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# Are you in or not? A study into student intention to use immersive metaverse for learning

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**Abstract**

*Learning and teaching have been transformed by technologies in the last few decades. The rise of immersive technologies, such as the metaverse, has started gaining educators'. This phenomenon brings the need for a thorough understanding of how the metaverse could be adopted effectively for learning purposes. This study applied the Technology Acceptance Model (TAM) and Diffusion of Innovation (DoI) to investigate the variables affecting student intention of using immersive metaverse for learning purposes. An online survey was conducted to collect student responses from a US university. A sample of 81 responses was analysed using Structural Equation Modelling (SEM). The results indicate that compatibility and perceived risk influence perceived ease of use and usefulness. Perceived usefulness influences attitudes which consequently influence the intention to use. However, personal innovativeness was not found to influence perceived ease of use and usefulness. The perceived ease of use was not found to impact attitudes.*

**Keywords**: Metaverse, Immersive Learning, Augmented Reality, Technology Adoption

## 1.0 Introduction

The metaverse, once thought to only be found in science fiction novels, is now becoming a reality into which both consumers and industry are buying. According to Statista (2022), the metaverse was valued a 38.85 billion US dollars in 2021 and has grown in value to 47.48 billion US dollars in 2022. It offers opportunities to access alternative realities that the physical and real world cannot offer (Kye et al., 2021). For educators and students, it creates environments for learning that have not been accessible before (Lin et al., 2022). Understanding what it means to educate using the metaverse provides envisaged opportunities, but it is not without its challenges (Dwivedi et al., 2022). It is a concept that is often contested, and many educators are unaware of its potential as the next generation of the internet (Hwang & Chien, 2022) and there is a lack of understanding about how it has progressed beyond science fiction roots and virtual reality (VR) into what we understand today (Dwivedi et al., 2022). The concept of the metaverse has been around prior to

the inception of the internet and is further conceptualised by Neal Stephensen's Snowcrash novel (1992). The early versions of virtual worlds including Second Life and World of Warcraft emerged for socialising and entertainment where users create and customise avatars, explore virtual environments and interact with other users in real time. The metaverse is one of the latest tools empowered by a suite of new technologies to enhance the user experience. The opportunities that it offers have developed from the convergence of virtual reality, artificial intelligence, blockchain and crypto, and the maturity of the internet (Web 3.0). The metaverse and Web 3.0 is built on principles of decentralisation with the aim that users and technology are more interconnected than ever before. This has huge ramifications for our understanding of ownership in the virtual world, with fractional ownership and property rights based on cryptocurrency (Belk et al., 2022). The combination of virtual reality, interconnectivity, and decentralised ownership has been shown to have huge potential for education (Choi & Kim, 2017; Dwivedi et al., 2022; Hwang & Chien, 2022; Park & Kim, 2022; Shin 2022; Tlili et al., 2022; Zhang et al., 2022).

The potential benefits for the metaverse to be used as a platform for education and training were soon realised for its ability to create highly realistic and immersive learning environments. Students could potentially learn and interact through simulations in a controlled environment. The metaverse's existence can be used to create a new learning environment. It enables students to enter the educational environment through wearable technology without being constrained by time or place, and it enables them to engage with various objects in real time using their digital identities, e.g., avatars. They will be able to feel engaged as if they were in a real-world educational environment as a result (Zhang et al., 2022; Rospigliosi, 2022). However, the impacts should be studied to ensure proper implementation and efficacy of learning.

## 2.0 Literature Review

The concepts in the scope of this research were further explored to help understand the theoretical foundations and build the conceptual model. The following sections will explore the areas of the metaverse, immersive metaverse learning challenges, technology adoption models, and metaverse.

### 2.1 Metaverse

The term metaverse first appeared in the 1992 science fiction novel *Snowcrash*, by Neal Stephenson, where people can meet one another in VR, in a computer-coded world. Set in the dystopian near future, the book follows the protagonist Hiro, a hacker and freelance swordfighter, as he investigates a computer virus called Snowcrash. Similarly, since then other science fiction films, e.g., The Matrix films, and books, e.g., Ready Player One, have used a Metaverse concept as a basis for their fiction. Metaverse can be defined as multiple and myriad virtual environments that allow for social interaction and user-generated content. Multiple users can use these digital realms for a range of purposes and can be accessed through various communication methods (Collins, 2008; Knox, 2022).

The fictional concept of the metaverse had its origins in the development of VR. The concept of VR began in the 1950s when Morton Hellig developed the Sensorama, a machine developed to simulate the human senses (Boss, 2013). In the 1960s, the first commercial VR headsets were released allowing users to experience a fully immersive 3D environment. In the 1980s, head-mounted displays (HMD) were developed to allow users to immerse themselves in 3D environments (Sherman & Craig, 2003). This was the basis for the 3D virtual world, Second Life, created by Linden Labs in 2003. This social platform allows users to create their avatars, explore the virtual worlds and build virtual communities. This has been developed further by the creation of more technological advancements through headsets such as those created by the Oculus company. Facebook bought Oculus in 2014 (Meta, 2014) and subsequently Facebook rebranded to become Meta Platforms (shortened to Meta) in 2021 (Meta, 2021). In 2021, Meta invested 10 billion US dollars in its Reality Labs business, the metaverse division in charge of developing AR/VR hardware, software, and content. Meta unveiled Horizon Workrooms in August 2021, a virtual meeting space where users of VR headsets can congregate as though they were at an in-person business gathering.

The move by Facebook to rebrand to become Meta was based on their ambition to move beyond social media. Mark Zuckerberg, the founder and CEO of Meta, has described the metaverse as the successor to the “mobile internet” (Milmo, 2014). Although the metaverse is greatly associated with the company Meta, the drive for metaverse adoption is being driven by other organisations as they see its broad potential in many diverse contexts (e.g. Roblox, Microsoft, Apple, etc.). The

application and use of the metaverse are very wide-ranging, particularly because the concept itself is vague and highly discussed.

A six-concept framework was developed to define the key components of a metaverse environment (PwC, 2022). The framework includes economy, interoperability, governance, identity, experience, and persistence. The economy involves digital monetary systems made of cryptocurrencies, non-fungible tokens, and other blockchain-based digital assets and currencies. For the metaverse to be truly effective, it must allow for seamless interoperability among users and platforms. Governance of tax collection, data, and regulatory compliance will be important to ensure trust. Security and authenticity also need to be addressed as a decentralised digital world may attract malicious actors and be vulnerable to the spread of disinformation. Trusted digital identities of people, assets and organisations will be necessary regardless of whether the identity is true, pseudonymous or anonymous. The metaverse will offer users a shared, unique, and immersive experience shaped by its aesthetics and the individual choices of its inhabitants. The metaverse must be persistent to reflect changes made by different participants in real-time, regardless of how and when they enter or leave the metaverse. Other fundamental features of the metaverse include identity, social, civility, low fiction, variety anywhere, economy and immersiveness, as put forward by David Basxucki, the founder of Roblox (Jeon, 2021).

### 2.2 Immersive Metaverse Learning

The immersive nature of the metaverse transforms people's experiences. The transition from traditional brick-and-mortar, to online and eventually metaverse-based experience in the retail environment highlights their difference in terms of the environment where it takes place, key actors, approaches, benefits and limitations (Papagiannidis & Bourlakis, 2010). A shift in focus is evident when moving from an online environment to an immersive one since online activities prioritise individual transactions while the metaverse prioritises rich, interconnected experiences (Eroglu et al., 2001; Papagiannidis & Bourlakis, 2010). Such a change occurs in various contexts, such as retail (Hassouneh & Brengman, 2015), gaming (Jungherr & Schlarb, 2022), and education (Kye et al., 2021).

Education can be described in a more limited sense as educators carrying out particular educational activities in particular places. In a broad sense, education refers to a person's ongoing learning

activities. The application of technologies in education has transformed learning and teaching. The use of technology has been shown to have a positive effect on learning (Jacobs et al., 2022). The global pandemic has drastically changed how people learn. Although the original change to online learning was mostly unplanned and unforced, several advantages show that it has a favourable impact on learning and engagement. The term online learning is defined in various ways (Moore et al, 2011). Online education uses information and communication technology (ICT), like electronic media, in the educational process (Thomas & Graham, 2019). Online learning is linked to distance learning but conducted via the use the technologies (Benson, 2002), which enables accessibility, connectivity, flexibility and interactions for learning (Oblinger & Oblinger, 2005). Students who learn online, however, miss out on several aspects of classroom-based learning, such as social connections and a purpose-built learning environment. The richer, interconnected experience enabled by the metaverse could potentially address this missing element.

With the advancement of immersive technology, the move from online learning to metaverse learning has been increasingly observed. Educational institutions have begun to adopt both non-immersive and immersive metaverse. For instance, Stanford's Virtual People course was one of the first courses to be taught fully in VR. Students wore VR headgear (Oculus Quest 2 provided by the university) to explore the current uses of popular culture, engineering, behavioural science, and communication (Hadhazy, 2022). University of Cincinnati's Center for Simulations & Virtual Environments Research offers a multi-disciplined approach to solving real-world problems in the metaverse. Students develop immersive technology applications for research, scientific collaboration, and higher education such as data visualisations, training simulations, and user experiences. Case Western Reserve University applies the Microsoft Hololens 2 to teach human anatomy without a cadaver. This approach has shown the use of the metaverse has a positive impact on the ease of student learning and team working (Baratz et al., 2022).

Effective metaverse learning requires several key components, e.g. the connection of technologies, the interaction between human users and avatars, the creation of the operating platform, the identification of users and entities in the virtual worlds, and the resources required for execution, such as internet connection and computing power (Lin et al., 2022). In addition to the benefits of online learning, such as accessibility, connectivity, flexibility and interactions, there are other many potential benefits of utilising metaverse for learning. For instance, it promotes the interaction

between the actual world and the virtual world for learning via realistic and rich educational experiences (Lee & Hwang, 2022). It allows students to learn in the same environment while giving access to students from various geographic locations without being limited by the constraints of the external reality (Park, 2021).

### 2.3 Challenges of Immersive Learning with Metaverse

The introduction of immersive learning in the metaverse brings about challenges for educators and education systems. The metaverse environment raises new challenges regarding gathering and protecting data, cyber security, and privacy (PwC, 2022). Lin et al. (2022) identified privacy risks, inclusiveness, technology implementation, addiction, and governance as challenges. Additionally, Kye et al. (2021) stated that metaverse environments may have weaker social connections, possible privacy infringement, maladaptation, and crimes due to anonymity. Weaker social connections refer to the ability to present a virtual version of one's self rather than presenting one's true self thus social connections are not based on truths.

Immersive metaverse learning may bring accessibility inequalities as VR experiences require high-tech, expensive headsets, and strong, reliable connectivity (Marr, 2022). Virtual environments are complex and can require a significant amount of computing power. If the technology is not properly implemented or if the users encounter internet connectivity issues it may disrupt the learning experience. Along this line, if the virtual environment is not properly designed for optimal user experience, students may not find it user-friendly or intuitive causing them to struggle and become frustrated. One of the main challenges of immersive metaverse learning is the potential for distractions and lack of focus. In a virtual environment, students may be easily tempted to multitask or engage in activities not directly related to the learning task (Inceoglu & Ciloglugil, 2022). This may make it difficult for students to retain information and stay engaged.

The research into learner perception of immersive metaverse learning has been gaining attention in recent years. A few studies have investigated the teacher and student perspectives of metaverse learning (MacCallum & Parsons, 2019; Almarzouqi et al., 2022). Some have been in specific fields such as dental care (Locurcio, 2022) and health care (Chengoden et al., 2022). However, the technologies involved with the immersive metaverse evolve rapidly and could continuously

change the learner's perception. Therefore, it is important to further research immersive metaverse for education.

### 2.4 Technology Adoption Models and Metaverse

The study of Rogers (2003), which describes how a new idea or product spreads among a community, led to the concept of Diffusion of Innovation (DoI). DoI states that the five main factors influencing an innovation's adoption are relative advantage, complexity, compatibility, trialability, and observability (Rogers, 2003). DoI has been used by researchers to study numerous technological innovations, such as mobile payment (de Luna et al., 2019; Pan et al., 2022) and connected autonomous vehicles (Talebian & Mishra, 2018). Technology Acceptance Model (TAM) is one of the most well-known methods for understanding how users embrace technology (Davis, 1989). TAM includes the two key determinants of perceived usefulness and perceived ease of use, and it lays the theoretical groundwork for understanding how external factors may directly or indirectly affect attitudes, intentions, and actual use of technology. The original TAM has been shown to be an efficient, reliable, and effective method and has been applied to various technology adoption, such as video-conferencing (Alfadda & Mahdi, 2021), mobile payment (de Luna, et al., 2019; Askool et al., 2021), online education (Han & Sa, 2022), and metaverse (Park & Kang, 2021; Mostafa, 2022; Misirlis & Munawar, 2022). For example, Toraman (2022) found a significant positive correlation between perceived usefulness, perceived ease of use, attitude towards use, and intention for metaverse adoption.

TAM has been used to ascertain the intention to use VR and the metaverse for educational purposes (Fussell & Truong, 2021). Furthermore, for higher education in the Gulf area, student's perceptions to use or intent to use the metaverse were associated with their individual innovativeness and inventiveness, in turn, was also influenced by perceived ease of use and usefulness (Akour et al, 2022; Almarzouqi, 2022; Alfaisal et al 2022). These studies are either based on VR, the predecessor to the metaverse, or relate to one geographical area (the Gulf), and do not consider the attitudes, intentions, and use of the metaverse technology for educational purposes for US-based students.

## 3.0 Methods

This research's main objective is to investigate student perceptions of immersive metaverse learning and their impacts on the intention of using immersive metaverse for learning. An exploratory analysis was conducted and the process of the experiment and hypotheses development is outlined in the following sections.

### 3.1 Exploratory Study Design

An online survey with both existing and prospective users of the educational immersive metaverse was used as the data collection approach. In the exploratory study, a survey to examine user intention to use immersive metaverse for learning was designed to test the hypotheses. The survey consisted of 30 questions comprising 22 construct questions, two prior metaverse experience questions, and four demographic questions. A 5-point Likert scale was used to create all construct variables. For the purpose of the exploratory study, the invited participants were from a US university.

### 3.2 Hypotheses

Based on TAM and DoI, this exploratory study develops a model (see Figure 1) to examine the factors influencing immersive metaverse for learning acceptance. This study will evaluate the degree to which variables have an impact on the intention to use immersive metaverse for learning.

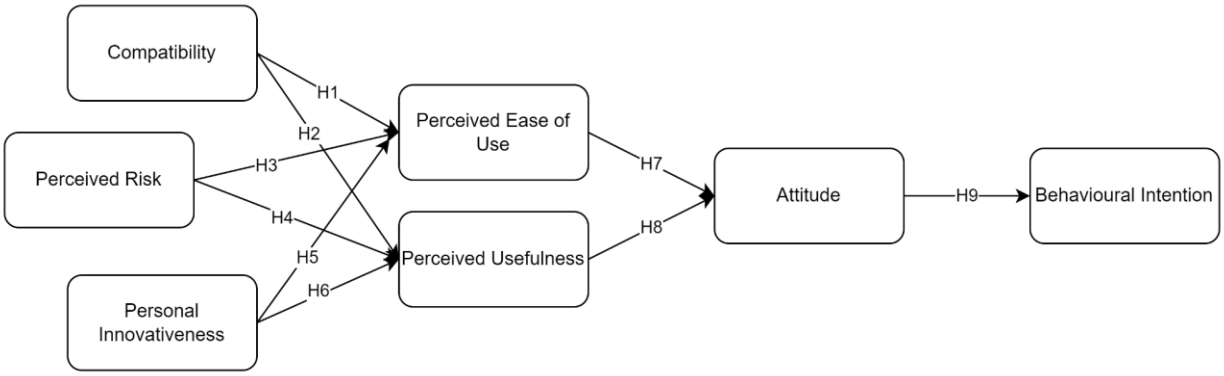


Figure 1. Research Hypotheses

**Compatibility:** A critical aspect of adoption is compatibility, which focuses on how well the innovation fits into the user's lifestyle. Such perception should affect an individual’s assessment of the perceived ease of use and usefulness of new technology.

***H1:*** *A student's perceived compatibility determines their perceived ease of use of immersive metaverse for learning.*

***H2:*** *A student's perceived compatibility determines their perceived usefulness of immersive metaverse for learning.*

**Perceived Risk:** Before adopting new technology, users evaluate the two risk factors, i.e. the degree of uncertainty and the gravity of the consequences, to determine whether they are willing to take such risks. It might have an impact on how new technology is viewed in terms of its usefulness and ease of use.

***H3:*** *A student's perceived security of immersive metaverse for learning determines their perceived ease of use of immersive metaverse for learning.*

***H4:*** *A student's perceived security of the immersive metaverse for learning determines their perceived usefulness of immersive metaverse for learning.*

**Personal Innovativeness:** The possibility that a person would experiment with new technology is referred to as personal innovativeness, and it has been linked to affecting technology adoption. Personal innovativeness could potentially affect the perceived ease of use and perceived usefulness of new technology.

***H5:*** *The personal innovativeness of the student determines their perceived ease of use of immersive metaverse for learning.*

***H6:*** *The personal innovativeness of the student determines their perceived usefulness of immersive metaverse for learning.*

**Perceived Ease of Use:** Ease of use is the opposite of complexity. Complexity, which could affect user adoption, is the degree to which an innovation can be thought of as comparatively difficult to use. It could affect a user's attitude towards the new technology.

***H7:*** *A student's perceived ease of use of immersive metaverse for learning determines their attitude towards using immersive metaverse for learning.*

**Perceived Usefulness:** The degree to which people feel utilising new technology will improve their efficacy and performance is known as perceived usefulness, which could influence the attitude of users.

> ***H8:*** *A student's perceived ease of use of immersive metaverse for learning determines their attitude towards using immersive metaverse for learning.*

**Attitude:** Attitude is understood to include cognitive, emotional, and behavioural components. An individual's attitude towards a new technology could affect their intention of adopting the technology.

> ***H9:*** *The attitude towards the use of immersive metaverse for learning determines the intention to use immersive metaverse for learning.*

# 4.0 Results and Analysis

There were 92 total replies to the exploratory study survey, 81 of which were complete and valid. The age distribution of the respondents is as follows: 78% are 18-24 year-olds; 12% are 25-34 year-olds; 9% are 35-44 years; and 1% are 45-54 years old. The participants self-reported their genders as 67% male, 32% female, and 1% as non-binary. The majority of respondents were at a Junior (63%) level, followed by Senior (27%), Sophomore (9%), and Freshman (1%).

## 4.1 Reliability

In order to measure the reliability or internal consistency of the scale items, Cronbach's coefficient alpha was performed. It was suggested that 0.70 is a cut-off point or 0.6 or greater is a satisfactory level (Hair et al., 2013). The Cronbach's alpha scores for the responses were all above 0.7 (shown in Table 1), confirming that all of the items return an acceptable score for reliability.

| Construct | # of Items | Cronbach's α set score |
|---|---|---|
| Compatibility | 3 | 0.7780 |
| Perceived Risks | 3 | 0.7096 |
| Personal Innovativeness | 3 | 0.7901 |
| Perceived Ease of Use | 3 | 0.7827 |
| Perceived Usefulness | 3 | 0.8773 |
| Attitude | 3 | 0.9405 |
| Behavioural Intention | 3 | 0.8590 |

**Table 1. Reliability Testing**

## 4.2 Hypothesis Testing

The hypothesis testing was performed using Structural Equation Modelling (SEM). The results show that H1, H2, H3, H4, H8, and H9 are all statistically significant. H5, H6 and H7 were not statistically significant with p-value being 0.8935, 0.2561 and 0.2039 respectively (shown in Table 2).

| # | Hypothesis | Path Coefficients | P-Values |
|---|---|---|---|
| H1 | Compatibility → Perceived Ease of Use | *0.327* | *0.0199* |
| H2 | Compatibility → Perceived Usefulness | *0.648* | *<.0001* |
| H3 | Perceived Risk → Perceived Ease of Use | *0.441* | *0.0122* |
| H4 | Perceived Risk → Perceived Usefulness | *0.529* | *0.0016* |
| H5 | Personal Innovativeness → Perceived Ease of Use | 0.102 | 0.8935 |
| H6 | Personal Innovativeness → Perceived Usefulness | 0.009 | 0.2561 |
| H7 | Perceived Ease of Use → Attitude | 0.397 | 0.2039 |
| H8 | Perceived Usefulness → Attitude | *1.088* | *0.0001* |
| H9 | Attitude → Behavioural Intention | *0.503* | *<.0001* |

**Table 2. Hypothesis Testing Result**

The path coefficient diagram is depicted in Figure 2 showing the coefficients between the variables. The solid lines show the paths that are statistically significant and the dashed lines depict paths that are not statistically significant. The analysis shows that compatibility and perceived risk indicate a student's self-perceived ease of use and usefulness of immersive metaverse learning. Perceived usefulness leads to a student's attitude towards immersive metaverse learning. Lastly, attitude is shown to impact a student's intention to use immersive metaverse for learning purposes.

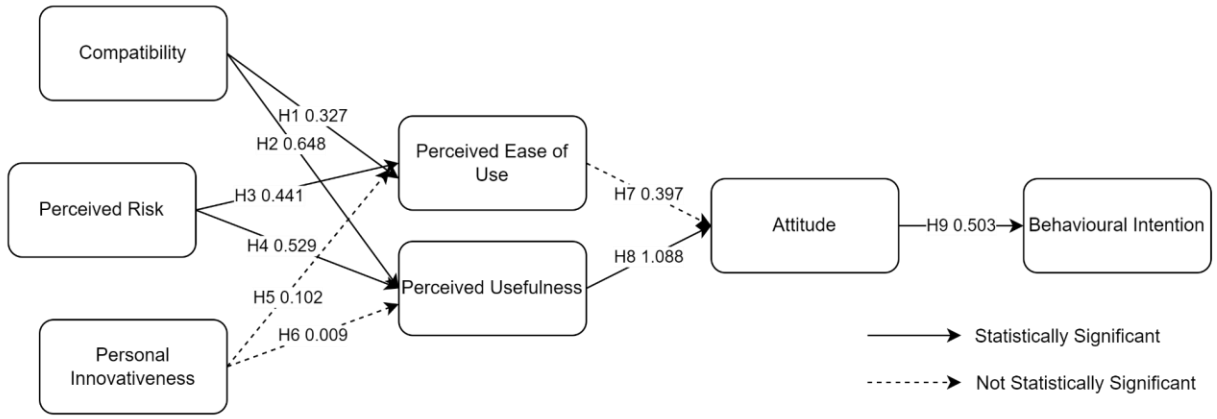


**Figure 2. Structural Equation Model (SEM)**

## 5.0 Discussion and Conclusion

Immersive metaverse learning is a type of educational experience in which learners engage with a simulated and potentially multi-layered environment that allows them to actively participate and gain knowledge and skills through realistic simulations. Immersive metaverse learning has advantages over traditional learning such as accessibility, connectivity, flexibility, and interactions. It also offers realistic and rich educational experiences. Whilst there has been research into immersive metaverse learning with samples from different regions, e.g. the Gulf and Korea, there is a lack of research into student perception and intention to use immersive metaverse for learning with more diverse samples. Therefore, an exploratory study into student perceptions of learning in an immersive metaverse was conducted.

Students responded to questions based on a model influenced by TAM and DoI. The study indicates that H1, H2, H3, H4, H8, and H9 are statistically significant. Therefore, a student's perceived compatibility determines their perceived ease of use and their perceived usefulness of immersive metaverse for learning. A student’s perceived risk of immersive metaverse for learning determines their perceived ease of use and perceived usefulness of immersive metaverse for learning. A student’s perceived usefulness of immersive metaverse for learning determines their attitude towards using immersive metaverse for learning. The attitude towards the use of immersive metaverse for learning determines the intention to use immersive metaverse for learning. The results also indicate that the personal innovativeness of the student does not

determine their perceived ease of use of immersive metaverse for learning. Lastly, a student's perceived ease of use does not affect their attitude towards use.

This exploratory study has some limitations. This survey had a small sample size (n=81) and was limited to students in one US university, which may reduce the diversity of the sample. Further research must be done to fully understand the perceptions of immersive learning. A larger investigation will be completed to include students from more educational institutions. Furthermore, more determinants could be considered, such as trust. The respondents' demographics could also be used as mediating factors to further understand the topic.

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