsoft Teams. These interviews, lasting between 25 and 30 minutes, allowed for in-depth exploration of participants' views. The interviews were guided by open-ended questions designed to elicit detailed responses regarding the potential role of the metaverse in project management education. These questions focused on areas such as the benefits and challenges of metaverse adoption, its impact on skill development (particularly soft skills), and considerations regarding technological barriers, accessibility, and the learning curve associated with new digital tools.

3.3. Data Analysis

Thematic analysis was employed to analyze the interview data, following Braun and Clarke's (2006) guidelines. This involved several stages:

- Familiarization: All interviews were transcribed verbatim and thoroughly reviewed to gain a deep understanding of the data.

- Coding: Data was systematically coded using both inductive (codes emerging from the data) and deductive (codes based on the research questions) approaches. NVivo qualitative analysis software was used to manage the coding process.
- Theme Development: Similar codes were grouped to identify broader themes related to the research questions, such as engagement and immersion, technological challenges, the impact on project management skills, and the future of education.
- Theme Review and Refinement: The identified themes were reviewed and cross-checked against the original transcripts to ensure they accurately reflected the participants' views.
- Theme Definition and Naming: Each theme was clearly defined and given a descriptive name, such as "Immersive Learning," which captured the metaverse's ability to create engaging virtual environments.

To provide context and deeper interpretation, relevant literature, including the sensemaking and sense giving framework by Gioia and Chittipeddi (1991), was integrated into the analysis. Verbatim quotes from the interviews were used to support the identified themes and ensure the findings offered meaningful interpretations grounded in the participants' experiences. Data saturation was reached after 28 interviews, as no new themes emerged in subsequent interviews; however, all 32 interviews were completed to ensure comprehensive data collection. This rigorous approach to data analysis ensured the credibility and validity of the study's findings.

4. Findings

This study employed thematic analysis to systematically analyze interview data and accurately capture the perspectives of participants. The research commenced with a thorough familiarization phase, involving a meticulous review of all interview transcripts to gain a deep understanding of the data and identify initial patterns. Subsequently, a systematic coding process was undertaken, incorporating both inductive and deductive approaches. Inductive coding allowed for the emergence of data-driven themes, while deductive coding ensured the systematic application of codes relevant to the research questions. Thematic analysis of the interview data revealed four primary themes: (A) Problems of Present Project Management Education, (B) Recommendations for Enhancing Current Project Management Education, (C) Potential of the Metaverse in Project Management Education, and (D) Obstacles in Metaverse Adoption for Project Management Education. These themes were rigorously reviewed and validated against the original interview transcripts to ensure data saturation – a point at which no new themes or insights emerged. Verbatim quotes were incorporated throughout to provide concrete examples and support the identified themes. Through this rigorous process, the study ensured that the findings were grounded in the participants' experiences and provided valuable insights into the potential and challenges of integrating the metaverse into project management education.

4.1. (A) Problems of present project management education

Participants identified several key shortcomings in current project management education, highlighting a need for improvement across various dimensions:

Lack of Standardized Curriculum and Outdated Content: Inconsistencies in curriculum quality across institutions and outdated course content that fails to reflect current industry practices and technological advancements were frequently cited. Participants emphasized the need for better alignment between academic curricula and industry certifications.

> "One of the challenges is the lack of standardized curriculum across institutions, leading to inconsistencies in the quality of project management education worldwide."

> "A lack of alignment between academic curriculum and industry certifications creates a gap in recognizing and valuing the skills acquired through formal education."

"Global project management education faces issues with outdated course content that doesn't always align with the rapidly evolving industry practices and technological advancements."

"The challenge of keeping course content relevant to diverse industries; a one-size-fits-all approach may not cater to the unique needs of different sectors."

Limited Emphasis on Practical Application: A strong emphasis on theory at the expense of practical application was a recurring concern. Participants stressed the importance of hands-on experience and the need for programs to incorporate more real-world scenarios and adaptive project management methodologies.

"A significant problem is the limited emphasis on practical application; many programs focus heavily on theory, leaving students unprepared for real-world project scenarios."

"There's a need for more emphasis on teaching adaptive project management methodologies to better prepare professionals for dynamic and unpredictable project environments."

Insufficient Integration of Technology: Participants noted a need for better integration of digital tools and technologies into project management education to keep pace with industry practices. They also highlighted inconsistencies in the use of technology across educational institutions.

"There's a need for better integration of technology in project management education, as many programs struggle to keep pace with the digital tools used in the industry."

"Inconsistent use of technology platforms and tools across educational institutions hampers the development of a unified and streamlined learning experience for students."

Inadequate Soft Skills Development: Insufficient emphasis on developing crucial soft skills such as communication, leadership, emotional intelligence, and cross-cultural communication was identified as a significant gap.

"Insufficient interpersonal skills like communication and leadership holds back project managers from being fully ready for the global workforce."

"Not giving enough attention to the importance of emotional intelligence in project management education can hold back the development of effective leadership and team management skills."

"Neglecting cross-cultural communication skills in project management education could hamper effective collaboration in our globalized business world."

Limited Industry Exposure and Internships: Participants highlighted the lack of real-world industry exposure and practical internship opportunities, hindering graduates' transition into professional roles.

"Many programs not offering real-world industry exposure and hands-on internships make it tough for grads to smoothly shift into professional project management roles. Getting practical experience is key for a smoother transition from school to the job."

"When academia and industry don't collaborate enough, there's a gap in understanding current industry needs, making it hard to churn out graduates with the right skills."

Accessibility, Sustainability, and Ethical Considerations: Concerns were raised regarding accessibility of quality education, particularly in resource-limited regions, as well as inadequate attention to sustainability and ethical considerations in project management practices.

"Issues with accessibility, particularly in regions with limited educational resources, pose a barrier to aspiring project managers who may not have equal opportunities for quality education."

"Some programs struggle to accommodate the increasing demand for project management education, leading to potential compromises in quality."

Lack of Emphasis on Continuous Learning and Emerging Trends: Participants noted that current programs often overlook the importance of continuous learning and staying updated with emerging trends in the field.

> "Global project management education often overlooks the significance of continuous learning and staying updated with emerging trends, putting professionals at a disadvantage."

> "The challenge of incorporating real-time project management experiences into the curriculum to expose students to the fast-paced nature of the industry."

Insufficient Focus on Risk Management Education: Participants felt that current programs do not adequately prepare students for the complexities and uncertainties inherent in project management, particularly regarding risk management.

> "An insufficient focus on risk management education in many programs leaves graduates unprepared for the complexities and uncertainties inherent in project management."

> "Problems with outdated assessment methods; many programs still rely heavily on traditional exams rather than incorporating practical, real-world assessments."

4.2. (B) Recommendations for enhancing current project management education

Based on their experiences, participants offered several recommendations for improving project management education:

Increased Practical Application and Real-World Relevance: Participants strongly advocated for integrating more practical case studies, interactive workshops, simulation tools, leadership practice opportunities, and critical thinking exercises based on real-world scenarios.

> "Integrating more practical, real-world case studies would enhance the relevance of project management education."

> "Implementing interactive workshops that allow students to apply theoretical knowledge in a practical setting."

> "Providing access to simulation tools that allow students to experience the challenges of managing complex projects."

> "Offering more opportunities for students to practice leadership roles in project scenarios."

> "Encouraging critical thinking by presenting students with complex, real-world scenarios to solve."

Emphasis on Agile Methodologies: Given the dynamic nature of modern projects, participants recommended an increased focus on teaching agile methodologies.

> "Increasing focus on teaching agile methodologies to adapt to the fast-paced nature of modern projects."

Collaboration with Industry Experts: Participants suggested collaborating with industry experts for guest lectures and encouraging student participation in industry conferences and networking events.

> "Collaborating with industry experts for guest lectures to provide students with insights into current project management practices."

> "Encouraging students to participate in industry conferences and networking events for real-world exposure."

Integration of Technology-Focused Coursework: Participants recommended incorporating more technology-focused coursework, including access to industry-standard project management tools and courses on emerging technologies like AI and blockchain.

> "Incorporating more technology-focused coursework to prepare students for the digital transformation in project management."

> "Providing access to industry-standard project management tools to familiarize students with practical applications."

> "Introducing courses on emerging technologies like artificial intelligence and blockchain in project management."

Stronger Emphasis on Soft Skills: Participants emphasized the need for a stronger focus on developing soft skills such as communication, leadership, and conflict resolution, including emotional intelligence.

"Including a stronger emphasis on soft skills such as communication, leadership, and conflict resolution."

"Highlighting how being tuned into emotions is key for rocking project management, especially when you've got a cool team dynamic going on."

Interdisciplinary Projects and Collaboration: Participants recommended incorporating interdisciplinary projects and fostering collaboration with other business functions.

"Providing opportunities for students to work on interdisciplinary projects to simulate real-world project environments."

"Promoting more collaboration among students through team-based projects to develop effective teamwork skills."

"Encouraging more interdisciplinary collaboration with other business functions like marketing and finance."

Emphasis on Continuous Learning: Participants stressed the importance of continuous learning and professional development throughout a project manager's career, including regularly updating course content to reflect the latest trends.

"Emphasizing the importance of continuous learning and professional development throughout a project manager's career."

"Regularly updating course content to keep up with the latest trends and advancements in project management."

Experiential Learning Opportunities: Participants advocated for implementing experiential learning opportunities, such as internships, to bridge the gap between theory and practice.

"Implementing experiential learning opportunities, such as internships, to bridge the gap between theory and practice."

4.3. (C) Potential of the metaverse in project management education

Participants expressed strong support for integrating the metaverse into project management education, highlighting its potential to:

Provide Immersive Learning and Practical Application: Participants believed the metaverse's immersive simulations would allow students to apply theoretical concepts in practical, risk-free environments, facilitating experimentation with different project strategies.

"Absolutely, the metaverse can revolutionize project management education by providing immersive simulations, allowing students to practically apply theoretical concepts."

"Yes, metaverse-based project simulations can offer a safe space for students to experiment with different strategies and approaches in project execution."

"Metaverse-enabled resource management simulations can help students understand the complexities of allocating resources in real projects."

Facilitate Global Collaboration and Connectivity: Participants recognized the metaverse's potential to foster global collaboration through virtual events, forums, and career fairs, connecting students with professionals worldwide.

"I believe the metaverse is essential in project management education for fostering global collaboration, enabling students to work together seamlessly regardless of geographical locations."

"Absolutely, metaverse-based networking events can connect students with industry professionals, expanding their professional circles and opportunities."

"Metaverse forums can connect students with professionals, creating a space for knowledge exchange and networking."

"Imagine metaverse career fairs as your shortcut to landing cool project management gigs! You get to connect with potential employers and snag direct job opportunities."

Offer Hands-on Experience in Risk-Free Environments: Participants highlighted the metaverse's potential for virtual project setups and virtual internships, allowing students to gain practical experience without real-world risks.

"The metaverse offers a dynamic platform for virtual project environments, enabling students to gain hands-on experience in a risk-free setting."

"The metaverse should be used for virtual internships, allowing students to work on real projects and build practical skills under simulated conditions."

Prepare Students for Real-World Challenges: Participants believed metaverse-driven role-playing scenarios and case studies could effectively simulate real-world project challenges, preparing students for the unpredictable nature of project management.

"Metaverse-driven role-playing scenarios can simulate real-world project challenges, preparing students for the unpredictable nature of project management."

"Yes, metaverse case studies can present students with diverse project scenarios, preparing them for a wide range of challenges in their careers."

"Yes, metaverse-based hackathons focused on project management challenges can stimulate creative problem-solving among students."

"Utilizing the metaverse for guest lectures and industry expert sessions can bring real-world insights into the classroom, enhancing the educational experience."

Enable Flexible Learning and Certification Programs: Participants acknowledged the metaverse's ability to support asynchronous learning and advocated for the integration of metaverse-based certification programs.

"Yes, metaverse platforms can facilitate asynchronous learning, providing flexibility for students to access project management content at their own pace."

"Implementing metaverse-based certification programs can offer students industry-recognized qualifications, boosting their credibility in the job market."

Enhance Collaboration and Teamwork: Participants emphasized the metaverse's role in strengthening teamwork and decision-making skills through collaborative project planning exercises.

"Using the metaverse for collaborative project planning exercises can enhance teamwork and decision-making skills among students."

Increase Engagement through Gamification and Interactive Learning: Participants supported the use of gamification in the metaverse to make learning more engaging and interactive.

"The metaverse should be integrated into project management education through gamification, making learning engaging and interactive."

"Adding metaverse vibes to project management classes can spice up the learning game, making it more fun and getting students more into it."

Support Continuous Professional Development: Participants saw the metaverse as a valuable platform for continuous professional development, keeping project managers updated on industry trends and best practices.

> "Think of using metaverse platforms for pro development like scoring project managers a VIP pass – it keeps them in the loop on the latest industry trends and best practices."

> "Adding metaverse tech to project management courses is like gearing up students for the digital tool takeover in the industry."

Facilitate Feedback Loops and Project Retrospectives: Participants acknowledged the metaverse's potential for providing continuous feedback in project simulations and conducting project retrospectives.

> "Using the metaverse for constant feedback in project simulations is like turbocharging students' decision-making skills."

> "Analyzing projects through the metaverse can uncover key lessons from both triumphs and failures in project strategies."

Enable Real-Time Monitoring, Evaluation, and Feedback: Participants noted that metaverse applications could enable real-time project monitoring and reporting, providing a comprehensive understanding of project progress.

> "Metaverse platforms can be used for real-time project monitoring and reporting, allowing students to understand project progress at a glance."

> "Utilizing the metaverse for continuous feedback loops in project simulations helps students refine their decision-making skills, promoting iterative learning."

> "The metaverse supported project retrospectives provide valuable insights into successful and unsuccessful project strategies, fostering a culture of continuous improvement."

> "Real-time project monitoring and reporting in the Metaverse allow students to understand project progress at a glance."

> "Continuous feedback loops in Metaverse project simulations help students refine their decision-making skills."

Offer Specialized and Industry-Specific Learning: Participants believed the metaverse could facilitate industry-specific project simulations, customizing education to address real-world challenges in different sectors.

> "Adding metaverse tech to project management courses is like giving students a heads-up for the rising use of digital tools in the industry, syncing up education with what's trending in the field."

> "Metaverse-enabled resource management simulations help students understand the complexities of allocating resources in real projects, a critical skill in project management."

> "Mixing in metaverse platforms for industry projects is like customizing education to fit each sector's unique challenges."

Broaden Project Exposure and Communication Skills: Participants suggested that exploring case studies and engaging in virtual study groups and project showcases in the metaverse could enhance communication and presentation skills.

4.4. (D) Obstacles in metaverse adoption for project management education

Despite the recognized potential, participants also identified several obstacles to metaverse adoption:

Financial and Infrastructure Hurdles: Participants expressed concerns about the upfront costs for technology and training, as well as the potential digital divide due to unequal access to hardware and internet connectivity.

> "A major snag we're facing is the upfront investment needed for the tech and training. It could cause some financial headaches for our educational institutions."

"Not all students may have access to the necessary hardware and high-speed internet, creating a potential disparity in learning opportunities."

Integration Challenges with Existing Curricula: Participants noted potential difficulties in integrating the metaverse into existing curricula and aligning it with traditional teaching methods, as well as a lack of standardization across metaverse platforms.

"Integration into existing curricula can be a hurdle as it requires redesigning courses and ensuring compatibility with traditional teaching methods."

"Limited standardization in Metaverse platforms may create compatibility issues and make it challenging to establish consistent educational experiences."

Security and Privacy Concerns: Participants raised concerns about data security and privacy, particularly when handling sensitive project information within the metaverse.

"Concerns about data security and privacy in the Metaverse could hinder its adoption, especially when dealing with sensitive project information."

Resistance to Change: Participants acknowledged potential resistance to change from educators and students accustomed to traditional teaching methods.

"Resistance to change among educators and students who are accustomed to traditional teaching methods may slow down the transition to a Metaverse environment."

Technical and Logistical Challenges: Participants highlighted the need for user-friendly platforms, ongoing technical support, and addressing potential technical issues that could disrupt learning.

"Ensuring that the Metaverse platforms are user-friendly and accessible to individuals with varying levels of technological proficiency is a significant challenge."

"The need for ongoing technical support and maintenance to address issues such as software updates and potential glitches can be a logistical challenge."

"The potential for technical issues, such as connectivity issues or software glitches, may disrupt the continuity of lessons and impact the learning experience."

Pedagogical Considerations: Participants raised concerns about adapting assessment methods for virtual settings, managing the learning curve for both educators and students, and overcoming the perception that virtual experiences lack the richness of real-world interactions.

"Adapting assessment methods to evaluate students' performance in a virtual setting presents a challenge, especially for traditional testing approaches."

"Managing the learning curve for both educators and students in adapting to the new technology can be time-consuming and may affect the pace of learning."

"Overcoming the perception that virtual experiences lack the richness and depth of real-world interactions may be a psychological hurdle for some learners."

"Striking a balance between the advantages of immersive experiences and potential sensory overload in the Metaverse is a design consideration."

Ethical, Legal, and Accreditation Issues: Participants highlighted concerns about distractions, ethical behavior within the metaverse, alignment with accreditation standards, copyright and intellectual property issues, and addressing potential cultural barriers.

> "Addressing potential distractions within the Metaverse, such as unrelated virtual elements, could impact the focus and effectiveness of learning experiences."

> "Establishing guidelines and best practices for ethical behavior within the Metaverse to maintain professionalism and integrity is a challenge."

> "Ensuring that the Metaverse environments align with accreditation standards and industry requirements is crucial for the recognition of educational programs."

> "Navigating copyright and intellectual property issues in a virtual space, especially when using real-world project scenarios, poses legal challenges."

> "Addressing potential cultural barriers that may affect the acceptance and effectiveness of the Metaverse in diverse educational settings."

These findings provide a comprehensive overview of the perceived potential and challenges associated with integrating the metaverse into project management education, offering valuable insights for educators, institutions, and policymakers.

5. Discussion

This study explored the potential of the metaverse in project management education through qualitative research involving interviews with project management professionals. The findings reveal a complex picture, highlighting both significant opportunities and considerable challenges associated with metaverse integration.

5.1. Enhancing practical experience and bridging the theory-practice gap

A key finding centers on the metaverse's potential to enhance practical experience. Participants consistently emphasized its capacity for immersive learning through simulations, virtual internships, and realistic project scenarios. This resonates with existing literature highlighting the limitations of traditional, theory-heavy approaches in project management education. The metaverse offers a dynamic, risk-free environment where students can apply theoretical knowledge, experiment with different strategies, and experience the consequences of their decisions in a safe setting. This addresses a crucial gap in current education by providing hands-on experience that better prepares students for real-world project complexities. This immersive approach aligns with findings from Jaccard et al. (2022) and Fernández-Sánchez et al. (2022), who highlight the use of VR and metaverse technologies in training scenarios within various industries.

5.2. Challenges and Obstacles to Metaverse Adoption

The adoption of metaverse technologies in education, while promising, faces several significant challenges that must be addressed for successful implementation. One of the primary barriers is financial and infrastructural, as the high initial investment in hardware, software, and training, combined with unequal access to technology and internet connectivity, can hinder institutions with limited resources. Integration and compatibility issues also arise, as incorporating the metaverse into existing curricula requires substantial course redesign and pedagogical adjustments, made more complex by the lack of standardization across metaverse platforms. Security and privacy concerns, particularly regarding the protection of sensitive project information in virtual environments, further complicate the adoption process, necessitating robust security protocols and data governance policies. Resistance to change from educators and students accustomed to traditional learning methods poses an additional obstacle, highlighting the need for effective change management strategies. Moreover, technical and logistical challenges, such as ensuring user-friendly platforms, providing ongoing technical support, and managing technical glitches, are critical to maintaining a smooth learning experience. From a

pedagogical perspective, adapting assessment methods, managing the learning curve for users, and ensuring the richness of virtual experiences compared to real-world interactions are significant concerns. Finally, ethical, legal, and accreditation issues, including concerns about ethical behavior in virtual environments, alignment with accreditation standards, copyright issues, and cultural barriers, require careful consideration. Addressing these challenges through careful planning and strategic implementation is essential for fully realizing the potential of the metaverse in education and ensuring equitable access for all students.

5.3. Recognition of Innovation and Transformative Potential

Despite the challenges, participants overwhelmingly expressed optimism about the metaverse's transformative potential in project management education. They recognized its groundbreaking nature in certifying student success through practical learning and hands-on approaches. The use of simulations for realistic evaluations was seen as a crucial advantage. This aligns with the broader trend of digital transformation in education, as highlighted by Fernández-Sánchez et al. (2022) and Jaccard et al. (2022), who emphasize the importance of integrating digital technologies and serious games into curricula.

Participants viewed the metaverse as a pivotal force in the future of project management, with its potential to revolutionize collaboration and learning, enhance practical skills, catalyze innovation and adaptability, facilitate global collaboration and continuous improvement, and provide a dynamic learning platform. This visionary perspective suggests a strong belief in the metaverse's capacity to redefine project management training and prepare students for the challenges of a rapidly evolving industry. The emphasis on realism, practical skill development, and adaptability aligns with the demands of the 4IR, as highlighted by Schwab (2017), who emphasizes the need for educational reforms to prepare the workforce for a future defined by complex technologies.

6. Practical implications

This study's findings, combined with existing project management theory, offer several practical implications for integrating the metaverse into project management education. The metaverse's immersive and interactive nature provides opportunities to enhance various aspects of learning and skill development:

6.1. Enhanced learning and skill development

The metaverse presents a novel paradigm for project management pedagogy, offering a transformative potential for enhanced learning and skill development. By leveraging immersive and risk-free simulated environments, the metaverse facilitates the application of theoretical concepts to authentic, real-world scenarios. This experiential learning approach, encompassing project planning, resource allocation, risk mitigation, and stakeholder engagement, cultivates practical skills and directly addresses the documented need for increased real-world application emphasized by learners. Furthermore, the integration of AI-powered collaborative tools within the metaverse significantly augments teamwork, communication, and workflow efficiency through real-time support, asynchronous collaboration, and streamlined processes. The advent of metaverse-based virtual internships provides invaluable industry exposure, enabling students to apply project management principles within interactive, professional-like contexts. This addresses the identified gap between academic learning and practical industry experience. Finally, the utilization of virtual reality (VR) technology within the metaverse enhances spatial comprehension and fosters a deeper understanding of real-world project environments, thereby bridging the gap between theory and practice and solidifying student preparedness for professional challenges.

6.2. Improving educational processes

The metaverse, through its immersive environment, offers significant potential for enhancing educational processes. Automated grading and feedback mechanisms, facilitated by advanced analytics and AI algorithms, can provide students

with real-time performance analysis and visually engaging feedback, thereby optimizing the assessment process. Furthermore, AI-powered continuous monitoring and predictive analytics can identify struggling students early on, enabling timely interventions and personalized support. Additionally, the metaverse can host adaptive learning platforms that provide real-time personalization, flexible learning paths, and rich multimodal experiences, catering to diverse learning styles and promoting student engagement. Finally, the integration of virtual assistants within the metaverse provides 24/7 global support, personalized assistance, and dynamic integration of multimodal elements, enhancing student engagement and understanding.

6.3. Application to project management knowledge areas

The metaverse offers innovative applications across various project management knowledge areas, enhancing learning and practical experience. In project charter development, it allows for the simulation of collaborative creation and approval processes in a virtual environment, enabling real-time discussions and decision-making. For project management plans, it facilitates dynamic, interactive planning sessions where participants can collaboratively build and refine strategies. In scope, schedule, and cost management, the metaverse provides a visual platform for defining scope, developing schedules, and controlling costs, supporting collaborative work on work breakdown structures and financial oversight. Quality management is enhanced through virtual simulations that allow participants to identify and address quality issues. Resource management benefits from immersive simulations that focus on resource planning, team development, and control, providing insights into resource allocation and team dynamics. Communication management is improved by simulating real-world communication scenarios, enabling participants to practice stakeholder engagement, while AI integration can monitor communication effectiveness. In risk management, the metaverse offers a platform for identifying, analyzing, and responding to risks in a virtual setting. It also enhances procurement management by simulating procurement processes, offering participants a complete experience of the procurement lifecycle. Lastly, stakeholder management is supported through a virtual environment for stakeholder identification, analysis, and strategy execution, fostering a dynamic and immersive approach to managing stakeholder relationships.

6.4. Addressing practical challenges

The practical implications discussed above must be implemented with careful consideration of the challenges identified in the study. Addressing financial and infrastructure hurdles, integration and compatibility issues, security and privacy concerns, resistance to change, technical and logistical challenges, pedagogical considerations, and ethical, legal, and accreditation issues is crucial for successful metaverse integration. Pilot programs, phased implementation, and ongoing evaluation can help mitigate these challenges and maximize the benefits of the metaverse in project management education.

By implementing these practical applications and addressing the associated challenges, educators can leverage the metaverse to create more engaging, effective, and relevant project management learning experiences that prepare students for the demands of the 4IR.

7. Conclusion

This study investigates the transformative potential of the metaverse within the context of project management education. It meticulously examines both the advantages and the critical challenges that must be carefully considered for successful implementation. The metaverse emerges as a dynamic platform with the capacity to significantly enhance practical learning experiences (Zhang, 2023). Despite the ongoing challenge of aligning project management curricula with the rapidly evolving demands of the professional landscape, the metaverse, as an emerging digital frontier, possesses the transformative potential to reshape the traditional educational paradigm by effectively transforming the world into a virtual global school. (Kaddoura & Al Husseiny, 2023). By offering immersive simulations, virtual internships, and authentic real-

world project scenarios, the metaverse provides a unique environment for students to apply theoretical knowledge and develop essential project management competencies. These critical competencies include leadership, communication, resource management, critical thinking, and problem-solving, all of which are crucial for successfully navigating the complexities of the Fourth Industrial Revolution (Rotatori et al., 2021).

The evolving technology underpinning the metaverse, including VR headsets, haptic gloves, AR, and Extended Reality (XR), enables users to fully immerse themselves in interactive experiences, prompting organizations to seriously consider its integration into existing business models (Dwivedi et al., 2022). The growing popularity of the metaverse across diverse domains further demonstrates its efficacy and versatility, offering immersive and interactive learning experiences within the realm of project management education (Jagatheesaperumal et al., 2022).

The utilization of the metaverse in project management education emerges as a transformative and promising avenue, supported by a growing body of scholarly perspectives and empirical evidence. Recent research strongly suggests that the metaverse can serve as a novel educational environment and an innovative pedagogical tool, effectively combining virtual and real-world educational settings (Chen, 2022; Hare & Tang, 2022). Equipped with wearable devices, learners can seamlessly enter immersive educational environments through the use of personalized digital identities, engaging in real-time interactions via avatars, or through the utilization of virtual learning resources. This hands-on approach provides students with the invaluable opportunity to engage with authentic and dynamic project management situations within a realistic virtual environment, thereby significantly enriching their comprehension and enhancing the development of critical competencies (Long, 2019).

The research questions guiding this study were comprehensively addressed through an analysis of the metaverse's role within the educational domain of project management. The findings demonstrate that the metaverse has the potential to enhance student engagement and learning outcomes. By creating immersive, simulation-based environments, it facilitates the application of theoretical concepts to authentic, real-world scenarios, fostering deeper understanding and improved knowledge retention. Furthermore, this study highlights the substantial benefits of metaverse technologies within the training context. These benefits include the facilitation of global collaboration, enabling students and instructors to connect and interact across geographical boundaries. The provision of real-time feedback mechanisms allows for immediate assessment and guidance, accelerating the learning process. Additionally, the metaverse develops practical skills through hands-on experiences in virtual environments, preparing students for the demands of modern project management roles. However, several critical challenges must be proactively addressed to ensure the successful and widespread adoption of metaverse-based educational initiatives. These challenges include:

- **Financial Constraints:** The initial investment in developing and maintaining metaverse platforms, acquiring necessary hardware (VR/AR devices), and providing ongoing technical support can be substantial for educational institutions.

- **Integration Complexities:** Integrating metaverse technologies into existing curricula and pedagogical approaches requires careful planning, faculty training, and ongoing evaluation to ensure effective learning outcomes.

- **Technological Limitations:** Issues such as limited accessibility to high-speed internet, compatibility issues with different devices, and potential for technical problems can disrupt the functioning of metaverse-based learning experiences.

- **Ethical Considerations:** Concerns related to data privacy, user safety, and the potential for the digital divide must be carefully addressed to ensure an equitable and inclusive learning environment for all students.

Despite these challenges, the metaverse has the potential to revolutionize project management education. By proactively addressing these critical issues through strategic implementation, continuous evaluation, and ongoing refinement, educators can effectively leverage the metaverse to create more effective, engaging, and relevant educational experiences.

This study explored the potential of the metaverse within project management education through a qualitative lens, employing thematic analysis based on Braun and Clarke's (2006) framework and informed by Gioia and Chittipeddi's (1991) sensemaking/sense giving perspective. This methodological approach facilitated an in-depth examination of how project management professionals not only identify existing challenges and propose solutions but also actively construct meaning around the concept of metaverse integration.

The findings reveal a dynamic interplay between these processes of sensemaking and sense giving. Participants engaged in sensemaking by diagnosing current shortcomings in project management education, including deficiencies in standardized curricula, limited practical application and soft skills development, and restricted industry exposure. Subsequently, they engaged in sense giving by proposing potential solutions, such as emphasizing experiential learning, fostering stronger links with industry and integrating relevant technologies, and prioritizing continuous professional development. Critically, participants also engaged in sensemaking regarding the metaverse itself. They interpreted its potential as a powerful instrument for addressing the identified educational gaps, envisioning immersive learning environments, enhanced opportunities for global collaboration, and expanded avenues for continuous professional development. However, this optimistic interpretation was tempered by a pragmatic assessment of potential challenges, including technological, financial, pedagogical, ethical, and security considerations. This highlights a key finding: the recognition of the metaverse's transformative potential is inextricably linked to a clear understanding of the obstacles that must be addressed for its successful and responsible implementation.

This dynamic between perceived benefits and anticipated challenges yields significant implications for practice. Educational institutions and educators should not view the metaverse as a simple technological solution but rather engage in a deliberate and strategic process of planning and implementation. This necessitates addressing the identified challenges through targeted investments in infrastructure, comprehensive pedagogical training for faculty, and the development of robust ethical guidelines and security protocols. Furthermore, fostering collaborative partnerships with industry experts and technology specialists is essential for creating relevant and effective metaverse-based learning experiences.

This study also suggests several avenues for future research. Further investigation is warranted to:

1. **Develop and rigorously evaluate specific metaverse-based learning interventions within project management education:** This involves designing and implementing pilot programs, collecting data on student outcomes, and analyzing the effectiveness of different metaverse applications in achieving specific learning objectives.

2. **Explore the long-term impact of metaverse integration on student learning outcomes and subsequent professional development:** Longitudinal studies are needed to track student progress, assess their career trajectories, and determine the long-term benefits of metaverse-based learning experiences.

3. **Investigate the broader ethical, social, and cultural implications of utilizing immersive technologies in educational contexts:** This includes examining issues such as equity of access, the potential for a digital divide, and the impact of immersive technologies on student well-being and social interactions.

4. **Develop and disseminate best practices for mitigating the identified challenges, including technological barriers, pedagogical considerations, and security concerns:** This involves sharing knowledge and resources among educators, developing guidelines and frameworks for best practices, and fostering a community of practice around the use of the metaverse in education.

By understanding the nuanced processes of sensemaking and sense giving inherent in the perception and implementation of the metaverse, educators and researchers can collaborate to responsibly harness its transformative potential, ultimately contributing to a more effective, engaging, and equitable future for project management education.

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Appendix A. Semi-structured interview questions:

- What are the problems you observe in global Project Management education?
- How do you think current project management education can be improved?
- Can Metaverse improve the quality of project management education?
- Do you think metaverse should be used in project management education? How?
- For what purposes can Metaverse be used in project management education? What opportunities do you think Metaverse has that the traditional method does not offer?
- How would you evaluate the obstacles to using the Metaverse environment in project management education?
- What do you think about using metaverse to measure and certify student success in project management education?
- How do you evaluate the Metaverse phenomenon in terms of the future of Project Management?

Biographical notes

Tufan Özsoy is a marketing professor focusing on the concept of sustainability. In addition to his studies on sustainable production and consumption, he teaches graduate-level project management courses and publishes academic publications in this field.

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