9th International Conference on Higher Education Advances (HEAd'23)
Universitat Politècnica de València, València, 2023
DOI: http://dx.doi.org/10.4995/HEAd23.2023.16080

Designing a Metaverse for an Immersive Learning Experience

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Abstract

This paper shares preliminary findings of a pilot project to study the potential of the metaverse as an option for course delivery in an immersive learning environment. As part of a first-year seminar course on the metaverse, the authors identified and applied design principles for building an effective immersive learning space to create a virtual space that mirrored a popular campus technology learning center. After learning about the metaverse throughout the course, students attended a class session online to experience this virtual environment, and then reflected on their own interest in and perceived value of immersive learning spaces.

Results from a student survey suggest that while students are skeptical about their own continued involvement with the metaverse after the course is over, many recognize potential of the metaverse as a social platform that fosters engagement and collaboration.

Keywords: *virtual reality; metaverse; immersive learning spaces; collaboration; online learning; emerging educational technologies.*

1. Introduction

In the years since Neal Stephenson introduced the concept of the metaverse in his novel *Snow Crash* (Stephenson 2003) in 1992, technology has advanced to turn his science fiction vision of living in virtual worlds into reality with the development of virtual reality (VR). The novel's characters visited an alternate world while wearing goggles and experienced it through the eyes of their avatars, just as people engage with the metaverse of today.

A single definition of the metaverse does not exist, and the use of the term often differs based on context. The metaverse is not one unique virtual space; today the metaverse is a collection of decentralized virtual spaces, or worlds, such as Meta Horizon Worlds, Roblox, Decentraland, and the Sandbox, where people gather synchronously online to conduct business meetings, play video games, attend social events, purchase real estate, and visit destinations they may not be able to get to in real life. Many metaverses have their own digital economies. Avatars or digital twins form a person's online identity across metaverses. (Kshetri 2022). At its most basic level, the metaverse is the next iteration or future of the Internet (Ramesh et al. 2022) as a Web3 application that brings value to the user generated content that characterizes Web 2.0 (Suderman 2022).

The advent of the COVID-19 pandemic accelerated the introduction of immersive virtual environments for educational purposes (Duan et al. 2021). Three-dimensional, immersive virtual learning spaces often reflect physical campus locations creating a stronger connection to the university campus; participants interact with each other through their avatars, causing students to consider issues of identity and how they wish to be perceived in the metaverse. They may also interact with elements of the virtual learning spaces, such as writing on virtual whiteboards or sharing websites on virtual browsers. They can communicate in real time through voice or chat, or share a webcam, as in most web-based video conferencing applications. Such spaces and their content persist from one visit to the next, and as such, foster the development of virtual communities (Kye et al. 2021), and some educational metaverses may offer the purchase of digital goods.

This paper describes preliminary results and the experiences of incoming first-year students enrolled in a discovery seminar studying the metaverse from multi-disciplinary perspectives. As part of the course, the authors designed and created an immersive virtual learning space modeled after a campus learning space. During the last class meeting, students visited this virtual space using VR headsets or web browsers to experience the metaverse's potential as a viable course delivery platform. Questions guiding this research are:

> RQ1. What principles should be considered when creating an immersive virtual learning space designed to resemble a campus physical learning space?

RQ2. After experiencing a class in an immersive learning space, what potential values do students see for learning in such an environment?

2. Immersive Educational Environments in the Metaverse

Many educational institutions are exploring virtual immersive environments (Hassanzadeh 2022; Hedrick et al. 2022) yet "few … have taken steps to offer courses in [a] metaverse (Hassanzadeh 2022:10)." Such environments can improve learning, empower students, and create a sense of presence among students (Hassanzadeh 2022). Virtual reality enables users to experience immersive spaces that cannot exist in reality (Kye et al. 2021). Several digital tools, including Alakazam, AltSpace, Frame, Gathertown, and Zepeto, facilitate the process of designing immersive virtual spaces.

Duan (2021) created a model of the Chinese University of Hong Kong, Shenzhen (CUHKSZ) as a metaverse for social good, "a mixed environment where students' actions in the real world could correspondingly affect the virtual world, and vice-versa." Location based sensors allow students in physical locations to interact with students in equivalent locations in the corresponding virtual world. Such worlds require significant usability testing to be effective (Lee and Gu 2022).

The use of immersive classrooms also requires significant onboarding and training. When using Meta's Horizon Workrooms as a virtual classroom, Hedrick (2022) found that gathering in a virtual space complete with desks, a whiteboard and a projector had its limitations in group size, ease of setup, and lack of documentation for a beta product. Still, they found that collaboration was possible and successful in such a virtual environment after the group acclimated to the user interface.

A goal for creating an educational metaverse is to provide a sense of community and link back to a familiar classroom or physical learning space. How one joins an educational metaverse has an impact on the user experience and participant retention. While a fully immersive experience with or without VR headsets may be preferred, "whether it satisfies students who want to experience learning that does occur in the same place or at the same time with other peers, is still unanswered (Lee and Hwang 2022)". Students sitting at computer screen or wearing VR headsets with pre-designed digital content "are less likely to experience the psychological sensation of being in a communal space (Lee and Hwang 2022)".

3. First-Year Discovery Seminar: Living in The Metaverse

This study, conducted at the end of the Fall 2022 semester, involved students enrolled in two sections of a first-year discovery seminar (FDS) course. These sections were taught by two

different instructors who followed the same schedule, assignments, topics, and readings. FDS is intended to help students acclimatize to their new surroundings in college and learn about research by exploring complex problems and themes from multidisciplinary perspectives. The theme of the two sections discussed in this paper is "Living in the Metaverse."

The course presented an overview of the metaverse from business, social, and technology perspectives, and provided several hands-on opportunities to explore various metaverses both in a browser and wearing VR headsets. Students attended events in AltSpace, designed virtual worlds and games in Roblox, created avatars in ReadyPlayer.Me, and investigated metaverse features in Decentraland. Their research papers focused on issues from governance to the impact of the metaverse on mental health.

During the final two-hour class session, students met in a virtual learning space modeled after the university's technology learning center. Before the class, students added slides summarizing their research papers, to a common PowerPoint Online slide deck. The instructor showed the slide deck on one of the floor-to-ceiling displays, as students maneuvered their avatars around the virtual space to see it. They listened to their classmates present their work in real time.

Many students participated in the metaverse activity using both their laptops and wearing VR headsets. Students joined on their laptops, positioning themselves in hallways and classrooms in the building where the class was held or wearing earbuds to avoid audio interference and feedback from students nearby. At 15-to-20-minute intervals, students proceeded in assigned groups of five to the nearby technology learning center, where they wore Quest 2 headsets to join the class for an immersive VR experience, until the next group arrived for their turns. This process allowed students to experience the immersive learning space in two different modalities. Students then gathered back in person in the physical classroom to debrief about their experiences for the last 15 minutes.

4. Designing an Immersive Metaverse Learning Space

Frame (http://framevr.io) is the development tool chosen for the design and implementation of a three-dimensional immersive social virtual meeting space replicates the university's technology learning center. Visitors can explore spaces created in Frame using mobile devices, laptops, or desktop computers through a browser, or by wearing a VR headset (such as Oculus Quest), making Frame a popular choice for prototyping, or developing virtual spaces. Frame metaverses support accessories such as floor-to-ceiling displays, live web browsers, and interactive whiteboards. Frame is persistent in that content added remains in place from one visit to the next. "Frame is widely used as an adaptive learning space suitable for educational purposes as it allows teachers and students in the same place to freely upload a wide range of content to deliver curriculum" (Lee and Hwang 2022). This proof-of-concept

immersive metaverse learning space was designed to stimulate the sensory input of the participants. The process was implemented in three phases: creating a shared experience, extending realism, and incorporating gamification, each abiding by principles of human-computer interaction. (Lee and Gu 2022; Terblanche 2014).

4.1. Phase 1. Creating a Shared Experience

Phase 1 emphasizes creating a shared experience and maintaining a sense of individualism. Every participant in the metaverse can fully-customize their 3D avatar and choose their clothing, accessories, body color, hairstyle from a collection of preexisting assets in Frame. The virtual space also enables participants to create digital identities by designing personalized avatars or linking their ReadyPlayer.Me avatars, created by generating 3D models from 2D photos captured through a webcam. This enables students to maintain their individual identity in the mirrored digital classroom.

4.2. Phase 2. Conveying Realism

Phase 2 extends the concept of realism as cues to educate the participants, thereby setting the FTUE (first-time user experience) for the metaverse. The essence of maintaining these real-world cues for a student participant goes beyond humans to virtual environments and objects. The color theme of the walls in the room, placement of smart screens, tables, monitors, and keyboards, to the most vital element of the present time – sanitizer bottles on a table, all resonate to create a sense of attachment which delivers an exceptional, easy-to-adapt human-centered FTUE. Figure 1 compares the mirrored virtual metaverse (top) with the physical space of the campus learning center (bottom).

Users entering the virtual classroom for the first time rely on these cues to navigate a virtual space that resembles the physical world. One significant difference between physical and virtual spaces is the absence of seating in the virtual environment. To create a more open space, moveable chairs are not included in this design because avatars do not need to sit.

4.3. Phase 3. Gamification

Phase 3 targets practical features by gamifying the new age of online learning enabled by gathering in the metaverse. Adding gaming elements into non-gaming sectors intrigues users to take part and perform (Groh 2012). “Gamified elements used in the Metaverse allow immersive and engaging ambiance, positively influencing the user mindset for social interaction (Tayal, Rajagopal, and Mahajan 2022:1598).” This immersive space features a floor-to-ceiling fully functional web browser displaying actual online content, a whiteboard to sketch, and an ultrawide floor-to-ceiling LED screen that everyone within the shared environment can view. These elements provide engaging, interactive, intuitive learning tools

within the immersive learning space. Figure 2 is a snapshot of a live session conducted with students and shows the use of a metaverse platform as a shared learning environment.

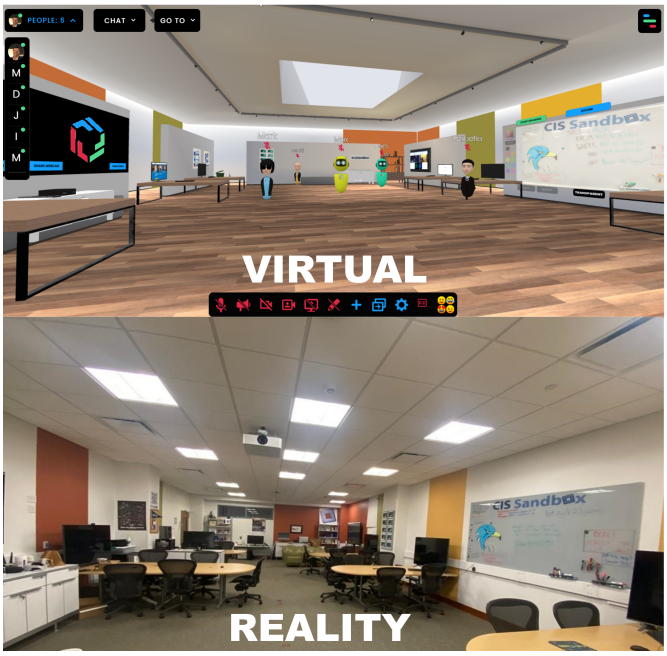

Figure 1. Top: Virtual metaverse; Bottom: Physical campus learning center

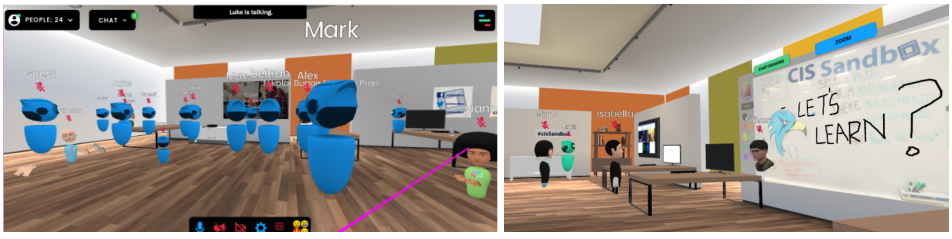

Figure 2. Live class session

5. Results

The authors administered a survey to 44 students in two synchronized sections of FDS, taught by two different instructors, on the last day of each class meeting. Two students were under 18 years of age, so their responses were not included. The remaining 21 students from each section were between 18 and 21 years old. All had used Quest headsets while completing two assignments earlier in the course. Responses showed that 27 of the 42 eligible students agreed or strongly agreed that they would like to explore VR more with headsets, 20 agreed or strongly agreed that VR environments offer a sense of place and connection to a physical

environment. Still, they were divided on their future level of participation in the metaverse. Only 12 agreed or strongly agreed that they could see themselves involved in a virtual community, and only 13 agreed or strongly agreed that they could see themselves attending an event in the metaverse. See Figure 3.

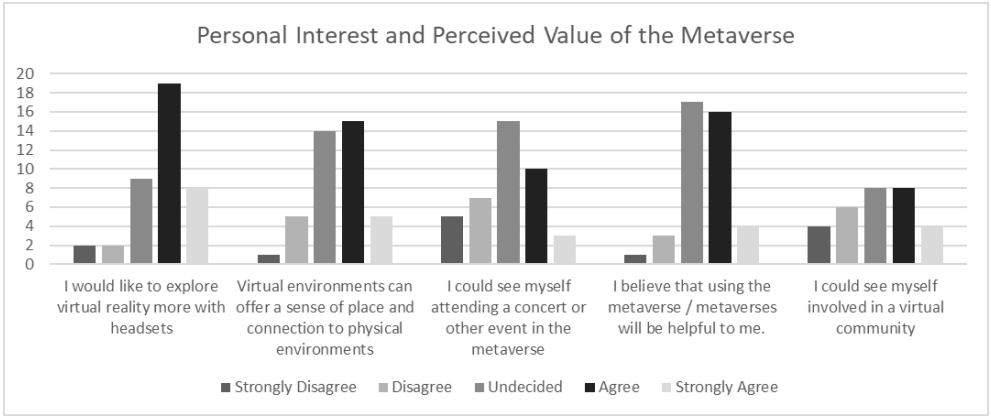

Figure 3. Survey data of participants

These results suggest that learning about the metaverse was fun and engaging, but many students are still skeptical about their personal involvement for extended periods. Students realized how the metaverse can provide new opportunities for doing business and interacting socially, but they also commented on social concerns related to increased engagement with the metaverse (abundance of virtual meetings, lack of social skills and lack of motivation). Said one student, "People may not be as willing to interact and speak with one another, whether online or in-person. The possibility of harassment [increases] because of the lack of authority in the metaverse… With no bounds to hold them accountable for their actions, people might freely bully and act harshly in the metaverse."

6. Conclusion

The ability to create immersive and interactive learning environments that simulate real-life experiences could significantly enhance student engagement and comprehension. Preliminary results suggest that students find the idea of learning in the metaverse to be compelling, providing access to educational resources and experiences that may not be feasible in traditional classroom settings.

Students experienced that meeting in the metaverse may change the future of instruction, and these interactions can benefit them in the real world. Exploring an immersive learning space was new for most students and provided a tangible way to relate to the conceptual knowledge gained by studying aspects of the metaverse. After the course, several students reflected that

they would have liked fewer readings, more activities using VR headsets, and more opportunities to explore and design virtual worlds. The need for technical infrastructure and digital literacy among educators and students are potential challenges. As technology advances, increased accessibility of hardware and the influx of human-centered interfaces will influence the design of a new kind of digital classroom.

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