**Metaverse for Digital Health Solutions**

**Abstract**

The intersection of the Metaverse and digital health represents a growing frontier in healthcare technology, promising innovative approaches to enhance health and well-being through immersive virtual environments. However, there is limited knowledge on how this technology can be used not only to enhance user engagement but also support the sustainable use of Metaverse for health and well-being platforms in Metaverse. This study investigates the transformative potential of the Metaverse in digital health for sustainable use, focusing on its capacity to revolutionise healthcare delivery and improve health and well-being outcomes. The research examines the impact of motivation to use Metaverse, Metaverse user experience and trust in the platforms on user engagement which further translates to the sustainable use of Metaverse. The study also investigates the mediation of self-concept between user engagement and the sustainable use of Metaverse. Moreover, immersion level is also tested for moderation and mediation in this study between motivation to use Metaverse, Metaverse user experience, trust in the platforms and user engagement. The study adopted a mixed methods approach including 15 interviews and 152 online surveys. The findings of the study reveal that the motivation to use the Metaverse and Metaverse user experience do not impact user engagement, however, trust in the platforms in Metaverse significantly impacts the user engagement. Furthermore, our analysis also shows that user engagement leads to the sustainable use of Metaverse for health and well-being platforms. Additionally, self-concept mediates the relationship between user engagement and the sustainable use of Metaverse, however, immersion level acts as a mediator and not a moderator between motivation to use Metaverse, Metaverse user experience, trust in the platforms and user engagement. The findings contribute valuable insights into the development of innovative health solutions within the Metaverse, aiming to advance digital health practices and improve health and well-being outcomes. Moreover, the study underscores the critical role of user trust and engagement in the success of digital health platforms, guiding future research and development efforts in this rapidly evolving field. Limitations of the study are acknowledged, and recommendations for future research directions are proposed to further enrich our understanding of sustainable healthcare use in the Metaverse.

**Keywords:** *Metaverse, User Engagement, User Motivation, User Experience, Trust, Immersion, Self-concept, Digital Health.*

1. **Introduction**

All healthcare companies aim to deliver services in a way that will be valued highly by their patients, and that will differentiate them from their competitors (Enthoven, 1993; Herzlinger, 2006). Anecdotes explain how Metaverse has revolutionised the healthcare sector by enabling digital solution providers to offer immersive experience to users, in a virtual environment (Ebrahimzadeh and Safa, 2024). Companies like Siemens are anticipating that in the future Metaverse will have the ability to create a computation model of every patient, through which it will work as a digital twin (Siemens, 2024). This tool will be useful for medical practitioners in anticipating their illness based on health background records and offer precision medicines, therapeutic options or suggest procedures with highly specific and accurate diagnosis made using data and information available, without variations. Literature defines Metaverse as a scalable and data based, three-dimensional virtual world that renders with real life to co-create experiences synchronised virtually with a sense of physical presence (Buhalis et al., 2022; Buhalis et al., 2023; Dwivedi et al. 2022; Cheng et al., 2022). These technological advancements, such as Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR), have the potential to transform healthcare systems, particularly in the area of mental health (Yang et al., 2022). Since the onset of COVID-19, mental health issues have become a critical concern, and digital tools have emerged as potential solutions (Chew et al., 2020). For instance, VR therapy has been increasingly used to treat anxiety, PTSD, and depression, offering immersive environments that help individuals confront stressors in a controlled and safe space (Bell et al., 2024). In the post-COVID-19 landscape, mHealth applications, including VR-based mental health interventions, have shown promising results in supporting both healthcare professionals and the general population (Thomason, 2021). Moreover, platforms like the Metaverse provide opportunities for creating virtual support groups, offering real-time therapy sessions, and promoting mindfulness through guided environments (Fagherazzi et al., 2020). These solutions indicate that the Metaverse and related technologies are not only relevant but increasingly crucial in addressing the growing mental health crisis. Mental health has become a significant issue particularly for those working in the health industry around the world (Thomason, 2021). The rising number of health cases has been well attributed to some cultural and social changes in new society (Bor et al., 2014).

Metaverse is expected to transform healthcare dramatically with anticipatory and multidimensional diagnosis required by medical practitioners for precise medication (Chaddad and Jiang, 2023). Furthermore, many research studies have explained how Metaverse is transforming experiences of patients about healthcare delivered to them as personalised care delivered with compassion in a virtual immersive and interactive environment (Chengoden et al., 2023; Pervez et al., 2024). Metaverse offers unique interactive feature of a virtual immersive environment and a range of facilities and tools that are being used by healthcare companies for delivering value to their users (Dunston et al., 2011; Oyewole et al., 2024). There are several capabilities attributed to use of Metaverse in health practice, for example its capability to deliver positive experiences of treatment with real-time monitoring to patients, is enabling healthcare companies to encourage use of digital healthcare solutions (Tan et al., 2022). In addition, the virtual experience through Metaverse can prove to be both cost and time efficient benefitting both patients and health care providers (Haleem et al., 2022). For example these benefits for patients could be that application of these tools and facilities can be used for transferring useful information such as health education to patients and advanced training to healthcare providers is helping many (Paul et al., 2024). Further we can refer to Metaverse and its implication in health care to helping patients dealing with Phobias (Freitas et al., 2021) use of communities for further emotional support (O’Gara et al., 2022) and exchange of information for latest treatment for patients suffering similar illnesses (Durkin, 2019; Sun et al., 2021). As well for healthcare providers and practitioners this can create opportunities such that it can connect to medical practitioners with like-minded peers or experts around the world (Xu et al., 2022) or aid them in finding informed experts in discussing and seeking help for unique cases in order to seek solution for their treatment (Liu et al., 2023; Xu et al., 2022). The technology can also be used as a tool to aid junior practitioners in tuning into virtual patient examination procedures and regulations (Abbas et al., 2020) or for training junior practitioners (Alam and Matava, 2022).

The Metaverse's capability to merge the digital and physical worlds creates an immersive, interactive space that engages participants in the conscious transformation of value through the sharing of their views and opinions (Gadekallu et al., 2023). The value thus created motivates users to engage in the immersive environment and develop trust in the platform (Pengnate et al., 2020). However, sustaining value creation through engagement of users in the Metaverse will still remain a challenge for many providers of digital healthcare solutions (Dwivedi et al., 2022). The success of a healthcare solution provider's virtual environment as well depends upon users' experience of immersion and recognition of value offered by these providers (Cha et al., 2024). Due to the novelty of the research area, most research conducted on Metaverse happens to be of conceptual nature (Dwivedi et al., 2022; Ritcher and Ritcher, 2023; Barrera and Shah, 2023; Dolata and Schwabe, 2023).

Although there is a growing body of literature on the Metaverse and its applications in education and entertainment (Buhalis et al., 2022; Dwivedi et al., 2022), research on its integration with mHealth is limited. Flavin et al. (2024) have highlighted the importance of empirical studies in this domain due to the lack of such research. Existing studies have not fully explored how the immersive experiences in the Metaverse can improve health and well-being outcomes and contribute to the sustainable use of health-related applications. This study fills that gap by empirically investigating how factors such as motivation, user experience, and trust impact the adoption and engagement with Metaverse-based health platforms, particularly in addressing mental health issues.

Mobile Health (mHealth) refers to the use of mobile devices and technologies to deliver health services and information (Obro et al., 2021). Since the COVID-19 pandemic, mHealth solutions have gained significant traction in providing remote healthcare services, particularly for mental health management (Thomason, 2021). This research focuses on integrating mHealth within the Metaverse, exploring how immersive virtual environments can enhance the delivery of mobile health interventions. The current study aims to empirically investigate the transformative nature of the Metaverse and its antecedents, such as motivation, user experience, and trust in the platform, which will impact the adoption of such platforms. In this study, we examine the impact of several antecedents, including motivation factors, user experience, and trust issues arising from the use of such platforms, as enablers of the adoption of these new technologies. We acknowledge the role of immersion in these platforms (Hoffman and Novak, 2009). Thus, the aim of this study is to gain a clearer understanding of the variables influencing individuals’ adoption of such immersive technologies. This study applies Flow Theory (Csikszentmihalyi, 1975) to explore how immersion in Metaverse-based health applications fosters sustained user engagement and positive experiences. Flow Theory suggests that when individuals are deeply immersed and enjoy the experience, they are more likely to exhibit sustained engagement. By applying Flow Theory, this research contributes to a deeper understanding of how immersive environments in the Metaverse can facilitate long-term engagement and positive user experiences within the context of digital health solutions. It also provides insights into how healthcare providers can use the Metaverse to deliver personalized, immersive mental health interventions, addressing the growing demand for digital solutions post-COVID-19.

Addressing the research gap in the literature, the present study is one of the first to examine the user side, focusing on the variables impacting user adoption of technological platforms, specifically in the context of healthcare apps. This research aims to examine enablers of Metaverse adoption that conceptualised variables such as motivation (Hwang and Koo, 2023), user experience (Papagiannidis et al., 2013), and trust in platform (Zhang et al., 2022) which can lead to positive user experience and thus the sustainable use of Metaverse. We have conceptualised the immersion level of users as moderator and mediator to check its impact on using health related apps for users.

**2. Background**

**2.1 Metaverse**

The Metaverse is an immersive form of the Internet, providing a platform for users to interact within digital technologies (Dwivedi et al., 2022). Since 1996, the Metaverse has been conceptualised, and it has since been subject to many definitions (Ng, 2022). In this study, we have adopted the definition proposed by Balla (2022, p.29): *‘[Metaverse is] a massively scaled and interoperable network of real‐time rendered three-dimensional (3D) virtual worlds that can be experienced synchronously and persistently by an effectively unlimited number of users with an individual sense of presence, and with continuity of data, such as identity, history, entitlements, objects, communications, and payments’*’*.* The expansive, immersive digital environment created by the Metaverse provides users with an interactive opportunity to engage with each other in a computer-generated universe that mimics and extends real-world interactions (Cheng et al., 2022). The environment provided by the Metaverse is a hybrid landscape, including both digital and physical aspects. The core of the Metaverse is its dynamism, characterised by a reciprocal connection between the virtual and physical worlds (Cerasa et al., 2024). Through the combination of several different digital technologies, including 3D shared XR environments, two-way IoT, biosensors, sensors, and wearable technologies, the connection supported by the Metaverse has been continually improved. Moreover, the boundary between the real and virtual worlds has been blurred. Medical extended reality (MXR) is seen as one of the outcomes of this development. The utilisation of the Metaverse plays a vital role in extending and enhancing the user experience in the medical field (Plechatá et al., 2022).

**2.2 Metaverse in Healthcare and Well-being**

It is widely acknowledged that ongoing physical interaction with patients is crucial for assessing their physical and mental health conditions (Ullah et al., 2023). Since the Covid-19 pandemic, the Metaverse has significantly advanced in supporting healthcare and well-being. The application of healthcare through the Metaverse is diverse (Wu et al., 2024). Bansal et al. (2022) categorises the domain of healthcare in the Metaverse into 7 major categories including: telemedicine, clinical care, educational, physical care, mental care, pharmaceutical and veterinary. For example, neurosurgeons at Johns Hopkins have employed augmented reality to perform surgeries on patients with chronic back pain and spinal tumours (Bansal et al., 2022; Massetti and Chiariello, 2023). Additionally, Sridhar et al. (2020) and Noben (2019) explored the potential of the Metaverse in reducing anxiety and stress for pregnant women. Moreover, the Metaverse is believed to create a controllable, safe, and customisable environment for both patients and physicians (Song and Qin, 2022). There is evidence that the Internet and videoconferencing are as effective as traditional in-person therapy for psychotherapy, such as for anxiety and depression (Berryhill et al., 2019a; Berryhill et al., 2019b). It is important and effective in psychotherapy for patients to customise therapeutic environments and scenarios to meet specific needs, preferences, and therapeutic goals (Cerasa et al., 2024). The ability to collect and conduct real-time monitoring and feedback based on the connection between the real and virtual worlds also helps therapists to obtain valuable data on patients' progress and engagement (Ali et al., 2023). The Metaverse has been widely adopted in supporting m-health therapy, offering an environment conducive to reducing health-related stigma (Del Hoyo et al., 2024).

Usmani et al. (2022) asserted that Virtual Reality Exposure Therapy (VRET) is an effective treatment for social anxiety disorder, improving patients' social interactions and communication abilities. Furthermore, research by Hennig-Thurau et al. (2023) indicated that VR could alleviate social anxiety and enhance social skills in individuals suffering from this condition. In addition, Oh et al. (2023) proposed that VR could boost empathy and encourage prosocial behaviours in those with Autism Spectrum Disorder. However, Benrimoh et al. (2022) stated that the adoption of the Metaverse in m-health improves availability and engagement rather than the therapeutic process. They believed that the increased utilisation of the Metaverse in m-health would improve the availability of VR and tele-therapy, rather than changing the therapeutic process. The use of the Metaverse provides an easier way to move therapy from therapists’ offices to crowded streets or public areas; this approach provides an opportunity for patients who have avoided or had difficulty accessing therapy to receive it (Benrimoh et al., 2022). To understand the full potential of the Metaverse in healthcare and well-being, it is crucial to examine how users engage with these virtual environments, as engagement is a key driver of sustained use and positive outcomes.

**2.3 User Engagement with Metaverse**

Engagement is a term shared by several disciplines (Bouvier et al., 2014). In business and marketing, customer engagement, in the most generic terms, refers to customers actively demonstrating interest and participation in relation to a company and its offerings and activities (Bruneau et al., 2018). Whereas, in technology and human-computer interaction, it is termed as user engagement. Engagement has been largely described as a multidimensional concept. Accordingly, categorisation of the concept has been approached both as mono-dimensional, referring to it as a state of mind or the propensity to be in a relationship (Bowden, 2009), and as multi-dimensional, attributing the construct to behaviour (Bruneau et al., 2016, p. 485). While the majority of scholarly work acknowledges the multidimensional nature of the concept, different scholars have attributed different dimensions to it. For example, Alvarez-Milan et al. (2018) highlights psychological and behavioural dimensions. In line with this, Vivek et al. (2012) describes the concept as multidimensional, defining dimensions such as cognitive, emotional, behavioural, and social. Hollebeek et al. (2014) also categorise the dimensions as cognitive, emotional, and behavioural. It is important to note that the definition of these dimensions will be closely related to the object of the relationship (be it the brand, brand community, website/software offered by the brand, etc.) (Kuvykaitė and Tarutė, 2015).

User engagement is solidly built upon user trust, which leads to their commitment (Pansari and Kumar, 2017). Essentially, users become engaged with a firm or its offerings when the relationship is based on commitment and trust, making it emotionally satisfying for users to maintain a long-term commitment (Kumar et al., 2010). One important aspect is the dynamic nature of user engagement (Kumar et al., 2010), meaning that the engagement stimulus constantly needs to be elevated to keep users continually engaged in the process and prevent the relationship from feeling one-sided (Harmeling et al., 2017). Traditionally scholars have long used a virtual atmosphere or some relevant stimulus cues to engage and attract users to their virtual environment. These stimulus cues to name a few are colour, music, aroma. Research into user online behaviour focused into nature and consequence of interaction with web experience that can create the immersive experience (Hoffman and Novak, 2009). The immersive experience as it has been called as flow experience in earlier literature is associated with lesser price sensitivity and more positive attitude towards the experience (Novak et al., 2000). Although Zeithaml et al. (2002) described immersion as irrelevant or not a key factor in web-based experiences, more recent research has linked immersion or the flow state to recreational use of web-based experiences. In the last few years, the positionality of Metaverse has brought this experiential element (Papagiannidis et al., 2013), to understand stimulus and response as Stimulus-organism-response (SOR) theory into fuller focus. SOR is mainly used to measure environmental stimuli on human behaviour. Authors such as Eroglu et al. (2013) studied the SOR model to conceptualise the impact online atmospheric by dividing it into low and high task relevant cues. High task relevant cues as per authors may include description of merchandise, pricing, return and refund policies, picture of merchandise and any other aid for searching for products and overall aspects relevant to utilitarian objectives. Examples of low task relevant cues will include colour, borders and background patterns, animation or sound to promote merchandise on the web domain and overall aspect relevant to support hedonic aspects. Through the years scholars have adopted SOR theory for use of other attributes of e-commerce including m-commerce (Chopdar and Balakrishnan, 2020), and live streaming (Guo et al., 2021; Ming et al., 2021).

Verhoef et al. (2009) consider flow theory as substantially important for user experience, engagement and enjoyment are antecedents of satisfaction when consumers are dealing with experiential marketing. Flow is defined as a state in which people are well immersed into certain activities that nothing seems to matter (Sun et al., 2019). Flow is separate from telepresence by distinguishing it from it as defining telepresence described as feeling of being there (feeling of immersion within an environment) (Weibel and Wissmath, 2011). Flow however is more related to being involved in an action and engaging and enjoying it. Being in the flow state for individuals and considering their experience with technology immersive seems like, forget most perceptions not relevant to their navigation and get fully immersed in their navigation and experience (Novak et al., 2000). Csikszentmihalyi (1990) defined flow as a state of mind that is purely enjoyable, causing users to stop paying attention to other activities around them. In other words, the experience is so enjoyable that individuals interact with it solely for the sake of enjoyment. Ghani and Deshpande (1994) refer to the components of the flow state as engagement and enjoyment. In this conceptualization, we argue that user engagement will be a prerequisite for enjoyment and thus the value in the use of the platform. As user engagement is a critical factor in driving long-term adoption and loyalty, it also plays a vital role in ensuring the sustainable use of the Metaverse, particularly for diverse populations.

**2.4. The Sustainable Use of the Metaverse**

The sustainable use of the Metaverse can be defined as the practice of leveraging Metaverse technologies in a manner that promotes long-term ecological balance, social equity, and economic viability (De Giovanni, 2023). This involves creating virtual spaces that are accessible to diverse populations, including those with disabilities, or having mental health problems or from marginalized communities, thereby enhancing social inclusion and educational opportunities. For instance, Park and Kim (2022) highlighted that the Metaverse can transcend physical limitations, offering equal educational and social opportunities and fostering a participatory learning environment that is sustainable over time.

The sustainable use of new technology is influenced by psychological, social, and technological factors (Roberts et al., 2021). Perceived advantage is typically the primary factor influencing consumers' decisions to adopt a new product or technology. These advantages can include motivations such as enhanced productivity (Chakraborty et al., 2024) or improved user experiences (Kim et al., 2013; Chakraborty et al., 2023). Moreover, the sustainable acceptance of emerging technologies heavily depends on users' confidence in their security and privacy features (Albayati et al., 2020). With increasing concerns about data security and privacy, addressing these issues is crucial to maintaining consumers' trust and ensuring their continued loyalty to the technology (Casaló et al., 2007). Several studies (e.g., Hollebeek, 2019; McLean and Wilson, 2019; Lim et al., 2019; and Molinillo et al., 2020) provide evidence that user engagement can be seen as a relationship-building tool in the online context. Engaged consumers are more likely to form attachments to a company and display positive behaviours, such as high retention rates and a strong intention to remain loyal users (Islam et al., 2019). Therefore, user engagement has been praised as a strategic tool for driving high profitability and achieving superior competitive advantages in the online marketplace (Ajiboye et al., 2019).

Earlier work on online experience has adopted the flow theory to explain the phenomena. Hoffman and Novak (2009) adopted Csikszentmihalyi’s theory of flow which was developed back in the 1970s (Csikszentmihalyi, 1975). Fiore et al. (2005) define telepresence as an intermediate variable when users are exposed to internet enabled stimulus as an antecedent and leading to impact consumer attitude and behaviour. Telepresence, which refers to the experience produced in a computer-mediated environment; depends on what extent this experience will simulate consumers' real-life experience (Shih, 1998). Fiore et al. (2005) argue of the main factors that impact telepresence. Accordingly, the state of flow is when consumers are absorbed in a n activity that nothing else seems to matter. Their theory is focused on the enjoyment dimension of the state as people are keen to carry on with the experience for the sheer benefit of enjoyment (Csikszentmihalyi, 1975, p.4). Moreover, Papagiannidis et al. (2013) argue on the difference between flow and telepresence state. Telepresence is normally considered the feeling of being involved in an action, whereas flow is the state is the experience of feeling and sensation of being there (Weibel and Wissmath, 2011). In their study Weibel and Wismath (2011) in an empirical study examined the presence of flow in a computer game. They found out the distinction between flow and telepresence and argued motivation and immersion plays as predecessors to flow and flow can result in higher performance and enjoyment. Similarly, thus incorporating the two dimensions associated with flow theory engagement and enjoyment (Ghani and Deshpande, 1994). Other scholars have acknowledged the theory. Past research has acknowledged the role of engagement in flow state and further engagement link to enjoyment (Oulasvirata et al., 2005).

**2.5 Theoretical basis: Flow Theory**

This theory is an important concept for understanding user experience and engagement (Novak et al., 2000; Hoffman and Novak, 2009); it was developed by Csikszentmihalyi (1975). Flow experience is a psychological state related to an individual's sensation in response to environmental stimuli (Huang, 2016). Specifically, when a person is fully concentrated on an activity and loses self-consciousness while engaging in it, leading to a sense of enjoyment, it is referred to as flow experience (Lee and Joshi, 2007). When consumers reach the flow state, they obtain the most positive experience (Csikszentmihalyi, 1975). Online activities provide an especially strong flow for consumers, such as online shopping, gaming, and social networking (Kim et al., 2019). Using the web is often intrinsically enjoyable, causing users to lose track of time and become cognitively immersed. This significantly increases the level of engagement for online users (Kaur et al., 2016; Kim et al., 2019). Flow generates positive marketing outcomes (Hoffman and Novak, 2009) because it leads to a positive attitude (Chen, 2006). In a highly competitive marketing environment, achieving a positive attitude is crucial because it directly influences users' behavioural intentions (Bart et al., 2014). Additionally, the subsequent behaviours of consumers are also impacted by flow (Hoffman and Novak, 2009). When users achieve a state of online flow, they are motivated to return to the website regularly and extend their visits to relive that enjoyable experience (Bridges and Florsheim, 2008; Ilsever et al., 2007). Continuance intention denotes a social media user’s intention to revisit the site and persistently use a product or service. Therefore, Flow Theory is appropriate for this research, as it explains why users keep returning to Metaverse applications for the immersive and enjoyable experiences they provide.

**3. Methodology**

This research used a mixed methods approach. We aimed for a two-stage data collection, combining interviews and surveys to fully explore the phenomenon being studied. We chose to begin with qualitative research because it provided valuable, in-depth insights into user experiences, motivations, trust and engagement with the Metaverse—areas that have not been extensively studied. Given the exploratory nature of our study, qualitative data was essential to uncover emergent themes such as motivation, user experience, immersion, health outcomes, and trust, which were instrumental in shaping the study’s theoretical framework. Furthermore, the qualitative insights specifically inform the hypotheses development by highlighting key patterns observed in the interviews. Moreover, the purpose of choosing such methodology is two folds. First, interviews provide qualitative insights by offering a detailed understanding of participants' opinions, attitudes, and experiences (Akyıldız et al., 2021). Second, surveys provide a broader and wider quantitative overview and are used to generalise the findings to a larger population (Bowling et al., 2005). The research seeks to leverage its strengths by using this mixed technique, guaranteeing a thorough investigation of the research questions. There are several reasons for conducting a mixed method approach in managerial research (Bryman, 2006). This approach will provide triangulation as use of both qualitative and quantitative findings will corroborate the data and would give additional validity to the result. As well in lesser-known areas such as present topic, qualitative data will give good feedback to develop and confirm quantitative conceptual framework. Finally the combined approach makes it feasible and helps with the practicality of offering practical proposals.

*3.1. Study 1: Interviews (Qualitative research)*

The qualitative data were collected through 15 semi-structured open ended interviews encouraging participants to respond freely and in depth. Techniques such as nodding and repeating were used to prompt deeper interpretations, and follow-up questions like "how?" and "why?" were asked to extract more detailed information. According to Weller et al. (2018), these extensive probing questions allow for a greater capture of salient items, even with a smaller sample size. In their research, a higher number of responses per person resulted in approximately 50% more items than with three responses per person with a sample size of 20 interviewees. The interview guide was structured around the research objectives and themes identified in the literature review (see Appendix B). To refine the interview process, a pilot study was conducted. The pilot testing is crucial as it allows to identify which questions produced comprehensive responses and which needed modification (Majid et al., 2017). Feedback from the pilot test highlighted areas of confusion, leading to adjustments that made questions clearer and more precise, thus enhancing the flow and efficiency of subsequent interviews. Furthermore, the interview questions were also rigorously tested for reliability and validity by experienced qualitative researchers (Creswell et al., 2018). An audit trail was maintained, documenting all decisions and modifications during data collection and analysis to ensure dependability. In order to examine emerging themes and confirm the reliability and consistency of the results, peer review sessions were conducted on a regular basis. Throughout the data collection procedure, ethical requirements were strictly followed which are crucial while conducting qualitative study specially interviews (Arifin, 2018). This guarantees the privacy and autonomy of participants and their right of participants to decide whether or not to participate and to know how their data will be used is protected by informed consent. Furthermore, ethical behaviour requires that any sensitive material shared during the interview process be kept private. In the end, this results in more trustworthy data collecting since it builds trust and motivates candid and open communication. Purposive sampling was employed to select participants for the study (Baabdullah, 2024). This method was chosen to ensure that individuals who could provide rich, relevant, and diverse information related to the research objectives were included. Participants were selected based on specific criteria relevant to the study, ensuring a comprehensive understanding of the phenomena under investigation. The sample size of 15 was determined using the principle of data saturation, which indicates that data collection should continue until no new themes or insights emerge from additional interviews (Guest et al., 2006). This approach ensures that the sample size is sufficient to capture the complexity and depth of the research topic while avoiding unnecessary redundancy. The principle of data saturation was used to define the sample size for qualitative interviews. All interviews were recorded with explicit participant consent beforehand, ensuring both ethical compliance and the accurate capture of data for analysis (Adeoye‐Olatunde et al., 2021). Table 1 outlines the list of our anonymous participants in our interview. We selected people with similar knowledge and exposure to healthcare apps but considered interviewing different ages and gender and their attributes in willingness to adopt new technologies. We considered sample size based on reaching saturation criteria was met and we did not reach new information (Malterud et al., 2016).

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| **Table 1- Interview Participants Profile** | | | | |
| **Serial Number** | **Age** | **Gender** | **Education** | **Designation** |
| 1 | 45 | Male | Graduate degree | Founder |
| 2 | 41 | Male | Post graduate Degree | Founder |
| 3 | 46 | Male | Post graduate Degree | Medical profession |
| 4 | 46 | Male | Graduate Degree | Founder |
| 5 | 39 | Female | Graduate Degree | Senior Associate |
| 6 | 30 | Male | Graduate Degree | Business Consultant |
| 7 | 26 | Male | Graduate degree | Founder |
| 8 | 32 | Female | Post graduate Degree | Research & Development |
| 9 | 30 | Female | Post graduate Degree | Business Development Manager |
| 10 | 33 | Female | Post graduate Degree | Pharmacist |
| 11 | 44 | Female | Post graduate Degree | Small business owner |
| 12 | 34 | Male | Post graduate Degree | Sport Profession |
| 13 | 22 | Female | Graduate Degree | Student |
| 14 | 39 | Male | Post graduate Degree | Manager |
| 15 | 38 | Male | Graduate Degree | Financial Role |

*3.1.1. Qualitative Findings*

As we discussed above, the 15 interviews were conducted post-experiment for a deeper understanding of the users’ motivation to use the Metaverse, their experience, and trust in the Metaverse platform along with their engagement and self-concept for using health and well-being apps in the Metaverse. These interviews included open ended and semi-structured questions, where interviewees were encouraged to elaborate more through probing questions. All the sessions were recorded with clear written and verbal consent from the interviewees. The interviews were then transcribed from both video and audio sources. This study used structured technique Braun et al. (2006) for identifying the common themes and patterns from the interviewees’ responses. By using an inductive approach to thematic analysis, new links and insights were uncovered in the data, leading to a more complex understanding of users' motivation, trust, experience, engagement and self-concept in the Metaverse for health and well-being platforms.

Table 2 summarises the result of thematic analysis through illustrative statements. We identified 5 key themes namely, *user’s motivations and reasons, trust and data privacy concerns, user engagement and experience, self-concept and health outcomes and preferences.* These key themes are further discussed and elaborated in the following section. The first questions asked were mainly about user motivation for engaging with Metaverse in healthcare apps. Both hedonic (Venkatesh et al., 2012) and economic (Awad et al., 2021) motivation occurred as a theme than other motivations. Thus, in conclusion, most of the interviewees stated hedonic and economic motivation as their primary reason to use the Metaverse for health and well-being platforms. Hedonic motivations such as fun, enjoyable and entertaining virtual workouts and well-being sessions were frequently mentioned. On the other hand, economic motivations did emerge as a significant contributor for the users’ motivation to engage in Metaverse. Several interviewees noted the cost-saving element of using a virtual headset instead of the cost incurred in making an appointment and adjusting the schedule for health and well-being sessions. These incentives highlight the Metaverse's potential to offer pleasurable and financially feasible means of evolving health and wellbeing platforms.

Trust and data privacy were the second questions, and the theme emerging was transparency and adhering to data regulation policy. Some users mentioned the importance of trust in review and trust it would create for longevity of staying loyal to the platform. The analysis of the interviews revealed a prominent theme of trust and privacy concerns, which indicates a considerable level of user apprehension regarding the security of their data within the Metaverse. While many interviewees found the Metaverse to be entertaining, helpful and useful for their health and well-being, they also stated that their confidence in these platforms is dependent on strict privacy policies and open data practices. This insight aligns with Banerjee et al.’s (2017) study where they mentioned the trustworthiness of online reviews and how it impacts the sales and business. Users' trust in products or services is often influenced by the reviews they read online or external endorsements like influencers promoting a product or service (Dwidienawati et al., 2020). Another key concern by users was data privacy in the Metaverse platforms. Interviewees highlighted how they feel that their data is kept private and safe by end-to-end encryption or two step verifications. In the healthcare context, trust and privacy take on an even more critical aspect. A few healthcare professionals were interviewed, and they mentioned the use of the Metaverse in patient care. They highlighted the non-disclosure agreements (NDAs) to protect patient data, this is aligned with Thapa and Camtepe (2021) specifying the importance of NDA and its Stringent data and their alignment with such policies.

Another key theme emerging in the interviews was user engagement and experience in Metaverse. Upon asking the interviewees what keeps them engaged in the Metaverse, the responses were scattered around immersive environments, gamification elements, quality of the content, design of the virtual space, personalisation and colours of the interface*.* A word cloud generated from the interviewees’ responses for immersive experience is presented in figure 1. Gamification elements including earning points or rewards, completing challenges, tracking progress enhance a user’s engagement in the Metaverse by triggering the intrinsic and extrinsic drivers (Sveder and Lundbäck, 2023). Additionally, high quality content and a well-designed virtual space adds more interest and thus triggers the users to engage more with the Metaverse platforms (Sutcliffe, 2022). Personalisation in the Metaverse apps give users a sense of control over the apps by allowing them to shape their virtual experiences to their unique preferences and identities which in turn enhances their engagement in the Metaverse (Rane et al., 2023). Moreover, appealing colour schemes influence the user engagement in Metaverse by evoking emotions and enhancing readability (Papagiannidis et al., 2017; Papagiannidis et al., 2013). However, the immersive environment was mentioned as one of the reasons behind engagement in Metaverse by a few interviewees. These insights suggest that by prioritising the development of increasingly immersive and realistic virtual experiences, Metaverse applications can heighten user engagement (Petersen et al., 2022). However, a few interviewees believe that the virtual environment is not realistic and needs to improve more.

Finally, the concept of self and identity emerged as a significant theme in the interviews, reflecting how individuals perceive and express themselves within the Metaverse. This theme covers various aspects such as self-expression, self-perception, and the ability to explore different sides of one's identity in a virtual space. role of the Metaverse as a platform for exploring and expressing one's identity in terms of actual vs ideal self (Balakrishnan et al., 2024). The ability to design and customise avatars allows users to represent their ideal selves, facilitating a deeper exploration of their identity (Ratan et al., 2022). These insights support the *“Proteus effect”* which was initially proposed by Yee and Bailenson in 2007. This framework explains the psychological effects of individuals’ digital avatars and how these avatars influence an individual’s behaviours and perception (Liu, 2023).

Another key theme identified in the interviews is the health outcomes and preferences. Several interviewees reported significant improvements in their physical health and mental well-being due to regular engagement with Metaverse-based health applications. The Metaverse offers immersive environments that can be specifically designed to promote relaxation and mindfulness. This can be particularly beneficial for stress management, which is a major public health concern. The report of Statista (2024) reinforces this connection which states that with a projected growth of Metaverse health and fitness users to nearly 200 million by 2030, it is evident that there is a rising interest in this field. This growing user base suggests that the Metaverse's potential to improve health outcomes and preferences, like the experiences mentioned by the interviewee, is being recognized by a wider audience. The immersive and interactive nature of these applications makes physical exercise more engaging, which can lead to higher adherence and better results (Dermody et al., 2020) and play a role in reducing stress and anxiety (El-Qirem et al., 2023).

A close up of words

Description automatically generated**Figure 1:** *Word Cloud for ‘Immersive Experience’*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Table 2: Result of the interviews** | | | | |
| **Themes** | **Hypotheses** | **Supporting Literature** | **Description** | **Example of participant response** |
| User Motivation and reasons | **H1:** The motivation to use the Metaverse has a significant impact on user engagement in the Metaverse. | Awad et al. (2021) | Economic motivation/ Cost benefit | *I can say my primary motivation is like accessing professional health service without travel cost* |
| *It (Metaverse) is also cost-effective to be honest. The amount of money I can spend in making an appointment for a therapy session, plus the consultation fee and the other charges* |
| Venkatesh et al. (2012)  Hamari et al. (2014) | Hedonic motivation | *I really like engaging the enjoyable nature of VR workouts and gamified health activities* |
| *I like working out in the Metaverse, it feels more like playing a game than exercising… I look forward to it because it's fun* |
| *it was intense, and I could feel that I was pretty into it and the app was immersive and it was interactive. I really liked it, and it was free so anyone can enjoy it* |
| Oliviera et al. (2022) | Social motivation | *I had a chance to explore Inner world which is an excellent therapeutic app, people gather around to just talk about themselves and it really relieves the pressure that is built inside you* |
| *I use health and well-being platforms in Metaverse because they provide a sense of community and support, helping me to connect with like-minded individuals* |
| Greš et al. (2023);  Maloney et al. (2021) | Escapism | *My opinion is that whenever you're looking for any mode of escape…. suppose you're in a busy office space or you're in a busy work-from-home environment* |
| *the sense of anonymity* |
| Trust and Data Privacy | **H3:** Trust in the Metaverse platform has a significant impact on user engagement in the Metaverse | Banerjee et al. (2017) | Transparency | *I trust the Metaverse and the virtual space to a certain extent. It is important to remember that the digital world is created and maintained by us humans right and as such there may be errors or inaccuracies present* |
| *I always try to use those apps that are open about their data collection practices, how they use user data, and have clear privacy policies* |
| Dwidienawati et al. (2020) | Online reviews | *I also check the reviews on YouTube before experiencing the app. If those apps, whether fitness or well-being, are highly recommended by the YouTube influencers, then I dive in and experience it.* |
| Oh et al. (2021), Bussone et al. (2020); and  Thapa et al. (2021) | Data privacy policy | *I feel my privacy is well-protected. The platforms employ robust security measures such as end-to-end encryption ensuring my personal and health data remain confidential* |
| *I feel secure about my privacy in the Metaverse due to the platform encryption and data protection practices* |
| *I have been using it for the last couple of months in our healthcare setup for outdoor and indoor patients. Can’t disclose the platforms as we have non-disclosure agreements (NDA) signed because of patient data privacy* |
| Shin et al. (2022) | Ethics in data handling | *If I think that there are no two-step verifications or they're not requiring my e-mail address or any password or any other encryption then I don't normally dive into those apps* |
| User engagement and experience | **H2:** The Metaverse user experience has a significant impact on user engagement in the Metaverse  **H6:** Level of Immersion will impact the relationship between motivation to use of Metaverse and engagement in Metaverse  **H7:** Level of Immersion will impact the relationship between Metaverse user experience and engagement in Metaverse.  **H8:** Level of Immersion will impact the relationship between trust in the Metaverse platform and engagement in Metaverse. | Sveder et al., (2023) | Immersive environment | *To me, the gamification of activities, the immersive environments, and the ability to track and see progress in real-time keeps me highly engaged* |
| *Mostly I like the immersive content, the quality of the graphics, the colours that they use for those fitness apps and how realistic it could feel, especially when you are doing the meditation trip* |
| Suler (2020) | Disinhibition effect | *It’s quite unique. people have opinions and are more conscious of other people”*. |
| *…So, I think that gives me a comfort level that nobody is actually seeing my face and I can tell my feelings and share my thoughts* |
| Petersen et al.(2022) | Transportation/ Flow | *I think that escape from reality is not just about unlocking from where you are. It's also about transporting you into a different place, which cannot happen physically,* |
| Self-concept | **H5:** Self-concept mediates the relationship between user engagement and the sustainable use of Metaverse | Balakrishnan et al. (2024) | Self-Expression | *It’s exciting to create an avatar that reflects who I really am inside* |
| *I feel that in the Metaverse, I can be more creative and express myself more that I might not show in the real world.* |
| Ratan et al. (2022) | Self -Perception | *After consistently using Fit XR, Beat Saber and challenge box, I noticed significant improvements in my physical fitness, including better breathing and muscle tone. I have lost a few pounds as well, which was amazing, which also improved my confidence and gave me motivation to continue using it* |
| Health Outcomes | **H4:** User engagement in Metaverse positively influences the sustainable use of Metaverse | Dermody et al. (2020);  El-Qirem et al. (2023) | Useful | *I have noticed significant improvement in my mental well-being through regular virtual fitness, sessions, and mindfulness workshops* |
| *TRIPP and other meditating apps have helped me catch and address a minor health issue early through regular monitoring, and TRIPP significantly reduced my stress levels through guided meditation sessions* |

**3.2. Study 2: Quantitative study - Hypotheses Development**

**3.2.1 Motivation to Use Metaverse**

Motivation is a key component of engagement (Delaney and Royal, 2017). When people are motivated, they invest additional time and energy into activities (Delaney and Royal, 2017). These motivations can be intrinsic or extrinsic (Deci, 1971; Ryan and Deci, 2000). The enjoyable and achievable outcomes of activities encourage individuals to be more engaged (Delaney and Royal, 2017). Additionally, motivation plays an important role in accepting and engaging with new technologies (Hwang and Chien, 2022). In the context of adopting the Metaverse, users need to remain engaged in the new adopting environment, thus making motivation increasingly vital to encourage user engagement (Hwang and Koo, 2023). Yang et al. (2024) examines how gamification in the Metaverse enhances learning motivation, which in turn significantly improves user engagement and learning satisfaction. Arpaci and Bahari (2023) highlighted that learners’ motivations significantly impact their level of engagement when adopting the Metaverse in their learning processes. Therefore, if users are more motivated, they will be more engaged in using the Metaverse.

**H1:** The motivation to use the Metaverse has a significant impact on user engagement in the Metaverse.

**3.2.2 Metaverse User Experience**

User experience refers to a user’s comprehensive experience of using a product or service (Kaveladze et al., 2022). In healthcare and well-being programmes, user engagement depends on high-quality user experiences (Wang et al., 2020). Moreover, it is difficult for users to tolerate poorly designed features (Huang and Benyoucef, 2023); such unsuccessful design features will decrease users’ satisfaction and lead to disengagement (Wei et al., 2020). Currently, interaction designers have paid much more attention to enhancing the users’ experience by creating enjoyable products rather than focusing on improving usability to increase users’ engagement (Peters et al., 2018). Furthermore, Madeira et al. (2018) examined a mobile health application and stated that personalising the user experience can be crucial for keeping patients engaged with the application over the long term, allowing them to fully benefit from its features. Yang (2022) suggests enhancing the cultural narrative of the Metaverse by augmenting its capabilities to improve the user’s interactive experience, thus increasing engagement. Therefore, in this study, we set the following hypothesis:

**H2:** The Metaverse user experience has a significant impact on user engagement in the Metaverse.

**3.2.3 Trust in the Metaverse Platform**

The Metaverse aims to establish a fully immersive, hyper spatiotemporal, and self-sustaining virtual shared space where people can play, work, and socialise, supported by several emerging technologies such as extended reality, artificial intelligence, and blockchain (Lee et al., 2021; Yang et al., 2022; Duan et al., 2021). However, significant privacy invasions and security breaches, whether inherited from underlying technologies or arising within this new digital environment, could impede its widespread adoption (Wang et al., 2022). The Metaverse combines several new technologies, while also inheriting the vulnerabilities and intrinsic flaws of these technologies (Wang et al., 2022). Moreover, the privacy of personal data in the Metaverse can be exceptionally detailed and omnipresent, creating a digital replica of the real world. This unprecedented level of data granularity opens new opportunities for crimes involving private big data (Falchuk et al., 2018). Zhang et al. (2022) stated that establishing cognitive trust and affective trust will make users more active in engaging with activities on Metaverse platforms. If users can rationally evaluate a Metaverse platform’s security and reliability, as well as trust the technological environment, they will be more engaged in the Metaverse (Gupta et al., 2023). Additionally, if they believe that adopting the Metaverse will bring them emotional happiness, they may be more inclined to engage with it (Zhang et al., 2022). Therefore, the hypothesis is set as:

**H3:** Trust in the Metaverse platform has a significant impact on user engagement in the Metaverse.

**3.2.4 Engagement in Metaverse and the sustainable use of Metaverse**

Engagement is not a fleeting or specific state; rather, it is a more enduring and pervasive cognitive-affective condition (Schaufeli et al., 2002). The enhanced engaged behaviour will reduce the possibility of leaving activities for users (Kim and Han, 2011). The sustainable use of a technology is determined by continued engagement (Lehrer et al., 2023). User engagement is solidly built upon user trust which will lead into their commitment (Pansari and Kumar, 2017). Mystakidis (2020) examined that the students’ engagement in social IVR platforms positively impacts their intention in using it long-term. Di Natale et al. (2024)’s study suggested that in the post adoption period, the confirmation of effective engagement in study platforms supported by VR and Metaverse will positively impact students’ sustainable use intention. Therefore, the hypothesis is set as:

**H4:** User engagement in Metaverse positively influences the sustainable use of Metaverse

**3.2.5 User Engagement in Metaverse, Self-Concept and the sustainable use of Metaverse**

Self-concept refers to the totality of an individual's thoughts and feelings about themselves as an object (Sirgy, 1985). There are two ways individuals associate themselves when using self-concept to explain: the actual self and the ideal self (Balakrishnan et al., 2024). In a digital environment, the method of expressing self-concept for users has significantly changed (Bardhi and Eckhardt, 2017). In psychology, self-concept is regarded as a dynamic element of the cognitive system that plays a role in regulating behaviour (Markus and Wurf, 1987). It encompasses all the knowledge, values, and opinions a person uses to understand themselves and the external world (Bartoli, 2022). Immersive technologies, such as AR and mixed reality, also significantly impact self-concept. By blending the physical self with its virtual representation (Javornik et al., 2021), these technologies create an augmented self that can bridge the gap between a consumer's real and ideal selves (Javornik and Pizzetti, 2017). Schnitzler et al. (2021) indicate that student engagement is positively correlated with academic self-concept. Engaged students often feel more competent and confident in their academic abilities, which enhances their overall self-concept.Furthermore**,** a strong and positive self-concept can lead to more meaningful and sustained engagement in virtual environments (Ambika et al., 2023). This is particularly relevant as users who feel confident and clear about their identity are more likely to explore, interact, and invest time in the Metaverse, contributing to its sustainable use (Kumar et al., 2024). Users with a well-defined self-concept might be more inclined to create avatars and virtual identities that reflect their real-world preferences and aspirations, leading to greater satisfaction and sustainable use of the Metaverse (Petroni, 2019). Therefore, this study hypothesis is set as:

**H5:** Self-concept mediates the relationship between user engagement and the sustainable use of Metaverse

**3.2.6 Level of Immersion**

The significance of immersion lies in its positive impact on a user's sense of presence in a simulated world (Peukert et al., 2019; Slater and Wilbur, 1997). Presence, on the other hand, is the feeling of being in an environment and is considered a state of consciousness influenced by the perception of one's surroundings (Steuer, 1992). When users experience higher levels of presence, they are more likely to behave in VR as they would in the physical world, thereby blurring the distinction between these two realities (Slater and Wilbur, 1997). The immersive nature of IVR fosters a sense of presence and embodiment, transforming students from passive recipients to active participants, thus enhancing learning outcomes (Di Natale et al., 2020). Immersive and interactive environment significantly boosts user engagement and motivation (Pyae et al., 2023). Therefore, the hypothesis is set as:

**H6:** Level of Immersion will impact the relationship between motivation to use of Metaverse and engagement in Metaverse

Mental immersion is crucial for user experience and engagement within the Metaverse. This immersive experience helps users feel more connected and engaged (Lee and Gu, 2022). There are several studies suggesting that higher levels of immersion in the Metaverse positively influence user experience and engagement by making interactions more realistic and engaging. Zuo and Shen (2023)’s study concluded that immersive features such as realistic physics engines and interactive mechanics are significant in enhancing user engagement and satisfaction. Immersion, facilitated by high levels of realism and interactivity, directly impacts user engagement and intention to use Metaverse platforms (Chandra et al., 2012). Therefore, the hypothesis is set as:

**H7:** Level of Immersion will impact the relationship between Metaverse user experience and engagement in Metaverse.

Immersion enhances the sense of presence and realism in a virtual environment, which is critical for fostering trust. High levels of immersion make interactions within the Metaverse more convincing and engaging, thereby reducing perceived risks and increasing user comfort and trust (Chandra et al., 2012; Hudson et al., 2019). Trust, in turn, is a fundamental determinant of user engagement. When users trust a platform, they are more likely to actively engage and invest their time and resources. This trust reduces uncertainties and encourages more robust interactions within the Metaverse (Dwivedi et al., 2023). Immersive experiences, which are interactive and realistic, help build a strong foundation of trust, leading to increased user engagement and participation (Zuo and Shen, 2023). Therefore, it is hypothesised that

**H8:** Level of Immersion will impact the relationship between trust in the Metaverse platform and engagement in Metaverse.

**H9:** Demographics moderates the relationship between user engagement and the sustainable use of Metaverse.

Figure 2 is the conceptual framework based on the above hypotheses.

A diagram of a process

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**Figure 2:** *Conceptual Framework*

**3.3Data collection and measures**

A comprehensive online survey, consisting of 39 questions, was administered to 150 participants. The survey included 11 demographic and general virtual experience questions, with the remaining 28 questions adapted from established scales used in prior studies. These 28 items utilised a 7-point Likert scale, where '1' indicated 'Strongly Agree' and '7' indicated 'Strongly Disagree' (Matell et al., 1971). Detailed constructs, statements, and references for each survey item are provided in Appendix A. The sample size of 150 participants was determined based on the recommendations for survey-based research, which suggest that a minimum of 150 respondents is adequate to achieve generalizable findings (Masialeti et al., 2024). The survey was created using Google Forms. This platform is frequently selected for survey research due to its accessibility, cost-effectiveness, and user-friendly interface. It provides researchers with a straightforward platform to create customizable surveys encompassing various question types and themes, thereby accommodating diverse research needs. The integration of Google Forms with other Google services such as Google Sheets facilitates seamless data collection and analysis processes, enhancing efficiency and accuracy. Moreover, its compatibility across different devices ensures widespread accessibility for participants, potentially increasing response rates. Furthermore, this survey employed a convenience sampling approach due to its practicality and efficiency. This sampling approach involves selecting participants who are easily accessible and willing to participate, which can be particularly useful when time or resources are limited (Stratton, 2021). Although convenience sampling may introduce selection bias and limit the generalizability of the findings, it is appropriate for exploratory research where the primary goal is to gather preliminary data and insights (Schreier, 2018). Additionally, convenience sampling is advantageous in online survey research, as it allows for the rapid collection of a large number of responses from diverse participants through platforms like social media (Emerson, 2021). The participation link was sent across various Metaverse-related social media platforms to reach a broad audience. To ensure the anonymity of the data collected, no personal questions were included in the survey. A cover letter preceding the questionnaire provided comprehensive information about the research and the survey, ensuring informed consent from the participants. Following data collection, statistical analysis was conducted to test the research hypotheses.

**4 Results and Analysis**

This section first presents the qualitative insights from the interviews and then presents the quantitative insights by applying Structural Equation Model (SEM) with the help of SMARTPLS4. To analyse the survey data, Structural Equation Model (SEM) was used using SMARTPLS4 as it can analyse each path in a single regression investigation (Wu et al., 2014). PLS-SEM estimates using a component-based method (Karahanna et al., 2006). The two-step process outlined by Anderson and Gerbing (1988) was used to assess the quality of the suggested model. First, the measurement model's validity and reliability were evaluated. The structural model was then tested to determine the direction and strength of the association between the variables.

***4.1 Model Assessment***

The measurement model, which comprises validity and reliability, is evaluated to determine the quality of the constructs in the study. First, factor loadings are examined, and then construct validity and reliability are established. According to Hair et al. (2019), using this methodological technique improves researchers' capacity to produce precise and broadly applicable findings. Table 3 presents Cronbach's alpha and composite reliability, two widely used techniques for evaluating reliability. The range of Cronbach's alpha scores was 0.72 to 0.913, but the range of Composite reliability was 0.827 to 0.939. The selected survey items for each construct are reliable measures, as both indicators are above the necessary threshold of 0.7 (Hair et al., 2019). Additionally, every factor loading value found in the measurement model was higher than the benchmark of 0.7 (Hair et al., 2019).

The assessment of constructs’ quality in the study involves evaluating the measurement model, which includes validity and reliability. The process begins with examining factor loadings, followed by establishing construct reliability and validity. This methodological approach enhances researchers' ability to achieve accurate and generalizable results (Hair et al., 2019). Two commonly used methods for assessing reliability, Cronbach's alpha, and Composite reliability, are presented in Table 3. Cronbach's alpha scores ranged from 0.724 to 0.938, while Composite reliability ranged from 0.844 to 0.952. Both indicators surpassed the required threshold of 0.7 (Hair et al., 2019), indicating that the selected survey items for each construct are reliable measures. Moreover, all factor loading values obtained in the measurement model exceeded the threshold of 0.7 as well (Hair et al., 2019), however, only DH1 had the factor loadings of 0.676. Hair et al. (2010) suggests a factor loading higher than 0.5. Numerous studies have reported better outcomes if the factor loadings are set 0.5 and above (Truong et al, 2011; Hulland, 1999). Therefore, all the factor loadings were retained which suggests acceptability. The AVE (Average Variance Extracted) should be higher than 0.5 and ranged from 0.545 to 0.875, indicating convergent validity of the measurement model (Lekwa et al., 2019). Consequently, the proposed measurement model demonstrates convergent validity.

**Table 3.** *Convergent validity, Discriminant validity and Construct Reliability*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Constructs | Items | Factor Loadings | VIF | Cronbach Alpha | Composite Reliability | AVE |
| MOV | MOV1 | 0.886 | 2.859 | 0.909 | 0.936 | 0.786 |
| MOV2 | 0.904 | 3.292 |
| MOV3 | 0.919 | 3.481 |
| MOV4 | 0.837 | 2.232 |
| UX | UX1 | 0.882 | 2.878 | 0.906 | 0.934 | 0.78 |
| UX2 | 0.918 | 3.69 |
| UX3 | 0.886 | 2.816 |
| UX4 | 0.844 | 2.241 |
| TR | TR1 | 0.865 | 2.376 | 0.913 | 0.939 | 0.794 |
| TR2 | 0.888 | 2.759 |
| TR3 | 0.913 | 3.503 |
| TR4 | 0.897 | 3.28 |
| UE | UE1 | 0.862 | 2.881 | 0.896 | 0.928 | 0.762 |
| UE2 | 0.884 | 2.939 |
| UE3 | 0.902 | 3.28 |
| UE4 | 0.842 | 2.579 |
| IE | IE1 | 0.895 | 2.969 | 0.913 | 0.939 | 0.793 |
| IE2 | 0.897 | 3.042 |
| IE3 | 0.909 | 3.226 |
| IE4 | 0.86 | 2.324 |
| SC | SC1 | 0.818 | 1.917 | 0.88 | 0.917 | 0.735 |
| SC2 | 0.846 | 2.095 |
| SC3 | 0.866 | 2.526 |
| SC4 | 0.899 | 2.919 |
| SUM | SUM1 | 0.676 | 1.285 | 0.72 | 0.827 | 0.545 |
| SUM2 | 0.814 | 1.599 |
| SUM3 | 0.706 | 1.378 |
| SUM4 | 0.753 | 1.387 |
| DEM | Age | 0.936 | 2.284 | 0.857 | 0.933 | 0.875 |
| Education | 0.935 | 2.284 |
| Gender | 1 | 1 |

*Abbreviations: MOV – Motivation to use the Metaverse; UX – Metaverse User Experience; TR – Trust in platforms in Metaverse; UE – User Engagement; IE – Immersion level; SC – Self-Concept; SUM – the sustainable use of Metaverse; DEM - Demographic*

Moreover, the Fornell-Larcker criterion can be applied to evaluate discriminant validity. As proposed by Fornell and Larcker (1981), this can be done by comparing the correlation coefficients between the latent variables (as shown in Table 4) with the square root values of the AVE. Discriminant validity is confirmed when all AVE square root values exceed the correlation coefficients (Rasoolimanesh, 2022). In regression analysis, the Variance Inflation Factor (VIF) measures the degree of multicollinearity among indicators (Fornell et al., 1981). A VIF of five or higher indicates potential multicollinearity issues (Hair et al., 2019). Table 3 shows VIF values for all items, ranging from 1 to 3.69, suggesting no multicollinearity concerns. Hu et al. (1999) determine a good model fit with their criterion, which requires an SRMR cut-off of greater than 0.08. The SRMR value in this study is 0.087, indicating an acceptable model fit. Additionally, all constructs exhibit HTMT values below 1 (Hair et al., 2019).

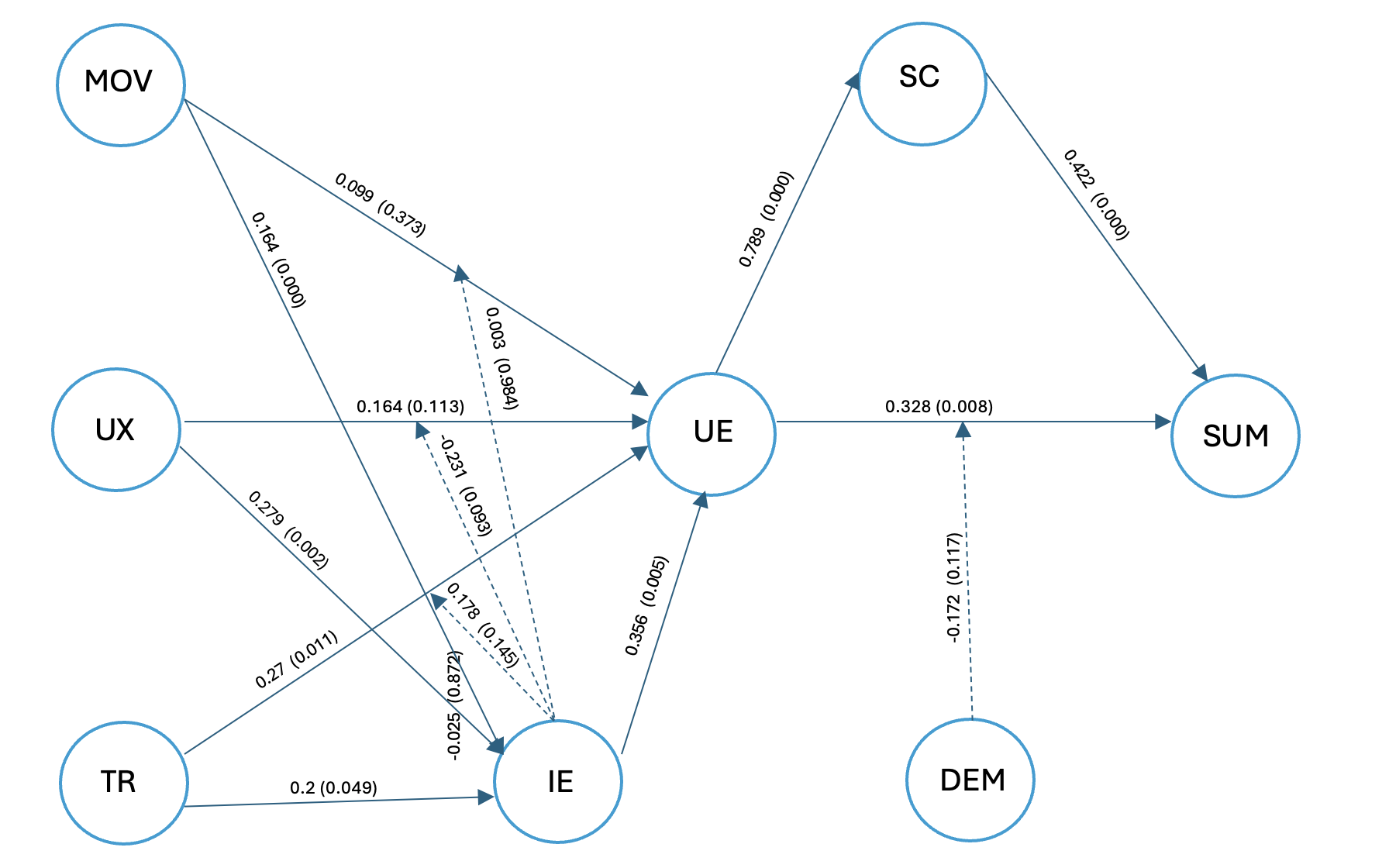
**Table 4.**  *Inter-correlation between the constructs and the square root of AVEs (Fornell–Larcker criterion)*

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | MOV | DEM | IE | MOV | SC | TR | UE | UX |
| SUM | **0.739** |  |  |  |  |  |  |  |
| DEM | 0.136 | **0.935** |  |  |  |  |  |  |
| IE | 0.669 | 0.185 | **0.89** |  |  |  |  |  |
| MOV | 0.533 | 0.174 | 0.758 | **0.887** |  |  |  |  |
| SC | 0.699 | 0.061 | 0.808 | 0.747 | **0.858** |  |  |  |
| TR | 0.559 | 0.172 | 0.723 | 0.796 | 0.703 | **0.891** |  |  |
| UE | 0.63 | 0.209 | 0.765 | 0.735 | 0.789 | 0.771 | **0.873** |  |
| UX | 0.582 | 0.253 | 0.746 | 0.819 | 0.741 | 0.818 | 0.724 | **0.883** |

*Note: Bold values represent the square-root of AVE*

*Abbreviations: MOV – Motivation to use the Metaverse; UX – Metaverse User Experience; TR – Trust in platforms in Metaverse; UE – User Engagement; IE – Immersion level; SC – Self-Concept; SUM – the sustainable use of Metaverse; DEM – Demographics*

After the above steps, *Structural Equation Modelling* was applied (Figure 2) to determine the impact of Motivation to use Metaverse, Metaverse User Experience and Trust on the Metaverse platforms on User Engagement and the sustainable use of Metaverse along with moderators such as Immersion level and Demographics and mediator Self-concept. Following hypotheses were tested with a sample size of 152 respondents using bootstrapping method in SMART PLS4.



**Figure 2:***Structural Modelling of the proposed hypotheses with Path coefficients and p-values*

*Note: The dotted line shows the moderation, and the straight lines indicate direct relation.*

*Abbreviations: MOV – Motivation to use the Metaverse; UX – Metaverse User Experience; TR – Trust in platforms in Metaverse; UE – User Engagement; IE – Immersion level; SC – Self-Concept; SUM – the sustainable use of Metaverse; DEM - Demographics*

**4.2 Hypotheses Testing Result**

The path coefficients, standard deviations, and p-values are presented in Table 5. *Hypothesis 1* stated that the motivation to use the Metaverse has a significant impact on engagement in the Metaverse. The path was insignificant (b = 0.099, p > 0.05) and the hypothesis was not supported. Furthermore, *Hypothesis 2* examined that the Metaverse user experience has a significant impact on engagement in the Metaverse. The Beta coefficient was insignificant and hypothesis 2 was also rejected (b = 0.164, p > 0.05). The rejection of hypotheses 1 and 2 suggest that other factors might play a more critical role in influencing user engagement within the Metaverse. This finding aligns with previous research that indicates motivation and user experience, while important, may not directly translate into engagement without the mediation of other variables such as social presence, perceived usefulness, or system quality (Venkatesh et al., 2003; Alalwan et al., 2017). *Hypothesis 3* was supported which states that the trust in the Metaverse platform has a significant impact on engagement in the Metaverse with b = 0.27 and p < 0.05. This finding suggests that users are more likely to engage with Metaverse if they trust the platforms and find them secure, safe and private for data collection purposes. This quantitative finding was also backed by interviews where participants said that they felt more inclined to engage deeply with the platform when they perceived it as trustworthy. They emphasised that features ensuring security, transparency, and reliability significantly enhanced their overall engagement and satisfaction with the Metaverse experience. According to Degutis et al. (2023), users are more likely to disclose personal information willingly if they trust the platforms adopting necessary security measures. Additionally, *Hypothesis 4* was accepted which states that the user engagement in Metaverse positively influences the sustainable use of Metaverse (β = 0.328, p < 0.05). This finding was evident from interviews where interviewees expressed that their continuous and active engagement with the Metaverse improved their overall health and well-being. A few interviewees mentioned weight loss and improvement in minor health issues by using health and well-being apps in Metaverse. As per Dermody et al. (2020), these applications’ immersive and interactive features make working out more interesting, which can increase adherence and produce better outcomes.

Moreover, *Hypothesis 5* was accepted which states that self-concept mediates the relationship between user engagement and the sustainable use of Metaverse. The relationship is a partial mediation which is further explained as indirect effects in table 4. This finding is evident from literature and interviews in our study. For instance, recent research has shown that self-concept significantly influences digital platform usage, where users who identify strongly with their digital personas are more likely to engage consistently and sustainably (Bayer et al., 2020). Interviews in our study supported this finding, by demonstrating how the Metaverse can offer a more relaxed setting for self-expression and engagement in activities that could be impeded in the actual world by feelings of self-consciousness and fear of being judged (Suler, 2020 and 2004). This finding emphasized that a strong self-concept within the Metaverse environment made user experiences more personal and meaningful, thereby fostering sustainable use.

This research tested the influence of Immersion level in two aspects: with moderation and mediation. *Hypothesis 6, 7 and 8* stated that Immersion level moderate the relationship between Motivation to use the Metaverse, Metaverse User Experience, Trust in the platforms and User Engagement respectively. These hypotheses were rejected with β = 0.003, -0.231, 0.178 and p > 0.05 respectively, suggesting that the immersion level does not substantially alter the impact of Motivation to use the Metaverse, Metaverse User Experience, Trust in the platforms on the User engagement in Metaverse. This finding aligns with Hwang et al.’s (2022) study where they found that while telepresence—a component often associated with immersion—affects the intention to use the metaverse, it does not moderate the relationship between motivation and engagement. Instead, factors like informativeness and enjoyment play a more critical role in sustaining user interaction. This aligns with the notion that user motivations are pivotal in driving engagement. Furthermore, Shin et al. (2018) highlighted that immersion is often viewed as an outcome of technology rather than a direct contributor to user engagement, implying that the process of engaging with the content may be more critical than the level of immersion itself. However, immersion level partially mediates the relationship between Motivation to use the Metaverse, Metaverse User Experience, Trust in the platforms, and User Engagement. The beta coefficients are β = 0.164, 0.279, 0.2 and p-value < 0.05 respectively. This finding suggests that while immersion level may not change the direct effects of these factors on user engagement, it plays a significant role in enhancing the overall user experience, thereby indirectly boosting engagement (Shamim et al., 2024). This finding is backed by qualitative insights from interviews where interviewees noted that higher levels of immersion created a more compelling and engaging environment, which in turn fostered greater interaction and prolonged use of the Metaverse for health and well-being platforms. Furthermore, *hypothesis 9* was rejected which states that demographics moderates the relationship between user engagement and the sustainable use of Metaverse.

**Table 5:**  Path coefficients, p values and hypotheses testing summary.

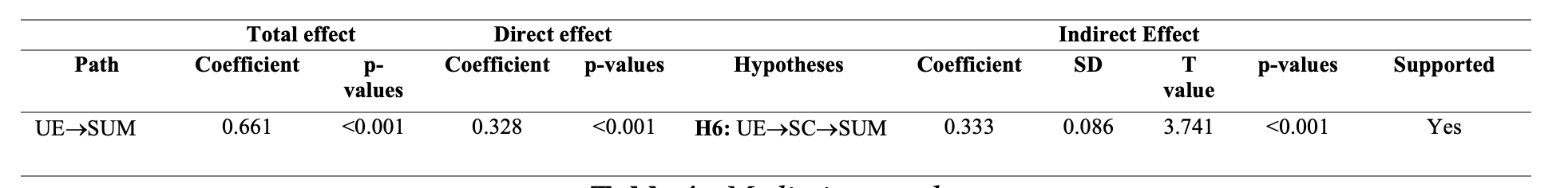
|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Hypotheses** | **Path** | **Beta coefficients** | **Standard deviation** | **P values** | **Supported** |
| **H1** | MOV → UE | 0.099 | 0.112 | 0.373 | No |
| **H2** | UX → UE | 0.164 | 0.103 | 0.113 | No |
| **H3** | TR → UE | 0.27 | 0.107 | 0.011 | Yes |
| **H4** | UE → SUM | 0.328 | 0.123 | 0.008 | Yes |
| **H6** | IE x MOV → UE | 0.003 | 0.129 | 0.984 | No |
| **H7** | IE x UX → UE | -0.231 | 0.137 | 0.093 | No |
| **H8** | IE x TR → UE | 0.178 | 0.122 | 0.145 | No |
| **H9** | DEM x UE → SUM | -0.172 | 0.11 | 0.117 | No |

*Abbreviations: MOV – Motivation to use the Metaverse; UX – Metaverse User Experience; TR – Trust in platforms in Metaverse; UE – User Engagement; IE – Immersion level; SC – Self-Concept; SUM – the sustainable use of Metaverse; DEM – Demographics*

*Indirect Effects*

Bootstrapping technique was used to test the mediating role of self-concept between user engagement and the sustainable use of Metaverse in the structural model (N = 5,000 samples). The results in Table 6 revealed significant (p < 0.05) partial mediation of immersion level between user engagement and the sustainable use of Metaverse. Hence, *hypothesis 5* was supported. Incorporating insights from both scholarly sources and participant interviews, our study underscores the influential role of self-concept on digital platform engagement. The interviews conducted during our study corroborate these findings, illustrating how platforms like the Metaverse facilitate enhanced self-expression and participation in activities often inhibited by real-world social anxieties (Suler, 2020; Suler, 2004). This exploration reinforces the notion that a robust self-concept within virtual environments enhances user satisfaction and engagement, thereby promoting enduring usage patterns.

**Table 6**  *Mediation results*

*****Abbreviations: MOV – Motivation to use the Metaverse; UX – Metaverse User Experience; TR – Trust in platforms in Metaverse; UE – User Engagement; IE – Immersion level; SC – Self-Concept; SUM – the sustainable use of Metaverse; DEM - Demographics*

**5. Discussion**

The Metaverse is an environment that engages users in an interconnected virtual space by converging, virtually enhancing physical reality as the self-concept of users in a physically persistent virtual space that works with augmented reality. This virtual space as Metaverse encourages them to collectively share, interact, learn and collaborate and experience the connection simultaneously by multiple users irrespective of their physical location (Barrera and Shah, 2023; Dwivedi et al., 2022). The attraction of using Metaverse for entertainment, fun, social interactions, learning for professional and personal development motivates them to come back to Metaverse. The experiences of leisure with realism in a Metaverse environment allows users to escape from their challenges and seek some fun for a moment of enjoyment. Therefore, the ability of Metaverse to connect users in an immersive environment that can make users feel physically present in a virtual environment, is being applied by companies for various other purposes such as trading or offering real estate experiences for selling, renting or for relaxation by the tourism industry. In addition to entertainment and education, Metaverse technologies are being increasingly applied in healthcare. Virtual reality (VR) has been used to treat anxiety disorders, phobias, and PTSD by exposing patients to controlled virtual environments (Bell et al., 2024). Augmented Reality (AR) allows healthcare professionals to practice surgical techniques in virtual environments, and Mixed Reality (MR) aids in patient diagnosis and treatment planning (Ye et al., 2021). For improving immersion, they use high quality graphics triangulated with principles of both virtual and augmented reality to offer users a sensory experience. Users also enjoy experiences of interaction with other users in an environment that responds and reacts to users in a way that users can control, customise or tailor as per their own individual personal preferences. During the use of Metaverse no experience of technical disruptions and uninterrupted performance of Metaverse ensures users that the information they are exchanging with other users is secure and protected. Such an assurance increases the level of engagement, thereby resulting in frequent visits for interactions in the Metaverse environment. Regular visits to the Metaverse for getting engaged with other users for planning group activities results in formation of communities that exist in the online virtual space and their online meetings sometimes become online events. Increase in participation with communities that are inclusive, open and enabling, develops a feeling of belongingness in the users. Users try to customise experiences of others about themselves using a digital representative who will represent them in a virtual world as their avatar. Selection of an avatar is a process that helps them explore different facets of their own identity. Use of avatar for representation of their self-concept and presenting the self-identity they aspire to, offers them a virtual identity. Through this virtual identity users sometimes tend to hide their demographics such as age, gender and cultural background, thereby altering the experiences and expectations of other users. High levels of engagement in the Metaverse can promote environmentally friendly and socially responsible practices needed for reducing the carbon footprints and ensuring transparency in digital transactions by educating users about the impact of their actions on the overall society.

mHealth, or mobile health, has rapidly gained traction since the COVID-19 pandemic, with healthcare providers leveraging digital tools to deliver services remotely (Fagherazzi et al., 2020). The integration of mHealth within the Metaverse adds a new dimension by providing virtual spaces for health-related interventions. Users can engage with health and well-being applications in an immersive environment, accessing virtual consultations, mental health support, and self-care activities. For example, users may consult virtual healthcare professionals within the Metaverse, explore simulated health scenarios, or participate in stress-relief exercises through VR-based mindfulness programs (Corporate Wellness Magazine, 2024). An app within Metaverse called ‘InnerWorld’ is increasingly becoming popular as it provides mental health support for anxiety, depression, ADHD, and more through peer-led activities and support groups (InnerWorld, 2024). These applications offer a unique opportunity to blend mHealth solutions with immersive technologies, ensuring continuity of care and improving accessibility to mental health services. This study explores how Metaverse tools can extend to healthcare by creating virtual environments that support mental well-being, particularly through immersive and interactive experiences. For instance, virtual support groups and mindfulness programs in the Metaverse can provide therapeutic interventions to individuals struggling with mental health issues. Our findings explain how interrelationship between these different contributions made by the Metaverse has the potential to increase belongingness to communities and combining them with positive experiences for meaningful engagements. Simultaneously, the virtual identity engagement can be driven by their desire to express their self-concept with a trust that their preferences and privacy will be respected and the complexity in their personal space will not be revealed. These concepts will shape their motivation, experience and trust in the Metaverse and define their level of engagement with immersion, thereby also strengthening their engagement in shaping the future of Metaverse.

The analysis of expert insights via interviews along with a survey gathered for this research revealed that users are increasingly adopting the Metaverse for healthcare applications, particularly in managing mental health and well-being. Our research aimed to understand how trust, user experience, and immersion influence engagement with health and well-being apps in the Metaverse. Respondents consistently mentioned the importance of personalized experiences and the ability to manage stress and anxiety through immersive environments. These findings align with our research question on how healthcare applications in the Metaverse can foster sustainable user engagement. By offering secure, customizable virtual spaces, healthcare professionals and patients can build trust in the platform, which enhances engagement and leads to better health outcomes.

Although the full potential of the Metaverse is yet to be explored, developers should focus on user engagement, which as per previous studies is profoundly shaped by user experience (Peters et al., 2018; Wang et al., 2024). The user experience in the virtual environment of Metaverse can also depend on the design of the virtual space and the type of app or device they use. A well-designed virtual environment when applied on advanced devices can elevate the user experience (Sveder and Lundbäck, 2023), making interactions more engaging and enjoyable (Sutcliff, 2022). Additionally, trust in the Metaverse, encompassing aspects such as safety, security, and authenticity, plays a critical role in fostering deeper engagement (Banerjee et al., 2017; Dwidienawati et al., 2020; Degutis et al., 2023). Users who trust the platform feel more secure and will be likely to engage more intensively (Thapa and Camtepe, 2021). Literature has established that the relationship between motivation, user experience, and trust, moderated by technology that offers immersion, establishes a strong foundation for user engagement (Wang and Ahn, 2024). Engaged users actively participate in creating and sharing personalised content and experiences within the Metaverse (Liu et al, 2023). This engagement, characterised by frequent and meaningful interactions, is facilitated by the users' desire satisfying their self-concept and making Metaverse a sustainable space.

This research focused on making use of Metaverse a sustainable space for those using Metaverse to engage for experiences based on their trust in the platform. Barrera and Shah (2023) argue hyperconnected environments such as Metaverse can aid in faster dissemination of information thus leaving consumers more in control of brand touchpoints and co-creation. Through the experience offered by Metaverse consumers can co-create with brands. This could manifest itself through social interaction, identification or self-expression (Buhalis et al., 2023). This in turn will result in motivation, and engagement from consumers side (Barrera and Shah, 2023).

The analysis of expert insights gathered for this research, reflected on the awareness of diverse opportunities offered by the interactive virtual environment of Metaverse amongst users. Users explained how innovatively they try to participate in Metaverse for various experiences, which could span from entertainment to education or for professional reasons. Our analysis revealed that participation in Metaverse has increased their social connectivity and the sophistication of the platform in terms of offering a level of immersion makes their Metaverse journey more enjoyable. Exposure of participants to the economic incentives offered by the blockchain technologies in the form of non-fungible tokens (NFTs) which they felt would be an opportunity for them to get into e-trade and make investments into virtual assets. However, these will need familiarity with the technology and tools used by platform developers. Educating themselves through Metaverse for improving their knowledge about Metaverse would ultimately lead to their personal growth and development. Another sensitive area that was revealed by our investigation was concerns of participants about data security and privacy within the virtual environment of Metaverse. There is an urgent need for policy makers to investigate the need for regulations to protect the interest of participants and will make the Metaverse a safe space for them to engage. Another important concern users had was about the control they had to their personal data and recommended user-governed data management practices that facilitate decentralised identity management for participants, to be followed by companies offering a Metaverse environment.

The capability of immersion to shape experiences of users depends upon integration of virtual reality, augmented reality and artificial intelligence. Users today seek personalisation, and AI offers customisation of content based on the personal preferences of users. Some of the users also mentioned that they expect Metaverse to use sophisticated tools with enhanced capability to make their social interactions or engagements deeper that will strengthen their ties with their community. They also explained how they expect Metaverse to enable users to seamlessly integrate itself with the physical world, enabling users to smoothly transition from one to the other environment. For this integration, the interest seems to be high in customisation of avatars for ensuring precision in self-expression and self-representation. Users view Metaverse as a platform useful for testing adoption of new identities with specific demographics such as gender and ethnicity.

**6.1 Theoretical contribution**

This study significantly contributes to the academic literature of sustainable consumption by addressing the link between Metaverse (Dwivedi et al., 2022) and digital health, a growing field with transformative potential in healthcare technology (Wu et al., 2024; Bansal et al., 2022). The research broadens the scholarly conversation on innovative applications of technology in healthcare delivery by examining how immersive virtual worlds can improve health and well-being. A thorough conceptual framework that incorporates important factors such as user experience (Papagiannidis et al., 2013; Papagiannidis et al., 2016), platform trust (Zhang et al., 2022), self-concept (Balakrishnan et al., 2024), immersion level (El-Qirem et al., 2023; Greš et al., 2023), user engagement, and motivation to use the Metaverse is developed and empirically tested in this study. Theoretical interpretation of the intricate relationships among these aspects not only closes gaps in the research but also improves comprehension of user behaviours and interactions inside virtual environments. By using a mixed methods strategy that includes both quantitative surveys and qualitative interviews, the research offers strong empirical support for theoretical claims and improves the validity and generalizability of findings in various healthcare settings. Furthermore, by identifying trust (Dwidienawati et al., 2020; Oh et al., 2021; Bussone et al., 2020) and user engagement (Sutcliffe, 2022) as pivotal drivers of sustainable platform use, the study offers actionable insights for healthcare practitioners and platform developers aiming to optimise the design and implementation of Metaverse-based health interventions (Del Hoyo et al., 2024).

**6.2 Managerial implications**

This study provides actionable insights into utilising Metaverse technology to improve health and well-being, which makes a substantial contribution to practical applications in the field of healthcare. Healthcare practitioners and platform developers can learn effective strategies for optimising user experience and platform effectiveness from the research, which identifies trust in platforms and user engagement as pivotal factors influencing the sustainable use of Metaverse-based health and well-being platforms. The practical ramifications encompass various aspects such as the necessity of establishing strong privacy and security protocols to foster user confidence, creating virtual environments that are immersive and easy to use to improve engagement and satisfaction, and including gamification components to encourage consistent platform usage. Moreover, the research highlights the need of applying user-centred design concepts in customising Metaverse applications to fulfil various healthcare requirements, consequently encouraging user involvement. These insights are crucial for guiding the development, implementation, and management of Metaverse-based healthcare solutions, ensuring they are not only technologically advanced but also effectively meet the practical needs and expectations of healthcare providers and users alike.

This paper advocates for the creation of standards and regulatory frameworks that facilitate the moral and efficient integration of Metaverse technology in healthcare, which significantly contributes to policy considerations. Through emphasising the pivotal function of platform trust and user engagement as necessary catalysts for sustained platform utilisation, the study delivers policymakers with empirically supported arguments. These findings highlight how crucial it is to give data security, privacy, and authenticity a priority while developing Metaverse-based healthcare solutions. These results can be used by policymakers to create legislation that protect patient rights in virtual environments, guarantee adherence to healthcare regulations, and encourage openness in platform operations. The investigation of self-concept mediation and immersion level dynamics in this study also contributes to the development of policies that maximise the therapeutic potential of Metaverse technologies while promoting good user experiences. By facilitating informed decision-making and fostering innovation in healthcare delivery, these policy recommendations aim to advance public health outcomes and promote equitable access to digital health services through Metaverse platforms.

**7. Limitations and Future Research**

There are certain limitations to this research, which must be acknowledged in order to fully comprehend the results. Firstly, although common in qualitative research, a sample size of 15 interviewees may restrict generalizability. In order to ensure that results are not limited to particular demographics, a larger and more diverse sample would provide a broader representation. Overall Metaverse related studies at this stage are more ahead in conceptualisation stage than reality (Richter and Richter, 2023). To find confident and well adopted consumer who have got an experience with platform still is a challenge and might bias the result attained (Dwivedi et al., 2022). Perhaps future tests will be more aligned with AR related than VR related technology as AR still has a touch of reality and VR fully aligns itself with full immersion (Rauschnabel et al., 2022). Some comparative studies for the feasibility of Metaverse might be a good idea to test the feasibility of such a platform from immersive experience point of view (Koohang et al., 2023).

Future research can enhance the study by addressing key areas. Firstly, increasing the sample size beyond 15 interviewees strengthens statistical power and generalizability. A more extensive participant pool would enable robust exploration, accommodating variations in familiarity and preferences related to Metaverse health and well-being. Due to lack of real-life experience, for the moment such studies in wider scale with light, to heavy users is not as viable (Hennig-Thurau et al., 2022; Mogaji et al., 2023). As well, adopting a longitudinal approach to track experiences over time offers a dynamic perspective on user engagement, motivation to use Metaverse, Metaverse user experience, trust in the Metaverse platform, self-concept and the sustainable use of Metaverse (Han et al., 2023). Lastly, future research should explore different methodological design such as experiments and real-time observations over time to check the improvements in health and well-being of users after the sustainable use of Metaverse (Dwivedi et al., 2023).

**8. Conclusion**

In conclusion, this research provides valuable insights for healthcare practitioners to leverage immersive technologies like Metaverse within the Metaverse for health and well-being. By examining factors like motivation to use Metaverse, Metaverse user experience, trust in the platform, self-concept and immersion level, the research provides a comprehensive view of their collective impact on user engagement and the sustainable use of Metaverse. Findings emphasise that if users trust the platforms in Metaverse then they are more likely to engage with the virtual environment like Metaverse. This engagement further translates to the sustainable use of Metaverse for health and well-being. Furthermore, it also underscores the important factor of self-concept which states that if users trust the platform and engage with it, then they are more likely to develop a positive self-concept within the virtual environment. This positive self-concept, in turn, mediates the relationship between user engagement and the sustainable use of Metaverse platforms for health and well-being. The study's findings highlight the intricate relationship between psychological factors and technological adoption, emphasising the need for holistic approaches in designing and implementing Metaverse-based healthcare solutions. By fostering a sense of identity and empowerment among users, Metaverse platforms can potentially enhance user satisfaction, adherence to health interventions, and long-term platform utilisation. Moreover, from the findings it was revealed that immersion level acts as a mediator rather than a moderator in our study which means that the degree of immersion experienced by users within Metaverse platforms influences the relationship between motivation to use the platform, user experience, trust in the platform, and user engagement. This mediation effect suggests that the level of immersion plays a significant role in shaping how users perceive and interact with virtual environments, thereby influencing their engagement with health and well-being services offered through the Metaverse. Understanding immersion as a mediator underscores its potential to enhance the realism, interactivity, and overall effectiveness of digital health interventions within virtual settings. This insight informs future research and development efforts aimed at optimising immersion technologies to maximise user engagement and improve outcomes in Metaverse-based healthcare applications.

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| **APPENDIX A -** *Constructs, items, and sources* | | |
| **Constructs** | **Statements** | **Sources** |
| **Motivation to use the Metaverse**  **(MOV)** | MOV1 - Using health and well-being platforms in Metaverse is enjoyable | Venkatesh et al. (2012) |
| MOV2 - My participation in Metaverse for health and well-being apps saves me money | Oliviera et al. (2022) |
| MOV3 - The use of Metaverse for health and well-being apps allows me to know people with similar interests |
| MOV4 - The use of Metaverse for health and well-being apps makes me feel like I'm more involved in the community |
| **Metaverse User Experience (UX)** | UX1 - I think the health and well-being apps in Metaverse are user-friendly and designed in such a way that most people will find it easy to adapt to | Kim et al. (2024) |
| UX2 - I think different types of devices (e.g., visual, haptic, auditive) shape my engagement for health and well-being platforms in the Metaverse | Barrera et al. (2023) |
| UX3 - Health and well-being apps in Metaverse let me feel as if I am visiting a real place. | Papagiannidis et al. (2017) |
| UX4 - I teleport to other places in the Metaverse | Lopez-Belmonte et al. (2022) |
| **Trust in the Metaverse platforms (TR)** | TR1 - The policies of health and well-being platforms in the Metaverse on how they would use any personal information about me, makes me feel that the technology is trustworthy | Jeong et al. (2023) |
| TR2 - Security rules in the Metaverse health and well-being platforms help me be more confident regarding the use of Metaverse technology |
| TR3 - Appropriate policy guidelines are in place to keep the users safe in the health and well-being apps in the Metaverse technology |
| TR4 - I trust that health and well-being apps in the Metaverse safeguard my privacy preferences | Guo et al. (2024) |
| **User Engagement (UE)** | UE1 - I am deeply engrossed in virtual experience for health and well-being platforms | Papagiannidis et al. (2017) |
| UE2 - I am absorbed intensely in virtual experience for health and well-being platforms |
| UE3 - My attention is focused in virtual experience for health and well-being platforms |
| UE4 - I concentrate fully in virtual experience for health and well-being platforms |
| **Immersion Level**  **(IE)** | IE1 – While using the virtual reality device I am absorbed in what I am doing. | Sun et al. (2019) |
| IE2- I completely concentrated on the contents while I am doing the VR tour | Lee et al. (2021) |
| IE3- I felt like time went by very quickly when I was doing the VR tour |
| IE4 - I didn’t have any irrelevant thoughts or external distractions during the activity | Georgiou et al. (2017) |
| **Self-concept (SC)** | SC1 - I feel comfortable discussing my health and well-being concerns and using Metaverse to address them | Chen et al. (2021) |
| SC2 - Compared to others, I consider myself skilled in using digital health applications in Metaverse |
| SC3 - I have always overcome any difficulties I have encountered in the digital world. | Goni et al. (2011) |
| SC4 - Interacting with health and well-being platforms in Metaverse enhances my self-expression | Derived from interviews |
| **Sustainable use of the Metaverse**  **(SUM)** | SUM1 - I think virtual information and advice in Metaverse can be a complementary solution to real-life consultations*.* | Montagni et al. (2018) |
| SUM2 - I felt calm and relaxed after using health and well-being apps in Metaverse. | Ellis et al. (2020) |
| SUM3 - I felt active and vigorous after using health and well-being apps in Metaverse. |
| SUM4 - I felt cheerful and in good spirits after using health and well-being apps in Metaverse. |

**APPENDIX B – Interview Guide**

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| **S. No.** | **Interview Questions** |
| **1.** | Are there any health or well-being platforms you have been active on in the past or are active on currently in the Metaverse environment? Please list them. |
| **2.** | How much time have you spent on the platforms you have been active on? |
| **3.** | What devices do you use to access these apps? |
| **4.** | What motivates you to use the health and well-being platforms in the Metaverse? |
| **5.** | What is immersive experience to you in terms of health and well-being apps in Metaverse? |
| **6.** | Do you think that elements like visual, haptic or auditive enhance the optimal experience of the Metaverse in terms of health and well-being? If so, how? |
| **7.** | Do you trust the Metaverse platforms which provide health and well-being services in terms of safety, security, authenticity and privacy? Please elaborate |
| **8.** | Have you ever faced any challenge related to data trust in the Metaverse? |
| **9.** | What keeps you engaged in the Metaverse for health and well-being platforms? |
| **10.** | How do you generally feel or think about the avatar in health and well-being platforms? |
| **11.** | Can you share specific instances where you felt that using these technologies directly contributed to improving your overall health outcomes or wellness journey? |
| **12.** | When engaging in health and well-being platforms, how realistic do you find the Metaverse environments and interactions? |
| **13.** | Can you share an example of any health and well-being activity that provided a highly immersive experience for you? |